REPUBLIC OF TURKEY
MINISTRY OF TRANSPORT, MARITIME AFFAIRS AND COMMUNICATIONS
Accident Investigation Board

Marine Accident Investigation Report
On the Injury of a Person
As a Result of Breaking of Towing Line of
M/V KRISTIN-C

Port of Güllük
21st August 2013

Report No: 10/2015

REPUBLIC OF TURKEY

MINISTRY OF TRANSPORT, MARITIME AFFAIRS AND COMMUNICATIONS

Accident Investigation Board

GÜLLÜK PORT

21 August 2013

This report is prepared by the Accident Investigation Board.

Address	:	Ministry of Transport, Maritime Affairs and Communications Hanımeli Sok.No:7 Sıhhiye, 06430 ANKARA / TURKEY
Phone / Fax	:	00 90 312 203 1431/00 90 312 229 72 89
E-mail	:	kaik@udhb.gov.tr
Web	:	www.kaik.gov.tr

PURPOSE

The main purpose of investigating a marine accident is to identify the factors causing the accident, with the aim of improving the safety of lives of personnel and passengers at sea,preventing similar accidents in the future and enhancing safety of navigation. It is not thepurpose to apportion liability, nor to apportion blame to anyone or any party.

NOTE

This marine accident is investigated in accordance with the Bylaw on the Investigation of Marine Accidents, which came into force after being published in the Official Gazette with reference number 26040 on 31st December 2005 and the Bylaw on the Investigation of Marine Accidents and Incidents which came into force after being published at the Official Gazette No.29056 on 10th July 2014 and which revoked the former Bylaw.

This report is not written with apportionment of liability in mind and is not intended to be used in court of law. It endeavours to identify and analyze the relevant safety issues pertaining to the specific accident, and to make recommendations aimed at preventing similar accidents in the future.

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LIST of FIGURES

ACRONYMS and ABBREVIATIONS

IMO :International Maritime Organization

BIMCO : The Baltic and International Maritime Council

R.P.M : Revolutions Per Minute

SWL : Safe Working Load

VHF : Radio system which operates in 156-174and and which is used for the purpose of communication of vessels with other vessels or mainland.

SUMMARY

Picture 1: *Location of the accident*

All times in the report are local times (GMT+2).

M/V KRISTIN-C berthed at dock number 1 at Güllük port on 19th August 2013 at 18:25 to load 6400 tonnes of quartz which was to be transported to the port of Grundartangi / ICELAND. Following the completion of loading operations on 21st August 2013 at 09:13, the official transactions which are required to depart from the port were completed and port departure maneuvers started when the port pilot got on board at 11:00.

All the mooring lines connecting the ship to the dock were respectively cast off and taken on board by 11:10. Since there was not sufficient space at the fore and aft of the ship, it was decided to tow the ship by a tugboat upon the recommendation of the pilot and, to do this, a ship rope was given to the tugboat and made fast by the tugboat. The ship started to depart from the dock in a parallel way by heaving up the starboard anchor and operating the bow thruster in the direction of departing for the bow of the ship and by pulling the towing line first slowly, then with half speed by the tugboat for the aft side.

While the aft of the ship departed only 2-3 m from the dock and the tugboat continued to pull the ship by increasing boat's speed gradually from slow to half

speed, the rope used in towing suddenly broke from the middle part at 11:15 and snapped back to the dock struck and caused grave injury to the port's personnel who was serving at the wharf as mooring staff.

PART 1 – FINDINGS OF THE ACCIDENT

1.1 SHIP, TUGBOAT and ACCIDENT INFORMATION

1.1.1 KRISTIN C Ship's Information

Name of Ship	:	M/V KRISTIN C
Flag	:	United Kingdom
Built At / On	:	Poland / 25/09/2008
Port of Registry	:	Cowes
Type of Ship	:	Dry Cargo Ship
Owner of Ship	:	Carisbrooke Shipping 6250 BV / Netherlands
Gross Tonnage	:	4151
Net Tonnage	:	2323
DWT	:	6799.92 mt
IMO No	:	9523938
Call sign	:	2CTI5
Overall length	:	106.07 m.
Width	:	15.50 m.
Depth	:	8.14 m.
Draft	:	6.63 m.
Main Engine	:	MAK 6M25C/ Caterpillar Motoren, 1980 kW
Bow Thruster	:	VETH, 250 kw
Number of Crew	:	10
Previous Port	:	Tuzla / İstanbul
Destination Port	:	Grundartangi / ICELAND

Picture 2: *M/V KRISTIN C*

1.1.2 Accident Information

Date and Hour	:	21 August 2013 / 11:15
Location of Accident	:	Turkey / Güllük Port
Coordinates of Accident Location	:	37° 15′,3 North - 027° 36′,3 East
Injury / Death / Loss	:	1 injured (Port's Mooring Staff)
Pollution	:	None

1.2 WEATHER and SEA CONDITIONS

At the time of the accident, the wind in the region was blowing from the west, force 1 in Beaufort Scale and the sea was calm. Sky was partly cloudy. There weren't conditions such as rain, fog, haze which might influence sight adversely; sight was rather clear.

1.3 COURSE OF EVENTS LEADING TO ACCIDENT

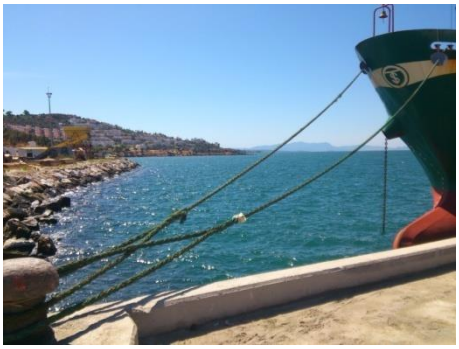
M/V KRISTIN-C berthed at dock number 1 at Güllük port on 19th August 2013 at 18:25 to load 6400 tonnes of quartz[1] which was to be transported to the port of Grundartangi / ICELAND. Following the completion of loading operations on 21st August 2013 at 09:13, the official transactions which are required to depart from the port were completed and preparations for port departure maneuvers started.

Picture 4: *Güllük Port dock number 1*

[1] With specific gravity 2,65 g/cm^3 and hardness 7, quartz mineral is used in glass, detergent, paint, ceramics, emery, filler and metallurgy industries.

The two mooring personnel who were serving that day at the port took their places on the berth, to let go the mooring lines given to shore from the ship, one staff in charge of the mooring lines at the forward of the ship and the other staff in charge of the mooring lines at the aft of the ship. The pilot got on board at 11:00, established communication with the mooring personnel and the captain of tugboat ASİN which participated in the maneuvers and departure maneuver of the ship from the port was started.

When KRISTIN-C started the maneuver of departing from the port, there was another ship at the aft side (at dock no 3) and there was a distance of 2-3 meters between the ships (*Picture 5*). Although there was 6-7 meters distance from the stern side of the ship towards the shore (port area) (*Picture 6*), the distance of safe maneuvering towards the stern side is about 2-3 meters because the sea depth decreases towards the coast.



Picture 5: *Picture showing the distance of ship from the bow to the shore (another ship in the same position)*

Picture 6: *M/V KRISTIN C*

Considering its present position and In order that the ship can move away from the berth by keeping a safe distance with the ship abaft and the shore, the pilot recommended to the ship's captain to give a strong rope of about 40 meters long from the aft side of the ship to ASİN tugboat which participated in the maneuver. The ship's personnel gave the white polypropylene rope produced from 8 strands of synthetic material of thickness 7 inches[2] (56 mm) to the tugboat.

[2] This is a measurement unit to measure the size of ropes and chains and it is found by measuring the diameter of the rope. While 2,54 centimeters correspond to 1 inch in natural fiber ropes, 1 inch corresponds to 8 millimeters in steel wire ropes.

While the towing rope was attached to the tow hook of the tugboat by the tugboat's personnel, the ship's personnel belayed the towing rope to the starboard aft bollard of the ship. Then all the ropes connecting the ship to the dock were cast off respectively and were taken on board by 11:10. Meanwhile, the tugboat first took up the slack part of the towing rope taken from the aft of the ship and then, upon the directive of the pilot, started to tow the ship first slowly, then in half speed at an angle of ninety degrees. Together with the towing process simultaneously Starboard anchor in the water was started to be heaved up and the bow thruster of the ship was started in the direction of moving the ship away from the berth. The ship which was under the effect of the forces applied from its stern and aft in the direction of edging the ship away, started to move away from the berth and at a position parallel to the berth.

Meanwhile, the mooring personnel Önal KARADUMAN, the accident victim who casted off the stern lines of the ship, went, with a rubber fender (automobile tire) against the possibility of damage to the ship by resting against the section of the berth where there are not any fenders (Picture 7); there stood another mooring personnel who had cast off the aft lines of the ship and who was informing the pilot about the distance between the ship and the other ship.

Picture 7: *Dock No 4 where the accident occurred*

While the aft of ship edged away only 2-3 meters (*Figure 1*) and the tugboat was continuing the towing process by increasing its pulling force from slow to half speed gradually (1000-1100 rpm), the rope given by the ship to the tugboat and used in the towing process suddenly broke into two from the middle (a portion of 17,3 m being left on board of the tugboat) at 11:15 and hit Önal KARADUMAN, one of the two mooring personnel who were standing side by side at the snapback area of the rope (*Picture 8*) and caused grave injury to him , ,.

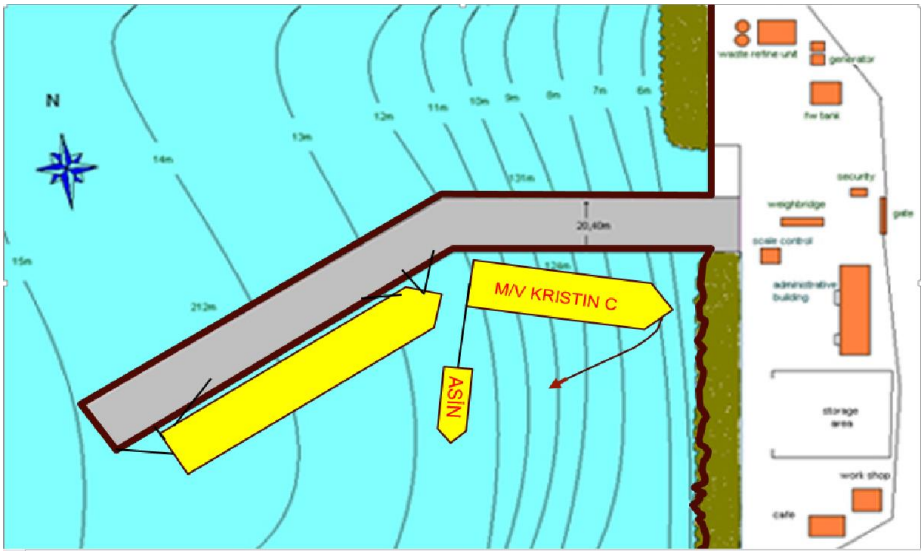
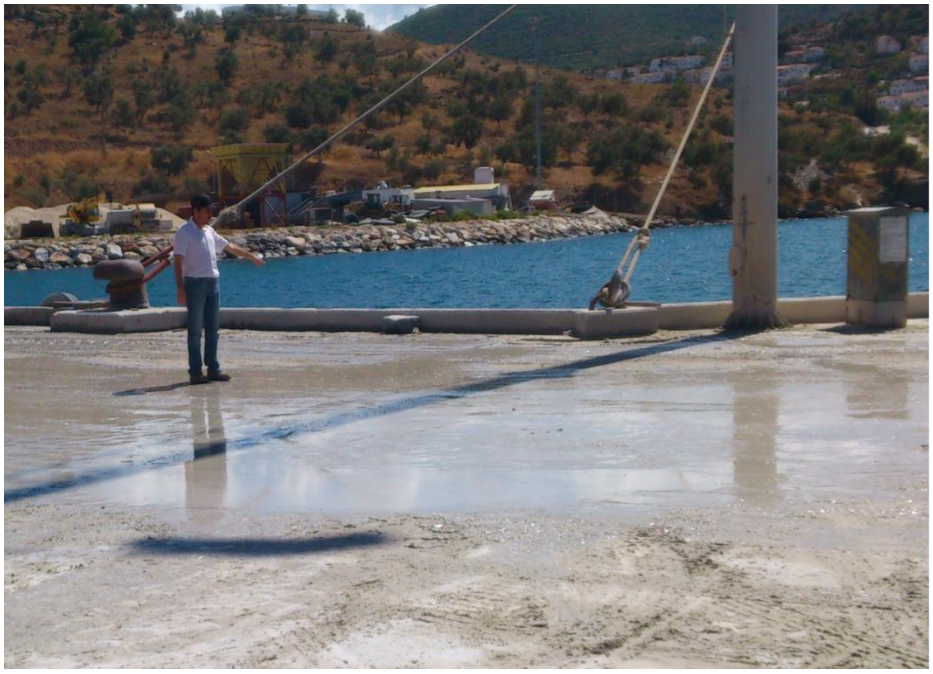


Figure 1: *Maneuver scheme*



Picture 8: Location of the accident victim during the maneuver

Önal KARADUMAN skid and fell down as a result of the hitting of the rope on his helmet (*Picture 9*) and shoulder (*Picture 10*). The first response was by the other hawser personnel who had first aid knowledge and who witnessed the incident. The other hawser personnel turned Önal KARADUMAN to his side against the risk of asphyxia and provided to keep his trachea open. Meanwhile, the security personnel of the port called 112 emergency ambulance service at 11:17. The ambulance attendants who burst into the scene of accident at 11:24 hospitalized the wounded at 11:34 after the first response to the accident victim.

Picture 9: Helmet of the accident victim to whom the rope hit

Picture 10: The location where the accident victim fell as the result of hitting rope

The ship's captain and pilot who were on the bridge at the moment of the accident and engaged in the maneuver learned from VHF that a person was wounded on the dock as a result of breaking of the rope. Upon the warning of the pilot, the ship's captain stopped the port departure maneuver of the ship and the ship again berthed to Berth No 1 from which it departed at 11:30 at the end of a 10 minutes maneuvering process.

The other hawser personnel and the tugboat captain who participated in the port departure maneuver of the ship witnessed the moment of accident. The personnel who participated in the maneuver at the aft of the ship had taken shelter at a safeguarded place at the aft side of the ship in accordance with the directive of the captain on the subject of keeping away from the rope against the probability of a break in the rope given to the tugboat, therefore they did not witness the breaking moment of the rope. However, one of the personnel who participated in the maneuver at the aft of the ship expressed that he heard some excessive stretching sounds from the rope. On the other hand, the personnel who participated in the maneuver at the stern of the ship did not witness the moment of accident since they should be engaged in the mooring process and report the distance of the stern side of the ship, which are close to the coast, from the coast. Also the personnel who

served on board of the tugboat took shelter at a safeguarded place against the probability of a break in the rope upon stretching sounds from the rope, therefore they did not see the breaking moment of the rope.

Following the works and actions concerning the judicial investigation started after the accident, KRISTIN C ship left Güllük port on 23/08/2013 at 18:30.

A loss of sight occurred at the right eye of the hawser personnel Önal KARADUMAN who was treated at the hospital for a long time. In addition, the accident victim whose right shoulder was broken stated that his shoulder did not heal completely.

1.4 Hawser Personnel

Önal KARADUMAN started his sea working life in 1997 at a 7 meters fishing boat as a ship boy and continued to work in a 9.6 meters fishing boat. In consequence of his sea experience acquired in fishing boats and trainings, he got able seaman competency on 16/11/2009. He started working at Güllük port on 07/06/2010 as security personnel. He continued to work following 02/02/2013 alternately as seaman in the tugboats and port hawser personnel.

Önal KARADUMAN got a one day long introductory compliance training at the date when he started to work as a port hawser personnel / tugboat seaman. Again, of the trainings organized at the port for a certain calendar year, he was trained at Güllük port between the dates 13-14/05/2013 by the occupational safety expert on the subjects of General Occupational Health and Safety Rules, Legal Rights and Obligations of the Employees, Occupational Health and Safety Law number 6331.

1.4.1 Working System of Hawser Personnel

At Güllük port, tugboat personnel and hawser personnel work alternately. In this working system, a setup is made so that each personnel works at the tugboat as seaman for a week, at the port as hawser personnel for a week and be on leave for a

week. According to this working system; while the hawser personnel work between 09:00-17:00 every day along one week, they participate in maneuvers when there is a ship maneuver out of these hours provided to be limited to only the maneuver time.

1.5 Occupational Safety In The Port

A full time occupational safety expert is employed in the port. It is understood from the records kept by the port operating institution that the trainings concerning occupational safety are given to the port employees in regular intervals within a planned schedule. In the investigation made in the port, the port employees are seen to observe the occupational safety rules sensitively. The witnesses of the incident and port employees have expressed that the accident victim had his helmet on his head, he was dressed in compliance with his task and he had taken the personal protective equipment which were given to him and used these in compliance with his training and directives. In addition, it is expressed that risk assessments were made by the occupational safety expert against the probable accidents and the necessary precautions are being taken.

When the occupational safety training program given by the occupational safety expert is examined, the training concerning rope accidents was given to the employees of the tugboat on 01/02/2013 and the next training was planned within 2014. However, since Önal KARADUMAN started on 02/02/2013, he could not get this training.

1.6 Tugboat

ASİN tugboat used in towing process was constructed at İstanbul on 01 January 2006 and started to serve at Güllük port after 10 July 2006. Initial marine survey of the tugboat was realized on 13 September 2011 and first anniversary survey on 19 September 2012 at Güllük port. In the certificates submitted by Güllük Liman İşletmeciliği İnş. Tur. San. ve Tic. A.Ş. concerning ASİN tugboat (*ANNEX-1*), it is determined that towing test was performed on ASİN tugboat at Güllük port by

Turkish Lloyd on 05 July 2013. In the towing test, (continuous) towing power of ASİN tugboat is certificated as 295,05 kN-30.08 tons.

1.6.1 Tugboat Captain

Tugboat captain previously started to work in fishing boats (seine fishing boats in majority) , then worked as captain in yachts. He has worked at tugboats for the last seven years. He has served as tugboat captain for the last 4 years of this time.

1.7 Pilot and Tugboat Utilization

The requirements concerning piloting and tugboat operation in our country in the berthing, mooring and unmooring of ships are regulated in article 13 of the Ports Regulation[3] and all ships in the range of 2000 gt-5000 gt are obliged to get 1 tugboat with minimum towing force of 16 tons. *(ANNEX 2).*

There exists two tugboats at Güllük port having a towing power of 30 tons for berthing and unmooring of the ships. One tugboat is used for 2000 – 4999 gt ships which will approach to and depart from the port and two tugboats are used for ships of 5000 gt and over. Since KRISTIN C is 4151 gt, 1 tugboat is used in the departure maneuver of the ship.

Again, the same Regulation obliges the foreign flag ships of over 500 gt to get piloting service in the port approach and departure maneuvers and mandatory piloting service is given to ships over 500 gt at Güllük port.

1.8 Rope Used In Maneuver

In the certificate of date 29/10/2012 submitted by the ship for the rope (*Picture 11*) used for towing process, it is indicated that the rope is manufactured from 8 strand, braided white polypropylene which is a synthetic material of thickness 7 inches (56mm) and its breaking force is 54.456 kg (*Annex-3*). However, information

[3] Ports Regulation published in the Official Gazette of date 31/10/2012 and number 28453.

concerning when the mentioned rope was included in the ship's inventory and for how long it was in service is not at hand.

Picture 11: Portion of the rope used in the maneuver left on the tugboat

In addition, in the report issued after the accident by the ship's captain, it is stated that the rope which was used in the towing process was not a new rope, but it was checked every month and the condition of the rope was good pursuant to the last check made on 05/08/2013 and the rope was believed to be robust.

PART 2 – ANALYSIS

2.1 Maneuver

Dock number 1 which the ship was moored to before departure maneuver has a length of 124 meters. Depth of the sea varies between 6 to 12 meters at the dock. The ships have to approach to and depart from dock no 1 in a more controlled manner due to the reason that dock no 1 makes an angle of approximately 140 degrees at the point of joining dock no 3 (Picture 12) and the depth of sea decreases towards the coast.

Picture 12: Güllük port docks no 1 and 3

Since the berthing and edging away maneuvers of the ships concerning dock no 1 are more difficult compared to the other docks at the port, the pilot serving at the port indicated that the ships to berth for dock no1 dropped anchor within the port to facilitate the maneuver of departing from the port. In the same manner, KRISTIN C dropped starboard anchor on 19 August 2013 and berthed at dock no 1.

The pilot planned to use the starboard anchor and bow thruster of the ship in the maneuver of the ship to depart from the port and asked ASİN tugboat to participate in the maneuver by towing the ship to facilitate the maneuver of the ship and provide safe edging away for the ship. For this, the pilot asked the ship's captain to give 40 meters of the strongest rope present on board of the ship to the tugboat from the ship's aft and make fast at the ship's aft side.

An approximately 40 meters long trail rope was given from KRISTIN C to ASİN tugboat upon the recommendation of the pilot. The trail rope was attached to the tow hook of ASİN tugboat after passing through the aft hawse hole of the ship. The tugboat took up the slack part of the rope in the first stage and started the process of towing with a ninety degrees angle in respect to the fore and aft line of the ship by the instruction of the pilot, heaving up the starboard anchor which was dropped into the water previously and at the same time starting its bow thruster, the ship's bow started to edge away from the berth . The ship started to edge away parallel to the dock while the tugboat towed the ship from its aft simultaneous with the forces applied to the ship at the bow. While the aft of ship edged away only 2-3 meters from dock no 1 and the tugboat's pulling force was increased from slow to half speed, the towing rope suddenly broke into two from a section close to the middle.

Upon the sudden break of the polypropylene rope which is included into the class of synthetic ropes and which is an artificial fiber rope, its portion left at the ship (about 22,7 meters) skid to the dock and the other portion (about 17,3 meters) was left on board of the tugboat. The broken rope caused grave injury of Önal KARADUMAN, one of the two adjoining hawser personnel just standing at the return area of the rope by hitting him.

While resilience rates of the polypropylene ropes are about %8-11 under normal working load, their elongation rates are about %25-40 under forces close to breaking forces.[4] Since polypropylene ropes yield more because they have an elastic structure, the back skidding force of the rope becomes more. As polypropylene ropes may suddenly break without giving any notice, the persons who handle the ropes should not stay within the return area of the rope which is shown in Figure-2 which is a very dangerous area.

[4] EROL, Aykut: Navigation, İstanbul 1987

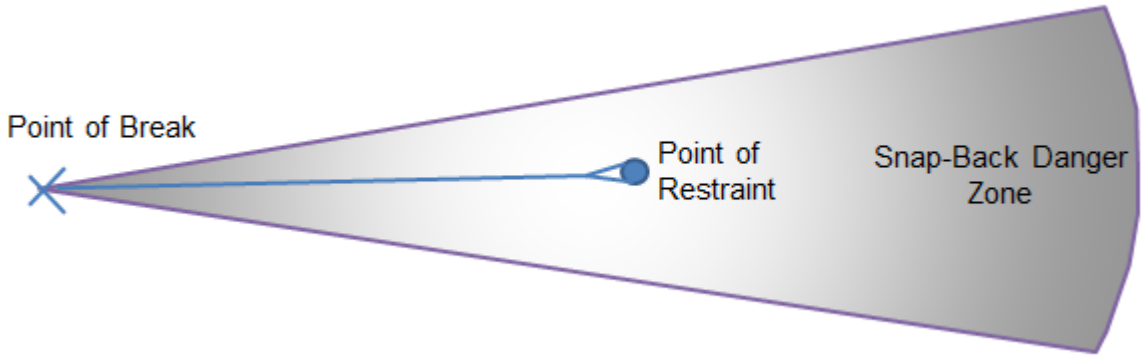


Figure 2: *Return Area of The Rope*

Within normal maneuver order, the hawser personnel should leave the port area after they cast off the ropes of KRISTIN C ship or wait for the instructions of the pilot away from the snapback area of the ropes. But, the hawser personnel (the one not being the accident victim) who cast off the aft ropes of the ship is positioned on the dock and at a point close to the aft of KRISTIN C to check the distance between KRISTIN C and another ship moored just at the aft side of KRISTIN C (at dock no 2) and to inform the pilot who was managing the maneuver about the distance between the two ships, as required. On the other hand, Önal KARADUMAN who cast off the stern ropes of the ship took a rubber fender against the probability of damage to KRISTIN C during the maneuver by hitting the section of the dock which did not contain any fenders and went beside the other hawser personnel. Despite the working and occupational safety rules determined by the port, this action by Önal KARADUMAN without the instruction and request of anybody shows the existence of a wrong practice at the port concerning similar cases. On the other hand, in the interviews made with the port employees, it is evaluated that the employees have adopted the business place and are inclined to act in the direction of their initiatives without taking instructions from anybody to prevent any damage to the berths and ships.

On the other hand, although the ship's captain stated that the broken rope was made fast to the starboard aft bollard, it is seen that the rope in question was on the port

aft drum of the ship in the pictures (*Picture 13-14*) taken from the aft side of the ship concerning the rope following the accident. This situation suggests the probability that the rope was made fast on the rope drum instead of the bollard.

Picture 13: *Quarter deck of KRISTIN C Ship after the accident*

Picture 14: *Quarter deck of KRISTIN C Ship after the accident*

We don't have any information about the brake system of the capstan used on this ship. However, it is an important requirement for the safety of maneuvering that the brake power of the rope capstans which are used in ships should be smaller than the breaking force of a rope under load . Before the load which is applied to the rope

reaches the breaking force, the rope drum which runs in connection with the capstan system should automatically release the rope.

As the rope drum's brake mechanism did not step in automatically, as the captain states, it is evaluated that the rope was either enlayed on the aft bollard or the rope was broken before the rope drum automatically stepped in since the rope was not robust.

2.2 Forces Acting On The Rope

The tugboat's captain expressed in the interview made by him that a standard towing process was applied to KRISTIN C, that the traction applied to the ship was increased gradually while towing of the ship continued, but that the rope which was used in the maneuver broke because it was not robust. On the other hand, the ship's captain indicated in his report based on the statement of his personnel who participated in the maneuver at the aft of the ship that the rope was broken as a result of the tugboat's sudden and very strong pull on the trail rope (jerk).

In the towing process, long connection method is used and the length of the rope required in the long connection method is determined as 40 meters by the pilot. Long connection method is the towing process made by using one or two long ropes which generally extend from the stern or aft side of the ship to the towing hook and which are called towing ropes.[5] The ship has given the rope of about 40 meters length to the tugboat by observing the recommendation of the pilot. Length of the rope to be used in long connection method should be minimum 2-3 times of the tugboat's length.[6] Considering that the tugboat's length is 18.29 meters (18.29 X 2 = 36.58 meters or 18.29 X 3 = 54.87 meters), it is seen that a rope of correct length was used in towing process.

Since, in the long connection method, a greater traction may be applied to the ship compared to short connection method, it is worldwide preferred. It is important that the rope to be used in the long connection method would especially be robust.

[5], [6] EROL, Aykut: Navigation, İstanbul 1987

A towing process can be realized with long connection method from 0 degree to 150 degrees angle with regard to the keel of the ship and the trail rope has made an angle of 90 degrees with regard to the hull at the moment of breaking of the rope. According to the force which is applied to the towing rope through long connection method by the tugboat, the highest turning effect on the ship emerges as regards to the center of gravity of the ship when the towing angle between the towing rope and the keel becomes 90 degrees.[7] Depending on the angle between the rope and the hull, the stern side of the ship tried to skid in a direction opposite to the towing direction. But, the skidding force applied to the stern side was overcome by heaving of the starboard anchor of the ship and using the bow thruster of the ship in the direction of edging the ship away simultaneously with towing and the stern side of the ship started to edge away. In the same way, using the bow thruster of the ship in the direction of edging the ship away and heaving of the starboard anchor of the ship formed a skidding force at the aft side of the ship towards the dock. This skidding force was overcome by the tugboat towing the ship and the ship started to edge away towards the towing direction of the tugboat. *(Figure-3)*

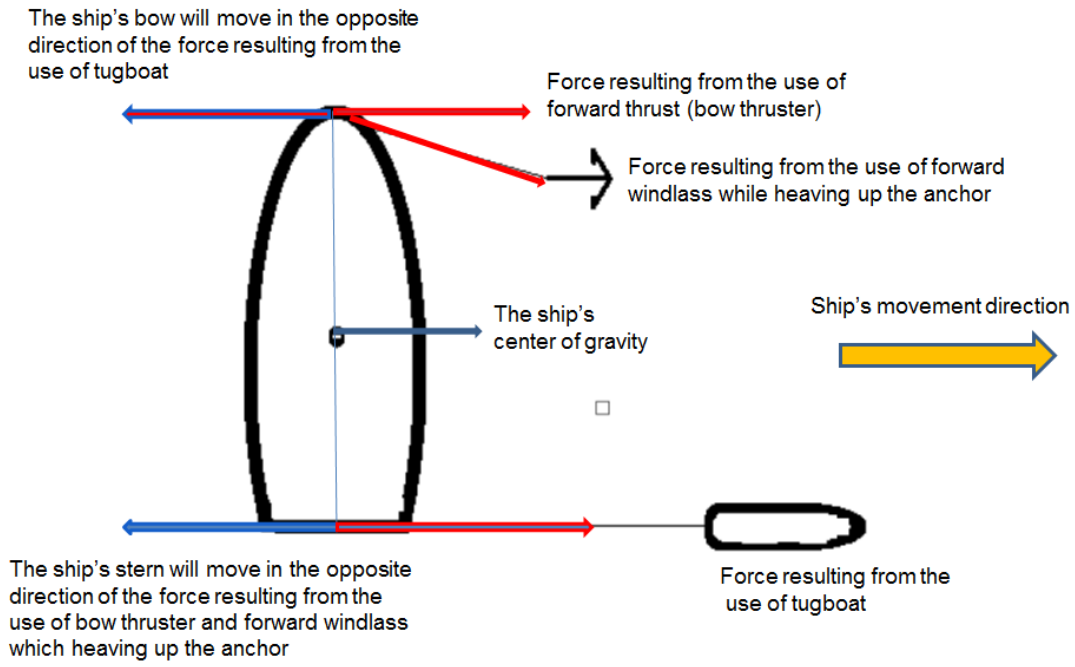


Figure-3 *Forces influencing the rope*

[7] EROL, Aykut: Navigation, İstanbul 1987

Body of the rope which is used in the process of towing the ship is basically under 3 forces. First of these forces is the force which is formed by the tugboat towing the trail rope. The other two forces are the indirect resultant forces (skidding force) formed by heaving the ship's anchor and running the bow thruster of the ship in the direction of edging away. It is evaluated that the rope which was influenced by the resultant influence of the forces expressed above was broken after a certain time passed.

When the tugboat realizes the towing process by a single rope with long connection method, another matter which should be considered is the importance of the vertical angle formed between the tugboat and the ship. As the vertical angle formed by the rope given from the ship to the tugboat gets smaller, there becomes a decrease in the force applied to the ship since a compressive force will be applied towards the sea besides the force applied to the ship in the direction of the tugboat. When the towing vertical angle between the ship and tugboat reaches to 45 degrees, the force applied to the ship decreases in a rate of 50 percent.[8]

In this respect, when the forces applied to the ship, thereby the trail rope, are evaluated, it should be considered that the tugboat is low compared to the ship and, consequently the trail rope makes a vertical angle too, and depending on this angle, an important part of the power applied by the tugboat on the rope influences the ship vertically (towards the sea) in addition to the influence in the direction of the towing.

2.3 Training and Experience of Hawser Personnel

Interdependence is under consideration between the activities at the coast and on board in the port approach and departure maneuvers of the ships. The malfunctions occurring on board of the ships and the port in the maneuvers influence the ship and port and the personnel on board and at the port adversely. For these reasons, sufficient number of tugboats and safe hawser (mooring) service must be provided at the ports. It gains importance to select the tugboat and hawser personnel who are in charge of carrying such services at the ports and tugboats from among the

[8,9] EROL, Aykut: Navigation, İstanbul 1987

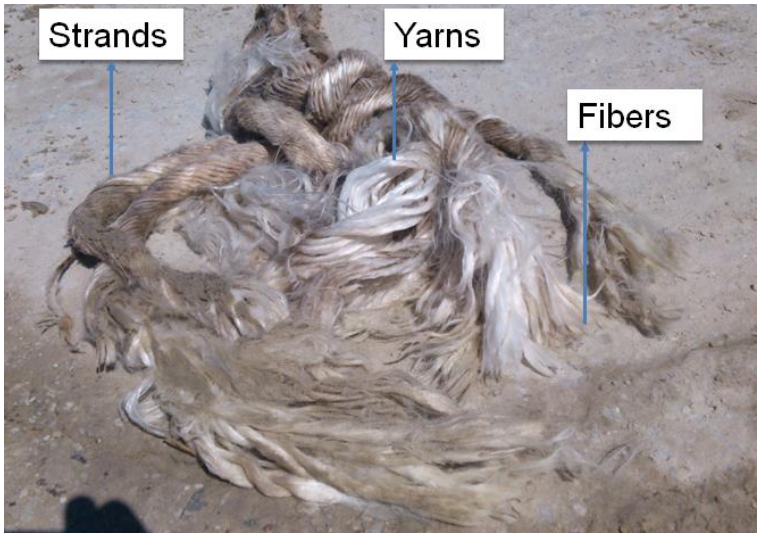
experienced personnel who previously worked at sea or train them appropriately for their task.

Önal KARADUMAN started his sea working life in 1997 at fishing boats. In consequence of his sea experience acquired in fishing boats and trainings, he got able seaman competency on 16/11/2009. He continued working at Güllük port on 07/06/2010 as security personnel and following 02/02/2013, alternately as seaman in the tugboats and port hawser personnel. Although it is evaluated that Önal KARADUMAN has the required knowledge and experience to be hawser personnel, it is evaluated that employing the personnel in consequence of the previous sea experience before giving the basic training / refreshing training concerning the work to be performed is not suitable from the point of occupational health and safety.

Minimum training requirements recommended for the hawser personnel are published through the circular of date 11 July 2005 and number FAL.6 / Circ. 11 published by the International Maritime Organization (IMO) concerning hawser personnel. This circular gives guidance about the training matters which are recommended for the hawser personnel. This guide is developed for the hawser personnel who want to enter the profession for the first time and it may also be used as a guide by those who want to develop programs to improve the knowledge of the existing hawser personnel and to increase their training level.

2.4 Rope Used In Maneuver

By joining the "*fibers*" which are the thinnest piece of the material from which the rope is made, "*yarns*" are formed; by uniting the "*yarns*", the "*strands*" are formed; by uniting the "*strands*", the "*rope's body*" is formed. (Picture 15)



Picture 15: *Parts of the rope used in the maneuver*

Since the breaking force of the rope varies according to the property of the substance used in the production of the rope's fibers, production type of the rope and the number of strands which the rope contains, the most correct source on the subject of the breaking force is the value given by its manufacturer.[9] The rope which was used for the towing process is a white polypropylene rope of thickness 7 inches (56mm), braided, 8-strand, synthetic material and its breaking force is indicated in its certificate as 54.456 kg.

Main function of the ropes which are used in ship maneuvers such as berthing, edging away and towing is to transmit a force from one place to another place or to change the location of application point of the force.[10] Three kinds of ropes are used on board of the ships according to the type of manufacturing material: fiber cordage (hemp, cotton, linen, manila, etc.), synthetic (nylon, polyester, polypropylene, etc.) and steel. Being the most important element in ship maneuvering, the ropes exhibit different behaviors according to the property of materials from which they are manufactured, their diameters and lengths when they are put under load and a rope compliant with the characteristics of the work to be performed should be selected. When a rope compliant with the work to be performed is not selected, accidents

[9] EROL, Aykut: Navigation, İstanbul 1987
[10] EROL, Aykut: Navigation, İstanbul 1987

may occur and the persons who handle the rope may get injured as a result of such accidents.[11]

When a force of same magnitude is applied to each one of the different kinds of, but the same length ropes, their quantity of elongation becomes different *(Figure 4).*

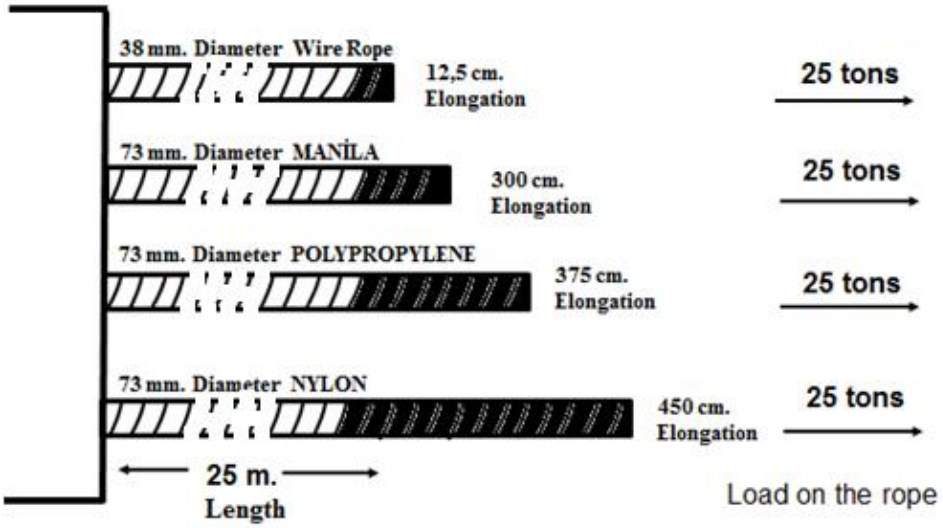


Figure 4: *Elongation values of different kinds of ropes with an unloaded length of 25 meters under a load of 25 tons.* [12]

When a force of same magnitude is applied to each one of two polypropylene ropes of same length, the rope whose thickness is less shows more elongation. *(Figure-5)*

[11] EROL, Aykut: Navigation, İstanbul 1987
[12] EROL, Aykut: Navigation, İstanbul 1987

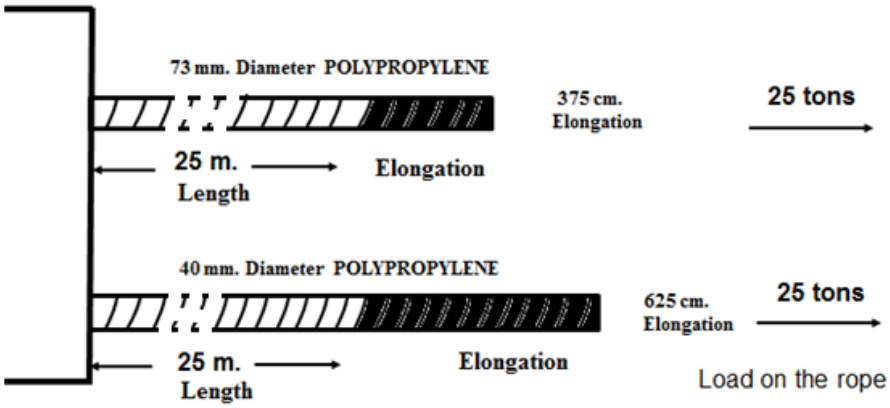


Figure 5: *Elongation values of* ***different diameter*** *polypropylene ropes under the same load* [13]

When a force of same magnitude is applied to each one of two polypropylene ropes of same thickness, the rope whose length is more shows more elongation. (Figure-6)

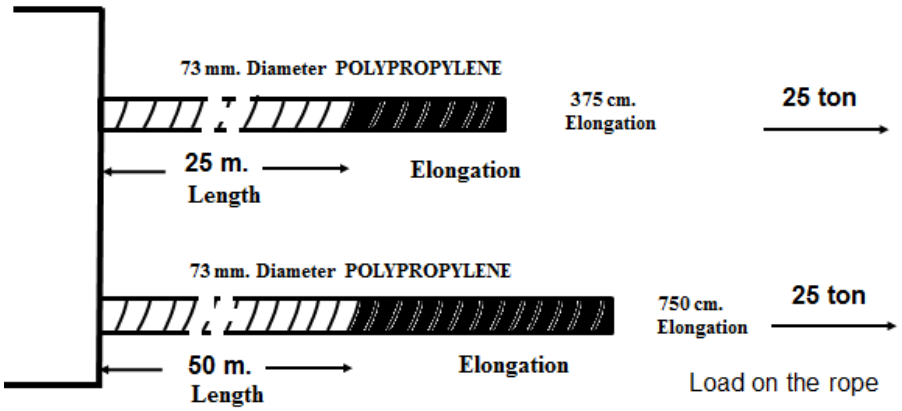


Figure 6: *Elongation values of* ***different length*** *75 mm polypropylene ropes under a load of 25 tons.*[14]

Captain of KRISTIN C expressed, based on the statement of his seaman, that the rope was broken with extraordinary sounds from the rope as a result of the tugboat's sudden and excessive pull on the trail rope. On the other hand, the tugboat's captain and personnel indicated that the rope was suddenly broken following the

[13],[14] EROL, Aykut: Navigation, İstanbul 1987

extraordinary sounds from the rope while the tugboat increased the traction gradually from slow to half speed (1000-1100 rpm) and continued the towing process while towing of the ship continued.

When the possibility that the rope was broken because of sudden and high traction as indicated in the statement of the ship's captain is evaluated; as the rope in question was generally making an angle with the ship close to 90 degrees and therefore it may be expected to break at a point in the vicinity of the hawsehole where friction is highest, but the rope was broken from a point close to the middle somewhere between the ship and tugboat. In the case of sudden pull by the tugboat (jerk) on the rope, miscellaneous sources indicate that the load applied to the rope may double the load applied by the tugboat during towing. Upon this assumption, it can be evaluated that the tugboat was realizing the towing process with half speed (15 tons), therefore the force applied to this rope by the tugboat increased approximately to 30 tons through sudden pull and when further influence of the reverse skidding force which was formed by the heaving up of starboard anchor and operation of the bow thruster of the ship was added to this force, the rope was broken. However, the fact that, despite the heaving up of starboard anchor and operation of the ship's bow thruster, breaking of trail rope occurred after the ship's aft edged 2-3 meters away from the dock shows that the tugboat applied load to the trail rope gradually. Otherwise, the rope would be expected to break just at the beginning of the towing process. Similarly, both the port employees and tugboat employees state that gradual force was applied to the rope after the slack of the rope was taken.

Physical condition of the rope and the forces applied are the primary elements which cause breaking of the rope. The most important reasons of breaking of the ropes which are used in maneuvering of the ships may be listed as the seams and ties which reduces the breaking strength of the rope, as well as, the wear of the rope and burst of strands as a result of contact of the rope with sharp and rough surfaces.

A 40 meters portion of the rope which was broken during the towing operation of the ship was used for the towing operation. As a result of the breaking of the rope, a 17.3 meters portion was left on board of the tugboat and the remaining part on board of the ship. The rope was broken approximately from the middle, but not at points where the rope was connected to the ship, near or over structures such as hawse holes and tugboat hooks and this shows that the rope did not rub to the sharp and rough surfaces which shall influence the breaking strength of the rope.

Although reports are prepared that the condition of the rope was good following the checks made in the ship concerning the rope, as observed in the photos taken on the ship just after the rope was broken, the rope is seen on the ship's drum and a burst strand is observed just beyond the breaking point. *(Picture 16)*

Picture 16: *Portion of the rope left on the ship*

In the further external physical examination of the portion of the rope left on board of the tugboat; it is observed that a strand was burst at the eye section of the rope (Picture 17, 18), there were local melting on the body surface of the rope due to the heat originating from friction (Picture 19), the fibers on the surface of yarns were ruptured depending on wear and paint residues within the strands of the rope (Picture 20). It is evaluated that the breaking strength of the rope was significantly

reduced and, due to this, the rope was broken because that the burst strands were present both at the eye and body of the rope, the body of rope exhibited in general a worn appearance and paint residuals were present in the body of the rope.

Picture 17: *A section of the rope used in the maneuver*

Picture 18: *A section of the rope used in the maneuver*

Picture 19: *The rope used in the maneuver*

Picture 20: *BODY of the broken ROPE*

2.5 Near-Miss

Rope accidents which occur in the ships and at the ports are generally notified to the accident investigation boards, but near-miss incidents are not notified. In the interviews made at the port, the employees mentioned that rope breaking incidents were experienced 1-2 times per year but until now nobody was injured.

Hundreds of unsafe conducts emerge following thousands of unsafe conditions, near-miss incidents are experienced after such conducts and accidents occur after these near-misses if still no measures are taken. In the paper of title Minimum Training and Experience for Hawser Personnel which was discussed as item 9 of the agenda of meeting 39 by Facilitation Committee of the International Maritime Organization (IMO), port industry mentioned that they had grave concerns due to near-miss cases experienced during hawser works (berthing-casting off) at the ports. In this respect, it is required to notice the near-miss incidents which are experienced at the port to the

port operator and take the necessary measures to avoid the accidents by making the necessary analysis directed to the prevention of incidents which shall result in accidents in the accident pyramid through assessment by the port administration.

PART 3 – CONCLUSIONS

The matters of safety concerning the occurrence of the accident are listed below:

3.1 As a result of the breaking of the rope which was being used in the towing operation of KRISTIN C, the hawser personnel Önal KARADUMAN who was standing at the snapback area of the rope is seriously wounded.

3.2 Ship crew could not evaluate the quality of the rope which was used for the towing operation correctly.

3.3 No procedure exists at the port or on board of the tugboat about safe rope operations.

3.4 General condition of the rope which is given by the ship was not suitable for use in the towing maneuver of the ship.

3.5 The incident in which the rope broke, snapped back and caused injury by hitting one of two adjoining hawser personnel shows that the hawser personnel employed at the port were not trained sufficiently or did not act according to their training on the subject of not being present in the snapback area of broken ropes.

PART 4 – RECOMMENDATIONS

4.1 M/V KRISTIN C Ship / Owner / Operating Firm (Carisbrooke Shipping 6250 BV / Netherlands) is recommended to;

4.1.1 Not employ worn ropes in ship maneuvers and replace them with new ones,

4.1.2 Keeping the ropes away from the chemicals such as paint which shall destroy their properties,

4.1.3 Making the checks for the evaluation of usability of the ropes on board of the ships more sensitively / carefully,

4.2 Directorate General for the Regulation of Maritime Affairs and Inland Waters is recommended to issue a notice to IMEAK and Mersin Chambers of Shipping and also to ship and port operators requiring from them to;

4.2.1 Maintain, keep and protect the ropes which are used in the ships in suitable conditions and not to use worn out ropes in ship maneuvers,

4.2.2 Train their personnel who are employed at the ports and on board ships on the subject of rope maneuvers and repeat these trainings in certain periods,

4.2.3 Require that the personnel who will work in mooring operations at ports should have been previously employed on board ships,

4.2.4 Give first aid training to the personnel employed at ports / on board ships and ensure that these personnel may apply this knowledge as required and without hesitation, considering that similar accidents can any time be experienced at the ports / on the ships ,

4.3 ASİN Tugboat Owner is recommended to;

4.3.1 When a rope is given from the ship to the tugboat, not to accept such ropes for the towing operation, which are worn out such as to reduce breaking strength, with strands burst out, melted as a result of heating originating from excessive friction and which are contaminated with chemicals,

4.4 Port Operating Company (Güllük Liman İşletmeciliği İnşaat Turizm Sanayi ve Ticaret A.Ş.) is recommended to;

4.4.1 Train all personnel, especially the hawser personnel, employed in the port on the subject of the dangers which the mooring ropes used during the approach and departure maneuvers of the ships may cause in the port area,

4.4.2 Make risk assessments against the accidents which may occur in the port, minimize the accident risks through regulative and preventive measures,

4.4.3 Develop procedures for the safe handling of hawser ropes, which are used during the approach and departure maneuvers of the ships, on board the tugboats and hawser boats,

The content of this Report shall not be used to blame or to apportion liability between the parties of the accident.

ANNEX 1

TÜRK LOYDU

BOLLARD PULL TEST CERTIFICATE

Çekme Gücü Test Sertifikası

Certificate No. *(Sertif. No)* : 13-1077-01
TL M No. : G-0474

1. Ship Particulars *(Gemi özellikleri)*

Name *Gemi İsmi*	Port of Registry *Bağlama Limanı*	Owner *Gemi Sahibi*	Shipbuilder *İnşa Tersanesi*
ASİN	İZMİR	GÜLLÜK LİMAN İŞLETMECİLİĞİ İNŞ. TUR. SAN. VE TİC. A.Ş.	-

Date of Build *İnşa Tarihi*	New Building Number *Yeni inşa No.*	Gross Tonnage *Gros Ton*	Type of Ship *Gemi Tipi*
01.01.2006	-	75.59	RÖMORKOR / TUG BOAT

Ship's dimensions *(Gemi ölçüleri)* :
- Length *(Uzunluk)* : 18.29 m.
- Breadth *(Genişlik)* : 6.7 m.
- Maximum draught *(Azami draft)* : - m.
- Displacement at maximum draught *(Azami draft da deplasman)* : - tons.
- Design Bollard Pull *(Dizayn Çekme Gücü)* - kN 30 tons.

2. Machinery particulars *(Makine özellikleri)*

2.1 **Propulsion machinery** *(Ana makineler)*
- Manufacturer *(İmalatçı)* : CATERPILLAR
- Type *(Tip)* : 3508B
- Number of units *(Makine adedi)*: 1
- Power at maximum cont. rate / shaft speed : 1100 BHP / 1940 r.p.m.
(Azami devamlı güç/şaft devir sayısı)

2.2 **Main reduction gear** *(Ana şanzıman)*: REDUCE2 **Reduction Ratio** *(Red. Oranı)* : 5/1

2.3 **Type of propeller** (Pervane tipi): KONVANSİYONEL
Number of propellers *(Pervane sayısı)*: 2 Number of blades *(Kanat sayısı)*: 4

TÜRK LOYDU

5. Test Result *(Test Sonucu)*

This is to certify that during bollard pull test carried out on 05.07.2013 **at** GÜLLÜK LİMANI **(continuous) bollard pull of** 295,05 kN - 30,08 tons **was attained.**

05.07.2013 *tarihinde* GÜLLÜK LİMANI'*da yapılan çekme gücü testi neticesinde (sürekli) çekme gücü* 295,05 kN - 30,08 ton *olarak bulunmuştur*

6. Notes:

6.1 After bollard pull test, it is not observed any deformation on bollard hook, by visual examination.(If bollard pull test has been performed by Tug's own bullard hook.)
Çekme testi sonrasında yapılan gözle muayene sonucunda, çeki kancasında herhangi bir deformasyon görülmemiştir.(Eğer çekme testi römorkörün kendi çeki kancası ile yapılmışsa)

Issued at **ISTANBUL** on **16.07.2013**

M.Burak MEZREA
Surveyor to TÜRK LOYDU

ANNEX-2

THE NUMBER OF TUGBOATS REQUIRED DEPENDING ON THE GROSS TONNAGE OF VESSELS AND TUGBOATS PULLING POWER

	Ship GRT	**Ship Type**	**The Required Numbers Of Tugboats (Minimum)**	**The Required Pulling Power (Minimum)**	**Explanation**
1	2000 – 5000	All Ships	1	16	Minimum 16 tons
2	5001 – 15000	All Ships	2	32	Minimum 16 tons for each
3	15001 – 30000	All Ships	2	60	Minimum 16 tons for each
4	30000 – 45000	All Ships	2	75	Minimum 16 tons for each
5	45000 Above	Ships not Carrying Dangerous Goods	2	90	Minimum 16 tons for each
6	45001 – 75000	LNG, Inflammable, Explosive and Chemical Tankers	3	90	Minimum 16 tons for each
7	75 000 Above	LNG, Inflammable, Explosive and Chemical Tankers	3	120	Minimum 16 tons for each
8	Each Tonnage	LNG Ships	3	150	Minimum 16 tons for each

ANNEX-3

GL Industrial Services GmbH.

Certificate No. GLIS/10/RR/179/4-10

Test Certificate

This is to certify that, at the request of **M/S.GULF MARINE & INDUSTRIAL SUPPLIES INC,** the undersigned surveyor to this society attended their Approved works, on 07.06.2010 for the purpose of inspection of the below mentioned items.

GLIS order No. : 0580-09-11023-202

Place of inspection : At Approved Works.

Materials / Items : **8 – STRANDS POLYPROPYLENE PLAITED DAN–STRONG WHITE COLOUR ROPES, (6 – FEET CANVAS COVERED EYES SPLICE AT BOTH ENDS).**

Items Inspected:

Size	No. of Coils	Coil Bale No	Length (as confirmed by manufacturer)	Minimum required Breaking Strength (in LBS)	Breaking strength of samples (in LBS)
DIA 56MM	01	8191	720 Feet	102000	103897

Inspection / Verification Performed: Selection of random samples. Witnessing Breaking Load Testing.

Identification : By Name of the Client / Size-DIA MM / Bale No. and has been hard stamped on Lead seal as " GIL ".

Results : The tes gave no reason for objection, it is confirmed that the ropes comply with the Minimum Guaranteed breaking strength requirement of **M/S. GULF MARINE & INDUSTRIAL SUPPLIES INC**

Note : Testing performed as per BS 4928-1985 & BS 5053-1985. Certificate issued based on test results of randomly drawn sample nos. **8188** from Coils Bale no.**8182 TO 8191.**

The inspection performed and certificate issued without prejudice to whomsoever it may concern.

Attending Surveyor: Mr. Pushilal

Date:
09-06-2010

RAJESH RAIKAR
For Germanischer Lloyd
Industrial Services GmbH

ORIGNAL

D S R

DSRCORP

SALES OFFICE: Woos in Bldg. 7F, 646-15, Yakama-dong, Gagman - go, Seoul, 135-911, Korea
TEL: 82-2-3420-3500, FAX: 82-2-3420-3600, E-mail: sales@dsrcorp.com. http: //www.dsrcorp.com

CERTIFICATE OF INSPECTION

Cert. No. : DMC 1243 Date : 29/10/2012

Purchaser : SPEED FOR EXPORT AND IMPORT Order No : EF2016

B/NO : 40-56 (5 COIL/EA) L/C No . : SUEZ 415/12MA

P.O. No. : ----------

ISSUING : ALEXANDRIA COMMERCIAL AND MARITIMEBANK. SUEZ BRANCH

L/C DATE : 02/10/2012

1.TYPE

Name of Rope : PP DAN ROPE
Circ. : 7"
Length : 220 MTR
Net Weight : 328 KGS
Gross Weight : 329 KGS
Color : WHITE

Construction : 8 - STRAND
Lay : MEDIUM
Twist : ----------
Specification : MILL SPEC.

2. TEST RESULTS

	Nominal or specified	Actual
Circ.	7"	7"
Breaking Strength	52.000 Kgs	54.456 kgs

Tested according to ISO standards

3. ORDER CONDITIONS

Surface Conditions..... GOOD
Workmanship ..... GOOD

4. MATERIAL

Name of Material.....POLYPROPLENE RESIN
Name of Supplier.....SK CORPORATION

DOKYOUN, KIM

QUALITY MANAGEMENT TEAM