Unit 6
TYPES OF SHIPS

LIQUID BULK CARGO SHIPS

A. Oil Carriers

The tanker is a very specialized vessel. It is designed to deal with bulk liquid cargoes permitting quick loading and discharge, thereby ensuring a fast turn-round (loading and discharge of cargo). Vessels return in ballast as it is seldom possible to obtain return cargoes.
In addition to oil tankers, liquid cargo is carried by specialized vessels such as chemical or product carriers, LPG (liquefied petroleum gas) and LNG (liquefied natural gas) vessels.
A typical LNG vessel has the crew accommodation and machinery aft. Cargo is contained in prismatic internally insulated aluminium tanks, three of which are fitted into each of the three holds. To keep the gas in liquid form, it must be kept down to minus 161° centigrade (-258°F).

VLCCs (Very Large Crude Carriers)

VLCC have a size ranging between 180,000 to 320,000 DWT. They are capable of passing through the Suez Canal in Egypt, and as a result are used extensively around the North Sea, Mediterranean and West Africa. **VLCC** are very large shipping vessels with dimensions of up to 470 m (1,540 ft) in length, beam of up to 60 m (200 ft) and draught of up to 20 m (66 ft). But the standard dimensions of these ships range between 300 to 330 meters in length, 58 meters breath and 31 meters in depth. They are known for their flexibility in using terminals and can operate in ports with some depth limitations. The cost of a **VLCC** ranges between $100 million to $120 million depending on its age.

ULCCs (Ultra Large Crude Carriers)

The term *ULCC* describes tankers which range from 300/500,000 *DWAT*[1]. They are mainly used for long haul operations between The Gulf and the Far East, Europe and North America, discharging their cargo at terminals especially constructed to handle such large vessels.
Knock Nevis is regarded as the longest **ULCC** supertanker ever built in the world with massive dimensions of 564,763 DWT, 458.45 m (1,504.10 ft) length and 68.8 m (225.72 ft) in width.

Exercises (A):

A1 Supply the missing terms:

The tanker is a very specialized vessel. It is _____ to deal with bulk liquid cargoes permitting quick loading and _____, thereby ensuring a

[1] **DWAT (Deadweight All Told)**. This is the total deadweight capacity of the ship comprising cargo, fuel, ballast water, fresh water, crew and their personal effects, stores and equipment, spare parts for the ship and any other item not being part of the ship's original construction.

fast _____ (loading and discharge of cargo). Vessels return in _____ as it is seldom possible to obtain return cargoes.
In addition to oil tankers, liquid cargo is carried by specialized vessels such as chemical or product _____, LPG (liquefied _____ gas) and LNG (liquefied _____ gas) vessels.
A typical LNG vessel has the crew _____ and machinery aft. Cargo is contained in _____ internally insulated aluminium tanks, three of which are fitted into each of the three holds. To keep the gas in liquid form, it must be kept down to minus 161° _____ (-258°F).

A2 Complete the text below:

The tanker is a very …… . It is designed to deal with …… permitting quick loading and discharge, thereby ensuring a fast turn-round (loading and discharge of cargo). Vessels return in ballast as it is seldom possible to …….. .
In …….. ., liquid cargo is carried by specialized vessels such as chemical or product carriers, LPG (liquefied petroleum gas) and LNG (liquefied natural gas) vessels.
A typical LNG vessel has the …….. aft. Cargo is contained in …… , three of which are fitted into each of the three holds. To keep the gas in liquid form, it must be …….. minus 161° centigrade (-258°F).

A3 Pair work: Describe the ship by making and answering questions based on the prompts below:

ULCCs

- the term *ULCC*:
- DWAT range (from ..... to .....)
- mainly used for ..... between ..... and ..... discharging their cargo at:

VLCCs

- VLCC:
- DWAT range
- employed
- discharge at
- advantage

MCCs

- MCC:
- range
- used for
- advantage
- flexibility

- transit the Suez Canal in ..... condition, depending .....

A4 Supply the missing phrase / sentence part

VLCC or Very Large Crude Carriers and ULCC or Ultra Large Crude Carriers are the largest vessels in the world ……..

With a size in excess of 250,000 Dead Weight Tonnage (DWT), these giant ships are capable of carrying huge amount of crude oil. Wit

Known as Supertankers, …….. these vessels are primarily used for long-haul crude transportation from the Persian Gulf to countries in Europe, Asia and North America.

ULCC or Ultra Large Crude Carriers are the largest shipping vessels in the world ……. 320,000 to 500,000 DWT.

……., they need custom built terminals. As a result they serve a limited number of ports with adequate facilities to accommodate them.

…….. for very long distance crude oil transportation from the Persian Gulf to Europe, Asia and North America.

ULCC are the largest shipping vessels being built in the world with standard dimensions of 415 meters length, ---------- .

- in a single trip
- with a size ranging between 320,000 to 500,000 DWT.
- They are primarily used
- operating cargo vessels in the world
- 63 meters width and 35 meters draught
- ong-haul crude transportation
- Due to their mammoth size

A5. Which types of ships are defined below?

• OBO carriers • oil tankers • LPG carriers • bulk carriers
• product carriers • barge carriers (LASH ships)

1. _____ : ships carrying liquid cargo such as crude oil.
2. _____ : ships carrying iron ore, bauxite and other bulk minerals.
3. _____ : ships carrying lighters.
4. _____ : ships which can carry bulk cargo, crude oil, iron ore etc..
5. _____ : ships designed for conveying derivatives.
6. _____ : ships designed to carry gases cooled down and pressurized into liquid cargo.

A6 Which of the ships listed below depend on the shore-based cargo handling gear? Underline your choice.

• oil tanker • barge carrier • cargo liner • LNG • LPG
• product carrier • OBO carrier • container ship

A7 Supply the missing words:

• liquefied natural gas • oil-bulk-ore • tankers • bulk carriers
• tankers • liquefied petroleum gas • ballast • barge carriers

• ore carriers • multi-purpose ships

In 1. _____ and 2. _____ the machinery has always been situated aft Today, also 3. _____ have the accommodation, bridge and machinery aft or three quarters aft. Oil is carried in 4. _____ . LNG stands for 5. _____ and LPG for 6. _____ . OBO is short for 7. _____ . 8. _____ depend on the shore facilities. Tankers sail in 9. _____ on their return voyage. 10. _____ are not so popular today as they were in the 60's and 70's.

A8 Supply the missing word (verb) as appropriate: • installed • driven • arranged - supplied • has • provided • controlled • used

Tanker loading/discharge

The vessel is 1. _____ to carry three parcels of oil, discharged through three 24in manifolds, for which three Shinko KV 450-4 vertical centrifugal cargo pumps have been 2. _____ , each with a capacity of 4000 m³/hr at 135 m head. These are 3. _____ by a Shinko **RX2** steam turbine. There is also one 200 m³/hr x 130 m head stripping pump. There are two 400 m³/hr x SUC - 3m stripping educators. The cargo is 4. _____ by a Nakakita all-valve system. Two tank level gauging systems are 5. _____ : a float-type, and a pneumatic type.

Tank cleaning is 6. _____ by 27 deck mounted machines, and seven bottom mounted machines. The tank cleaning heater 7. _____ a capacity of 180 m³/hr. Sumitomo Precision has 8. _____ one oil content monitor. Inert gas is supplied by Gadelius 15000 m³/hr capacity system, with three independent main lines on deck.

Grammar

A9. Put the words below into the correct columns according the pronunciation of the vowel in the stressed syllable:

• iron ore • obtain • carrier • accommodation • fertilizer • trade • gas • hatch • grain • provided • lighter • ballast • raise • conveyor

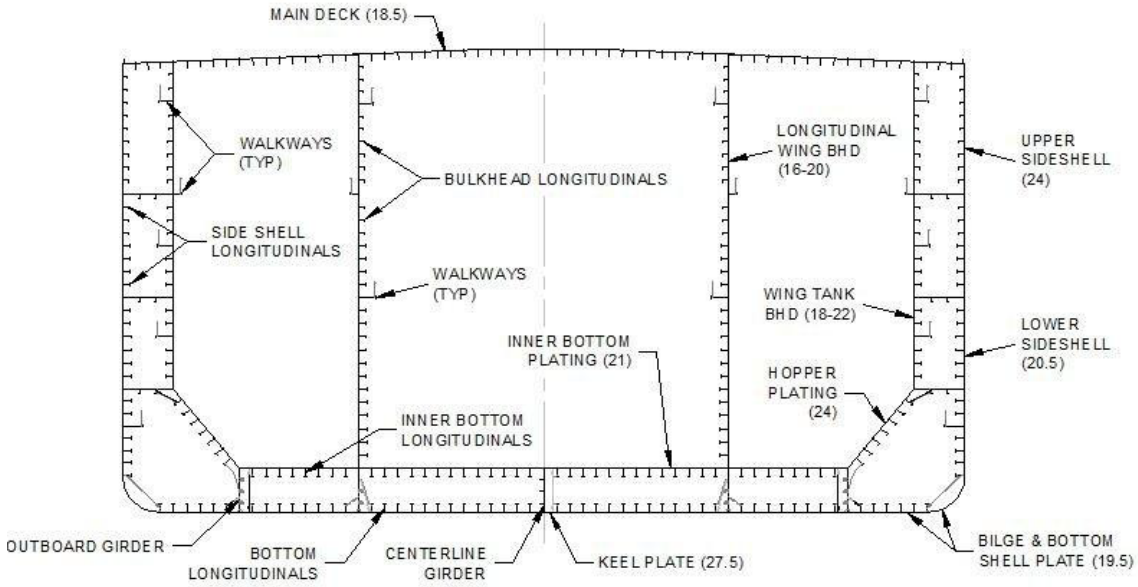
æ	*ei*	*ai*
tanker	***grain***	***iron ore***

A10 Supply the missing articles (a, an, the) where necessary:

There's 1. _____ huge ship coming in. She must be 2. _____ mile long. I think she's 3. _____ tanker, with 4. _____ two funnels. She's one of 5. _____ big supertankers. Her superstructure doesn't cover 6. _____ full width of 7. _____ vessel, except for two wings attached to 8. _____ bridge. 9. _____ wings are supported by thin posts underneath them. 10. _____ tanker is being pulled along by two tugs, and there are two others at 11. _____ stem.

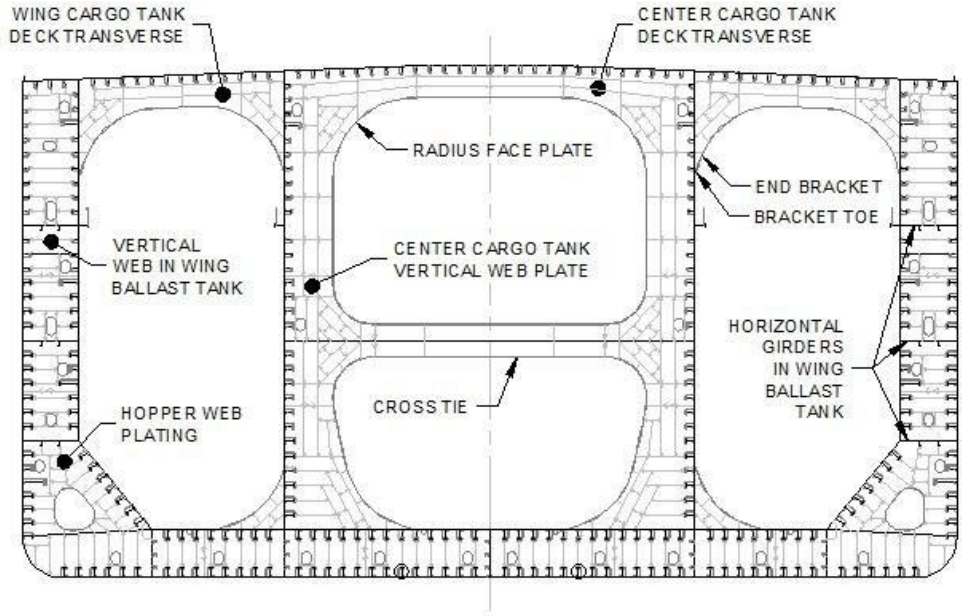
B. Tanker construction

Tankers are constructed to a simple but well tested system. The vessel is divided by longitudinal and lateral bulkheads that normally give vessels a series of centre tanks flanked by two wing tanks. In modern times, some of the wing tanks are used only for water ballast and, being segregated, do not become contaminated with oil cargo.



The ballast can then be discharged overboard into the sea, thus enabling the vessel to call at terminals that do not have the facility to handle dirty or contaminated ballast water. Tanks designated purely for water ballast are referred to as 'segregated ballast tanks' or SBTs for short hauls or destinations.

As a result, all new tankers now have to be built with a double hull and there is a programme in place to phase out all older single skin tankers within a relatively short period of time.



Tanker cargo handling

Tankers are invariably self-discharging and most are equipped with at least four pumps that operate at high speed enabling a fast turn round in port. The rate of discharge is of course affected by local conditions such as climate, small shore lines, distance of receiving tanks from the berth, etc. When carrying certain types of oils, tankers require heating coils within the tanks to keep the cargo fluid. Those coils, usually fitted in the bottom of the cargo tanks, can maintain a constant heat of up to approx. 50 degrees C. Heating coils are not usually found in ULCC's or VLCC's, as they are usually too large to load at terminals that supply the heavy and sticky crude oils.

Exercises (B):

B1 Choose and underline the key terms for tanker construction and cargo handling (e.g. bulkhead, tank, etc.)

B2 Supply the missing tanker terms

Tanker construction

Tankers are _____ to a simple but well tested system. The vessel is divided by longitudinal and _____ _____ that normally give vessels a series of centre tanks flanked by two wing tanks. In modern times, some of the wing tanks are used only for _____ and, being _____, do not become _____ with oil cargo.

The _____can then be discharged overboard into the sea, thus enabling the vessel to call at terminals that do not have the _____ to handle dirty or contaminated ballast water.

Tanks designated purely for water ballast are referred to as '_____ ballast tanks' or SBTs for short _____ or destinations.

As a result, all new tankers now have to be built with a _____ and there is a programme in place to phase out all older _____ tankers within a relatively short period of time.

Tanker cargo handling

Tankers are invariably _____ and most are equipped with at least four pumps that operate at high speed enabling a fast _____ in port. The _____ of discharge is of course affected by local conditions such as climate, small shore lines, distance of receiving tanks from the berth, etc. When carrying certain types of oils, tankers require _____ within the tanks to keep the cargo fluid. Those coils, usually fitted in the bottom of the _____, can maintain a constant heat of up to approx. 50 degrees C. Heating coils are not usually found in ULCC's or VLCC's, as they are usually too large to load at terminals that supply the heavy and sticky _____.

(crude oils - self-discharging - cargo tanks - rate - heating coils - turn round)

B3 Complete the following text:

Tanker construction

- A tanker is divided by ..... and consists of the following tanks .....
- In modern times, some of the wing tanks are used only for ..... and, being segregated, ...
- The ballast can then be discharged overboard into the sea, thus …….. .
- Segregated ballast tanks (SBTs) are designated for for ……. and are used for ……...
- All new tankers now have to be built with .....
- Therefore all older single skin tankers will be ..... within .....

C. Gas carriers

An **LNG carrier** is a tank ship designed for transporting liquefied natural gas (LNG). A typical LNG carrier has four to six **tanks** located along the center-line of the vessel. Surrounding the tanks is a combination of **ballast tanks**, **cofferdams**[2] and voids (empty spaces); in effect, this gives the vessel a **double-hull** type design.

- [2] The cofferdam is a void or empty compartment, an enclosed space, provided between the tanks to prevent two different liquids from mixing with each other, and to protect the liquid cargo from the engiroom spaces. Cofferdams are additionally fitted between (liquid) cargo space and machinery space.

Inside each tank there are typically three submerged pumps. There are two main **cargo pumps** which are used in cargo discharge operations and a much smaller pump which is referred to as the spray pump. The **spray pump** is used for either pumping out liquid LNG to be used as fuel (via a **vaporizer**), or for cooling down cargo tanks. It can also be used for "**stripping**" out the last of the cargo in discharge operations. All of these pumps are contained within what is known as the **pump tower** which hangs from the top of the tank and runs the entire depth of the tank. The pump tower also contains the tank **gauging system** and the tank **filling line**, all of which are located near the bottom of the tank.

In **membrane-type vessels** there is also an empty pipe with a spring-loaded foot valve that can be opened by weight or pressure. This is the emergency pump tower. In the event both main cargo pumps fail the top can be removed from this pipe and an emergency cargo pump lowered down to the bottom of the pipe. The top is replaced on the column and then the pump is allowed to push down on the foot valve and open it. The cargo can then be pumped out.

All cargo pumps discharge into a common pipe which runs along the deck of the vessel; it branches off to either side of the vessel to the **cargo manifolds**, which are used for loading or discharging.

All cargo tank vapour spaces are linked via a **vapour he**ader which runs parallel to the cargo header. This also has connections to the sides of the ship next to the **loading and discharging manifolds**

Exercises (C):

C1 Pair work: Discuss the following terms with your partner (shape, size, location, function, etc.)

- **cargo tank**
- **ballast tank**
- **cofferdam**
- **double-hull design**
- **cargo manifold**
- **vaporizer**
- **stripping**
- **gauging system**
- **tank filling line**

C2 Supply the missing text

- An **LNG carrier** is a tank ship designed for transporting .....
- A typical LNG carrier has four to six **tanks** located .....

- ..... is a combination of **ballast tanks**, **cofferdams**[3] and voids (empty spaces); in effect, this gives the vessel a **.....** .
- Inside each tank there are typically three ……..
- There are two main **cargo pumps** which are used …….. and a much smaller pump which ……. as the spray pump.
- The **spray pump** is used for either pumping out liquid LNG to be used as fuel (via a **vaporizer**), or for ……..
- It can also be used for …….
- All of these pumps are contained within what is known as the **pump tower** which hangs …….. and runs …….
- The pump tower also contains the …… and the tank **filling line**, all of which are located ……...

C3 Supply the missing verbs as appropriate

In **membrane-type vessels** there is also an empty pipe with a spring-loaded foot valve that can be _____ by weight or pressure. This is the emergency pump tower**.** In the event both main cargo pumps _____**,** the top can be removed from this pipe and an _____ lowered down to the bottom of the pipe. The top is _____ on the column and then the pump is allowed to _____on the foot valve and open it. The cargo can then be _____ out.

All cargo pumps _____ into a common pipe which runs along the deck of the vessel; it _____ off to either side of the vessel to the **cargo manifolds**, which are used for _____ or discharging.

All cargo tank vapour spaces are linked via a **vapour he**ader which _____ parallel to the cargo header. This also _____ connections to the sides of the ship next to the **loading and discharging manifolds**

D. Liquid Petroleum Gas (LPG)

- [3] The cofferdam is a void or empty compartment, an enclosed space, provided between the tanks to prevent two different liquids from mixing with each other. Cofferdams are additionally fitted between (liquid) cargo space and machinery space.

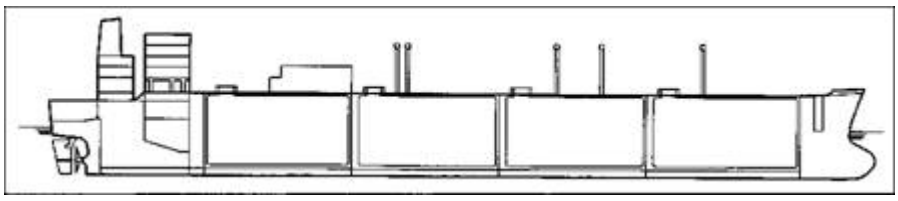


Diagram of *LPG* Carrier

Source: Syd Harris - Fully Refrigerated LPG Carriers

LPG Tankers have a capacity of up to 110,000m^3, and an average overall length around 120 m. The design of today's LPG tankers is characterised by a high speed and thus high propeller loading. This requires a low overall resistance and related good powering performance but also an excellent after body design, with a good flow towards the propeller(s) and rudder(s), without flow separation. LPG tankers are mostly sailing with a traditional single screw propulsor.

The two main types of LPG - Butane[4] and Propane[5] - have the advantage from the transportation point of view, that they can be kept in a liquid state so long as a high pressure is maintained. As with all gases in a liquid state, however, they are able to be kept that way more easily at a low temperature.

Gases can, therefore, be carried under any one of the following conditions:

- At ambient temperature under pressure.
- In insulated tanks at liquefaction temperature, but at atmospheric pressure.
- In a combination of liquefaction temperature under pressure.

For loading purposes, the gases are liquefied by reducing their temperature by an amount dependent on the actual product involved; this operation is normally carried out by the shore installation.

Most modern LPG carriers are, however, fitted with refrigeration equipment which allows them to reduce and maintain the cargo temperature as required usually to minus 50 deg C, thus any vapourising during the voyage or discharging can be liquefied by the internal system onboard the vessel.

The size of the LPG carrier has increased over the past twenty years from vessels that carried 700 cubic metres to vessels in excess nowadays of 70,000 cubic metres.

Cargo tanks in LPG carriers are normally cylindrical in shape constructed from aluminium alloy and are self supporting and free standing. Further they are insulated to keep the heat out by a coating of a suitable material such as polyurethane foam.

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[4] /'bju:tein/

[5] /'prəʊ pein/

Exercises (D):

D1 Supply the missing terms in the appropiate place in the sentence:

LPG Tankers have a of up to 110,000m^3, and an average overall length around 120 m. The of today's LPG tankers is characterised by a high speed and thus high propeller loading. This requires a low overall and related good powering performance but also an excellent after body design, with a good flow towards the propeller(s) and rudder(s), without flow separation. LPG tankers are mostly sailing with a traditional single screw. (***propulsor, design, capacity, resistance***)

Gases can, therefore, be carried under any one of the following conditions:

- At temperature under pressure.
- In tanks at liquefaction temperature, but at atmospheric pressure.
- In a combination of temperature under pressure.

For loading purposes, the gases are liquefied by reducing their temperature by an amount dependent on the actual product involved; this operation is normally carried out by the shore. (***liquefaction, installation, ambient, insulated***)

Most modern LPG carriers are, however, with refrigeration equipment which allows them to reduce and the cargo temperature as required usually to minus 50 deg C, thus any vapourising during the voyage or discharging can be by the internal system onboard the vessel.

The size of the LPG carrier has increased over the past twenty years from vessels that 700 cubic metres to vessels in excess nowadays of 70,000 cubic metres.

Cargo tanks in LPG carriers are normally cylindrical in shape from aluminium alloy and are self supporting and free standing. Further they are to keep the heat out by a coating of a suitable material such as polyurethane foam. (***maintain, insulated, liquefied, carried, fitted, constructed***)

D1 Complete the sentences below:

LPG Tankers have a capacity of …….., and an ……. around 120 m.
The design of today's LPG tankers is characterised by ……. and thus high ……..
This requires a low ……. and related good powering performance but also an excellent after body design, with a good ……., without flow separation.
LPG tankers are mostly sailing with ……..

The two main types of LPG - ..... - have the advantage from the transportation point of view, that they can be kept in a liquid state so long as .....
As with all gases in a liquid state, however, they are able to be ..... at a low temperature.

Gases can, therefore, be carried under any one of the following conditions:

- ..... under pressure.
- In insulated tanks ....., but at atmospheric pressure.
- In a combination of .....

For loading purposes, the gases are liquefied by reducing their temperature by .....; this operation is normally carried out .....

Most modern LPG carriers are, however, fitted with refrigeration equipment which allows ..... usually to minus 50 deg C, thus any vapourising during the voyage or discharging can be .....

..... has increased over the past twenty years from vessels that carried 700 cubic metres to vessels in excess nowadays of 70,000 cubic metres.

Cargo tanks in LPG carriers are ..... in shape constructed from ..... and are self supporting and free standing.
Further they are insulated to ..... by a coating of a suitable material such as polyurethane foam.

E. Liquid Natural Gas (LNG)

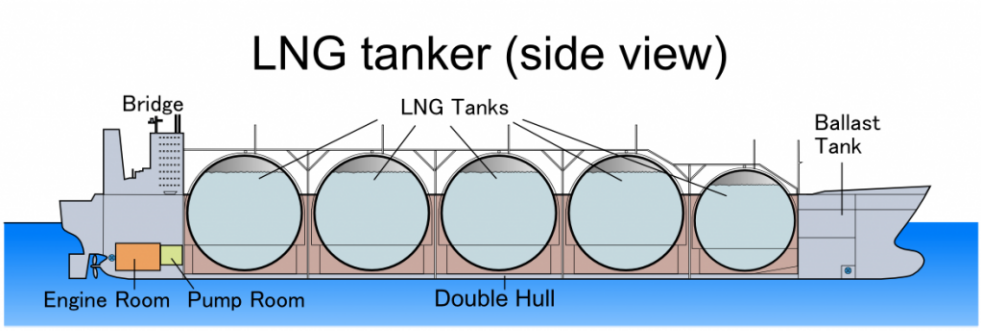

Diagram of *LNG* Carrier

Natural gas cannot be liquefied by pressure alone and so has to be carried at very low temperatures. The main types of natural gas are Ethane[6] and Methane[7]. Ethane requires to be carried at minus 104°C and Methane at minus 163°C, both being carried at atmospheric pressure.

There are two very different systems used in the design of LNG ships although both of them rely on insulated tanks to store the cargo.

Firstly there is the Moss system, named after its designer, which is instantly recognisable by the spherical tanks protruding high above the ship's deck.

The tanks themselves are made from an aluminium alloy surrounded by insulation and protected by a steel outer shell. The tanks are connected to the ship's hull, but do not form part of it

The second types of ship are referred to as membrane types. Unlike the spherical tanks of a Moss type LNG tanker, the prismatic tanks of a membrane LNG carrier are fully integrated into

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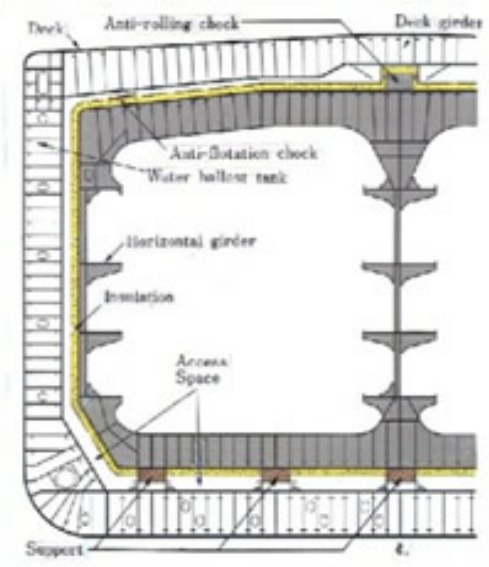
[6] /i:θein/; /'ɛ θein/

[7] /'mi:θein/

the hull. The cargo containment system is fitted inside the tanks, between the inner hull and the liquid cargo.



Neither type of storage system is fully effective and, the gas cargo boils off at the rate of around 0.15 per cent per day. Ordinarily this would be considered a negative factor, but for the fact that most LNG ships are designed to make use of this tendency and are equipped with gas turbine engines that are mostly fuelled by the Boil Off Gas (BOG). For this reason LNG carriers only need to take on bunkers for auxiliary engines and for running the boilers for the turbines in port.

The most usual size for an LNG ship is 135,00 - 145,000 M3 (equal to about 60-70,000 *DWAT*) and, although larger ships are planned, most of the shore facilities have been built to accept the present sizes of ships

Exercises (E):

E1 Supply the missing information:

Natural gas cannot be liquefied by pressure alone and so has to be carried ..... The main types of natural gas are ..... . Ethane requires to be carried ..... and Methane at minus 163°C, both being carried at ..... .

There are two very different systems used in the design on LNG ships although both of them rely on ..... .
Firstly there is the Moss system, named after its designer, which is instantly recognisable ..... protruding high above the ship's deck.

The tanks themselves are made from an ..... surrounded by insulation and protected by ..... . The tanks are connected to the ship's hull, but ..... .

The second types of ship ..... (=are called) membrane types. Unlike the spherical tanks of a Moss type LNG tanker, the prismatic tanks of a membrane LNG carrier are fully ..... . The ..... is fitted inside the tanks, between the ..... and the liquid cargo.

Neither type of storage system is fully effective and, the gas cargo ..... around 0.15 per cent per day. Ordinarily this would be considered ....., but for the fact that most LNG ships are designed to make use of this tendency and are equipped with gas turbine engines that are mostly fuelled by the ..... (BOG). For this reason LNG carriers only need to ..... for auxiliary engines and for running the boilers for the turbines in port.

E2 Insert the missing word in the right place of in the text below:

Natural gas cannot be by pressure alone and so has to be carried at very low temperatures. The main types of natural gas are and Methane. Ethane to be carried at minus 104°C and Methane at minus 163°C, both being carried at atmospheric pressure. (*requires, liquefied, Ethane*)

There are two very different systems used in the design of LNG ships although both of them rely on tanks to store the cargo.

Firstly there is the Moss system, named after its designer, which is instantly recognisable by the protruding high above the ship's deck.

The tanks themselves are made from an surrounded by insulation and protected by a steel outer shell. The tanks are connected to the ship's hull, but do not form part of it. (*spherical tanks, insulated, aluminium alloy*)

The second types of ship are referred to as types. Unlike the spherical tanks of a type LNG tanker, the tanks of a membrane LNG carrier are fully into the hull. The is fitted inside the tanks, between the inner hull and the liquid cargo.

type of storage system is fully effective and, the gas cargo at the rate of around 0.15 per cent per day. Ordinarily this would be considered a negative factor, but for the fact that most LNG ships are to make use of this tendency These ships are equipped with gas turbine engines that are mostly by the Boil Off Gas (BOG). For this reason LNG carriers only need to take on bunkers for and for running the boilers for the turbines in port. (*membrane, Moss, prismatic, integrated, cargo containment, system boils off, Neither, designed, fuelled, auxiliary engines*)

E3 Pair work. Discuss the difference between the two types of LNG carriers following the prompts below:

- ***types of natural gas***
- ***ethane – carried at … and methane at …***
- ***the two systems***

- ***both systems rely on …***
- ***the Moss system***
- ***tanks in the Moss system***
- ***the membrane type of lng carrier***
- ***cargo containment systems***
- ***why are the two storage systems not fully effective?***
- ***bog - the positive side of lng ships***
- ***bunkers taken only for …***

F. Chemical tankers

A chemical tanker is a type of tanker ship designed to transport chemicals in bulk. As defined in MARPOL Annex II, chemical tanker means a ship constructed or adapted for carrying in bulk any liquid product listed in chapter 17 of the International Bulk Chemical Code.

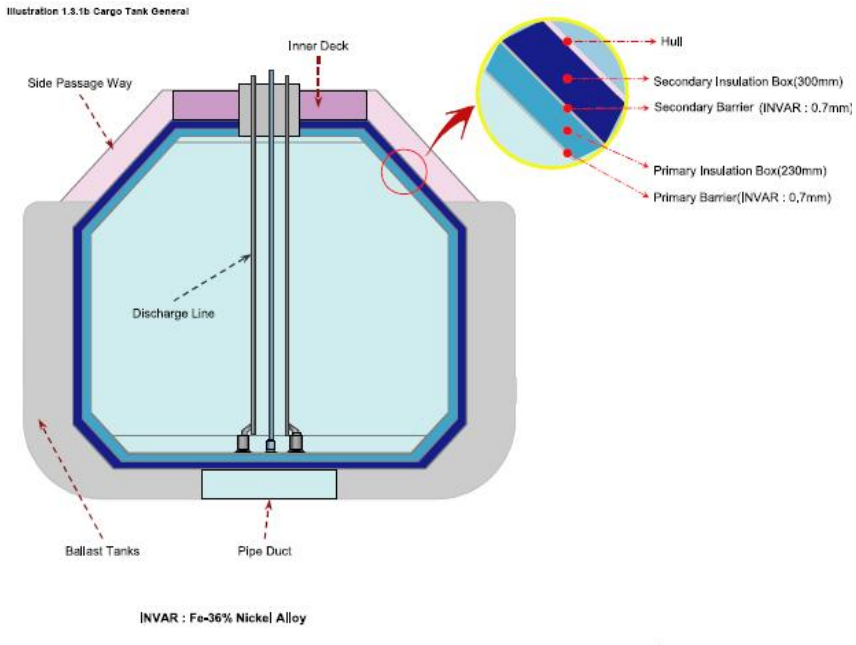
Chemical tankers often have a system for tank heating in order to maintain the viscosity of certain cargoes, typically by passing pressurized steam through stainless steel 'heating coils' in the cargo tanks, transferring heat into the cargo which circulates in the tank by convection[8]. Many modern chemical tankers feature double hull construction and have one tank for each pump with separate piping, which means that each tank can load a separate cargo without any mixing. Tank cleaning after discharging cargo is a very important aspect of chemical tanker operations, because tanks which are not properly cleaned of all cargo residue can adversely affect the purity of the next cargo loaded. Before tanks are cleaned, they must be properly ventilated and checked to be free of potentially explosive gases. Chemical tankers usually have transverse stiffeners on deck rather than inside the cargo tanks, in order to make the tank walls smooth and easier to clean by fitted tank cleaning machines.

Cargo tanks, either empty or filled, are normally protected against explosion by inert gas blankets. Often nitrogen is the inert gas used, supplied either from portable gas bottles or an inert gas generator (IGS) system.

Most new chemical tankers are built by shipbuilders in Japan, Korea or China, with other builders in Turkey, Italy, Germany and Poland. Japanese shipbuilders now account for the large majority of stainless steel chemical tankers built, as welding stainless steel to the accuracy required for cargo tank construction is a skill which is difficult to acquire.

The chemical tanker market is dominated by several major chemical tanker operators, including Stolt-Nielsen, Navig8 Chemicals, Odfjell, Eitzen Chemical, Nordic Tankers, Tokyo Marine and Berlian Laju Tanker. Charterers, the end users of the ships, include oil majors and specialist chemical companies.

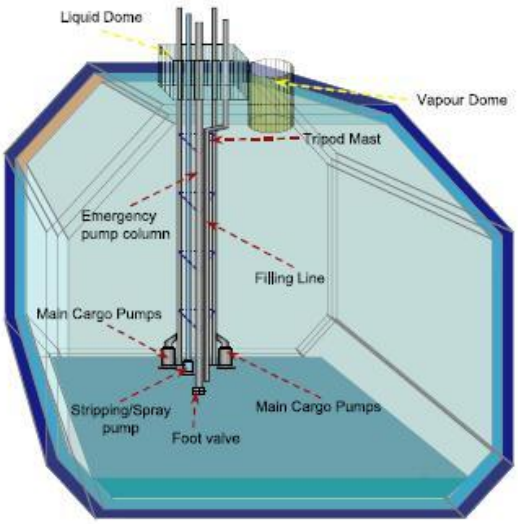
[8] a process of heat transfer through a gas or liquid by bulk motion of hotter material into a cooler region



Source: http://www.liquefiedgascarrier.com/LNG-vessel-construction.html
Chemical and Parcel Tankers

In the last thirty years the expansion of the petro-chemical industry has seen the need for specialist vessels to carry the sophisticated products now produced. The smallest speck of rust or drop of water can in some cases ruin the specification of many petro-chemical cargoes.

To counter this, modern Chemical Tankers are built with cargo tanks internally coated with types of epoxy, silicates or polyurethanes[9], with the different coatings being compatible (or, respectively, incompatible) with different chemicals. The most sophisticated chemical carriers are those whose tanks, pipes and pumping systems are made of stainless steel.



Source: http://www.liquefiedgascarrier.com/LNG-vessel-construction.html
Chemical and Parcel Tankers

[9] /pɔ li 'juːərə,θein/

Exercises (F):

F1 Supply the missing information in the description of chemical tankers:

A chemical tanker is a type of tanker ship designed to ..... . As defined in MARPOL Annex II, chemical tanker means ..... for carrying in bulk any liquid product listed in chapter 17 of the International Bulk Chemical Code.

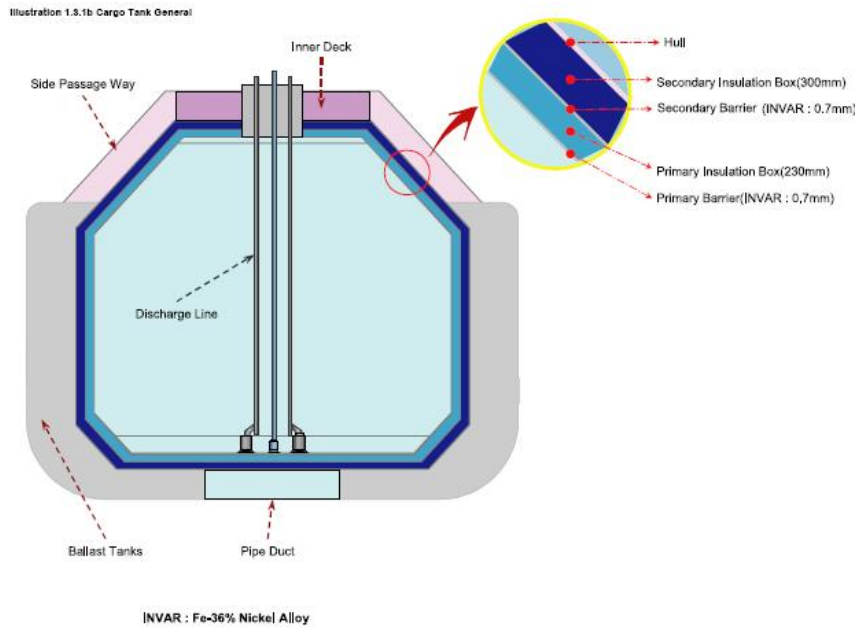
Chemical tankers often have a system for tank heating in order to ....., typically by passing pressurized steam through stainless steel 'heating coils' in the cargo tanks, transferring heat into the cargo ..... by convection. Many modern chemical tankers feature ..... and have one tank for each pump with separate piping, which means that each tank can ..... without ..... . Tank cleaning ..... is a very important aspect of chemical tanker operations, because tanks which are not properly cleaned of all cargo residue can ..... the next cargo loaded. Before tanks are cleaned, they must be ..... and checked to be free of ..... Chemical tankers usually have ..... on deck rather than inside the cargo tanks, in order to make the tank walls smooth and easier to ..... .

Cargo tanks, either empty or filled, are normally protected against explosion ..... . Often nitrogen[10] is the inert gas used, supplied either from portable gas bottles or an ..... .

The ..... is dominated by several major chemical tanker operators, including Stolt-Nielsen, Navig8 Chemicals, Odfjell, Eitzen Chemical, Nordic Tankers, Tokyo Marine and Berlian Laju Tanker. Charterers, ... , include oil majors and specialist chemical companies.

F2 Discuss the layout of the tank of a chemical tanker (see the image below)

[10] /'naitrədʒ(ə)n/



F2 Cloze – Every fifth word in the text below is missing. Supply the missing one:

In the last thirty ___ the expansion of the ___ industry has seen the ___ for specialist vessels to carry ___ sophisticated products now produced. ___ smallest speck of rust ___ drop of water can ___ in some cases ruin ___ the specification of many petro-chemical ___.

To counter this, modern ___ Tankers are built with ___ tanks internally coated with ___ of epoxy, silicates or ___, with the different coatings ___ compatible (or, respectively, incompatible) ___ different chemicals. The most ___ chemical carriers are those ___ tanks, pipes and pumping ___ are made of stainless steel.

F3 The data below on an LNG ship have been jumbled. Study the table below and find appropriate data used in displaying the main particulars of a ship –:

Ship data		Ship data	
DWT:	No	**DWT:**	
Draft:	Singapore	**Draft:**	
Loa:	20.938 mt	**Loa:**	
Beam:	12.10	**Beam:**	
Flag:	6.378	**Flag:**	
GT:	9.77 m	**GT:**	
NT:	Yes	**NT:**	
Bowtruster:	147.83 m	**Bowtruster:**	
ICE:	24.22 m	**ICE:**	
IMO Number:		**IMO Number:**	9349643
Built:		**Built:**	22
Cubic (98%):		**Cubic (98%):**	Yes
Coating:		**Coating:**	Yes
Segregations:		**Segregations:**	sampling
Nitrogen:		**Nitrogen:**	Steam coils
Heating capacity:		**Heating capacity:**	2006
Cargo heating system:		**Cargo heating system:**	21,506.36
Steam coils:		**Steam coils:**	No
Super stripping:		**Super stripping:**	Yes, closed
Closed sampling:		**Closed sampling:**	Stainless Steel

F4 Choose the right (i.e. the most appropriate) term

Chemical tankers often have a system for tank **cooling/heating/cleaning** in order to maintain the viscosity of certain cargoes, typically by passing **pressurized/liquefied/purified** steam through stainless steel 'heating coils' in the cargo tanks, transferring heat into the cargo which **moves/circulates/runs** in the tank by **connection/segregarion/convection**. Many modern chemical tankers feature double hull construction and have one tank for each pump with separate **loading/piping/lining**, which means that each tank can load a separate cargo without any **fixing/mixing/moving**. Tank cleaning after discharging cargo is a very important aspect of chemical tanker operations, because tanks which are not properly cleaned of all cargo **resistance/rest/residue** can **conversely/adversely/reversely** affect the purity of the next cargo loaded. Before tanks are cleaned, they must be properly ventilated and checked to be free of potentially explosive gases. Chemical tankers usually have transverse **stiffeners/fittings/stringers** on deck rather than inside the cargo tanks, in order to make the tank walls smooth and easier to clean by **inserted/fitted/provided** tank cleaning machines.

Cargo tanks, either empty or filled, are normally protected against explosion by inert gas **gaskets/blankets/gadgets**. Often nitrogen is the inert gas used, supplied either from **movable/replaceable/portable** gas bottles or an inert gas generator (IGS) system

G. Typical cargo cycle in LNG ships

A typical cargo cycle starts with the tanks in a "gas free" condition, meaning the tanks are full of air, which allows maintenance on the tank and pumps. Cargo cannot be loaded directly into the tank, as the presence of oxygen would create an explosive atmospheric condition within the tank, and the rapid temperature change caused by loading LNG at −162 °C could damage the tanks.

First, the tank must be 'inerted' to eliminate the risk of explosion. An inert gas plant burns diesel in air to produce carbon dioxide (CO_2); this is blown into the tanks until the oxygen level is below 4%.

Next, the vessel goes into port to "gas-up" and "cool-down", as one still cannot load directly into the tank: The CO_2 will freeze and damage the pumps and the cold shock could damage the tank's pump column.

Liquid LNG is brought onto the vessel and taken along the spray line to the main vaporiser, which boils off the liquid into gas. This is then warmed up to roughly 20 °C in the gas heaters and then blown into the tanks to displace the "inert gas". This continues until all the CO_2 is removed from the tanks. Initially, the IG (inert gas) is vented to atmosphere. Once the hydrocarbon content reaches 5% (lower flamability range of methane) the inert gas is redirected to shore via a pipeline and manifold connection by the HD (high duty) compressors. Shore terminal then burns this vapour to avoid the dangers of having large amounts of hydrocarbons around which may explode.

Now the vessel is gassed up and warm. The tanks are still at ambient temperature and are full of methane.

The next stage is cool-down. Liquid LNG is sprayed into the tanks via spray heads, which vaporises and starts to cool the tank. The excess gas is again blown ashore to be re-liquified or burned at a flare stack. Once the tanks reach about −140 °C the tanks are ready to load bulk.

Bulk loading starts and liquid LNG is pumped from the storage tanks ashore into the vessel tanks. Displaced gas is blown ashore by the HD compressors. Loading continues until typically 98.5% full is reached (to allow for thermal expansion/contraction of cargo).

The vessel can now proceed to the discharge port. During passage various boil-off management strategies can be used. Boil-off gas can be burned in boilers to provide steam for propulsion, or it can be re-liquefied and returned to the cargo tanks, depending on the design of the vessel.

Once in the discharge port, the cargo is pumped ashore using the cargo pumps. As the tank empties, the vapour space is filled by either gas from ashore or by vaporising some cargo in the cargo vaporiser. Either the vessel can be pumped out as far as possible, with the last being pumped out with spray pumps, or some cargo can be retained on board as a "heel".

If all the cargo is pumped ashore, then on the ballast passage the tanks will warm up to ambient temperature, returning the vessel to a gassed up and warm state. The vessel can then be cooled again for loading.

If the vessel is to return to a gas free state, the tanks must be warmed up by using the gas heaters to circulate warm gas. Once the tanks are warmed up,

the inert gas plant is used to remove the methane from the tanks. Once the tanks are methane free, the inert gas plant is switched to dry air production, which is used to remove all the inert gas from the tanks until they have a safe working atmosphere.

Exercises (G):

G1 Supply the missing verbs

A typical cargo cycle with the tanks in a "gas free" condition, which means that the tanks are full of air, which maintenance on the tank and pumps. Cargo cannot be directly into the tank, as the presence of oxygen would an explosive atmospheric condition within the tank, and the rapid temperature change caused by loading LNG at −162 °C could the tanks.(in order of appearance: **starts, allows, loaded, create, damage**)

First, the tank must be to eliminate the risk of explosion. An inert gas plant diesel in air to produce carbon dioxide (CO_2); this is into the tanks until the oxygen level is below 4%.

Next, the vessel goes into port to "gas-up" and "cool-down", as one still cannot load directly into the tank: The CO_2 will freeze and damage the pumps and the cold shock could damage the tank's pump column. (**'inerted', burns, blown**)

Liquid LNG is onto the vessel and taken along the spray line to the main vaporiser, which the liquid into gas. This is then warmed up to roughly 20 °C in the gas heaters and then into the tanks to the "inert gas". This continues until all the CO_2 is removed from the tanks. Initially, the IG (inert gas) is to atmosphere. Once the hydrocarbon content reaches 5% (lower flamability range of methane) the inert gas is redirected to shore via a pipeline and manifold connection by the HD (high duty) compressors. Shore terminal then burns this vapour to the dangers of having large amounts of hydrocarbons around which may. Now the vessel is and warm. The tanks are still at ambient temperature and are full of methane. (**brought, boils off, blown, displace, vented, avoid, explode, gassed up**)

G2 Supply the missing information

The next stage is cool-down. Liquid LNG is sprayed into the tanks via spray heads, which ..... . The excess gas is again blown ashore to be re-liquified or ..... . Once the tanks reach about −140 °C the tanks are ..... .

Bulk loading starts and liquid LNG is pumped from .....into ..... . Displaced gas ..... by the HD compressors. Loading continues until typically 98.5% full is reached (to allow for .....).

The vessel can now ..... the discharge port. During passage various ..... can be used. Boil-off gas can be burned in boilers to ....., or it can be re-liquefied and ....., depending on the design of the vessel.

Once in the discharge port, the cargo ..... using the cargo pumps. As ....., the vapour space is filled by either gas from ashore or by vaporising some cargo in the cargo vaporiser. Either the vessel can be pumped out as far as possible, with the last being pumped out with spray pumps, or some cargo ..... a "heel".

If all the cargo is pumped ashore, then ..... the tanks will warm up to ambient temperature, returning the vessel to a gassed up and warm state. The vessel can then ..... .

If the vessel is to return to ....., the tanks must be warmed up by ..... to circulate warm gas. Once the tanks are warmed up, the inert gas plant is used to ..... . Once the tanks are methane free, the inert gas plant is switched ....., which is used to remove all the inert gas from the tanks until they have ..... .

G3 Read the text below again and make your own outline of the contents by providing headings and sub-headings showing thesequence of operations and measures taken in the process of the cargo cycle in LNG ships

Typical cargo cycle in LNG ships

A typical cargo cycle starts with the tanks in a "gas free" condition, meaning the tanks are full of air, which allows maintenance on the tank and pumps. Cargo cannot be loaded directly into the tank, as the presence of oxygen would create an explosive atmospheric condition within the tank, and the rapid temperature change caused by loading LNG at −162 °C could damage the tanks.

First, the tank must be 'inerted' to eliminate the risk of explosion. An inert gas plant burns diesel in air to produce carbon dioxide (CO_2); this is blown into the tanks until the oxygen level is below 4%.

Next, the vessel goes into port to "gas-up" and "cool-down", as one still cannot load directly into the tank: The CO_2 will freeze and damage the pumps and the cold shock could damage the tank's pump column.

Liquid LNG is brought onto the vessel and taken along the spray line to the main vaporiser, which boils off the liquid into gas. This is then warmed up to roughly 20 °C in the gas heaters and then blown into the tanks to displace the "inert gas". This continues until all the CO_2 is removed from the tanks. Initially, the IG (inert gas) is vented to atmosphere. Once the hydrocarbon content reaches 5% (lower flamability range of methane) the inert gas is redirected to shore via a pipeline and manifold connection by the HD (high duty) compressors. Shore terminal then burns this vapour to avoid the dangers of having large amounts of hydrocarbons around which may explode.

Now the vessel is gassed up and warm. The tanks are still at ambient temperature and are full of methane.

The next stage is cool-down. Liquid LNG is sprayed into the tanks via spray heads, which vaporises and starts to cool the tank. The excess gas is again blown ashore to be re-liquified or burned at a flare stack. Once the tanks reach about −140 °C the tanks are ready to load bulk.

Bulk loading starts and liquid LNG is pumped from the storage tanks ashore into the vessel tanks. Displaced gas is blown ashore by the HD compressors. Loading continues until typically 98.5% full is reached (to allow for thermal expansion/contraction of cargo).

The vessel can now proceed to the discharge port. During passage various boil-off management strategies can be used. Boil-off gas can be burned in boilers to provide steam for propulsion, or it can be re-liquefied and returned to the cargo tanks, depending on the design of the vessel.

Once in the discharge port, the cargo is pumped ashore using the cargo pumps. As the tank empties, the vapour space is filled by either gas from ashore or by vaporising some cargo in the cargo vaporiser. Either the vessel can be pumped out as far as possible, with the last being pumped out with spray pumps, or some cargo can be retained on board as a "heel".

If all the cargo is pumped ashore, then on the ballast passage the tanks will warm up to ambient temperature, returning the vessel to a gassed up and warm state. The vessel can then be cooled again for loading.

If the vessel is to return to a gas free state, the tanks must be warmed up by using the gas heaters to circulate warm gas. Once the tanks are warmed up, the inert gas plant is used to remove the methane from the tanks.

Once the tanks are methane free, the inert gas plant is switched to dry air production, which is used to remove all the inert gas from the tanks until they have a safe working atmosphere.

E.g.

1. tanks in a "gas free" condition
2. inerting the tanks
3. .....
4. .....
5. etc.

G4 Writing skills: Summarise the text on the "Typical cargo cycle in LNG ships" in writing using the outline you have cerated in the exercise above. The summary should be limited to 250 words.

G4 Speaking skills: (pair and group work) Present the text on the "Typical cargo cycle in LNG ships" above to your partner or to your group. Make a five-minute presentation using your notes (outline)

G5 Grammar - Text connectors – Study the text above and find the way the paragraphs are introduced, interconnected, related to, etc.

e.g.

A typical cargo cycle starts with the tanks in a "gas free" condition, meaning the tanks are full of air, which allows maintenance on the tank and pumps. Cargo cannot be loaded directly into the tank, as the presence of oxygen would create an explosive atmospheric condition within the tank, and the rapid temperature change caused by loading LNG at −162 °C could damage the tanks.

First, the tank must be 'inerted' to eliminate the risk of explosion. An inert gas plant burns diesel in air to produce carbon dioxide (CO_2); **this** is blown into the tanks until the oxygen level is below 4%.

Next, the vessel goes into port to "gas-up" and "cool-down", as one still cannot load directly into the tank: The CO_2 will freeze and damage the pumps and the cold shock could damage the tank's pump column.

.....

..... etc.

G6 The paragraphs of the text below have been jumbled. Put them into the right sequence. The first and the last one have been done for you.

Typical cargo cycle in LNG ships

1	A typical cargo cycle starts with the tanks in a "gas free" condition	1A
2	Next, the vessel goes into port to "gas-up" and "cool-down", as	

	one still cannot load directly into the tank: The CO_2 will freeze and damage the pumps and the cold shock could damage the tank's pump column.	
3	Liquid LNG is brought onto the vessel and taken along the spray line to the main vaporiser, which boils off the liquid into gas. This is then warmed up to roughly 20 °C in the gas heaters and then blown into the tanks to displace the "inert gas".	
4	First, the tank must be 'inerted' to eliminate the risk of explosion. An inert gas plant burns diesel in air to produce carbon dioxide (CO_2); this is blown into the tanks until the oxygen level is below 4%.	
5	The next stage is cool-down. Liquid LNG is sprayed into the tanks via spray heads, which vaporises and starts to cool the tank. The excess gas is again blown ashore to be re-liquified or burned at a flare stack. Once the tanks reach about −140 °C the tanks are ready to load bulk.	
6	Now the vessel is gassed up and warm. The tanks are still at ambient temperature and are full of methane.	
7	Bulk loading starts and liquid LNG is pumped from the storage tanks ashore into the vessel tanks. Displaced gas is blown ashore by the HD compressors. Loading continues until typically 98.5% full is reached (to allow for thermal expansion/contraction of cargo).	
8	The vessel can now proceed to the discharge port.	
9	If the vessel is to return to a gas free state, the tanks must be warmed up by using the gas heaters to circulate warm gas.	
10	If all the cargo is pumped ashore, then on the ballast passage the tanks will warm up to ambient temperature, returning the vessel to a gassed up and warm state. The vessel can then be cooled again for loading.	
11	Once in the discharge port, the cargo is pumped ashore using the cargo pumps.	
11	Once the tanks are methane free, the inert gas plant is switched to dry air production, which is used to remove all the inert gas from the tanks until they have a safe working atmosphere.	12L

G7 Match the sentences which have been jumbled. The first one has been done for you.

1	A typical cargo cycle starts with the tanks in a "gas free" condition,	a	could damage the tanks.	1d
2	Cargo cannot be loaded directly into the tank,	b	to eliminate the risk of explosion.	
3	The rapid temperature change caused by loading LNG at −162 °C	c	"cool-down", as one still cannot load directly into the tank	
4	First, the tank must be 'inerted'	d	which means the tanks are full of air, which allows maintenance on the tank and pumps.	
5	An inert gas plant burns diesel in air to produce carbon dioxide (CO_2);	e	as the presence of oxygen would create an explosive atmospheric condition within the tank	
6	Next, the vessel goes into port to "gas-up" and.	f	the cold shock could damage the tank's pump column.	
7	The CO_2 will freeze and damage the pumps and	g	this is blown into the tanks until the oxygen level is below 4%.	

H. The Tanker Pump Room

The pump room is a cofferdam kind of space which begins on main deck and ends at the keel. It may have more than 2 decks, however these decks are not normally solid decks but are partial decks made of expanded metal, so you are able to see right to the bottom. There would be a companionway leading from the top to the next deck and so on right to the bottom.

At the lowermost deck are situated the Cargo Oil Pumps (COP's). The numbers of pumps vary in number – for crude oil tankers it is normal to have 4 pumps, three being used at any one time.

For product oil tankers the number of pumps depend on the number of grade of oil that the ship is capable of carrying. So if the ship can carry 4 grades of oil then she would be having 4 pumps.

Once the gravity flow to the COP's is not possible, the stripped pumps are started. These pumps are of the reciprocating type and have great capacity to create partial vacuum to suck out the remaining oil from the tanks. Again on a product oil tanker the number of stripped pumps would be equal to the number of grades of oil that it can carry.

Earlier on Crude oil carrier there would be stripper pumps of the reciprocating type however today largely eductors are used to remove the remaining oil from the tank. Generally 2 eductors are provided on each crude oil tanker. However 1 stripper pump is always provided to strip the cargo lines of any residual oil and to pump the same to the shore system.

The pumproom is a hazardous area. Therefore the light fittings are gas tight and only tanker safety torches are used. The ventilation system is of the exhaust type and has intakes from all the levels with the intakes being fitted with closing devices so that if required only a certain level can be evacuated.

Hydrocarbon gases being heavier than air tend to settle at the bottom of the pumproom. Therefore the main exhaust are always from the bottom level.

The pumproom lighting is devised in such a way that the lights do not come on unless the ventilation has been started and is kept on for 15 minutes.

AT the top of the pumproom a harness and lifting arrangement is provided to lift out a person from the lowermost deck, for this reason a clear passage is left vertically from the top to the bottom of the pumproom.

Fire man's outfit are also placed at the top of the pumproom, the pumproom may have different types of fixed fire fighting appliances such as total flooding by CO2 or by foam applicators fitted in the bilges (below the floor plates under the lowermost deck).

Bilge alarms are fitted which give alarms when the bilges are filled – a high level and a low level alarm is fitted which gives indications in the Engine room as well as in the Cargo Control room.

Exercises (H):

H1 Supply the missing word

The pump room is a _____ kind of space which begins on main deck and ends at the _____.

It may have more than 2 _____, however these decks are not normally solid decks but are partial decks made of expanded metal, so you are

able to see right to the bottom. There would be a _____ companionway leading from the top to the next deck and so on right to the bottom.

At the lowermost deck are situated the _____ (COP's). The numbers of pumps vary in number – for _____ tankers it is normal to have 4 pumps, three being used at any one time.

For _____ oil tankers the number of pumps depend on the number of grade of oil that the ship is capable of carrying. So if the ship can carry 4 _____ of oil then she would be having 4 pumps.

Once the _____ to the COP's is not possible, the stripped pumps are started. These pumps are of the _____ type and have great capacity to create partial vacuum to suck out the remaining oil from the tanks. Again on a product oil tanker the number of _____ pumps would be equal to the number of grades of oil that it can carry.

Earlier on Crude oil carrier there would be stripper pumps of the reciprocating type however today largely _____ are used to remove the remaining oil from the tank. Generally 2 eductors are provided on each crude oil tanker. However 1 stripper pump is always provided to _____ the cargo lines of any _____ oil and to pump the same to the shore system.

H2 Supply the missing phrases showing time, place, cause, manner, condition, result, purpose, quantity, contrast, etc.

The pump room is a cofferdam kind of space which begins _____ and ends _____. It may have more than 2 decks, however these decks are not normally solid decks but are partial decks made of expanded metal, _____. There would be a companionway leading from the top to the next deck and so on _____. (**at the keel, on main deck, right to the bottom, so you are able to see right to the bottom**)

_____ are situated the Cargo Oil Pumps (COP's). The numbers of pumps _____ – for crude oil tankers it is normal to have 4 pumps, three being used _____ .

For product oil tankers the number of pumps depend on the number of grade of oil that the ship is capable of carrying. So if the ship can carry 4 grades of oil _____ she would be having 4 pumps. (**at any one time, at the lowermost deck, vary in number, then**)

Once the gravity flow to the COP's is not possible, the stripped pumps are started. These pumps are of the reciprocating type and have great capacity to create partial vacuum to suck out the remaining oil from the tanks. Again on a product oil tanker the number of stripped pumps would be equal to the number of grades of oil that it can carry.

Earlier on Crude oil carriers there would be stripper pumps of the reciprocating type. However today largely eductors are used to remove the remaining oil from the tank. Generally 2 eductors are provided. However 1 stripper pump is always provided to strip the cargo lines of any residual oil and to pump the same to the shore system. (**again, once, to create partial vacuum, earlier on Crude oil carriers, to strip the cargo lines of any residual oil, however, on each crude oil tanker**).

The pumproom is a hazardous area. _____ the light fittings are gas tight and only tanker safety torches are used. The ventilation system is of the exhaust type and has intakes from all the levels with the intakes being fitted with closing devices so that _____ only a certain level can be evacuated.

Hydrocarbon gases being heavier than air tend to settle at the bottom of the pumproom. Therefore the main exhaust are always from the bottom level.

The pumproom lighting _____ that the lights do not come on unless the ventilation has been started and is kept on for 15 minutes. (**so that, from the bottom level, therefore, if required, is devised in such a way that)**

At the top of the pumproom a harness and lifting arrangement is provided to lift out a person from the lowermost deck, for this reason a clear passage is left vertically from the top to the bottom of the pumproom.

Fire man's outfit are also placed at the top of the pumproom, the pumproom may have different types of fixed fire fighting appliances such as total flooding by CO2 or by foam applicators fitted in the bilges (below the floor plates under the lowermost deck).

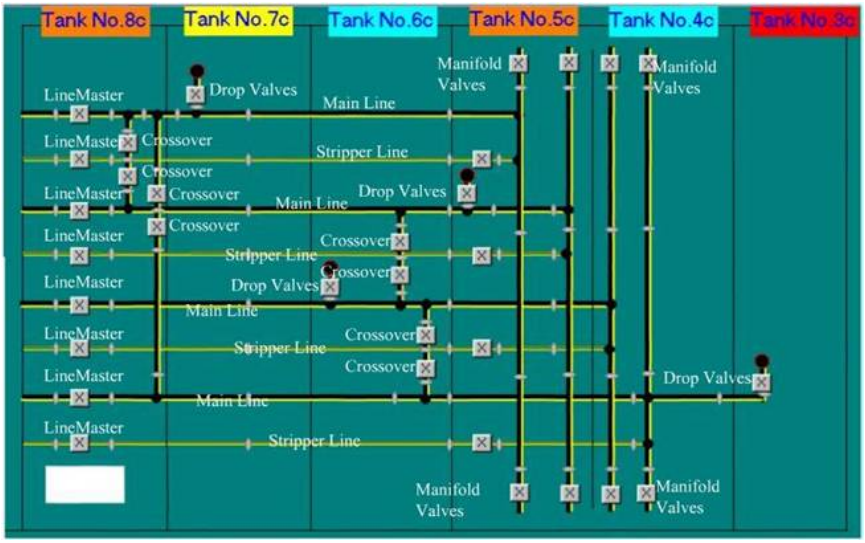
Bilge alarms are fitted which give alarms when the bilges are filled – a high level and a low level alarm is fitted which gives indications in the Engine room as well as in the Cargo Control room. (**to lift out a person, when the bilges are filled, for this reason, at the top of the pumproom)**

H3 Match the sentences (or part of the sentence) in the left column with those in the right column.

1	For product oil tankers the number of pumps depend on the number of grade of oil that the ship is capable of carrying.	a		
2	So if the ship can carry 4 grades of oil then she would be having 4 pumps.	b		

3	Once the gravity flow to the COP's is not possible,	c	Therefore the light fittings are gas tight and only tanker safety torches are used.	
4	These pumps are of the reciprocating type	d	However today largely eductors are used to remove the remaining oil from the tank.	
5	Again on a product oil tanker the number of stripped pumps would be equal to the number of grades of oil that it can carry.	e	the stripped pumps are started.	
6	Earlier on Crude oil carrier there would be stripper pumps of the reciprocating type.	f	and have great capacity to create partial vacuum to suck out the remaining oil from the tanks.	
7	Generally 2 eductors are provided on each crude oil tanker.	g	However one stripper pump is always provided to strip the cargo lines of any residual oil and to pump the same to the shore system.	7g
8	The pumproom is a hazardous area.	h	so that if required only a certain level can be evacuated	
9	The ventilation system is of the exhaust type and has intakes from all the levels with the intakes being fitted with closing devices.	i	Therefore the main exhaust are always from the bottom level.	

I. Cargo Oil Pumps (COP)



A centrifugal pump is provided in the pumproom bottom platform. The dark green pipeline is the discharge line. The pump consists of an impeller which rotates within the casing. Due to this rotation which is generally about 1000 – 1700 rpm the oil is speeded up and this increase in velocity causes the oil to flow out at a great pressure. These pumps are capable of delivering a very high rate of discharge (up to 4000 m3/hr). With this type of pump the level of oil has to be above the pump – as such the pump is situated at the bottom of the pump room.

The earlier centrifugal pump situated in the pumproom is driven by a shaft which is connected to the steam turbine – situated in the ER. The shaft passes from the ER to the pumproom through the pumproom bulkhead via a gas and oil tight gasket.

The turbines are driven by superheated steam from the boiler in the ER.

Positive displacement pumps such as the reciprocating pump work on the principle of a hand pump – the movement of the piston creates a vacuum which sucks out the fluid. However the size of the pump is dependent on the size of the piston and the length of the strokes so for discharging at a high rate is practically impossible. In general these pumps are used to discharge small quantities of oil such as the strippings – the balance that the centrifugal pump cannot discharge due to the oil going below the level of the pump. The pump is used today on crude tankers to strip out the pipelines after

discharging and then collecting these line content (small) and then pumping them to shore.

I1 Supply the misssing term

A centrifugal pump is provided in the pumproom bottom. The dark green pipeline is the. The pump consists of an which rotates within the casing. Due to this rotation which is generally about 1000 – 1700 the oil is speeded up and this increase in velocity causes the oil to flow out at a great pressure. These pumps are capable of delivering a very high rate of discharge (up to 4000 m3/hr). With this type of pump has to be above the pump – therefore the pump is situated at the bottom of the pump room. (**rate of discharge, platform, the level of oil, discharge line, impeller, rpm**)

The earlier centrifugal pump situated in the pumproom is driven by a shaft which is connected to the steam turbine – situated in the _____. The shaft passes from the ER to the _____ through the pumproom bulkhead via a gas and oil tight _____ . The _____ are driven by superheated steam from the boiler in the ER. (**pumproom, turbines, ER, gasket**)

Positive _____ pumps such as the reciprocating pump work on the principle of a hand pump – the movement of the piston creates a vacuum which sucks out the _____. However the size of the pump is dependent on the size of the piston and the length of the strokes so for _____ is practically impossible. In general these pumps are used to discharge small quantities of oil such as the _____ – the balance that the centrifugal pump cannot discharge due to the oil going below the level of the pump. The pump is used today on crude tankers to strip out the _____ after discharging and then collecting these line content (small) and then pumping them to _____. (**at a high rate, pipelines, displacement, fluid, strippings, shore, discharging**)

J. Tanker Berthing

BERTHING: Tankers should ask for the berthing time and act according to instructions given by the port. Two berths for LPG , four berths for product carriers, two berths for crude oil (Max. vessel size : 250,000 DWT) are available.
Incoming tankers discharge at a "T" type oil jetty just south of the Tasli Burnu Light. The jetty runs parallel to the coastline and is approximately situated 39° 39' 30" N, 26° 57' 30" E. The outer arm of the jetty, 317 m. long, is designed for crude oil tankers 100.000 DWT on the outer side and for tankers os 25.000 DWT on the inner. The outer SE arm is designed for product tankers up to 22.000 DWT an the inner berth for small tankers of up to 5.000 DWT. The crude oil berth is roughly in the center of the NW arm and has 4 loading arms. The jetty is protected by 4 pivotal concrete buffers. The product berth is similarly in the center of the arm and is equipped with flexible hoses. Crude oil pumping rate about 3.000 tons/hour. Vessels with drafts up to 16.5 meters are allowed to berth at the crude oil wharf.

BERTHS	LOA (m)	DRAFT (m)	D.W.T.	PRODUCT
VLCC JETTY (a)	360	-19.2	250.000	Crude
"T JETTY": (b)Berth No.1	285	-16	150.000	Crude & products
Berth No.2	180	-12	60.000	White products & Lub oil
Berth No.3	100	-8	5.000	Products
Berth No.4	100	-6	3.500	White products & Lub oil
Cargo Pier	95	-6	3.000	Black & white products, lub oil,asphalt
LPG Platform: (c) Berth No.1 Berth No.2	230 103	-13 -6.5	44.000 5.000	LPG LPG

(a) VLCC Jetty; 4x16 in. FMC loading arms for crude oil discharging and 2x12 in. loading arms for bunker loading. Unberthing and berthing is possible only during daytime. The crude oil unloading capacity is 10.0 Million Tons/year.
(b) "T " Jetty; No.1; 4x12 in. FMC loading arms for crude discharge or black product loading.If LOA is more than 200m. berthing only during daytime.
(c) LPG Platform; No.1 ; 1x8 in. FMC loading arm for LPG, berthing only during daytime.(There is only one platform with 2 berths). Underwater line's Length: 1.700 m. Temperature: -12 C Pressure: 11 kg/sqcm.
The LPG unloading capacity is 0.6 Million Tons/year.
(d) Height of vessel's discharge manifold above sea level at the end of discharge (with permanent ballast) should not be more than 22 m. for VLCC Jetty No.1 and should not be more than 18 m. for "T" Jetty No.1 to avoid causing damage to FMC loading arm.

(e) Fixed cranes are available at all berthing points, lifting capacities up to 1.5 tons.

J1Supply the missing bething term

Tankers should ask for the _____ and act according to instructions given by the port. Two berths for LPG , four berths for product ,two berths for crude (Max. vessel size : 250,000 DWT) is available.
Incoming tankers discharge at a _____ just south of the Tasli Burnu Light. The _____ runs parallel to the coastline and is approximately situated 39° 39' 30" N, 26° 57' 30" E. The outer _____, 317 m. long, is designed for crude oil tankers 100.000 DWT on the outer side and for tankers os 25.000 DWT on the inner. The outer SE arm is designed for _____ tankers up to 22.000 DWT an the inner berth for small tankers of up to 5.000 DWT. The crude oil berth is roughly in the center of the NW arm and has 4 _____. The jetty is protected by 4 pivotal concrete _____. The product berth is similarly in the center of the arm and is equipped with flexible _____. Crude oil _____ is about 3.000 tons/hour. Vessels with drafts up to 16.5 meters are allowed to _____ at the crude oil wharf. (**loading arms, arm of the jetty, product , berthing time, pumping rate, Max. vessel size"T" type oil jetty, jetty, hoses, buffers, wharf, berth**)

J2 Supply the missing verbs used in describing a tanker berth

BERTHING: Tankers should _____ for the berthing time and _____ according to instructions _____ by the port. Two berths for LPG , four berths for product ,two berths for crude (Max. vessel size : 250,000 DWT) _____ available.
Incoming tankers _____ at a "T" type oil jetty just south of the Tasli Burnu Light. The jetty _____ parallel to the coastline and is approximately _____39° 39' 30" N, 26° 57' 30" E. The outer arm of the jetty, 317 m. long, is _____ for crude oil tankers 100.000 DWT on the outer side and for tankers os 25.000 DWT on the inner. The outer SE arm is _____ for product tankers up to 22.000 DWT an the inner berth for small tankers of up to 5.000 DWT. The crude oil berth is roughly in the center of the NW arm and _____ 4 loading arms. The jetty is _____ by 4 pivotal concrete buffers. The product berth is similarly in the center of the arm and is _____ with flexible hoses. Crude oil pumping rate about 3.000 tons/hour. Vessels with drafts up to 16.5 meters are allowed to _____ at the crude oil wharf.

J3 Supply the missing information

a) VLCC Jetty; 4x16 in. FMC loading arms for crude oil discharging and 2x12 in. loading arms for …….. . Unberthing and berthing is possible only …….. . The crude oil unloading capacity is ……..

b) "T " Jetty; No.1; 4x12 in. FMC …….. for crude discharge or black product loading.If LOA is more than 200m. ……...

c) LPG Platform; No.1 ; 1x8 in. FMC loading arm for LPG, berthing only during daytime.(There is only one platform with 2 berths). Underwater line's Length: 1.700 m. ……..: -12 C ……..: 11 kg/sqcm.
…….. capacity is 0.6 Million Tons/year.

d) Height of vessel's discharge manifold above sea level at the end of discharge (with permanent ballast) should not…….. and should not be more than 18 m. for "T" Jetty No.1 to avoid ……...

e) Fixed cranes are available …….., lifting capacities up to 1.5 tons.

Further reading

Kawasaki Shipbuilding Corporation has delivered the *Energy Advance* (HN: 1521), a large LNG carrier with LNG carrying capacity of 145,000m3, to Tokyo LNG Tanker Co., Ltd. Kawasaki developed the LNG carrier of this class, which can visit any LNG terminal ports worldwide, with similar dimensions to the conventional 130,000m3 class.
The carrier is the fourth newbuilding of the 145,000m3 class and second delivery to Tokyo LNG Tanker. The four LNG cargo tanks are of the independent spherical MOSS type. The heat insulation is the Kawasaki panel
system that demonstrates a high heat insulation effect. This insulation system maintains the BOG rate at approximately 0.1% a day.

The cargo tanks are installed inside the compartment built with double side shells and double bottom to ensure safety so that the cargo tanks are not damaged directly. The wheelhouse is equipped with advanced integrated
navigation equipment, which has improved ship operation. Windows around the wheelhouse provide a panoramic view of 360 degrees, allowing one-man operation during oceangoing navigation.

Cargo-handling operation is carried out at the cargo handling room located in front of the accommodation quarters, where the Kawasaki IMCS (Integrated Management Control System) is installed for monitoring and controlling the cargo handling operation as well as monitoring engine conditions. The Kawasaki IMCS is very easy to use since it was developed by incorporating experience and suggestions from many operators.
Principal particulars

L (o.a.) x L (b.p.) x B x D x d: 289.53m x 277.00m x 49.00m
x 27.00m x 11.404m
DWT/GT: 71,586t/119,233t
Cargo tank capacity: 145,410m3 (at -163oC, 98.5%)
Main engine: Kawasaki UA-400 steam turbine x 1 unit
MCR: 26,900kW x 80rpm
Speed, service: abt. 19.5kt
Complement: 43
Classification: NK

Completion: Mar. 30, 2005

Cargo ships or vessels come in different types and sizes to meet the various demands of marine cargo transportation. Cargo ships are categorised partly by capacity and partly by dimensions (often related to the different canals and canal locks they are traveling through). Sizes of cargo vessels range from a modest **handysize** carriers(10,000 - 30,000 DWT) to mammoth**VLCC** and **ULCC** super tankers with a capacity to carry cargoes of more than 200,000 DWT. **Aframax** and **Panamax** are mid-sized cargo vessels.

Aframax

AFRA stands for **Average Freight Rate Assessment**. As the name suggests, **Aframax** are medium-sized oil tankers with a dead weight tonnage (DWT) between 80,000 and 119,999. Though relatively small in size in comparison to **VLCC** and **ULCC**,**Aframax** tankers have a capacity to carry up to 120,000 metric tonnes of crude oil. They are just ideal for short to medium-haul oil trades, and are primarily used in regions of lower crude production, or the areas that lack large ports to accommodate giant oil carriers.

Aframax tanker

Capesize

They are very large and ultra large cargo vessels with a capacity over 150,000 DWT. They are categorised under **VLCC**,**ULCC**, **VLOC** and **ULOC** and can be as large as 400,000 DWT or even more. They serve regions with largest deepwater terminals in the world and are primarily used for transporting coal and iron ore. Because of their giant size, they are suitable to serve only a small number of ports with deepwater terminals.

Very Large Ore Carrier

Chinamax

Chinamax ships are very large bulk carrier which can't be longer than 360m (1,180 ft), wider than 65 m (213 ft) and her draft can't be more than 24 m (79 ft). The deadweight tonnage of these vessels is 380,000–400,000 DWT.

Ship's maximum measurements are defined by the **Chinamax** standars, allowing ports to determine whether they can accommodate ships in this class. As the name suggests, these ships are often used to move cargo to and from China along several trade routes, such as the iron ore route from Brazil to China.

Chinamax ship

Handymax/ Supramax

Handymax are small-sized cargo ships with a size less than 60,000 DWT. **Supramax** vessels have capacity between 50,000 to 60,000 DWT. Due to their small size, they are capable of operating in regions with small ports with length and draught restrictions. They form the majority of ocean going cargo vessels in the world.

Handymax

Handysize

Handysize are small-sized ships with a capacity ranging between 15,000 and 35,000 DWT. These vessels are ideal for small as well as large ports, and so make up the majority of ocean cargo vessels in the world. They are mainly used in transporting finished petroleum products and for bulk cargo.

Handysize

Malaccamax

As the name suggests, **Malaccamax** ships are the largest ships that can pass through the **Strait off Malacca** which is 25 m (82 ft) deep. As per the current permissible limits, a Malaccamax vessel can have a maximum length of 400 m (1,312ft), beam of 59 m (193.5 ft), and draught of 14.5 m (47.5 ft).

New Maersk Tripple E class - Malaccamax ship

Panamax and New Panamax

As the name suggests, **Panamax** and **New Panamax** ships are travelling through the **Panama Canal.** They strictly follow the size regulations set by the Panama Canal Authority, as the entry and exit points of the Canal are narrow. A **Panamax** vessel can't be longer than 294,13 m (965 ft), wider than 32,31 m (106 ft) and her draught can't be more than 12,04 m (39.5 ft). These vessels have an average capacity of 65,000 DWT,

and are primarily used in transporting coal, crude oil and petroleum products. They operate in the Caribbean and Latin American regions.
The **New Panamax** has been created as a result of the expanding plans for Panama Canal locks. Expanded locks will be around 427 m (1400 ft) long, 55 m (180 ft) wide and 18,30 m (60 ft) deep so Panama Canal will be able to handle larger vessels .

Ships in Panama Canal

Q-Max (Qatar-max)

Q-Max's are largest LNG carriers that can dock at the LNG terminals in Qatar.
Q-Max ship is 345 metres (1,132 ft) long, 53.8 metres (177 ft) wide and 34.7 metres (114 ft) high, with a draught of approximately 12 metres (39 ft). It has a capacity of 266,000 cubic metres (9,400,000 cu ft), equal to 161,994,000 cubic metres (5.7208×109 cu ft) of natural gas.

Q-max Mozah

Seawaymax

As the name suggests, **Seawaymax** ships are the largest ships that can pass through the locks of **St. Lawrence Seaway**.

These ships are 225,6 m (740 ft) long, 23,8 m (78 ft) wide and 35,5 m (116 ft) high, with a draught of 7,92 metres (26 ft).

Seawaymax ship

Suezmax

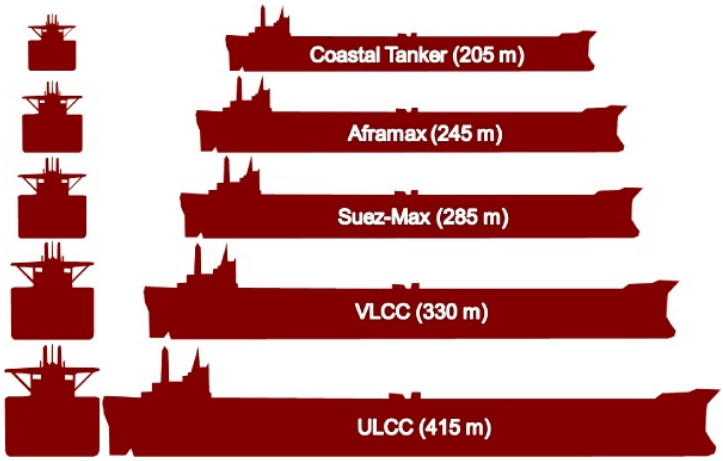
Suezmax are named after the famous **Suez Canal**. They are mid-sized cargo vessels with a capacity ranging between 120,000 to 200,000 DWT. They are designed to pass through the majority of the ports in the world. Currently the permissible limits for suezmax ships are 20.1 m (66 ft) of draught with the beam no wider than 50 m (164.0 ft), or 12.2 m (40 ft) of draught with maximum allowed beam of 77.5 m (254 ft).

Ship passing through Suez Canal

VLCC and ULCC

VLCC stands for **Very Large Crude Carriers**. They have a size ranging between 180,000 to 320,000 DWT. They are very flexible in using terminals and can also operate in ports with depth limitations. **VLCC**s are used extensively around the North Sea, Mediterranean and West Africa.
ULCC or **Ultra Large Crude Carriers** are the largest shipping vessels in the world with a size more than 320,000 DWT. Called Super Tankers, **ULCC**s are used for long-haul oil crude transportation from Middle East to Europe, Asia, and North America.

Ultra Large Crude Carriers



Comparison of Tanker sizes

MES delivers 137,100m3 membrane type LNG carrier to Malaysia International Shipping Corp. Bhd. (Sea Japan, No. 311, June 2005)

Mitsui Engineering & Shipbuilding Co., Ltd. (MES) has delivered the 137,100m3 LNG carrier, *Puteri Mutiara Satu* (HN: 1562), to Malaysia International Shipping Corporation Berhad (MISC) at its Chiba Works. The *Puteri Mutiara Satu* is the last ship of the six Puteri Satu series, which were ordered by MISC from Japanese shipbuilders: three from MES and three from Mitsubishi Heavy Industries, Ltd. The ships will be used in LNG transport from Malaysia to Japan.

The features of *Puteri Mutiara Satu* are as follows:

The cargo containment system licensed by GTT (Gaztransport & Technigaz) of France is called the "GT No. 96E. 2F" heat insulation system(membrane system).

0.7mm thick invar (Fe-36%Ni) material is used for the inner tank construction.

Cargo pumps have the soft start system utilizing an inverter system toreduce the impact to the pipings at start-up. The distributed control system for machinery and cargo control system is provided in the centralized control room for centralized monitoring and operation of plant and equipment.

The integrated bridge system allows safe operation and also contributes to reduced manpower requirements.

The ballast water can be replaced by an automatic ballast water exchanging system.

Principal particulars

- L (o.a.) x L (b.p.) x B x D x d: 276.00m x 263.00m x 43.40m x 25.50m x 11.01m
- DWT/GT: 76,229t/94,446
- Tank capacity: about 137,595m3
- Main engine: Steam turbine x 1 unit
- MCR: 26,800kW x 89rpm
- Speed, trial max.: 21.38kt
- Complement: 55
- Classification: LR
- Completion: Apr. 22, 2005

K. Containment systems

Reliquefaction and boil-off

In order to facilitate transport, natural gas is cooled down to approximately −163 °C at atmospheric pressure, at which point the gas condenses to a liquid. The tanks on board an LNG carrier effectively function as giant thermoses to keep the liquid gas cold during storage. No insulation is perfect, however, and so the liquid is constantly boiling during the voyage.

According to WGI, on a typical voyage an estimated 0.1–0.25% of the cargo converts to gas each day, depending on the efficiency of the insulation and the roughness of the voyage.[3] In a typical 20-day voyage, anywhere from 2–6% of the total volume of LNG originally loaded may be lost.[3]

Normally an LNG tanker is powered by steam turbines with boilers. These boilers are dual fuel and can run on either methane or oil or a combination of both.

The gas produced in boil off is traditionally diverted to the boilers and used as a fuel for the vessel. Before this gas is used in the boilers, it must be warmed up to roughly 20 °C by using the gas heaters. The gas is either fed into the boiler by tank pressure or it is increased in pressure by the LD compressors.

What fuel the vessel runs on is dependent on many factors which include the length of the voyage, desire to carry a heel for cooldown, price of oil versus price of LNG.

There are three basic modes available.

Minimum boil-off/maximum oil:- In this mode tank pressures are kept high to reduce boil off to a minimum and the majority of energy comes from the fuel oil. This maximises the amount of LNG delivered but does allow tank temps to rise due to lack of evaporation. The high cargo temps can cause storage problems and offloading problems.

Maximum boil-off/minimum oil:- In this mode the tank pressures are kept low and you have a greater boil-off but still there is a large amount of fuel oil used. This decreases the amount of LNG delivered but the cargo will be delivered cold which many ports prefer.

100% gas:- Tank pressures are kept at a similar level to max boil off but this is not enough to supply all the boilers needs so you must start to "force". A small pump is started in one tank to supply LNG to the forcing vaporiser, where the LNG is warmed and vaporized back into a gas that is usable in the boilers. In this mode no fuel oil is used.

Recent advances in technology reliquefication plants to be fitted to vessels, allowing the boil off to be reliquefied and returned to the tanks. Because of this, the vessels' operators and builders have been able to contemplate the use of more efficient slow-speed Diesel engines (previously most LNG carriers have been steam turbine-powered). Exceptions are the LNG carrier Havfru (built as Venator in 1973), which originally had dual fuel diesel engines, and its sister-ship Century (built as Lucian in 1974), also built with dual fuel gas turbines before being converted to a diesel engine system in 1982. Vessels using dual or tri-fuel diesel electric propulsion systems are now in service.

Eductors

Eductors work on the principles of Bernoulli's Principle.

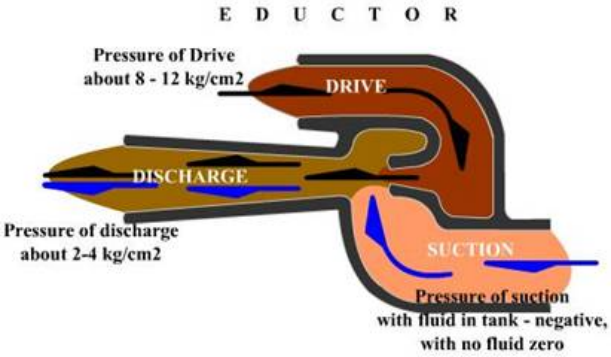
A driving fluid is pumped down the main line, with very high velocity, through a constriction, and past a relatively smaller opening, thus creating a vacuum.

When eductors are used for clean ballast, the driving fluid is seawater.

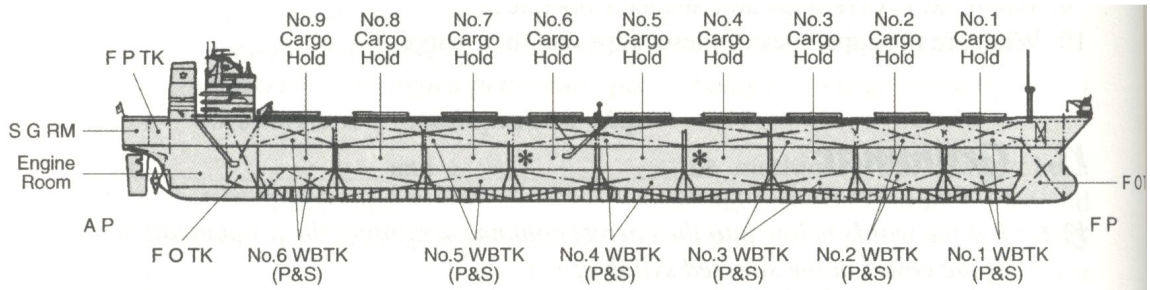
When used for stripping crude oil, the driving fluid is the cargo itself- delivered by means of a bypass from one of the main cargo pumps.

When used for stripping tank washings, the driving fluid is from the secondary slop tank and then re-circulated back to the primary slop tank. In the latter case the driving fluid is either crude oil or seawater, depending on the tank cleaning method.

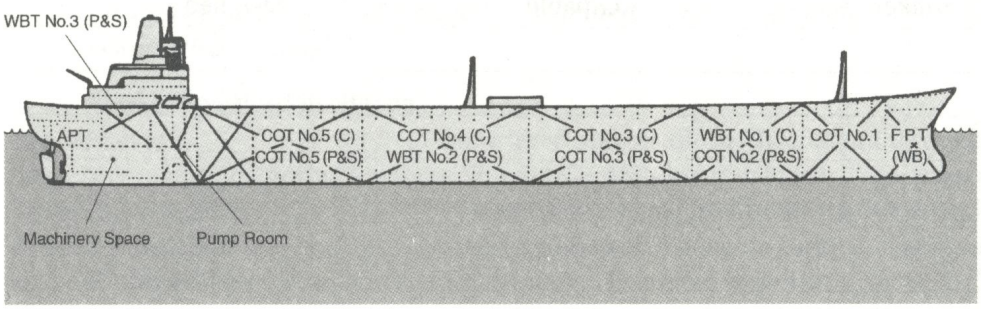
Eductors are simple and rugged, have no moving parts, and do not become air locked like other type of pumps. They are widely used on tankers of all types and sizes.



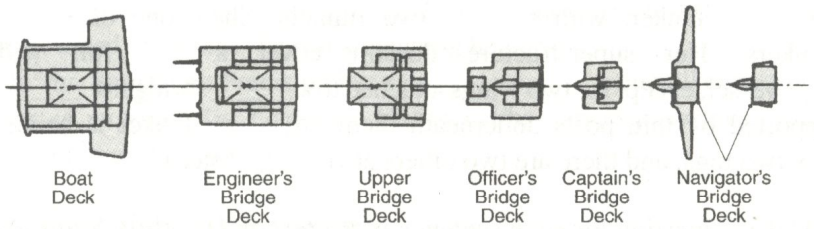
Exercises (H):

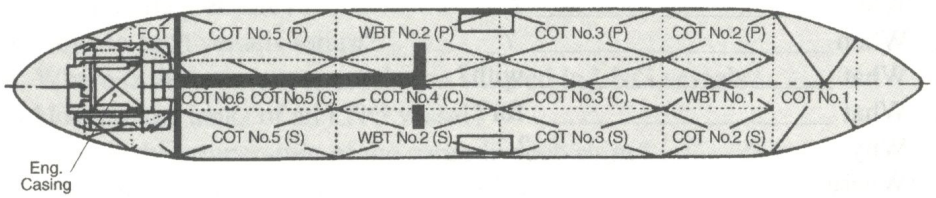


**Floodable Hold*

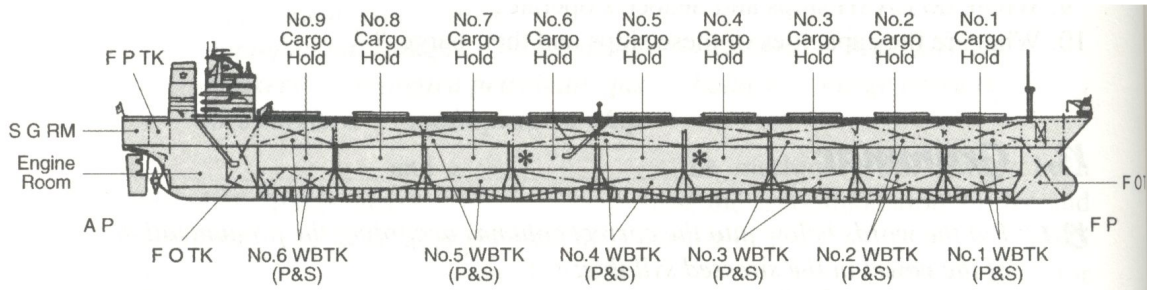


Outboard Profile





Upper Deck



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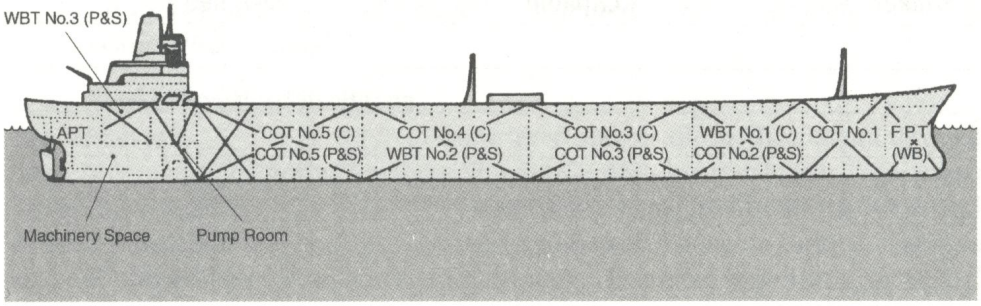

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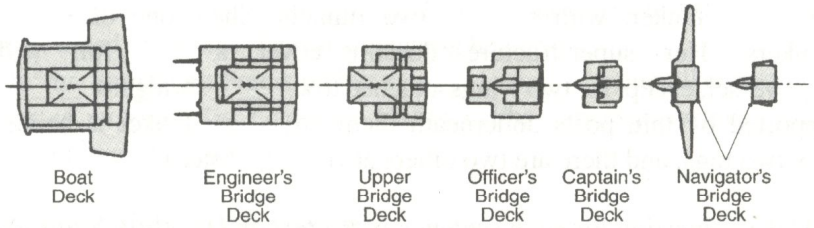

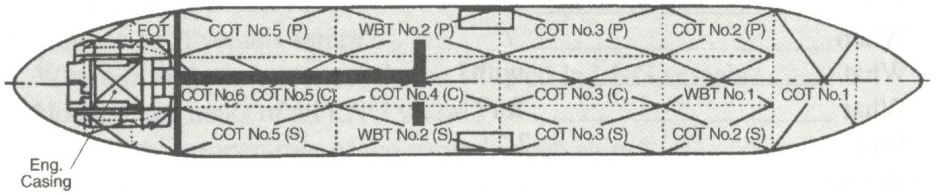

Upper Deck