# THE CRANE CORNER

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*Navy Crane Center Technical Bulletin*

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**Inside this issue:**



## A WORD FROM TOPSIDE

*Tim Blanton*

A Navy activity with a very large and busy weight handling program (by the way, there are more than 450 shore activities with weight handling programs around the world) recently addressed the NAVFAC P-307 requirement for a Monitor (Observation) program to their workforce. They stated:

"NAVFAC P-307 requires us to have a monitor program that captures deficiencies, poor work practices, improvements, etc., that affect efficient lifting and handling work. This data collection allows us to identify and resolve trending issues at a lower-level. The idea is that if we resolve lower level issues as we see them, we can prevent larger scale issues from occurring."

While the activity is correct in their reading of the requirement, I personally view this requirement as much broader. I believe the Navy's weight handling program is staffed with the highest level of professionals. Professionals who have the desire to continuously improve on each element of each job every day. Whether you are a crane operator, rigger, equipment mechanic, electrician, crane walker, supervisor, manager, engineer, etc., I believe you strive each and every day to improve your support to the Navy's weight handling program. Think about it in this manner, yes a monitor program is a requirement; however, more importantly, it is a method or tool that allows you, your activity, command, SYSCOM, and ultimately the Navy to identify minor issues prior to those issues developing into a significant problem, a problem that, left unmitigated, could ultimately cause delays in returning an aircraft back on-line, a ship back to sea, or a facility/system back in service. Yes, it is a requirement, but as a professional, you understand it also provides you an opportunity to personally improve your activity's weight handling program. The monitor program provides activities with the opportunity to have a rapid process to learn and share what they have learned with others. As we share the monitor program's lessons learned, we can avoid costly mistakes and score a win for the Navy. Over time, these lessons learned should be reviewed for trends, and in turn these trends should be acted upon to improve training, work instructions, and oversight/supervision plans across the Navy.

The activity that I quoted before goes on to state:

"The number of entries is to be proportionate to the work performed. Our activity ensures we meet/exceed the requirement by having supervisors and general foremen complete, at a minimum, one observation per week." The concept of mandating a minimum number of monitor program observations has always bothered me. I believe as a professional you care about your work and desire to make improvements every day.

I also believe you understand how important your work is to the Navy and the Warfighter. The monitor program allows us to focus on continuous improvement in weight handling, which contributes in large part to the overall mission of keeping our fleet ready to fight. So I struggle with why anyone would have to mandate a minimum number of observations (one observation per week is a very low expectation for the activity quoted, where deficiencies are bound to occur frequently throughout the course of the week while executing weight handling work). Our work in weight handling is for the most part very complex and we are human and make errors. The monitor program can be a very effective process in ensuring those errors remain minor, that we stop for just a second to "Find, Fix, Document, and Trend." I would expect that the monitor process would be overflowing with issues and lessons learned to improve every aspect of our weight handling program. As a newly introduced concept, there is likely a lack of understanding of the value of the monitor program. It may be viewed purely as a requirement versus an opportunity for us to identify and make improvements to our daily tasks, as well as improve the efficiency of our support to the Navy. Therefore, the rationale behind this article!

In developing this article, I shared it with a couple of Navy Crane Center personnel to obtain their feedback. I was reminded that as Navy Crane Center has stated many times, both officially and informally, that NAVFAC P-307 contains the minimum requirements for a Navy shore based weight handling program to be in compliance and considered to be performing satisfactorily. Focusing on the "requirement" aspect of a function, as opposed to its perceived and actualized benefits, sets a standard for the program to maintain the "status quo" and focus on mitigating non-compliances. Section 2, "Program Management," was added to NAVFAC P-307 not with the sole expectation to enact another requirement for activities to remain in compliance, but to evolve weight handling programs with a focus on spurring continuous improvement. Utilization of such time proven methods as the monitor program, internal audits, and metrics to self-identify and correct deficiencies and poor practices have shown substantial effect in improving overall performance and minimizing fluctuations in performance levels. The true value in implementing these program management "requirements" is for high performing activities to accelerate the rate of improvement with a focus on continually striving for excellence, and further improving performance from the level of what is considered minimally satisfactory. I would not expect any Navy weight handling program to be striving to be minimally satisfactory, but be striving to be part of a program, our Navy's weight handling program, that other programs note for their ability to truly continuously improve with each and every task we accomplish in support of the Navy.

Each of us contributes to the success of the Navy's weight handling program team. We have the honor to support the greatest Navy the world has ever seen, and through your efforts, we will continue to remain ahead of all who strive to make our Navy second rate.

## ASBESTOS IN CRANE EQUIPMENT

***T***wo activities reported finding asbestos in the friction material of several hoist brakes. In all cases, the hoists and brakes predate Navy regulation of asbestos. Navy Crane Center policy directs activities to procure weight handling equipment free of asbestos containing materials in accordance with OPNAVINST 5100.23G. OPNAVINST 5100.23G, "Navy Safety and Occupational Health Program Manual" provides policy and guidance regarding control or elimination of asbestos containing materials that supplement Department of Labor standards. Per OPNAVINST 5100.23G, Section 1702: Navy policy is to eliminate asbestos hazards by substitution with asbestos free material or, where this is not possible, through the use of engineering, administrative controls and respiratory protection. Do not remove installed asbestos containing material, which are in good condition, for the sole purpose of eliminating asbestos. For existing equipment, material tests may be performed to determine the asbestos content level of the material. Local activity safety offices have procedures for handling these materials. If brake components or other equipment containing asbestos need to be replaced, activities are reminded to follow the NAFAC P-307 requirements for determination of replacement parts in section 6.4.2.

Warning: replacement parts for older equipment may come from storage and predate industry removal of asbestos containing equipment, replacement parts containing asbestos should not be installed.

Historical notes:

- Environmental Protection Agency (EPA) banned asbestos in 1991.
- US Supreme Court overturns the ban that affects existing products in 1993. The ban on new asbestos containing materials products remains in place.
- EPA issues updated rules in 1995. The rules regulate the use of existing asbestos containing materials products.
- MIL HDBK 1038, 3 March 1998, prohibits asbestos in brake material and conductors in new crane procurements. This requirement remains in Navy Crane Center design requirement documents up to and including the current NAVCRANECENINST 11405.2.

## TIP OF THE SPEAR
## SECOND QUARTER FY18 EVALUATION SUMMARY

Of the 47 activity weight handling programs evaluated in the second quarter, 45 were fully satisfactory and 2 were marginally satisfactory. Monitor (observation) program issues continued to dominate evaluation items. Although most of these activities have instituted monitor programs (10 have not), many are finding and documenting very few deficiencies and even fewer tangible deficiencies, i.e., those that if left uncorrected could result in a crane or rigging accident. In addition, numerous activities that perform maintenance, inspection, and load testing were not including those functions in their monitor programs. The second most common item was unsafe crane and rigging operations observed by the evaluation teams. Activities need to review the types of unsafe practices noted below and start self-identifying and documenting, and correcting, similar practices.

**SUMMARY OF PROGRAMS EVALUATED**
47 Navy WHE programs were evaluated, with 45 being fully satisfactory and 2 being marginally satisfactory.

**SATISFACTORY CRANES**
44 of 48 cranes were satisfactory (92%).

Reasons for Unsatisfactory Cranes.
Secondary limit switch not properly tested (2 cranes).
Load moment indicator out of tolerance.
Mechanical load brake not properly tested.

**EVALUATION ITEMS**

Common Evaluation Items (five or more items):

- Lack of monitor program or established program that needs improvement or does not cover all program elements – 39 items.

- Various unsafe crane and rigging operations observed by the evaluation team (side loading, unattended load, standing/walking beneath the load, operating without signals, poor signaling, pinch points, slings bunched in hooks, load not balanced, no synthetic sling protection, brakes not checked at start of lift, side loading of shackles, trackwalker out of position, swivel hoist rings not torqued, trolley racked to one side, etc.) – 20 items.

- Inspection and certification documentation errors – 18 items.

- Operator's Daily Check Lists/Operator's Monthly Check Lists (ODCLs/OMCLs) and simulated lifts performed incorrectly or not performed - 13 items.

- Operators/riggers/inspectors/test directors lacked essential knowledge (recognizing crane accidents, complex lifts, knowing the weight of the load, how to connect special equipment, etc.) – 13 items.

- Lack of (or low number of) lower order crane or rigging accident and near-miss reports – 10 items.

- Poor maintenance planning and/or execution (parts not tagged/bagged, hazardous materials not properly stored, work documents not available, lubrication not per schedule, lack of long-range maintenance schedule, components not reassembled properly, activity deficient in structural bolt installation, missing screws) – 10 items.

- Local WH instruction/SOPs non-existent or inadequate – 10 items.

- Unrecognized/unreported accidents or near misses (including damaged gear not investigated for cause) – 9 items.

- Training issues, including contractor personnel (training not taken, training weak or not effective, refresher training not taken or not taken within three months of license renewal, lack of inspector training, instructor not authorized by NCC, locally required training not taken, training course score less than 80 percent, non-Navy eLearning (NEL) certificates) – 9 items.

- Cranes/rigging gear/crane structures/other section 14 equipment not in the program or lack documentation – 7 items.

- Crane improperly stowed/secured (hook block in, or too close to, upper limit switch or stowed in path of traffic, machines, etc., power not secured, stowed with gear left on hook and the hook latching mechanism not secured) – 6 items.

- Rigging gear, containers, brows, test weights, etc., not marked properly or marking not understood by riggers (including illegible marking, mismatched components, SPS vs GPS, pin diameter not marked on alternate yarn roundslings) – 6 items.

- ODCL/OMCL documentation deficiencies (including incorrect form used and pre-completed forms) – 6 items.

- Expired or non-program gear in use or not segregated from in-service gear – 6 items.

- Designation issues (no designation, performance examiner designation not specific, designee not qualified, NAVFAC P-307 not referenced) – 6 items.

- Lack of leading metrics/metrics not being properly analyzed – 5 items.

- Operator license/file discrepancies (no Objective Quality Evidence (OQE) of performance exam, examiner not licensed, no OQE of safety course, no OQE of operation to waive performance test, course not signed by examiner, course improperly graded, corrective lenses not noted, course not graded, licensed for more than 2 years, license not in possession of operator, operating with expired license/training, operating with no license) – 5 items.

- Electrical disconnect issues (not lockable in open position, access blocked, unprotected exposure to live circuits, did not have required minimum clearance, disconnect switch operated without proper PPE, not identified to equipment, panel not labeled with its voltage) – 5 items.

## SUMMARY OF WEIGHT HANDLING EQUIPMENT ACCIDENTS FIRST QUARTER FY18

The purpose of this article is to disseminate and share lessons learned from select shore activity weight handling accidents, near misses, and other unplanned occurrences so that similar events can be avoided and overall safety can be improved.

For the first quarter of fiscal year (FY) 18, 63 Navy weight handling accidents (53 crane and 10 rigging) were reported. Accident reporting decreased in the first quarter by 34 percent when compared to the fourth quarter of FY 17 (75) and FY16 (80). The number of significant accidents (as defined by reference a, NAVFAC P-307) this quarter (16) was almost stable when compared to the first quarters of the previous two fiscal years and to the fourth quarter of FY17; however, the ratio of significant accidents was higher this quarter due to the overall decrease in reported accidents. Overloads and injuries accounted for more than half of the significant accidents. Of the 48 other accidents, collision was the number one type of accident reported. Many of the collisions occurred due to crane teams not performing a thorough envelope inspection prior to the start of operations. Eight contractor accidents (seven crane and one rigging) were reported in addition to the above accidents, three of which were significant.

### INJURIES

Four injuries (three rigging and one crane) were reported in the first quarter.

While rigging a network cabinet into a radio room, a swivel hoist ring (SHR) disengaged from a beam clamp and contacted the rigger's shoulder, resulting in a lost workday. While lashing a shipboard load, a rigger's finger was injured (pinched/laceration).

While positioning a battery in the battery well of a submarine, the battery handling trolley and hoist came loose and fell from the bridge rail, resulting in minor injury to a worker and damage to equipment. A rigger sustained a finger injury when it was caught between a shackle and another piece of gear when the crane was hoisted without direction.

**Lessons Learned:** All of these accidents were the result of improper rigging or improper operation of a crane. During rigging evolutions, tight spaces and clearances are often encountered making it necessary to ensure all loads are properly constrained/controlled in the rigging configuration. Additionally, to help prevent personnel injuries, body positioning needs to be discussed in the event something does not go as planned. In one injury, a crane operator was identified in an activity's monitor program as having a history of performing crane operations without direction. In this instance, periodic analysis of the activity's monitor program and corrective actions resulting from this analysis may have been able to identify poor performance and prevent this event from occurring.

## OVERLOADS

Five overload accidents (three crane and two rigging) were reported. During certification of a category 4 crane, the crane was overloaded when the maximum test load tolerance was exceeded. Manual chain hoists were load tested in excess of NAVFAC P-307 maximum test tolerances. A locally designed and manufactured davit used to lift a component was overloaded. Rigging gear was overloaded while attempting to remove a component from a diesel engine shipboard. A sling assembly being used to remove a component from an aircraft was overloaded.

**Lessons Learned:** In the case of the overloaded manual chain hoists, the activity was not following new test tolerance requirements of reference (A). The category 4 crane was tested to an incorrect procedure. In both cases, review of applicable test requirements to verify procedures and processes are correct would have prevented these events. Another overload was the result of inadequate engineering on a davit. The design capacity was trusted to be correct and not verified by the crane team prior to initial use. Rigging gear was overloaded when it took two people to pull a manual chainfall due to a bound load shipboard. The sling assembly overload occurred while a crane was used to apply tension to the assembly (to remove bolts); however, too much tension was applied and the sling assembly was overloaded. Both rigging gear overloads could have been averted if a load indicating device (LID) and a dedicated LID reader were utilized.

## DROP LOADS

There were three dropped load crane accidents. During load test of a mobile boat hoist, six connecting hardware (deck hooks) failed resulting in a dropped load and damage to the crane. While lifting landing gear parts, a wire rope sling parted. Material fell from a food module being lifted through a ship's food supply chute.

**Lessons Learned:** Equipment failure was identified in two of these events (deck hooks and wire rope slings) that needed engineering analysis to determine reasons for failure. General inspections of rigging gear for cracks, cuts, gouges, and bends could have identified deficiencies that led to these failures. In the case of the food module lift, an adequate inspection of the load prior to lifting would have identified the need to secure the load better to prevent this from occurring.

## TWO-BLOCK

Three two-block crane accidents were reported. A mobile crane was two-blocked when the operator scoped the crane out causing the hoist to engage the upper limit switch which subsequently failed to activate. The hoist block of a bridge crane traveled through the upper limit switch "two-blocking" the hoist block into the upper sheave assembly causing damage. While performing secondary upper limit switch verification of a monorail crane, the hoist operated in the up direction without input from the operator resulting in two-blocking the hoist.

**Lessons Learned:** All three of these events were caused by personnel error. Personnel were identified as distracted or not performing as trained. On the mobile crane, the rigger-in-charge was distracted by the events taking place on a barge and his focus was not on the entire scope of the job (auxiliary hoist positioning). As the boom extended, the auxiliary hoist headache ball was drawn into the anti-two-block device which also failed to operate properly and allowed the two-block condition.

Additional investigation identified the anti-two-block switch was defective due to moisture intrusion. A secondary upper limit switch on a monorail crane was being tested when an employee placed a jumper on wrong connection points which caused damage to the crane. In another instance, an operator on a bridge crane was operating the hoist in high speed to check the upper limit switch causing it to drift and contact the upper sheave assembly. Operators are required per reference A to check limit switches in the slowest speed possible. Safety devices are put into place to help prevent accidents from occurring; however, these devices sometimes fail due to inadequate maintenance. Nothing works better than attentive crane team members performing as trained.

**CRANE COLLISIONS**

Collisions continue to be the number one accident type. A mobile crane counterweight contacted and damaged a panel guard railing. A conex box being lifted contacted a delivery truck. A portal crane contacted a dry dock conveyer system causing damage to the cranes hotel power junction box. Some of the other collisions reported were caused by personnel leaving obstacles in the crane envelope without crane team knowledge.

**Lessons Learned:** These accidents could have been prevented if a thorough envelope inspection had been performed. A complete envelope check (to the maximum extent possible) should be performed prior to work to identify potential hazards that affect the safe operation of cranes. During initial setup of mobile or portal cranes, the rotate and travel paths need to be reviewed for potential interferences/hazards.

**NEAR MISSES AND UNPLANNED OCCURRENCES**

Activities reported 64 near misses (54 crane and 10 rigging) and 26 unplanned occurrences (22 crane and 4 rigging). More than half of the near misses were good near misses that helped avert potential dropped loads, overloads, collisions, and damaged equipment. Many of the causes identified were attributable to improper operation, improper rigging, and improper job planning or personnel error. In some cases, quick intervention was required by supervision to prevent accidents from occurring. Examples include prevention of an overload when a support rigger identified the load indicating devices (LIDs) were incorrectly positioned on a two crane complex lift; and synthetic slings slid inward during a lift of a mobile crane while tensioning the load because hold backs were not installed as mandated by a procedure. Weight handling program managers, operations supervisors, and safety officials should review the above lessons learned with personnel performing weight handling operations and share lessons learned at other activities with personnel at your activity. Data reported in the first quarter of FY18 indicates improvement in identifying lower level events that lead to accidents. While there was a drop in accident reporting, there was an increase in near miss and unplanned occurrence reports when compared to the first and fourth quarters of FY17. Reporting of lower level accidents (avoidable contact with minor scratches or no damage) and reporting of near misses and unplanned occurrences are signs of a mature weight handling program and should not be looked at negatively. Activities are encouraged to review your monitor program for lower level deficiencies that lead to accidents and near misses thus broadening your safety triangle bases accordingly.

## WEIGHT HANDLING TRAINING AND SAFETY BRIEFS

***W***eight Handling Training and Safety Briefs (WHTBs and WHSBs) are provided for communication to weight handling personnel. The following briefs were issued during the past quarter.

The briefs are not command-specific and can be used by your activity to increase awareness of potential issues or weaknesses that could result in problems for your weight handling program. They can be provided directly to personnel, posted in appropriate areas at your command as a reminder to those performing weight handling tasks, or used as supplemental information for supervisory use during routine discussions with their employees. When Navy Shore Weight Handling Safety or Training Briefs are issued, they are also posted in the Accident Prevention Info tab on the Navy Crane Center's web site at http://www.navfac.navy.mil/ncc.

Navy Crane Center point of contact for requests to be added to future WHTB distribution is nfsh ncc crane corner@navy.mil.

# Navy Shore Weight Handling Training Brief!

**Title:** 3 Revised NAVFAC P-307 Training Courses Now Available!
**Target Audience:** Maintenance: Crane Electricians
Operations: Category 2 and Cab-Operated Category 3 Crane Operators

Updated
Crane Electrician, NCC-CE-02
Category 2 and Cab-Operated Category 3 Crane Safety, NCC-C2CS-03
Category 2 Crane Safety Refresher, NCC-C2CSR-04
courses
now available

Online course access information and descriptions are available at:
http://www.navfac.navy.mil/ncc
via the Training link

Use the Navy eLearning (NeL) direct link:
https://learning.nel.navy.mil
to access
NAVFAC P-307 online courses

The **Crane Electrician course (NCC-CE-02) on Navy eLearning (NeL) has been updated** to reflect the most recent changes to NAVFAC P-307. NCC-CE-02 replaced NCC-CE-01. If you work with, manage, supervise, inspect, or provide oversight of electrical work on cranes, you will want to review this material to update your level of knowledge and familiarize yourself with the latest requirements. One new requirement allows journeyman electricians to make noted MISR signoffs in lieu of electrical inspectors.

The **Category 2 and Cab-Operated Category 3 Crane Safety (NCC-C2CS-03) on Navy eLearning (NeL) has been updated** to reflect the most recent changes to NAVFAC P-307. If you operate category 2 or cab-operated category 3 cranes, oversee operators of these cranes, or are involved in the training and licensing of these types of crane operators, you will want to review this material to update your knowledge and familiarize yourself with the latest information. NCC-C2CS-03 replaced NCC-C2CS-02. Category 2 and Cab-Operated Category 3 Crane Safety, NCC-C2CS-03, is required training for initial license for category 2 and cab-operated category 3 crane operators.

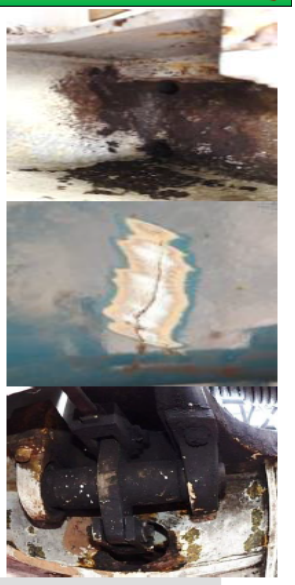
The **Category 2 Crane Safety Refresher course (NCC-C2CSR-04) on Navy eLearning (NeL) has been updated** to reflect the most recent changes to NAVFAC P-307. NCC-C2CSR-04 replaced NCC-C2CSR-03. If you operate category 2 or cab-operated category 3 cranes, oversee operators of these cranes, or are involved in the training and licensing of these types of crane operators, you will want to review this material to update your knowledge and familiarize yourself with the latest information. Category 2 Crane Safety Refresher, NCC-C2CSR-04, is required for license renewal for category 2 and cab-operated category 3 crane operators.

27 February 2018 **Training** *Navy Crane Center 18-T-01*

# Navy Shore Weight Handling Training Brief!

**Title:** CRANE/STRUCTURE INSPECTION
**Target Audience:** Mechanics, Inspectors, Engineers, Certifying Officials

- **Event:** Recently, multiple activities have reported excessive metal loss (corrosion) or cracks in base material in load bearing areas on various crane types including bridge and mobile cranes, particularly in areas where it is more difficult to inspect. Late identification of these issues has resulted in an unrepairable material condition and the cranes were required to be removed from service. For the most recent mobile crane corrosion issue, the repair cost is estimated to be very high (>$500K). These critical cranes will require evaluation on whether to repair or replace the cranes.
- **Lessons Learned:** Structural inspection attributes are included in NAVFAC P-307, Appendices C and D. These inspections comprise all areas identified on the crane, including areas in which inspections are difficult to perform or are inaccessible by regular visual inspection means including voids and crawl spaces. Early detection of corrosion issues allows for mitigation of problems before they become catastrophic.
- **Noteworthy Items:**
  - Crane repositioning may be required in order to complete all inspections.
  - Cracks can form in areas outside of welds and bolted connections.
  - When corrosion is found on one side of a member, the opposite should be inspected for corrosion as well.
  - Inspection instruments such as a borescope may be necessary to perform the required comprehensive inspections.



27 March 2018 **Training** *Navy Crane Center 18-T-02*

# Navy Shore Weight Handling Safety Brief!

**Title: HYSTER MODEL S60FTG FORKLIFT LIFTING HAZARD**
**Target Audience: WEIGHT HANDLING PERSONNEL**


5 March 2018

NAVSUP WEAPON SYSTEMS SUPPORT Mechanicsburg, PA issued Naval message R071418Z FEB 18 following a ship's crane accident involving the lifting of a Hyster Model S60FTG forklift. The counterweight (lift point) separated from the forklift chassis during the lift due to suspected deterioration and/or improper torque values of the counterweight's single retention capscrew. Navy shore activities have the potential to lift this equipment. When lifting this particular model of forklift, consider the following:.

- All ships that utilize this forklift were given direction to check the capscrew for proper pre-load torque prior to lifting.
- Apply extra caution when performing lifts of this model forklift and observe for any movement of the counterweight prior to the wheels leaving the ground.
- If in doubt as to the integrity of the connection, consider alternative lifting methods such as the use of approved platform or basket hitches with appropriate sling protection and frapping.
- Contact a rigging supervisor or the activity engineering organization for additional assistance as necessary.
- For questions regarding this forklift or message, contact MHE ISEA Bob Monroe, robert.j.monroe@navy.mil, 973-724-1449.

**SAFETY**

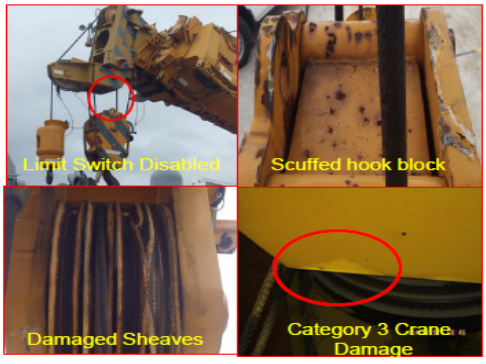
*Navy Crane Center* 18-S-01

# Navy Shore Weight Handling Safety Brief!

**Title: TWO-BLOCK ACCIDENTS**
**Target Audience: ALL WEIGHT HANDLING PROGRAM PERSONNEL**

**Two-Block** is defined in NAVFAC P-307 as " Over-hoisting by direct hoisting or indirectly by lowering the boom or telescoping the boom so that the hook block and the upper sheave assembly or trolley/hoist frame come in contact, resulting in possible damage to the structure, parting of the hoist line, and dropping of the load."

*These pictures illustrate damage that resulted from two blocking events.*




5 April 2018

**An increasing number of two-block accidents have been reported recently involving mobile and category 3 cranes. The majority of these two-block accidents were the result of improper operation (human error). Nearly half of all two-block events this fiscal year have occurred during performance of maintenance, inspection, and testing. This brief discusses several recent two-block events and emphasizes important lessons learned that may help prevent two-block accidents.**

## PREVENTING TWO-BLOCKING ACCIDENTS

- An operator inadvertently pulled the wrong lever which raised the whip hoist through the anti two-block switch. **Lessons learned: The operator should always visually verify the correct lever prior to engaging.**
- While stowing the crane boom for travel, the operator deactivated the anti two-block limit switch on the main hoist and raised the main hoist while lowering the boom causing the main hook block to contact the boom sheaves. **Lessons learned: Performing multiple functions at the same time made it hard to focus on accomplishing the task safely.**
- During maintenance of the upper hoist limit switch, the team did not recognize the upper limit switch failed to stop the hoist and a two-block event occurred. **Lessons learned: Personnel should exercise caution while testing a limit switch after repairs/maintenance. The limit switch could fail or be out of adjustment.**
- A crane operator raised the main hoist to check the upper limit switch at high speed causing the hook block to drive through the limit switch. **Lessons learned: NAVFAC P-307 paragraph 9.1.2.1.4(h) requires checking of limit switches be performed at slow speed. This method allows the operator to react when a limit switch does not activate as expected. In this specific case, the limit switch set point did not account hoist drift.**

**SAFETY**

*Navy Crane Center* 18-S-02

# DID YOU KNOW?
# FUNCTIONAL SAFETY REQUIREMENTS APPLICABLE TO CRANE WIRELESS CONTROL SYSTEMS

The use of wireless controls for Electric Overhead Traveling (OET) cranes has become much more prevalent over the past decade, as technological advancements have been made. Functional safety is of utmost concern when designing and implementing wireless control systems in lifting and handling applications. With these safety concerns in mind, NAVCRANECEN INSTRUCTION 11450.2, requires that radio control systems be designed in accordance with CMAA #70, NEMA ICS 8, and ECMA 15. ECMA 15, Specifications for Cable-less Controls for Electric Overhead Traveling Cranes, is an industry standard that was developed in order to promote standardization and equipment selection guidance regarding wireless controls.

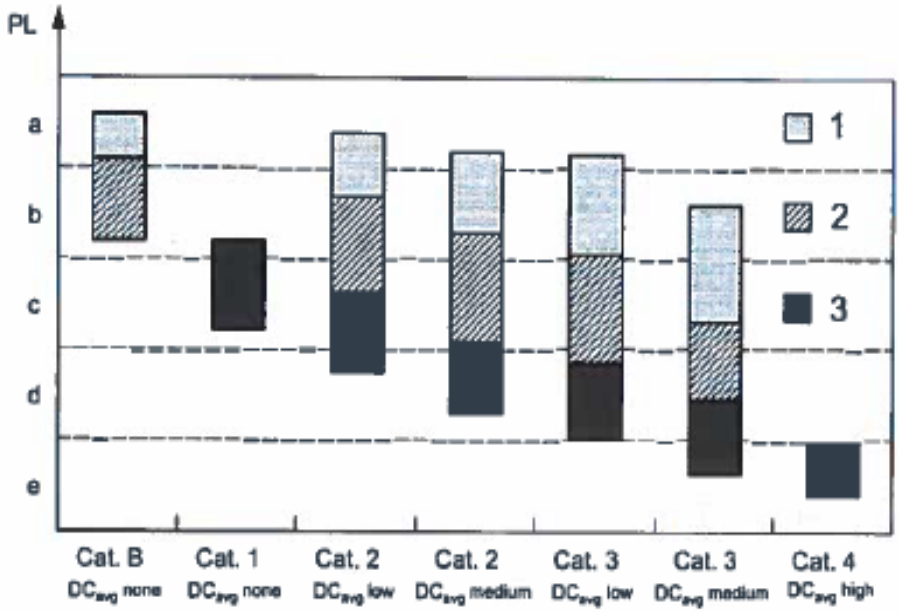
ECMA 15 specifies that wireless control stop circuits should be designed to Category 3, as defined in European Norm (EN) Standard 954-1. EN 954-1 is a machinery control safety standard released in 1996 and is recognized as being the safety authority used globally for all equipment applications. This standard utilizes five Safety Categories [B, 1, 2, 3, 4] to define the criticality of the safety related parts within the control system; B being the least critical and 4 being the most critical. Category 3 requires a level of redundancy such that one component failure will not result in the failure to perform any of the equipment safety functions. In layman's terms, this means that the crane operator should be able to stop the crane using the wireless controller regardless of any internal component failure within the wireless controller. Relative to the wireless control stop circuit in the controller, this would typically require two sets of contacts in the push button circuitry, as well as redundant signal transmitter and receiver circuits.

Upon further review of EN 954-1, it was discovered that the standard has been retired as of 2011, and has since been superseded by ISO Standard 13849-1: Safety of Machinery, Safety-Related Parts of Control Systems. This new ISO Standard is based on EN 954-1, so it does retain use of the Category rating system. However, the standard also introduces a new rating system, called Performance Level (PL), which gives a more comprehensive indication of total functional safety. This new rating system utilizes five safety levels [a, b, c, d, e] to define the probability of a dangerous failure from occurring. The more critical the safety function, the higher the PL that is required to reduce the risk. The PL of a system is determined by several factors; including the Category, the Mean Time Between Failure (MTTF), and the Diagnostic Coverage (DC), among other factors (see chart below). As a result, while the Category rating has an impact on PL, there isn't a direct correlation between these two rating systems because of other factors at play. For example, a high PL may be achieved, with a somewhat low Category rating, provided the system has a high MTTF.

After conducting market research, it was found that a number of wireless control manufacturers had already begun migrating to the new PL rating system to certify their products, while others were still using the older Category rating system. Essentially, wireless controls manufacturers are able to achieve stop circuit redundancy with either an EN 954-1 Category 3 rating or an ISO 13849-1 PL D rating.

The important takeaway from this research is that when selecting crane wireless controls, the stop function should be designed to Category 3 or higher as defined in EN 954-1 or a performance level (PL) of "d" or higher as defined in ISO Standard 13849-1.

For more information, please contact nfsh ncc crane corner@navy.mil.




**Key**

PL performance level

1 $MTTF_d$ of each channel = low

2 $MTTF_d$ of each channel = medium

3 $MTTF_d$ of each channel = high

**Figure 5 — Relationship between categories, $DC_{avg}$, $MTTF_d$ of each channel and PL**

**Table 7 — Simplified procedure for evaluating PL achieved by SRP/CS**

| Category | B | 1 | 2 | 2 | 3 | 3 | 4 |
|---|---|---|---|---|---|---|---|
| $DC_{avg}$ | none | none | low | medium | low | medium | high |
| $MTTF_d$ of each channel | | | | | | | |
| Low | a | Not covered | a | b | b | c | Not covered |
| Medium | b | Not covered | b | c | c | d | Not covered |
| High | Not covered | c | c | d | d | d | e |

## WEIGHT HANDLING PROGRAM SAFETY VIDEOS

***Accident Prevention*** provides seven crane accident prevention lessons learned videos to assist activities in raising the level of safety awareness among their personnel involved in weight handling operations. The target audiences for these videos are 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.

***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.

***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.

***"Take Two" Briefing Video*** provides an overview on how to conduct effective pre-job briefings that ensure interactive involvement of the crane team in addressing responsibilities, procedures, precautions, and operational risk management associated with a planned crane operation.

***Safe Rigging and Operation of Category 3 Cranes*** provides an overview of safe operating principles and rigging practices associated with Category 3 crane operations. New and experienced operators may view this video to augment their training, improve their techniques, and to refresh themselves on the practices and principles for safely lifting equipment and materials with Category 3 cranes. Topics include: accident statistics, definitions and reporting procedures, pre-use inspections, load weight, center of gravity, selection and inspection of rigging gear, sling angle stress, chafing, D/d ratio, capacities and configurations, elements of safe operations, hand signals, and operational risk management (ORM). This video is also available in a standalone, topic driven, DVD format upon request.

All of the videos can be viewed on the Navy Crane Center website:

http://www.navfac.navy.mil/navfac_worldwide/specialty_centers/ncc/about_us/resources/safety_videos.html.

## SHARE YOUR SUCCESS

We are always in need of articles from the field. Please share your weight handling/rigging stories with our editor nfsh_ncc_crane_corner@navy.mil.