Lesson Learned

April 2012

Parted Wire Dropped a Work Boat

The following is an edited version for distribution of a recent incident aboard a NOAA ship.

Summary of events

During the recovery of the ship's work boat with the crane, the crane hoisting wire parted, dropping the boat 12-14 feet while suspended over the water. The boat dropped into the water, clearing the side of the ship on the way down, with the sea painter and forward and aft frapping lines still attached. Minor damage was sustained to the boat from the impact of the crane's overhaul ball and hook assembly. (see figure 1) Personnel involved in the boat recovery operations were clear and sustained no injuries.❖

Background

The work boat's original delivered dry weight was 6,800 pounds including the propulsion system. The fuel capacity is 142 gallons of diesel at 100% tank capacity. The manufacturers' suggested capacity is a maximum carrying capacity of 1800 pounds, persons and cargo, not more than 8 persons. The boat was weighed a week after the incident using a calibrated load cell. The total hoisted weight was indicated at 8,134 pounds with all required equipment and 64 gallons of fuel (45% of tank capacity). This is the configuration and hoisting weight for this work boat as documented in the ships written policy.

The crane involved in the incident Certified Safe Working Load (SWL) is 8100 pounds for a radius of 25'-42' and 5000 pounds at 60' extended with 0 degree boom angle. The installed wire rope at the time of the mishap was a 5/8" diameter steel stranded core. The overhaul ball (headache ball) and hook assembly were stamped with a weight of 150 pounds. The crane is equipped with a panel view loading cell and alarm panel system with four weight limiting modes of operation. The launching and recovery is restricted to protected water only, and only when panel mode is in "Dockside Static" or "At Sea on Vessel 2.5m wave" modes as per the ships written operational procedures. Weight verification was conducted approximately a week after the incident utilizing a calibrated load cell used for scientific research and the loading alarm panel was found to be displaying the applied weight accurately within 3%.

Immediate Cause

The wire rope parted, dropping the boat. (see figures 2 and 3)

Contributing Causes

A combination of factors created the series of events leading up to the failure.

1. The crew reported that the wire rope had repeatedly jumped off the boom head sheave and become caught between the sheave and sheave block. Crew also reported the wire, when being payed in, does not always lie properly on the winch drum and tends to rat nest or cross lay. Port crane has 170 pound headache ball assembly and starboard crane assembly is 150 pounds. (see figure 4) The crane manual drawing indicates cranes were engineered and designed with a 300 pound overhaul ball (headache ball) and hook assembly (see figure 5). The headache ball and hook assembly does not have enough weight to maintain constant tension with no load attached to crane, which allows slack in the rope throughout its travel.

Figure 1 – Crane and headache ball

Figure 2 – Parted wire

Figure 3 – NOT actual boat dropped in this case.

2. During the winter 09/10 dry-dock period, new rope wires were purchased by the ships force and installed on both deck cranes. The wire rope involved in the mishap is 5/8" 19X7 IP (Improved Plow) IWRC (Independent Wire Rope Cores), Safe Working Load (SWL) of 6,720 lbs at a safety factor of 5 to 1. The original wire rope was 5/8" 6X36 XXIP (Extra Extra Improved Plow) IWRC, SWL of 9080 lbs.

3. Crane wire ropes are secured to deck pad eyes under 2,000 lbs of tension when not in use to reduce lateral movement of the crane's boom in its cradle while at sea. This was a common deck practice not documented in ship policy. Excessive tension on the wire rope while lying in the sheaves causes the wire rope to flatten, which over time reduced the wire's tensile strength. The point at which the wire parted was at the same distance from the headache ball as where it lies on the sheaves.

4. Crane cradle supports were not designed to reduce port and starboard lateral movement when the boom is resting in its cradle. Both crane boom cradles are constructed to allow for 3-5" of lateral movement when the crane is resting in its cradle, secured for sea. This lateral movement increases the dynamic tension being applied to the wire rope over and above the 2,000 lbs of tension being applied by securing the rope to the deck pad eye.

5. Post mishap inspection of the parted wire rope strands indicated an irregular fracture of the individual wires; which is caused by a combination of bending fatigue and tensile overload. (see figure 2) An abnormal bend was documented during the post mishap visual inspection of the existing wire rope on the STBD crane. This deformation occurred after the defective section of wire rope had been cut off, re-terminated and the headache ball reattached. The current deformation occurred over a one month time span. (see figure 6) Corrosion of the internal strands was documented during the inspection. Maintenance records and crew interviews indicate the parted wire rope had been greased by hand.

6. The boat was weighed a week after the incident and found to be 8,134 lbs, which exceeds the crane's 8,100 lb SWL limitation. The weight test was done with 64 gals (45%) of fuel and minimal required equipment. Crew had reported on occasions when lifting the boat that the weight limiting alarm would sound, but they would ignore the alarm indication of overloading.

7. Maintenance records indicate the crane involved in the incident had not been examined annually by a competent person from American Bureau of Shipping (ABS) or a third party inspector certified by OSHA. An initial ABS inspection and weight test was completed and a certificate of Register of Lifting Appliances was issued by the attending ABS surveyor. ABS requires an annual inspection be conducted by an ABS surveyor. Certificate was last endorsed by ABS in 2008, which included visual inspection and a 125% weight test. After 2008, the certificate was allowed to lapse and become invalid.

8. Crewmembers aboard the ship have not received formal crane and rigging training from an approved training provider. Onboard Performance Qualification Standards (PQS) are currently the only requirements to complete prior to being qualified to operate the cranes and does not require formal training for any position onboard.

Figure 4 – Headache balls (port and starboard)

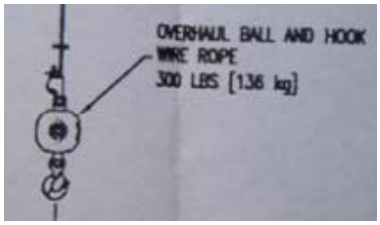

Figure 5 - Crane manual drawing

Figure 6 – Note abnormal bend in wire where stored.

Root Causes (not in any particular order)

1. Lack of Engineering Configuration Control

- The boat's routine weight (minimum fuel and equipment) is beyond the crane's SWL capacity; neither the port nor starboard cranes aboard have the ability to lift the boat within their SWL.
- Need to define and implement clear standards for installation, maintenance, inspections and certified proof testing of weight handling gear aboard NOAA ships.
- The lack of lateral support on the cradle structure added to excessive tension applied during routine storage of crane.

2. Failure of SOP/Safe Working Practices

- Applying 2,000 lbs of tension to the crane's wire rope when made ready for sea contributed to flattening and deformation of the wire.
- Technical manuals and manufacturers recommendations were not consulted and strictly adhered to when replacing weight handling gear.

3. Failure of Safety Management System

- A system was not in place to ensure that key personnel who write procedures and supervise operations had sufficient knowledge of the operation. It was not clearly demonstrated that all personnel were aware of and familiar with procedures published by OMAO, including 1102-12, Crane Operation.

4. Lack of Maintenance Standards

- The headache ball was changed out by past crewmembers without referring to the manufacturer's technical manual.
- The existing crane's wire rope (SWL of 6,720 lbs) installed during the winter 09/10 dry-dock period was rated well below the 8,100 lbs SWL limit posted on the crane and listed in the manufacturer's technical manual.
- Cranes, davits, winches, and associated equipment on board are no longer being maintained to industry standard (since 2008) and are not being inspected to ABS or OSHA standards by a certified inspector.
- SAMMs lacks procedures for maintenance and care of all steel wire ropes. Power slushing is a sound marine engineering practice and standard used throughout the military, marine, and construction industries to reduce corrosion of the ropes internal stranded cores and is not currently being utilized.

5. Lack of ongoing Risk Management

- Crewmembers repeatedly ignored the weight limiting alarm on the davit as it was indicating an overloading condition when lifting the boat.
- Failure to update and reassess risks did not include controls to identify hazards associated with the all aspects of the operation.

6. Lack of Training

- Crewmembers have not had professional crane and rigging training to educate them in maintaining the lifting equipment or conducting proper annual and daily inspections.
- Department training did not contain critical safety controls for all hazards and risks associated with the operation and associated equipment.
- A training system was not in place to ensure that all employees associated with the operation received adequate training and proficiency to conduct the operation and to do inspections or tests on the lifting equipment.

7. Lack of Safety Culture

- Comments from crew later included, "This was an accident waiting to happen and everyone on board was aware of it." Officers and crewmembers knew that this boat was over the Safe Working Load of the crane, but continued to operate, based on precedence set by previous commands.
- Despite repeated requests, funding was not found to address this issue. Lacking support for requested upgrades, the improper practice of launching and recovering a boat that was over the SWL continued.
- Junior employees may not have felt comfortable questioning more senior employees about what they perceived to be a risky operation, and therefore may not have spoken up to stop unsafe acts/conditions. All personnel need to be reminded that how they respond to comments can open or close lines of communication that could save their lives someday.

Safety is everyone's responsibility. Listen to that "little voice" that says something isn't right, and if you're not sure, ask for direction or clarification

The best ideas for improving safety come from the fleet.

Got an idea to help prevent injuries?

Please send any suggestions and we will share it with the fleet. MOC.Fleet.Accidents@noaa.gov