The Practice and Safety Security of the whole Marine Diesel Engine on Maritime Transportation

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The Practice and Safety Security of the whole Marine Diesel Engine on Maritime Transportation

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Abstract. In order to effectively mitigate risks and improve the safety of whole machine transportation at sea, it is necessary to study the safety of the maritime transport of the whole machine .The safety of marine diesel engine transportation is discussed in this paper, with company management, ship type selection, ship management and actual operation.

1. Introduction

Qingdao Haixi Marine Diesel Engine Co., Ltd. (QMD) is an important base for the production of marine diesel engines under CSIC. The current shipyard adopts modular production is an important development trend. It usually requires marine diesel engines to carry out the whole machine shipment. For one thing, it can save the installation time, for another thing, it is beneficial to the cleanliness of the diesel engine and maintain the overall consistency with the machine test. However, due to the limitation of the size of the berths of QMD terminals and the lack of berths and hoisting capacity of some shipyards, it is currently impossible to use large-tonnage ships for diesel engine transportation. In addition, the height of the diesel engine is large, which makes it impossible to pass the hatch cover during sea transportation with completely sealed. At the same time, the high engine size of the diesel engine also increases the wind receiving area of the ship and reduces the stability of the ship, thus bringing a series of safety issues involving strength, stability, securing, and weather tightness. The safety of marine diesel engine transportation is discussed in this paper, with company management, ship type selection, ship management and actual operation.

2. Transportation status

The diesel engines delivered by QMD are shipped to the shipyard through the company's terminal. The length of the wharf is designed and constructed according to 3000t and water depth according to 5000t general cargo ship. To date, QMD has delivered hundreds of marine diesel engines. The main diesel engine products are Wärtsilä's RT-flex series of electronically controlled diesel engines with cylinder bores from 480mm to 820mm and power ranges from 8725kW to 31640kW. The ships are equipped with most commercial vessels ranging from bulk cargo to tankers to container ships. In recent years, the largest model of overall transportation is 6S60ME-C8.2, with a gross weight of 385 tons and a height of over 11m.

In the practice in recent years, if it is impossible to achieve complete sealing through the hatch cover, it is sealed with other materials through three anti-cloths to ensure the water tightness of the cargo hold. At present, the mode of transportation is relatively common, and after several years of practice, no related accidents and hidden dangers have occurred, and the safety record is good.

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The only related accident was on the morning of May 28, 2006. The “Baoan City” Ship was on its way from Dalian to Shanghai and sank in the vicinity of Lianyungang waters. The ship has a deadweight of 800 tons and the total weight of the transported diesel engine was about 500 tons. The diesel engine was dismantled into three parts and completely covered by the hatch. Due to the schedule, the ship ventured into the windy weather and sailed to the sea area of Lianyungang (about 50 nautical miles offshore). The ship swayed more than 30 degrees, and was displaced due to the inability of the diesel engine to be fastened , and the common word channel pierced the hull to cause the water to sink.

3. Ship stability and strength calculation

According to the production situation and transportation situation of QMD diesel engine in recent years and the future development, the combination of 6S60ME-C8.2 diesel engine and typical 3,000-ton dry bulk carrier is selected to calculated for the ship's complete stability, total longitudinal bending strength and structural strength of the hull section.

TABLE 1. Stability calculation

No.	Item	Unit	Ship loading status	
			Departure	Arrivall
1	Loading displacement	t	1809.26	1713.14
2	Full load displacement	t	3867.00	
3	diesel engine	t	385	385
4	Ballast water	t	409.1	409.1
5	Average draught	m	2.712	2.582
6	freeboard	m	3.588	3.718
7	trim	m	-1.295	-0.332
8	the initial stability height	m	1.652	1.844
9	the 30-degree resilience arm	m	0.924	0.984
10	the ultimate inclination angle	degree	38.000	38.000
11	the stability criteria K	-	14.04	10.76

Table 2. Calculation of total longitudinal bending strength of the hull

No.	Item	Unit	3000-ton ship
1	the maximum hydrostatic shear force	kN	1609.99
2	the maximum hydrostatic bending moment	kN·m	19795.96
3	the maximum total longitudinal bending normal stress of the deck	N/mm^2	57.82
4	the required value of above	N/mm^2	175
5	check		meet the requirement
6	the maximum total longitudinal bending normal stress of the ship’s bottom	N/mm^2	39.66
7	the required value of above	N/mm^2	175
8	check		meet the requirement
9	the maximum total longitudinal bending shear stress of the side outer panel	N/mm^2	30.69
10	requirement of total longitudinal bending shear force requirement	N/mm^2	110
11	check		meet the requirement

Analysis of calculation results:

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(1) The ship is in a semi-load state with a large freeboard and good anti-sinking capacity. The Rules require 0.15m for the initial stability height of the ship, 0.20m for the 30-degree resilience arm, 25 degrees for the ultimate static angle and 1 for the stability criterion. The ship stability index under all loading conditions meets the requirements and has a certain margin. The stability data of ships leaving Hong Kong and arriving in Hong Kong are comparable, and the stability changes little.

(2) The total longitudinal strength of the hull structure of the ship-loaded diesel engine under the whole working condition meets the requirements of the Rules, and the maximum calculated stress of each hull section is less than the allowable stress.

4. security measures

4.1 Company Management

QMD shall set up special organization and safety management departments in accordance with the relevant requirements for marine transportation of marine diesel engines, and strengthen the whole process of dynamic tracking and monitoring of port operations and diesel engine maritime transportation. The relevant information such as the unloading port of the whole diesel engine, the berth of the unloading dock, and the lifting capacity of the unloading berth loading and unloading equipment shall be reported to the maritime authority in a timely manner.

4.2 Selection criteria

QMD and its shipping agency shall comply with the following principles when selecting the ship type and condition of the marine diesel engine:

(1) The ship selected for the marine transportation of the marine diesel engine shall not exceed 12 years.

(2) Ships that have a detention record for safety reasons in the ship safety inspection should be selected to undertake the marine transportation of the diesel engine.

(3) Ships with incomplete certificates and incomplete ship inspection data should be selected to undertake marine transportation of diesel engines. The necessary ship inspection data are: hull description, profile drawing, general layout drawing, basic structural drawing, cross-sectional view, stability report, hydrostatic data, hull strength calculation book, etc.

(4) The ship agency company shall clearly define the ship selection standard, and require the ship agency company to select the ship to be carried out in strict accordance with the ship selection standard, and promptly report the ship information to be carried to the maritime authority.

(5) If it is restricted by the loading berth or the unloading berth, it is impossible to achieve complete sealing by the hatch. The ship with a deep cabin should be selected as much as possible to minimize the height of the hatch cover at the highest point of the diesel engine.

4.3 Natural conditions restrictions

QMD and shipping vessels are subject to the following natural conditions:

(1) When the QMD is hoisted on the diesel engine, the wind should not exceed 5 levels.

(2) The ship is to be transported under the conditions of Pu's Class 6 wind and Class 6 weather, and the sea level with a wave height not exceeding 2 m is visually observed. If it exceeds or is expected to exceed the above limit, the ship shall promptly search for suitable waters to park and shelter from the wind.

(3) The ship in transit shall comply with the local restrictions on natural conditions when entering and leaving the port and when leaving the port.

(4) QMD should actively contact the marine and gas departments. Before the ship sails, it should prepare a “voyage plan/weather navigation list”, that is, the meteorological and sea conditions predicted by the weather forecast on the sea area expected to sail every day. The meteorological and sea conditions must meet the limit of the above natural conditions .

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4.4 Transportation distance and route selection

QMD diesel engine unloading port is mainly domestic southern coastal or riverside port. From the navigational habits, the ship route is generally not kept within 20nmile, so the diesel engine transportation should be selected as the offshore navigation area and above. The design of the route should take into account the temporary safe parking area that can be selected when the ship is in an emergency or encounters an emergency (beyond the aforementioned natural restrictions, etc.).

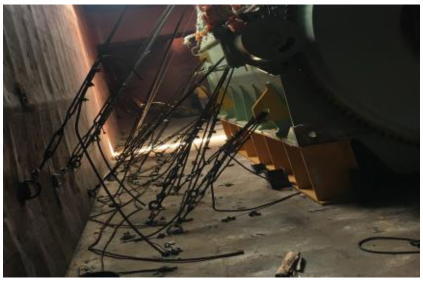
4.5 stowage

Diesel engine transport ships are usually tail-type, with two cargo tanks, one cargo tank loaded with one diesel engine, and the other cargo tank loaded with dozens of diesel engine parts packaging. Considering the weather tightness and the prevention of cargo tank water intake, the latter cargo hold is relatively less affected by wind and waves and is superior to the cargo hold. The center of gravity of the diesel engine should be placed centrally along the bow line (considering the eccentricity of the center of gravity of the diesel engine, the ship should be free from heeling). For the cargo box loading parts and packing parts, the packing boxes should not be stacked, and the adjacent packing boxes should be closely attached to each other, placed in the horizontal direction of the ship, and should be fitted with the left and right inner walls of the cargo space as much as possible. If there is a gap, the supporting materials can be used to fix the box. .

4.6 securing

The shipping base is installed to increase the landing area of the diesel engine, reduce the pressure on the bottom of the cabin, and weld the channel steel in both directions at both ends

for fixing. In addition, the lifting points and support beams of the base, the frame and the



Fgure 1. Base, frame fastening

Figure 2 Channel fixing

According to the calculation of the solidification calculation, the 20mm steel wire rope can not meet the safety requirements of the 6S60ME-C8.2 diesel engine with a gross weight of 385 tons. The solutions are as follows: increase the number of wire ropes to be solidified, increase the strength of the wire rope, and weld the hull with full welding when the channel is fixed to the base, and the welding is aligned with the vertical support plate of the base.

4.7 Sealing

Diesel engine transportation is a major piece of sea transportation, and due to a series of conditions, it is impossible to completely seal through the hatch. In order to ensure the water tightness of the cabin, the "four-step sealing method" can be used for sealing.

In the first step, the hatch is covered as much as possible with the hatch cover so that the part that cannot be covered with the hatch cover is as small as possible.

In the second step, the diesel engine is covered with a three-proof cloth and fastened with a tie wrap, as shown in Figure 3.

In the third step, the hatch cover is covered with an external tarpaulin, and cover the tarpaulin with a cover net to prevent the tarpaulin from tearing, as shown in Figure 4.

In the fourth step, the front and rear hatches are covered with a sealing cloth and overlapped with the machine joint cloth joints; all the sealing cloths are tied tightly with ropes. Among them, the machine sealing cloth in the direction of the bow should be under the front hatch sealing cloth to prevent the water from seeping in the ship's stern and the strong wind in the direction of the ship blowing the sealed cloth; the machine sealing cloth in the stern direction It should be placed above the front hatch cover to prevent water from flowing through the machine seal after the ship is on the waves.

The hatch cover shall provide relevant evidence that it is sufficiently waterproof and strong.

Figure 3.Schematic diagram of three-proof cloth covered diesel engine

Figure 4. Schematic diagram of the cover net rope covering the tarpaulin

5. Conclusion

Based on the QMD mass transportation practice, this paper explores the actual operation method of marine diesel engine whole sea transportation. So far, the marine diesel engine has a good record of maritime transportation. However, with the changes in coastal traffic environment and the risks of major parts transportation at sea, it is necessary to further strengthen the safety of marine transportation of diesel engines. The suggestions and operation methods proposed in this paper have reference and guiding significance for the marine transportation of marine diesel engines, and can also provide reference for the safety of other major marine transportation.

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