TONG LI
TWIN-SCREW TRAILING SUCTION HOPPER DREDGER
FOR TIANJIN DREDGING COMPANY

Builders: IHC Holland/Merwede Shipyard, Hardinxveld-Giessendam, The Netherlands
Owners: Tianjin Dredging Company, The People’s Republic of China

Introduction
The ‘Tong Li’ is the second unit in a series of three dredgers, all of different design, for Chinese account.

The twin-screw trailing suction hopper dredger, owned by the Tianjin Dredging Company, has been built by the Merwede Shipyard, sister company of IHC Holland.

The sponsoring ceremony of the ‘Tong Li’ was performed by Mrs. Hu Juntan, wife of the Ambassador of the People’s Republic of China in The Netherlands.

General
The ‘Tong Li’ is a twin-screw trailing suction dredger with a hopper capacity of 5,400 m³ and provided with two side suction pipes. The maximum dredging depth is 30 metres. The maximum load capacity is 8,440 tons. The dredge pumps are situated in the pump room forward of the hopper and are driven by diesel engines.

The dredge pumps can also be used for feeding the bow thrust system.

The ‘Tong Li’, built under yard number 664, has the following principal particulars:

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length o.a.</td>
<td>111.40 m</td>
</tr>
<tr>
<td>Length b.p.</td>
<td>105.50 m</td>
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<tr>
<td>Beam</td>
<td>21.00 m</td>
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<tr>
<td>Depth</td>
<td>8.10 m</td>
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<tr>
<td>Hopper capacity</td>
<td>5,400 m³</td>
</tr>
<tr>
<td>Loading capacity</td>
<td>8,440 tons</td>
</tr>
<tr>
<td>Diameter suction pipes</td>
<td>900 mm</td>
</tr>
<tr>
<td>Dredging depth</td>
<td>30 m</td>
</tr>
<tr>
<td>Propulsion power</td>
<td>2 x 3,300 kW</td>
</tr>
<tr>
<td>Dredge pumps</td>
<td>2 x 1,400 kW</td>
</tr>
<tr>
<td>Speed (fully loaded)</td>
<td>13.5 knots</td>
</tr>
<tr>
<td>Complement</td>
<td>50 persons</td>
</tr>
<tr>
<td>Tank capacities</td>
<td></td>
</tr>
<tr>
<td>Fuel oil</td>
<td>575 m³</td>
</tr>
<tr>
<td>Lube oil</td>
<td>15 m³</td>
</tr>
<tr>
<td>Fresh water</td>
<td>195 m³</td>
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</tbody>
</table>

The accommodation for crew and officers is arranged in a four-tier deckhouse situated aft.
above main deck. The completely airconditioned accommodation is arranged for a total complement of 50 persons. The wheelhouse is situated at the upper tier, the navigation deck. A sun protection vistor is fitted all around the wheelhouse topdeck which has windows fitted all around. A large window in front of the dredging operator's stand allows a good view on the trailing suction pipes and the gantries.

Below the navigation deck the A-deck comprises four single-berth officer's cabinets with separate sleeping room and private bathroom, two single-berth officers' cabins with private bathroom, one converter room, one locker, one sanitary space with toilet and wash-hand basin for bridge personnel and a radio room. The B-deck comprises eight single-berth officers' cabinets, one meeting room, a ship's office and an officer's washing place. At poopdeck level eight twin-berth crew cabins, one messroom, a galley, a hospital and a washing place are accommodated. The main deck comprises ten twin-berth crew's cabinets, a washing place, a laundry, a drying room, lockers, store rooms, sanitary facilities, the CO₂ room, and the steering gear room.

The noise level in the accommodation deckhouse is less than 68 dB(A) in the main deck cabins and 65 dB(A) in the cabins situated at poopdeck level and at A and B-deck level due to the following noise reducing measures:

- floating sound-insulating floor coverings in accommodation spaces of the main deck and poopdeck;
- all weather exposed steel outer walls of the accommodation are insulated;
- panelling, partition walls and ceilings consist of insulated sandwich panels;
- panelling, partition walls and ceilings in accommodation not in contact with steel bulkeads and decks;
- flexibly mounted diesel generator sets.

Special attention has also been paid to the exhaust gas silencers of the main engines. The separated funnel deckhouse situated im-

The well-raised stem forward is constructed of steel plate with a cylindrical section, suitably strengthened by means of frames and stringers. The stem is provided with a double plate centre line skeg, welded to the hull structure. The base of the skeg is in line with the bottom of keel line. A major part of the hull, of all-welded construction, is strengthened by longitudinal frames, transversely supported by web frames. The aft part is built to a transverse framing system. The hull is reinforced with an extra web frame at locations where the cardan ring of the trailing suction pipes and the draghead could touch the hull plating. The longitudinal strength and rigidity of the hull is suitable for the vessel's working conditions and the longitudinal rigidity of the hull has been such designed that it can easily withstand the deflection of sagging/hogging caused by loading and dumping. A 90 degree pipe segment fitted on the hull side knuckle in the areas where the suction pipe suspension wires can rub when the pipe has moved under the vessel. The hull area around the suction openings in the hull and behind the sliding piece guide tracks is strengthened by heavy web frames positioned horizontally and vertically. The sliding piece guide tracks of the trailing suction pipes are recessed into the hull plating in order to minimize the ship's resistance. Continuous welding is applied for all welding work, except for longitudinal on tweendecks and for non-watertight welding work in deckhouses, for example stiffeners on bulkeads and deck longitudinals, which are fitted by intermittent welding. The engine room, the pump engine room and the pump room have been provided with a double bottom arranged with lube oil storage tanks and various smaller tanks. Centre side keelons of the vessel are extended as far as practicable throughout the length of the vessel and are incorporated in the foundations of engine rooms and pump room. Drainholes are cut in all bottom floors as low as possible to facilitate adequate drainage and a good flow to the suction.
The forepeak tank is arranged as a trim tank, to be filled by means of the jet water pumps, in order to reduce the vessel's trim in light ship condition or partly loaded condition.

**Hopper System**

The hopper of the 'Tong Li' can be loaded by opening of two rows of 11 bottom doors or by a self-discharging system using the dredgepumps. In the latter case the mixture is pumped over the bow to a floating pipeline. The hopper coaming top level is situated about 0.5 m above the spoil level of 5,400 m³. Discontinuities in structure are avoided as far as practicable. The longitudinal hopper walls are continued by brackets to transfer the structural strength gradually to the deck and the bottom structure. The stringer plates on top of the buoyancy compartments at sides of hopper extend gradually into the fore and aft deck.

Hopper platings on spool side are plain, stiffeners of hopper are fitted opposite spoil side of the bulkheads. Transverse saddles are provided between the bottom door compartments in the hopper in line with the transverse web frames in the buoyancy compartments. The buoyancy compartments beside the hopper are provided with fuel bunkers and fresh water tanks as indicated on general arrangement plan, the space above the tanks serving as a pipe- and cable tunnel. Frames, longitudinals and stiffeners are generally of bulb plate profiles.

At the extreme forward and aft ends of the hopper, the coaming is of increased height to prevent splashing and spilling during loading and when the ship pitches. The hopper is provided with a telescopic type overflow duct, continuously adjustable from 3,500 m³ up to the maximum hopper capacity of 5,400 m³. The hopper design allows optimal settling and dumping of the spoil, athwart brackets in the longitudinal flow being cut out as far as possible and cross girders kept out of the load space. The lower part of the hopper, on either side of the bottom doors is asymmetric, a raked bulkhead of the centre box girder being opposite a vertical bulkhead, in order to promote optimum discharge of the spoil.

The hopper is discharged through 22 hydraulically operated double box type bottom doors, arranged in two rows, one on either side of the centre box girder. The hopper can be discharged too by pumping out spoil with the port or starboard dredgepump, via a self-emptying arrangement, consisting of a suction channel with hydraulically operated suction channel doors fitted on each side of the centre box girder, connected to the suction side of the dredge pump. The hopper can be drained of excess water prior to dredging by means of the hopper draining system. Furthermore, a hopper diluting system is installed, fed by both jetwater pumps working in parallel, capable of diluting the hopper load at selected hopper spaces to facilitate removal of the spoil.

The bottom door system of the hopper consists of twin-type bottom doors of the IH-C standard type. The doors are box-shaped and of all-welded steel construction and are well-stiffened at the inside. In closed position the doors are flush with the ship's bottom. Each twin bottom door is closed and positively opened by its own double-acting hydraulic cylinder, suitable for a working pressure of 200 bar. The hydraulic bottom door cylinders are controlled in three groups from the hydraulic part of the navigation control console in the wheelhouse where a signal lamp indicates the open or closed position of each group of bottom doors.

A longitudinal flushing system is applied for emptying the hopper by means of the port or starboard dredgepump, delivering the spoil to the shore. A suction channel with hydraulically operated suction channel doors is fitted in the hopper on each side of the centre box keelson. By opening the doors, which form the top of the suction channels, the spoil will enter these channels in which seawater can be admitted in order to dilute the hopper load at selected hopper spaces to facilitate removal of the spoil. The system is fed by two electrically driven jetwater pumps, working in parallel.

**Dredging Performance**

The 'Tong Li' has been designed for a dredging speed of about 3.0 knots over the bottom against a current of 4.0 knots while dredging compacted fine sand from a water depth of 22 metres with a California type draghead in standard execution, and with both propulsion engines running at full power. When dredging from a water depth of 30 metres, this dredging speed will decrease to about 2.5 knots against a current of 4.0 knots. Pumping water the capacity of each dredge pump is about 15,000 m³/h.

The two trailing suction pipes of the 'Tong Li' have an internal diameter of 900 mm. They are of such a flexibility that the draghead can remain flat on the bottom exerting full vacuum, even when the bottom is bumped or when the draghead gets under the ship or away from its whilst turning. This flexibility is achieved by a trunnion elbow and a vertical hinge with rubber hose at the upper end of the trailing suction pipe, a universal hinge (both vertical and horizontal) with rubber hose, a turning gland enabling the draghead to rotate around the pipe axis, and the draghead itself, which has a hinged self-adjusting vizer. The length of the trailing suction pipes is based on a dredging depth of 30 m below light draught condition at 45 degree angle between suction pipe and the ship's baseline. The dragheads are connected to the trailing suction pipe by bolted flanges and are provided with a 'Resistance' fender in order to avoid damage to the hull plating.

Each trailing suction pipe is hoisted and lowered by Hydrowega hydraulic winches via three gantries, viz. near the draghead, near the gimbal joint and near the trunnion. The hoisting wire of the draghead is provided with a swell compensating gear, suitable for a vertical movement of about 8 metres. Gantries and winches are of adequate strength and power to hoist the suction pipe when it is in the outboard position and to move the pipe from the outboard to the inboard position where it can be stowed in saddles incorporated in the gantries. Inboard and outboard movement of the trailing suction pipes
are operated by a hydraulic cylinder at location of draghead gantry, intermediate gantry and
trunnion gantry. The gantries are of the latest IH/IC Standard type.

The hydraulic draghead winches are of the hydraulic type with a single grooved drum, suit-
able to accommodate the hoisting wire in one layer. The winch is driven by a hydraulic motor
via a totally enclosed gearbox. The normal haul-
ing speed of the winch is about 4.5 m/min,
which is also the hauling speed on the suction pipe, suitable to hoist the dragheads.

The intermediate suction pipe winches are
hydraulic winches of the same design as the
draghead winches, however adapted to the rele-
vant load. The hauling speed of the winch is
about 4.5 m/min, which is also the hauling speed on the suction pipe, suitable for the re-
quired load.

The hydraulic trunnion winches are also of
the same design as the draghead winch, however,
adapted to the relevant load. These winches
give the trunnion part of the suction pipe the ne-
necessary up and down movements. The hauling speed of these winches is about 9 m/min, corre-
sponding to 4.5 m/min at the suction pipe, suit-
able for the required load.

When discharging to shore the hopper load by
pumping, the possible combination of flow rate
and concentration depends on the discharge
length. When pumping the mixture through a
pipeline of 800 mm internal diameter with not
more than five ball joints or similar in it, and a
goetheit height of 4 m above the water level,
the unloading time is approximately 88 minutes
based on a mean mixture density of 1,300 kg/m³.

The dredge pumps are IH/IC Standard single-
walled centrifugal pumps, type 190-55-90, and
are each driven via a reduction gearing by a die-
 sel engine with a maximum output of 1,400 kW.

To connect both dredge pumps in series a
pipeline of 900 mm diameter is fitted between
the discharge side of the port dredge pump and the suction side of the starboard dredge pump.

The series connection pipe is fitted with a
hydraulically operated rubber ring type gate
value of IH/IC Standard type 900 of 900 mm di-
ameter, remote controlled from the wheel-
house. Above main deck the crossover is fitted
with a branche pipe of 800 mm leading to the
bow connection pipeline to give possibility to
pump ashore with either port or starboard
dredge pump or in series.

Two jet water pumps supply water for the drag-
head nozzles for loosening compact grounds,
serving the port and starboard dragheads.

The engine room of the ‘Tong Li’ is fitted with a
sound and heat insulated airconditioned control
room. The control room accommodates the
main switchboard, the engine control console,
the alarm panels and the necessary indicators
for the main engines such as propeller pitch,
lube oil pressure, temperature and fresh water
temperature of the main engines and fuel flow
meters. A sound-insulated airconditioned
watch room is installed in the pump engine
room housing the relevant alarm panels. Both
engine rooms have their own machinery work-
shop fitted with machine tools delivered by
Thoflex.

The machinery installation of the ‘Tong Li’ com-
prises the following diesel engine configura-
tions:

- two propulsion diesel engines;
- two dredge pump diesel engines;
- one jet pump diesel engine;
- three auxiliary diesel generator sets;
- one emergency generator diesel engine.

The two Stork-Wärterslii Diesel main engines,
each develop 3,900 kW at 1,000 rev/min driving a
3,000 mm diameter four-blade NiAl bronze Lips
controllable pitch propeller through a flexi-
bile coupling and a horizontally offset reduction
gearbox. Each propeller revolves in a fixed Van
de Giessen nozzle, type 19A-NSP fitted with a
stainless steel inner ring. The cp-propellers are
electrically controlled from the wheelhouse. For
emergency purpose an electric emergency
telegraph installation links the navigation control
console with the control position of each main
diesel engine/cp-propeller in the engine room.

The two Stork-Wärterslii Diesel draghead pump
diesel engines, type 6 SW280, each develop
1,400 kW at 1,000 rev/min driving a dredge
pump through a flexible clutch coupling and a
horizontally offset L-S reduction gearbox and
tooth coupling. The Stork-Wärterslii Diesel
jet pump diesel engine, type 6 SW280, develops
1,400 kW at 1,000 rev/min and drives two Nij-
huis jet pumps in tandem through a flexible cou-
pling and a tooth coupling between both pumps.
Between the first jet pump and the driv-
ing diesel engine a flexible coupling is mounted.
Between both jet pumps a tooth coupling is fit-
ted. The three auxiliary diesel generator sets
each consists of a Cummins diesel engine, type
NT 855 G3, driving an AC generator, while the
AC emergency generator is driven by a Cum-
mins, type 6 CTA 8.3 G, emergency generator
diesel engine.

The propulsion diesel engines, dredge pump
diesel engines and jet pump diesel engine are
suitable for running on HFO. The auxiliary gener-
ator engine and emergency generator diesel
engine run on MDO. Fuel consumption of the
propulsion engines is 198 g/kWh, with built-on
pumps, with a tolerance of 3 per cent when run-
ning under ISO conditions on MDO, having a
calorific value not less than 42,700 kJ/kg.

The diesel engines are cooled by a central cool-
ing water system designed for a maximum out-
side raw water temperature of 32°C. The sys-
tem consists of a raw water circuit and a low
temperature fresh water cooling water circuit.

The propulsion engine, dredge pump diesel en-
gine and jet pump diesel engine are provided
with a built-on cooling water pump for the high
temperature cooling circuit. The high tempera-
ture circuit of the cooling water system of pro-
 propulsion engines, dredge pump diesel engines
and jet pump diesel engine are equipped with
a heat exchanger and circulating pump for pre-
heating. The heater is fed by a Wiesloch thermal
oil installation. Directional control of the vessel is with a
Brussel Marine Industry steering gear of the electro-hydraulic type with two rudder stocks linked by means of a heavy rod. The hydraulic system of the steering gear is fed by three electrically driven hydraulic pumps, two normally in operation. The time to bring the rudders from 35 degrees on either side to 30 degrees on the other side does not exceed 25 seconds using two pumps, at maximum service speed of the vessel. The twin rudders, manufactured by Van de Giessen, are rectangular of shape with an approximate streamlined cross section. They are of the free hanging type, each having an area of about 9.88 m². The rudder arrangement permits a maximum rudder angle of 37 degrees from centre each side. The steering gear is controlled from the navigation control console in the wheelhouse by means of a double electric steering system, consisting of one main system and the second serving as emergency system. In case of emergency it is possible to control the steering gear from the wheelhouse by means of the second electric circuit.

Auxiliaries

Engine room auxiliaries include two electric-driven, self-primming, Stork Pompen centrifugal pumps which can be used for bilging, fire-fighting, and ballasting purposes as well as for general services. Each pump - running at about 2,900 rev/min - has a capacity of 100 m³/h at a pressure of 2 bar as bilge and general service pump, and a capacity of 66 m³/h at a pressure of 4 bar when servicing as fire pump.

In order to discharge sand laden water from the dredge pump wells a bilge ejector with cast steel housing and bronze nozzle is fitted in the pump room.

An electric-driven, non self-primming centrifugal emergency fire pump is installed in the pump engine room. The pump - running at about 2,900 rev/min - has a capacity of 44 m³/h at a pressure of 4 bar. The electric motor of the emergency fire pump is connected to the emergency switchboard.

Room.

Each pump is an electric-driven horizontal, self-priming, double acting, piston pump with a capacity of 2.5 m³/h at a pressure of 2 bar. For transfer of fuel oil two pumps have been installed: one electric-driven gear-type pump running at about 1,450 rev/min with a capacity of 5 m³/h at a pressure of 2 bar and one electric-driven screw-type HFO transfer pump running at about 1,450 rev/min with a capacity of 15 m³/h at a pressure of 2 bar. For the treatment of fuel and lube oil a combined fuel oil/lube oil separator compartment, make Alfa Laval, has been installed in the engine room. A separate lube oil separator, also make Alfa Laval, has been fitted in the pump engine room. Pressurized fuel oil feeding booster units for supplying fuel oil to the combined fuel oil feed system of the diesel engines in that room which are running on HFO have been installed both in the engine room and the pump engine room. An electric-driven lube oil transfer pump of the gear-type is fitted in the engine room. The pump runs at about 1,450 rev/min and has a capacity of 3 m³/h at a pressure of 3 bar. Starting air for the diesel engines is supplied by two starting air compressors by Van Duijvendijk, each running at about 1,450 rev/min and delivering 100 m³/h at a pressure of 30 bar. The one-cylinder, two-stage air compressors are fresh water cooled with built-on cooling water pumps arranged for automatic operation. A manually started diesel-driven emergency air compressor with a capacity of 30 m³/h at a pressure of 30 bar serves as back-up unit. For flushing of the shaft side and the suction side of the dredge pumps six glandpumps are installed: four have a capacity of 55 m³/h at 2 bar and two a capacity of 55 m³/h at 6 bar. These pumps are in operation during trialing and when pumping ashore. Flushing of the gate valves in the suction and delivery pipe lines of the dredge pump is with an electric-driven pump installed in the pump engine room. The pump, running at about 2,900 rev/min has a capacity of 55 m³/h at a pressure of 3 bar. The jetwater systems of the trailing dragheads, operating in series, and the hopper diluting system are served by two non-self-priming centrifugal pumps installed in the pump room. Each pump runs at 1,000 rev/min and has a capacity of 1,500 m³/h at a pressure of 8 bar. The pumps are driven in tandem by a diesel engine. The complete electrical installation has been engineered, delivered, installed and put into operation by Marine & Offshore by, of Rotterdam, who also delivered the five Marelli Moteri generators: three 350 kVA generators, one 1,875 kVA generator and one 180 kVA emergency generator. For heating purposes a thermal oil installation has been installed. The installation comprises an oil-fired Westloch thermal oil boiler with a capacity sufficient for the total heat consumption of the vessel and two thermal oil exhaust gas boilers, one in the exhaust gas pipe line of each propulsion engine. The oil-fired thermal oil boiler starts automatically when the propulsion engines are out of operation or can not supply sufficient heat.

Hydraulic System

The "Tong Li" is fitted with a hydraulic power unit of the HFC standard type installed in the fore ship. The power unit comprises a stainless steel hydraulic oil tank, filters, safety valves, non-return valves, solenoid operated valves, indicators, a control box and 4 x 2 hydraulic pump.
sets. The hydraulic pump sets serve the following devices:
- two pump sets for the hydraulic motors of the drophead winches and cylinders of the drophead gantries;
- two pump sets for the hydraulic motors of the intermediate suction pipe winches and cylinders of the intermediate gantries;
- two pump sets for the hydraulic motors of the suction pipe trunnion winches and cylinders of trunnion gantries;
- two pump sets for cotterless sailing (one pump set as standby unit).
These pump sets also serve the following systems: bottom door system, gate valve system, swell compensating system, overflow system, auxiliary launder door system, and suction channel door system. Furthermore, the butterfly valves in the jet pump lines, the winch for coupling of the floating pipe line and coupling mechanism of shore discharge connection at the bow, the windlass, and the capstan. The capacity of the hydraulic pumps is sufficient for a controllable opening and closing time of the bottom door system of approximately 3 and 5 minutes respectively with all bottom door groups working simultaneously.

Operation of the hydraulic systems is electrohydraulic with the following controls situated in several control consoles in the wheelhouse:
- starting and stopping of the hydraulic pumps;
- suction pipe winches;
- suction pipe gantries;
- bottom door system (in three groups);
- gate valve system;
- overflow system;
- auxiliary launder door system;
- suction channel door system;
- butterfly valves in jet pump pipe lines.
The windlass, capstan, couple mechanism for shore discharge connection at the bow, the winch for coupling of the floating pipe and the hydraulic pressure of the swell compensating system are controlled locally.

Deck Equipment
The 'Tong LI' has a windlass of the horizontal hydraulically driven type placed on the forecastle deck. The windlass, delivered by Brussel Marine, includes a top deck mounted fixed single stage cast steel cable lifters for 50 mm diameter stud link chain cable of high tensile strength steel, grade Q3. The cable lifters are provided with a fermado-lined hand operated screw spindle brake and a hand operated steel dog clutch. For mooring purposes, two cast iron warping heads with a diameter of 630 mm and a width of 530 mm are provided, one at each side of the winch. The windlass is driven by a hydraulic motor via a totally enclosed gearbox, giving the cable lifters a hauling speed of about 10 m/min.

The hydraulic motor is fed from the main hydraulic system. The forward windlass handles two stockless bow anchors of the high holding power type each weighing 2,835 kg and connected to 50 mm diameter stud link chain cable with a length of 522.5 m.
The aft windlass fitted on the poop deck is suitable for a holding force of 15 tons with two warpings and one disengagable cast steel cable lifter for a stud link chain cable of high tensile strength steel, grade Q3. A chain stopper combined with guide roller and turnbuckle is fitted between windlass and hatchway pipe. The windlass handles one 2,835 kg stockless stern anchor of the high holding power type suitable for a holding force of 16 tons. The anchor is connected to a 220 m studlink chain cable with a chain diameter of 50 mm. Furthermore the vessel is provided with bollards, fairleads, mooring posts, hawser and wire ropes. Anchors and anchor chain cables have been supplied by Wortfober.

A travelling hydraulic deck crane of Boomsche Metaalwerke is installed to facilitate repairs and maintenance of the dredging installation and for handling heavy weights. The crane consists of a portal construction with hydraulic travelling drive, a slewing column and a jab. The crane portal is a box-type welded steel structure with machined pedestal, box-type legs connected by tiebeam and machined supports for bogies and travelling gearboxes. The crane has a maximum hoisting capacity of 17.5 tons at a radius of 14 m and provides a hoisting distance over the ship's side of 3.5 m.

For transferring spares and provisions from ship to shore and vice versa, two fixed-mounted fully electric slewing cranes are provided on the aftship reaching to outboard and also above the relevant hatches, suspended from the aft deckhouse. These deck cranes have a hoisting capacity of 1 ton at an maximum reach of 1.5 m outside ship's side and consist of a horizontal slewing beam, provided with an electric hoist and an electric travelling carriage. The cranes are designed for full load operation at a ship's list of 5 degrees and 2 degrees trim.

Lifesaving Appliances
The 'Tong LI' is fitted with two totally enclosed lifeboats, of which one serves as a rescueboat. Each lifeboat is capable to accommodate 50 persons and complies with the requirements of SOLAS. The hull and interior of the lifeboats are constructed of laminated GRP and fire retardant resins, with integrated buoyancy tanks filled with polyurethane foam in situ. Each lifeboat is equipped with a water cooled diesel engine, suitable for a speed in calm water of 6 knots. The lifeboats are suspended from a pair of gravity davits, type 'normal track', placed inside the length of the boats. Other lifesaving appliances include: 4 20-persons automatic inflatable life rafts, 10 life buoys, 56 life jackets, 1 line throwing apparatus, 2 pilot ladders, 12 rocket parachute flares, 2 embarkation ladders, and immersion suits.

Nav aids
The wheelhouse is fitted with various control consoles and equipment for navigation and telecommunication systems fitted by Radio Holland in accordance to the requirements of GMDSS for A3 navigational zone (worldwide navigation except the polar zone), including:
- one Kelvin Hughes Observer, type 10, magnetic compass;
- one Anschütz Standard 14 gyro compass;
- one Anschütz autopilot with built-in repeater compass;
- one De Hoop Groenpoel combined electric steering andudder position indicating system;
- one Furuno FE-881 MK-II echosounder;
- one Ben Phoca electromagnetic speed log;
- one Furuno FR-2010 radar system;
- one Furuno FR-2030S radar system;
- one SP Radio RT-2049 VHF transceivers with DSC;
- one JRC JUE-45A Mk II Inmarsat-A terminal;
- two Jotron TRON-305 Mk II EPIRBs;
- two Jotron TRONSART9 radar transponders;
- one SIRIO R-501 watchkeeping receiver;
- one Furuno NX-500 Navtex receiver;
- one radio telephone alarm signal generator;
- three two-way VHF radio telephones for the survival craft;
- one Vingtor VMP 32/2 automatic telephone/loudspeaker installation;
- one Furuno GP-500 GPS satnav;
- one Obisnert OMC-160 wind measuring system;
- one long range daylight signalling lamp;
- one Zöhler air whistles;
- two 3,000 kW search lights.

Classification
The 'Tong LI' has been built according to the regulations of Bureau Veritas for the class 3/0 Hopper Dredger (Deep Sea) and under the supervision of China Classification Society of the People's Republic of China (CCS).

List of subcontractors and suppliers of equipment fitted on board the 'Tong LI', built under yard number 664 (partial list):

<table>
<thead>
<tr>
<th>Company</th>
<th>Equipment/Equipment</th>
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<tbody>
<tr>
<td>ABB Marine, Rotterdam</td>
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<td>Ajax Brandanveiliging, Amsterdam</td>
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<td>Breejen &amp; Zn, Sledrecht</td>
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<td>Brusselise Marine Industrie, Nieuwepoort (B)</td>
<td>steering engine, anchor winches</td>
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<td>Cetema, Oss</td>
<td>cathodic protection</td>
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<td>Coopra, Rotterdam</td>
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<td>Cummins, Oordrecht</td>
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<td>Dacro, Rotterdam</td>
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<td>DBK</td>
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<tr>
<td>Hardinweld-Giessenland</td>
<td>generator sets</td>
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<td>Drummont, Werkendam</td>
<td>Polynex, cape marine board, assembly profiles</td>
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<td>Duivendijk v, Rotterdam</td>
<td>starting air compressors</td>
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<td>Econosto, Rotterdam</td>
<td>valves &amp; fittings, air whistle</td>
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<td>Giessen v.d., Hardinweld-Giessenland</td>
<td>rudders, propeller nozzles</td>
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<td>Grijp v.d., Sledrecht</td>
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<td>Hatenboer-Deni, Rotterdam</td>
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<td>Heinen &amp; Hopman, Spakenburg</td>
<td>AC and ventilation</td>
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<td>Hydronaut Bruinohof, Rotterdam</td>
<td>L+S dredging gearboxes, couplings</td>
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<td>Hydrozwea, Oosterhout</td>
<td>hydraulic winches</td>
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<tr>
<td>ICH Lagersimt, Kinderdijk</td>
<td>seals &amp; bearing bushes</td>
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