THE CRANE CORNER

Navy Crane Center Technical Bulletin

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A WORD FROM TOPSIDE

Sam Bevins

Most crane accidents are the result of human error and the most commonly cited cause is inattention. As the summer months approach, safe weight handling equipment operations become more challenging as the many distractions associated with the vacation season, graduations, sporting events, and increased outdoor activity compete with attention to the critical job at hand.

Operational Risk Management 5-Step Process

- Identify Hazards
- Assess Hazards
- Make Risk Decisions
- Implement Controls
- Supervise (Watch for Changes)

There are a number of actions that can be taken to combat inattention. Embracing and practicing operational risk management (ORM) helps the crane team to focus in advance on the risks associated with each weight handling operation and take the appropriate precautions to ensure a safe lift.

For all operations, but for mobile crane operations in particular, ORM needs to be practiced even when there is no load on the hook. Interactive crane team briefings will help ensure each member of the crane team knows the lift plan and their individual responsibilities. Effective teammates look out for all members of the team. They take the time to be safe and stop operations when something is amiss. Surveillances by experienced operation and rigging personnel help identify potential unsafe practices. Activities should also include surveillances of shop operations, where cranes are often operated by personnel who may not be involved in crane operations as frequently as dedicated operators who operate cranes on the waterfront. Lessons learned from surveillances should be shared with all hands. Management should consider preemptive safety awareness briefings to ensure the crane team is aware of management's expectations and commitment to weight handling safety. Crane safety videos distributed by the Navy Crane Center are good starting points for further discussion on weight handling safety awareness. As personnel return from vacation or extended leave, supervisors must re-focus them to the necessity of safe weight handling operations.

Management also needs to ensure all weight handling personnel are aware of our encompassing definition of a weight handling equipment accident and know to report them when they occur. Our philosophy of reporting, and learning from, the small accidents has proven very successful in preventing more serious accidents from happening. In fact, for the first half of FY05, there has been only one weight handling accident that has met the OPNAV mishap classification thresholds.

Inside This Issue

Once more, I ask everyone involved in weight handling to intensify your efforts toward making FY05 the safest year on record for the Navy's weight handling program. Each accident diminishes support to the fleet. A safe and reliable Navy weight handling program is essential for fleet readiness.

HAVE YOU HEARD ABOUT?

Crane runway and bridge electrification is available in the form of rigid insulating housing enclosing up to eight copper conductors. This compact arrangement uses a minimum of space and provides automatic alignment of conductors and collector shoes on the collector head. (Figure 1 shows a cross-section of the housing and conductors.) The housing sections are offered in straight or curved segments up to 4.0 meters in length. The housing has a polarizing profile to preclude inadvertent backward installation of the collector head and reversal of phases. The conductors may be continuous or segmented with plug-in or bolted joints. Current ratings are 200 amperes for the continuous and bolted conductors, and 100 amperes for the plug-in type. Power feed sets are factory assembled as 1.0 meter in-line segments or end feeds. Open ends are protected by end caps, and segment connections are made with insulated joint caps.

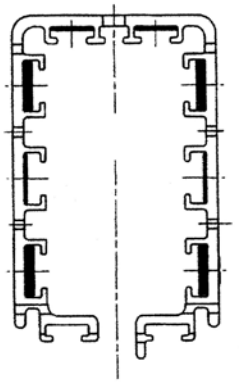

FIGURE 1 - Cross-section of the housing and conductors.

Special segments designed to accommodate particular operating conditions are also available. These include:

- Flexible sealing strips that open and close as the collector head is towed along the housing;
- Telescopic segments for length compensation due to temperature variation;
- Entry / Exit and transfer segments for interconnections between runways and bridges;
- Turntable and switch segments for routing among sections of monorail tracks;
- Heated segments for prevention of condensation and freezing at interface between indoor and outdoor sections of the electrification.

The collector shoes are spring-loaded, and may be doubled-up when required. Fixed-point hangers are provided to anchor the housing and sliding hangars are installed to allow longitudinal movement of the housing, when required. The manufacturer also provides electrical terminal boxes and hinged or flexible towing arms for the collector head. All mounting hardware, including the fixed point and sliding hangers, is stainless steel. (Figure 2 depicts a typical installation and collector head inside the housing.)

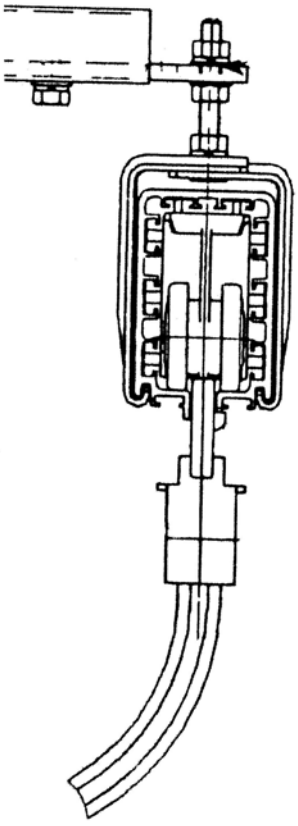

FIGURE 2 - Typical installation and collector head inside housing.

SHARE YOUR SUCCESS

We are always in need of articles from the field. Please share your sea stories with our editor, (610) 595-0905, fax (610) 595-0748, or e-mail m_lstr_ncc_ccorn@navy.mil.

CRANE SAFETY ADVISORIES AND EQUIPMENT DEFICIENCY MEMORANDA

We receive reports of equipment deficiencies, component failures, crane accidents, and other potentially unsafe conditions and practices. When applicable to other activities, we issue a Crane Safety Advisory (CSA) or an Equipment Deficiency Memorandum (EDM). A CSA is a directive and often requires feedback from the activities receiving the advisory. An EDM is provided for information and can include deficiencies to non-load bearing or non-load controlling parts.

CRANE SAFETY ADVISORIES

CSA-146: Westmont 60-Ton Portal Crane Load Bank Wiring Deficiency. An activity reported shorted main power wiring to the three-phase load bank on a Westmont 60-ton portal crane. The shorted wiring led to localized damage to the conduit and wiring resulting in a tripped circuit breaker. Subsequent investigation revealed incorrect wiring (not per plan) was used and the wiring's insulation was found chafed inside the conduit, exposing the conductors, which caused the wires to short against the metal conduit. This condition was most likely caused during initial installation.

Inspect the main power wiring in the load bank circuits of all Westmont 60-ton portal cranes. If the wiring is not per Westmont Drawing (AP) AC/Power Conduit Cable List El1062, then the load bank shall be isolated by opening and tagging the circuit breaker in accordance with shipyard procedures. A naval shipyard has performed testing and concluded the load bank is unneeded and may be disconnected and removed in its entirety. No realistic operational situation exists that requires utilization of the load bank. If the wiring is in accordance with Westmont Drawing (AP) AC/Power Conduit Cable List El1062, leave the load bank in operation or isolate it out.

CSA-147: Riverhawk Company Model HET-1288 and HET-2193 Hydraulic Fastener Tensioner Failures. Two of a total of four supplied hydraulic tensioners failed during rotate bearing fastener tensioning operations on the Samsung Heavy Industries (SHI) portal cranes. SHI supplied two Riverhawk Co. model HET-1288 units and two Riverhawk Co. model HET-2193 units, and one of each model failed. Both failures were similar, occurring in the threaded portion of the puller screw. The puller screw is threaded to the fastener to be tensioned. The puller screw separated into two pieces with little yielding. Upon puller screw failure, the hydraulic tensioner may experience uncontrolled movement, if not secured, due to the high hydraulic pressure within the puller assembly. Target hydraulic pressure is 12,000 to 14,950 psi. Uncontrolled movement of the puller assembly can be dangerous.

Unless secured to prevent uncontrolled movement upon failure of the puller screw by a means approved by local shipyard technical division, all Riverhawk Co. model HET-1288 and HET-1296 hydraulic tensioners shall be removed from service until further notice. CSA-137, Samsung Portal Cranes Rotate Bearing Mounting Fastener Tension Checks, tensioning checks may be accomplished using the Bolt Mike III ultrasonic measurement equipment. Bolt Mike III equipment and reference data were supplied via the SHI portal crane contract. Alternate methods of checking and tightening the rotate bearing fasteners may be used, provided local shipyard technical division approval is obtained. The Navy Crane Center will review on a case-by-case basis requests for waivers or deferrals of rotate bearing fastener tension checks submitted via a Request for Clarification, Deviation, or Revision, NAVFAC P-307 figure 1-1.

EQUIPMENT DEFICIENCY MEMORANDA

EDM-077: Possible Weld Failure in Shepard Niles Series 50 Brake Adjustment Shaft. Welds may have failed in the brake wheel assembly on Shepard Niles series 50 brakes. The brake wheel is threaded and welded onto the air gap adjustment shaft that extends outside the brake housing. The weld only prevents the threaded shaft from turning during brake adjustments and is not load bearing. An activity discovered during brake disassembly that this weld had failed and was of poor quality. The replacement part was inspected and the weld was of much higher quality. The series 50 brake is the same design as the series 150 and 350 brakes.

It is highly unlikely that failure of this weld will cause the threaded shaft to back itself off the brake wheel due to the frictional forces imposed by several threaded assemblies and normal operation does not impose a torque on the shaft. Normal operation forces the threaded shaft to push (engages the brake) and pull (disengages the brake) on the brake wheel through the threaded connection. If the weld were to fail, there could be some movement of the threaded shaft during brake adjustments or an increase in the air gap. The threaded shaft would need to back off approximately 9/16 inch to completely disengage from the brake wheel, which would be measured from the increasing air gap measurement point. The OEM's air gap tolerance is 1/64 inch to 1/16 inch.

During the next inspection period of Shepard Niles series 50, 150, and 350 brakes, activities should pay particular attention to the threaded shaft during air gap adjustments. Movement of the threaded shaft during brake adjustments, manual brake release, or an increase in the air gap measurement compared to previous measurements may indicate that the weld has failed and closer inspection and disassembly is warranted.

EDM-078: Failed Bracket on a 1998 Grove TMS875 Outer Mid Section Boom. An activity reported that the support bracket that the hydraulic manifold (Grove part number 662000037) is mounted to failed, causing the telescoping cylinder hydraulic lines to part while extending the boom. The bracket failed at the weld where it is attached to the outer mid-section frame. The cause for failure is unknown.

The OEM identified Grove models RT880, RT890, RT990, and RT9100 as other models that utilize a similar bracket. The OEM has reported that no other failures of this type have occurred on other TMS875 units or the other models utilizing a similar bracket.

The bracket can be inspected for damage, distortion, or cracked welds without boom disassembly. Activities that use the Grove model cranes identified above should ensure that the manifold bracket is inspected during annual inspection. Questionable conditions should be referred to the activity engineering organization or the OEM for resolution.

EDM-079: Dillon Dynamometer Discrepancies. An activity recently reported three Dillon dynamometer discrepancies. The first discrepancy reported that a Dillon 5,000-pound capacity Prolift model dynamometer (10-inch face) was not tracking with the load when all the slack was taken out of the rigging. Preliminary investigation found that the #6-32UNC screws that secure the dial case assembly to the housing were loose, causing contact between the dial inlay and the load indicator pointer. This contact prevented the pointer from rotating correctly.

The second discrepancy reported that a Dillon 10,000-pound capacity AP model dynamometer (5-inch face) had a dial inlay with enough movement to allow contact between the dial inlay and the hub portion of the load indicator pointer. The #6-32UNC screws that secured the dial inlay to the gauge movement assembly were loose, allowing movement of the dial inlay. These screws are not normally disturbed during servicing or calibration.

The activity performed subsequent investigations of similar Dillon AP and Prolift model dynamometers by manipulating the dial inlay with respect to the load indicator pointer and could not duplicate the discrepancies.

The third discrepancy reported that the OEM's service manuals for Dillon AP and Prolift model dynamometers specify an incorrect torque specification of 78 inch-pounds for #6-32UNC screws. The OEM has stated that the #6-32UNC screws are tightened to 10-12 inch-pounds and that the tabulated value in the OEM service manuals for the AP and Prolift model dynamometers would be changed to reflect the proper torque value. The OEM confirmed that the other torque specifications tabulated in the OEM service manuals for the AP and Prolift model dynamometers are correct.

Activities that utilize Dillon AP and Prolift model dynamometers should review servicing/calibration procedures to ensure that adequate assembly instructions are provided. Instructions should include checks for proper operation of the load indicator pointer (ensure that no interference between the dial inlay and the pointer exists) and proper tightening of fasteners (ensure that the #6-32UNC screws are tightened to 10-12 inch-pounds torque). Questionable conditions should be referred to the activity engineering organization or the OEM for resolution.

EDM-080: Pallet Bar Failure. A pallet bar was manufactured from AISI 1018 schedule 80 steel pipe with the opening pressed shut and re-enforcement eyes welded around the lifting holes. Two such pallet bars were hanging from a crane hook about to be used when they came into contact with each other and one failed at the start of the crimped area. Approximately 60 percent of the fracture edge was corroded indicating that the crack had been present for some time. There were no records of a manufacturer for the pallet bars and it is surmised that they were manufactured by the activity.

It is important to visually check all rigging gear before each lift and annually as required by the NAVFAC P-307 paragraphs 14.4.2 and 14.4.3 respectively. Areas of stress concentrations such as bends, changes in radius or thickness, or holes are especially prone to crack initiation. During pre-use inspections, pay special attention to these areas. If any defects are discovered, the piece of rigging gear should be immediately taken out of service and sent to a qualified engineer for analysis.

SECOND QUARTER FY05 ACCIDENT REPORT

The Navy Crane Center disseminates crane accident lessons learned to prevent repeat accidents and improve overall crane safety. NAVFAC P-307 requires commands to submit to the Navy Crane Center a final, complete accident report (including corrective/preventive actions) within 30 days of an accident, regardless of severity or type. This reporting requirement includes rigging gear accidents, i.e., gear covered by section 14 of NAVFAC P-307 used by itself in a weight handling operation. In addition, contracting officers are required to forward to the Navy Crane Center and the host activity reports of all contractor accidents including contractor caused accidents with Navy-owned cranes.

For the second quarter of FY05, 36 Navy weight handling equipment (WHE) accidents (30 crane accidents and 6 rigging accidents) plus 3 contractor crane accidents were reported. Significant Navy accidents this quarter included 2 injuries, 2 dropped loads, 2 overloads, and 1 two-blocking.

INJURIES

Accident: While a Herculite canopy was being lifted, one of the canopy support rings fell, striking a worker on the hand. The canopy has upper and lower aluminum support rings that are used to maintain the canopy's shape. Investigation revealed a design flaw with the Velcro fasteners used to retain the support rings. Failure of these fasteners has occurred in the past. Management has requested a redesign of the fasteners.
Lessons Learned: Equipment deficiencies should be fully evaluated and remediated to ensure they do not recur.

Accident: A mechanic injured a finger when the crane supporting an engine was accidentally lowered. A monorail crane had been used to support a jet engine mounted in an H-3 helicopter to facilitate replacement of an engine mount. The crane operator placed the crane controller down on the engine access panel while he assisted the mechanic in moving the engine. While the mechanic's hands were between the engine and the engine mount, the crane operator moved his foot, accidentally hitting the controls, lowering the engine, and pinching the mechanic's finger.

Lessons Learned: Crane operators must stay alert and remain at the crane controls whenever a load is suspended. Personnel must look for alternate procedures to minimize placing body parts under suspended loads.

DROPPED LOADS

Accident: A ship's brow was dropped when two of the four lifting eyes failed. The lifting eyes are at the ends of the 70-foot long brow. Four short slings were attached to the lifting eyes because of the close area where the brow had to be placed. This configuration caused the lifting eyes to be loaded at a severe angle. Over time, the continuous use in this configuration overloaded the eyes to the point of failure.
Lessons Learned: The short slings placed significant horizontal loading on the lifting eyes. Per NAVFAC P-307, paragraph 14.7, slings shall not be used at angles of less than 30 degrees from horizontal, unless specifically authorized by an engineering work document.

Accident: A fire pump rotor was dropped when the wrong lifting fixture was used. After shop personnel realized they had assembled the rotor incorrectly, they decided to remove the rotor with its end caps and bearings attached as a unit to save time. Not knowing the weight as a unit, they got a lifting fixture normally used for larger rotor assemblies. This fixture did not properly grip the assembly and as it was lifted, it slipped out of the fixture and dropped onto a pallet. Not recognizing this as an accident, they continued their evolution by disassembling the unit and lifting each part separately. When another person in the shop heard the noise and found out what happened, he informed the shop personnel that it was a crane accident.
Lessons Learned: When involved in weight handling operations, personnel should not take short cuts or make guesses as to the appropriate equipment to use. Management must ensure that personnel perform "as trained" to follow proper procedures, including the steps to take when an accident occurs. As in all accidents, no time was saved.

OVERLOADS

Accident: While repairing a pipe bending machine, a mechanic overloaded a nylon sling, causing it to part. To facilitate repairs, the mechanic needed to lift a hydraulic ram to remove the part that required repair. The mechanic borrowed a nylon sling from a machine operator, who asked the mechanic if he had a crane license. The mechanic replied "yes." (During the investigation, it was found that the mechanic was unlicensed.) The mechanic then rigged the ram with the nylon sling in a basket hitch. While lifting the ram, it came in contact with another part, producing a binding condition, which caused excessive loading and failure of the nylon sling. The mechanic then moved the crane and placed the damaged sling in a nearby cart disturbing the accident scene. The machine operator reported the accident.
Lessons Learned: Management must ensure that personnel are held accountable for unauthorized acts.

Accident: While attempting to lift a plug assembly on a submarine, the lifting eyes on the plug were overloaded. Procedures for removal of the plug required the securing stud to be loosened until vertical movement of the stud was achieved. However, the procedure did not indicate how much vertical movement was expected. After the mechanic loosened the stud, the rigger attached 5/8-inch nylon rope lashing to the lifting eyes and then attached the nylon rope to wire rope slings on the crane. The crane operator was signaled to bump up the hoist to remove slack from the rigging gear. At this time, the rigger noticed movement of the plug and signaled the operator to bump up the hoist again. While the rigger was checking the rigging gear, he noticed one of the lifting eyes was bent open. The center stud had not been fully disconnected.
Lessons Learned: Management must ensure that procedures utilized to provide technical instructions and information are accurate and complete for the task.

TWO-BLOCKING

Accident: A mobile crane auxiliary hoist was two-blocked while preparing to travel the crane. The operator was lowering the boom at maximum speed and mistakenly raised the auxiliary hoist instead of the main hoist at maximum speed while communicating via radio. The crane was in travel mode and the limit switches were by-passed.
Lessons Learned: Operators must remain focused at all times and operate at speeds where they remain in full control of the operation. Simultaneous operation of two or more functions at maximum speed greatly increases the risk of an accident. Special attention must be given whenever mobile crane safety devices are by-passed for traveling or reconfiguring the crane.

SIGNIFICANT RIGGING GEAR ACCIDENTS

Accident: A shaft seal housing was dropped when a 3-ton chain hoist failed. During the investigation, it was determined that the load chain of the chain hoist had become twisted as a result of the lower load hook passing through the 2-part load chain while not in use. Pre-existing damage and or missing load chain guides allowed this twist in the load chain to pass through the guide onto the load chain sheave. This condition did not allow proper engagement of the load chain to the cogs in the load chain sheave. The vibrations encountered while moving the load caused the remaining load chain links, which were partially engaged, to disengage from the load chain sheave, allowing the load chain to slip through the sheave and drop the load. It was also noted that the side plates of the chain hoist were spread, which reduced the effectiveness of the load chain guides, causing them to shift. This condition probably occurred as a result of a previous two-blocking of the lower load hook. A pre-use inspection of the chain hoist was not performed, which would have identified the defective hoist.
Lessons Learned: A visual inspection for equipment condition is required prior to each use of portable hoists.

SIGNIFICANT CONTRACTOR CRANE ACCIDENT

Accident: A contractor overloaded a mobile crane while attempting to reposition a camel between a service barge and a ship. A contractor, who was working on another project, was asked by Navy personnel to reposition a camel that had moved with the outgoing tide. This request was outside the scope of work of the contract. The contractor agreed to make the lift if he could get help with the rigging. A Navy rigger supervisor and a shop mechanic assisted. After attaching a sling from the camel to the crane's whip hoist, the shop mechanic remained on the camel. The rigger supervisor then signaled the contractor to hoist to remove the slack from the rigging gear and drag the camel back into position. When the contractor and rigger supervisor realized that the speed of the outgoing tide and the weight of the camel was inducing a side load on the crane, they stopped the evolution.
Lessons Learned: Unauthorized personnel must not solicit assistance from contractors. Personnel must not place themselves on loads about to be lifted. Cranes must be used for lifting loads vertically and not for dragging loads. Management must ensure that assigned personnel perform "as trained" and are held accountable when they do not.

Weight handling program managers and safety officials are encouraged to consider the potential risk of accidents occurring at your activity similar to those highlighted above and apply the lessons learned to prevent similar accidents. OPNAVINST 3500.39, Operational Risk Management, prescribes methods for assessing hazardous operations, which should be used in the planning and preparation of all WHE lifts.

E-mail submission (m_lstr_ncc_safe@navy.mil) of reports of accidents, unplanned occurrences, and near misses is encouraged. The reports must include a complete and concise situation description, recommended corrective and preventive actions, probable cause and contributing factors, and an assessment of damage. For equipment malfunction or failure, include a specific description of the component and the resulting effect or problem caused by malfunction or failure.

NAVFAC P-307 CHANGE 4

The biennial load test program referenced in paragraph 3.4.1 currently applies to category 3 cranes. Historical data provided by various activities for category 2 cranes indicates that these cranes should be included in the biennial load test program.

Paragraph 3.4.1 was revised as follows: "Annual Certification. The certification is valid for one year from the date of signature of the certifying official. A crane shall not be used in service without a valid certification. The certification process shall include a condition inspection and appropriate tests. For category 1 and 4 cranes, the annual tests shall include a load test. Category 2 and 3 cranes shall be inspected, operationally tested (without load), and certified annually, however, a load test shall be performed at every second annual certification, as a minimum. The certification shall so indicate when a crane is in the biennial load test program. For floating cranes (including mobile cranes mounted on barges), as a condition for certification, the barge shall be determined fit for further service as evidenced by a current material inspection report and documentation of a current depot availability or an approved deferral of depot availability as required by OPNAVINST 4780.6.

Weight Handling Program Films

Accident Prevention, seven crane accident prevention lessons learned videos are available to assist activities in raising the level of safety awareness among their personnel involved in weight handling operations. The target audience for these videos is crane operations and rigging personnel and their supervisors. These videos provide a very useful mechanism for emphasizing the impact that the human element can have on safe weight handling operations. Send requests to m_lstr_ncc_ccorn@navy.mil for these videos.

Weight Handling Program for Commanding Officers provides an executive summary of the salient program requirements and critical command responsibilities associated with shore activity weight handling programs. The video covers NAVFAC P-307 requirements and activity responsibilities. The video is available at http://dodimagery.afis.osd.mil/ (DAVIS/DITIS) (PIN 806467) in VHS, CD-ROM, and DVD.

Load Testing Mobile Cranes at Naval Shore Activities provides load test personnel guidance on properly testing mobile cranes per NAVFAC P-307. The video is available at http://dodimagery.afis.osd.mil/ (DAVIS/DITIS) (PIN 806634) in VHS, CD-ROM, and DVD.

Mobile Crane Safety covers seven topics: laying a foundation for safety, teamwork, crane setup, understanding crane capacities, rigging considerations, safe operating procedures, and traveling and securing mobile cranes. The video is available at http://dodimagery.afis.osd.mil/ (DAVIS/DITIS) (PIN 806721) in VHS, CD-ROM, and DVD.

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