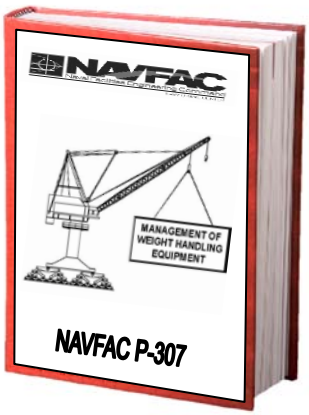
Navy Crane Center



NAVFAC P-307 Training

ELECTRICAL CRANE INSPECTOR

WEB BASED TRAINING

STUDENT GUIDE

NCC-ECI-01

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INTRODUCTION

Course Description

Electrical Crane Inspector is designed to acquaint electrical crane inspectors with Navy requirements for the safe inspection of electrical components on Navy cranes and provide a knowledge base on which to build upon with on-the-job experience. Topics include specific documentation requirements for inspection and record keeping. Prerequisite: NAVFAC P-307 Crane Electrician Course.

TOPICS COVERED

Electrical Crane Inspector covers NAVFAC P-307 familiarization, basic electrical safety, National Electric Code for electrical installations relating to cranes, electrical theory and tips for maintaining, troubleshooting, and repairing AC and DC generators, motors, and controllers.

ELECTRICAL CRANE INSPECTOR MODULES

Modules presented in this course include:

- NAVFAC P-307 Electrical Inspections 1
- NAVFAC P-307 Electrical Inspections 2
- Basic Inspection Techniques
- Rotating Equipment Inspections
- Controller Inspections
- Associated Equipment Inspections

REFERENCES

References and support materials for this course can be located and obtained from the course reference area. Click the “Reference” button above the content screen to view and/or print supporting materials.

NOTES

NAVFAC P-307 ELECTRICAL INSPECTIONS 1

Inspections

NAVFAC P-307 covers inspection requirements in Sections 2, 3, and 5, and gives examples of inspection attributes and sample forms in Appendices C and D. Inspections are performed at frequencies required by NAVFAC P-307. Inspections shall consist of observing the functioning of components and parts before, during, and after operation. Examination shall be by sight, sound, touch, and as necessary, instrumentation, nondestructive testing, and disassembly.

Inspection Safety

Primary emphasis during inspections shall be given to ensure maximum safety by maintaining all load bearing and load controlling parts and operational safety devices in a safe and sound working condition. Inspectors shall not engage in calculated risks or depend on their judgment alone where there is a doubt in their mind regarding a questionable condition. Questionable conditions of load bearing and load controlling parts and operational safety devices shall be referred immediately to the activity engineering organization and, if necessary, to the certifying official for resolution. Contact the Navy Crane Center for engineering assistance if necessary.

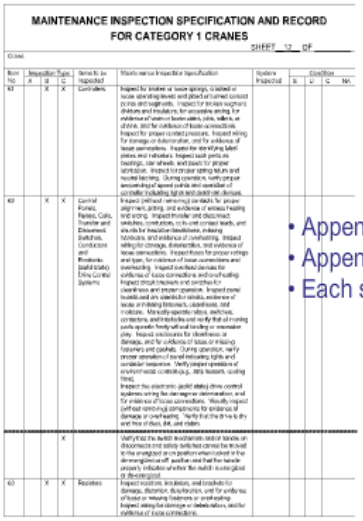
Specification Record Forms

Maintenance inspection specifications sample forms are identified in NAVFAC P-307 Appendices C and D for crane Categories 1, 2, and 3. These prescribe the type of inspection (A, B, C, or annual), the components and parts to be inspected, and the inspection action. The extent of disassembly shall be as noted. Each activity shall develop Maintenance Inspection Specification and Record or MISR forms in accordance with the sample formats shown in Appendices C and D. For unique items not covered, additional inspection attributes shall be included. Inspection Specifications forms for Category 4 cranes shall be developed by the activity based on applicable portions of Appendix C and as recommended by the OEM.

Maintenance Inspection Specifications

Here is an example of the Inspection Specification sheets from the NAVFAC P-307 Appendix C. Appendix C has the specifications for Category 1 cranes. Appendix D has the specifications for Category 2 and 3 cranes. As you can see, the item specifies a particular component of the crane; for example, controllers, and then explains the details of the inspection attributes

Maintenance Inspection Specifications


MAINTENANCE INSPECTION SPECIFICATION AND RECORD
FOR CATEGORY 1 CRANES

- Appendix C for Category 1
- Appendix D for category 2 and 3
- Each sheet specifies inspection

SPECIFICATION DATA SHEETS

Each activity shall augment the specifications noted above with specification data sheets. These shall contain all guidance and technical information needed by inspectors in checking for wear, adjustments, settings, and tolerances during inspections. This information shall be extracted from OEM's technical manuals and other authoritative technical sources. Measurement locations for verifying settings shall be clearly identified.

Brake Data Sheets

MAINTENANCE INSPECTION SPECIFICATION AND RECORD
FOR CATEGORY 1 CRANES
BRAKE DATA

Brake Data Sheet

Here is an example from NAVFAC P-307 of a brake specification data sheet. It contains all the pertinent data necessary for a thorough inspection of the brake. It includes information such as torque spring length, armature air gap, and lining thickness. Notice that there are enough spaces on the form for nine different brakes. If your crane has more than this you would use two forms.

Inspection and Corrective Actions

Inspection conditions and corrective actions must be documented. MISR forms shall be used to record conditions at each inspection. These shall be filed in the equipment history file. All inspection conditions shall be recorded as satisfactory, unsatisfactory, or not applicable. Where measurements are specified or required for acceptance, the actual readings shall be recorded.

Deficiency Reports

Deficiencies (and corrective actions) to load bearing and load controlling parts and operational safety devices shall be documented. Deficiency reports must be filed in the equipment history file. Shown is a sample of the form used to report deficiencies to the Navy Crane Center. Deficiencies include failure or malfunction of equipment, improper engineering, inspection, or maintenance procedures, and major or unsafe discrepancies between design drawings and equipment configuration. This does not include normal wear on the equipment. In those instances where deficiencies are detected that have applicability at other Navy activities, the Navy Crane Center shall be notified within five days of the discovery. A summary report of the deficiency, including corrective actions taken or recommended, shall be forwarded to the Navy Crane Center within 21 days.

Deficiency Reports

- Must be filed in Equipment History File
- Must be filed with the Navy Crane Center if it affects other cranes

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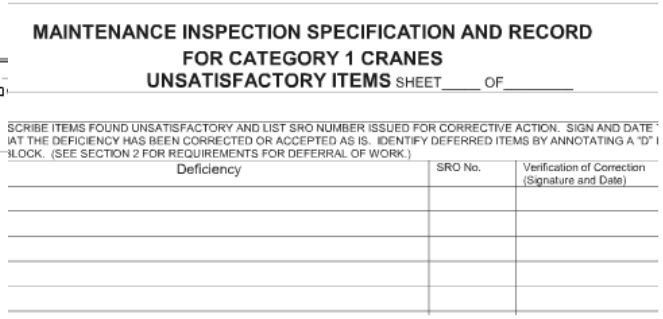


Replacement Parts

Replacement parts are a concern when doing crane repairs. Replacement load bearing and load controlling parts and safety devices shall be identical to those of the original design. Where circumstances require substitution of either material or design configuration, such matters shall be approved by the activity engineering organization, or by the Navy Crane Center.

Re-Inspection

Re-inspection is sometimes required for work done. Where the adjustment, repair, or replacement has been performed satisfactorily and the original unsatisfactory condition eliminated, the inspector shall sign the repair document to verify actions taken have corrected the reported deficiency. Re-inspection shall include an operational test, where necessary.

Deferral of Work

Some work may be deferred to a later date. Major deficiencies shall be corrected prior to annual or biennial certification. If it is not practical to complete other work to load bearing and load controlling parts and operational safety devices, such work may be deferred upon approval by the certifying official. Engineering justification for deferral shall be provided. Deferred work shall be completed prior to the next annual or biennial certification unless further deferral is approved by the certifying official.

Equipment History File

Each activity shall establish and maintain an individual equipment history file on each crane. The equipment history file, or history jacket as it's commonly called, shall contain the documentation discussed in NAVFAC P-307, section 5. The files shall be made available to government oversight agencies (e.g., OSHA, Navy Crane Center) upon request. The equipment history file shall contain the documentation which we will discuss next.

Maintenance Inspections

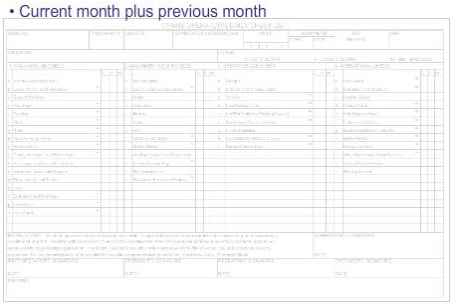
The minimum record retention requirements for Type A Inspection documentation is to keep the latest inspection document plus the previous two inspection documents (if on a calendar basis) or the latest plus the previous two years (if on an engine hour operating basis). For Type B, Type C, and Type Annual Inspections, the latest inspection document plus one previous inspection document will be retained.

OPERATOR'S DAILY CHECKLIST

The current and previous month's ODCLs shall be retained on file.

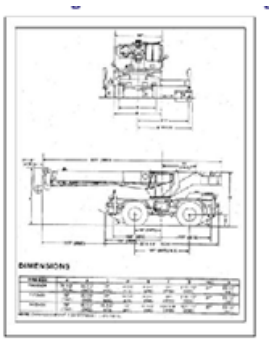
Operator's Daily Checklist

- Current month plus previous month



SHOP REPAIR ORDERS

Shop Repair Orders (SRO) or other repair documents must be included. SRO's for repairs to load bearing/load controlling parts and operational safety devices must be included and kept in the record for seven years. Repairs to all other components must be left in the record for one year.



WORK DOCUMENTS INVOKING CRANE ALTERATIONS

All crane alteration documentation, including approval, installation, and certification paperwork, whether approved by the local activity or by Navy Crane Center, shall be kept in the equipment history file for the life of the crane.

NON-DESTRUCTIVE TEST REPORTS

The latest Non-Destructive Test Reports for any component must be included.

Crane Condition Inspection Record

The current (and interim's) Crane Condition Inspection Record plus the previous annual record must be included.

Certification of Load Test

The Certification of Load Test for each crane must appear in the history file. Include the current with any interim's and extensions plus one previous annual certification.

Third Party Certifications

For cranes which require Third Party Certifications: The current plus one previous certification must be included.

Wire Rope Records

For new cranes and for replacement wire rope on existing cranes, the history jacket must include the latest Wire Rope Breaking Strength Certification Record. This is the rope manufacturer's certification that the rope meets the published breaking strength, or the actual breaking strength of a sample taken from the reel and tested. For cranes used in cargo transfer operations, certification of actual breaking strength is required.

Crane Alterations

All crane alterations, whether approved by the local activity or by Navy Crane Center, shall be kept in the equipment history file for the life of the crane.

Deficiency Reports

Deficiency Reports

Deficiency reports for load bearing or load controlling parts or operational safety devices must be maintained for seven years.

Purchase Contracts

Purchase Contracts

Any purchase contracts for the crane shall be retained in the history file for the life of the crane.

Accident Reports

Crane Accident Reports are kept in the history file for 7 years.

Accident Reports

Hook Base Measurement

Hook Base Measurement

Hook Base Measurement must be included in the history file and is kept for the life of the hook. Hooks must be marked and measured before installation to provide this base measurement. When measured as part of the annual certification, the new measurement is compared to the base measurement on record.

Lifts Exceeding Capacity

Records of any operational lifts made which exceed the rated crane capacity must be kept in the Equipment History File for the life of the crane. The crane must not be overloaded without Navy Crane Center approval. Requests must verify that there are no other safer means available (including leased equipment) to make the lift.

Lifts Exceeding Capacity

Specification Data Sheets

• Kept for the life of the crane

Specification Data Sheets

Specification Data Sheets must be kept for the life of the crane. This will allow brake readings and other measurements to be compared with the original specifications.

Crane Acceptance Test

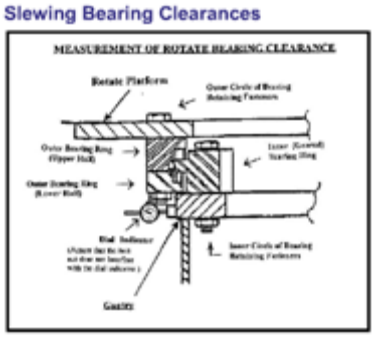
The records of the original Crane Acceptance Test shall be maintained for the life of the crane.

Ancillary Equipment Procedures

The manufacturer's instructions for the operation of ancillary equipment, (for example how to correctly set up a fly away jib) should be kept with the Equipment History File for the life of the crane.

Roller Clearance Standard

The ‘crane-roller-clearance-data-standard-of-acceptance’ for balance deck design cranes shall be kept in the equipment history jacket for the life of the crane.

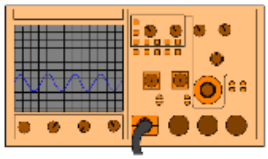


Slewing Bearing Clearances

The bearing clearance readings for the slewing bearings shall be maintained for the life of the bearing.

Oil or Vibration Analysis Data

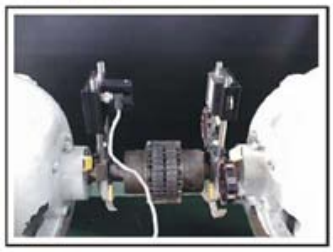
Results of oil or vibration analysis shall be kept for the life of the component. When tests like these are done, the first set of test data becomes the baseline to which subsequent test data are compared to determine if detrimental wear is taking place. Note: The same equipment or process should be used each time to be sure that results will be valid. An alternative to these tests is an inspection report of the internal gears of the component, which will involve disassembly.



Floating Crane History File

The equipment history file for floating cranes must include: the latest Material Inspection Report (per OPNAVINST 4780.6) and includes any waivers of depot availability. The crane portion of a floating crane is handled like any other crane, but the barge is a naval vessel and there are special requirements for dry-docking, hull fitness inspections, void inspections and so forth.

Coupling Alignment Data



COUPLING ALIGNMENT DATA

The equipment history file must also include coupling alignment data. The latest alignment data must be on file.

REVIEW AND SUMMARY

This module covered: Requirements for performing crane maintenance inspections, requirements for documenting crane deficiencies, and the records required for the Crane History File.

NOTES

NAVFAC P-307 INSPECTIONS 1 MODULE EXAM

Online exam questions may appear in a different order than those shown below.

1. Which document augments maintenance inspection forms with additional technical data and specifications?

A. technical foot notes
B. data entry forms
C. naval technical review pages
D. specification data sheets

2. Which of the following will NOT be found in the Equipment History File?

A. certification of load test
B. crane location record
C. non-destructive test reports
D. Crane Condition Inspection Record

3. Where in NAVFAC P-307 would you find the electrical inspection requirements for a bridge crane installed at a Navy Shore Activity?

A. Appendix A
B. Appendix B
C. Appendix C
D. Appendix D
E. Appendix E

4. What determines the minimum items to be inspected during the crane inspection?

A. your own good judgment and experience
B. the Maintenance Inspection Specification Record (MISR)
C. past inspections and problem areas
D. written guidance from the certifying official

5. NAVFAC P-307 specifies which of the following for crane inspections?

A. type of inspections
B. all listed inspections
C. frequency of inspections
D. required documentation

6. Which of the following will NOT be found in the equipment history file?

A. Crane Operator’s Daily Checklist
B. Crane Operator’s Monthly checklist
C. Maintenance Inspection Specification and Record
D. Shop Repair Orders
E. Crane Operator’s Log Sheets

7. Which of the following will NOT be found in the Equipment History File?

A. purchase contracts
B. deficiency reports
C. list of applicable drawings
D. crane alterations
E. crane accident reports

NAVFAC P-307 Electrical Inspections 2

Crane Certification Program

Navy shore activities that possess WHE shall have a WHE certification program. The commanding officer is responsible for ensuring safety within the activity. He/She shall designate the WHE certifying official(s) who shall ensure the activity's WHE is inspected, tested, and certified in accordance with NAVFAC P-307. Certifications shall be based on the condition inspection and load test as prescribed. These inspections and tests shall be performed by technically competent inspection and test personnel under the direction of a designated test director. Upon successful completion of the condition inspection and load test, a Certification of Load Test and Condition Inspection shall be signed by the test director, inspection personnel, and the certifying official.

Inspection and Test

The purpose of the condition inspection is to ensure that the overall structural, mechanical, and electrical components of the equipment have been maintained in a safe and serviceable condition and are functioning properly. The purpose of the load test is to ensure by controlled operation with prescribed test loads that the equipment is capable of safely lifting and moving the rated load through all design motions.

Annual Certification

The certification (for all crane categories) 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. Except as noted, the certification process 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. For jib, pillar, pillar-jib, monorail, boat davit, and fixed hoist type cranes assigned to a biennial certification program, the certification is valid for two years from the date of signature of the certifying official. The certification process shall include a condition inspection and load test. The certification shall so indicate when a crane is in the biennial 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.

Interim Recertification

Interim certification is done based on the following: Re-certification is required when the adjustment, repair, disassembly, alteration, or replacement of a load bearing part, load controlling part, or operational safety device on a crane must be a load tested to verify work performed. To determine if a load test is required, the component's impact on holding strength shall be assessed. If holding strength could be affected by the work performed (i.e., failure to make the proper adjustment, repair, etc., could result in dropping, uncontrolled shifting, or uncontrolled movement of the load), then a selective inspection, load test, and re-certification shall be performed. This includes rotate and travel components when the rotate or travel function may operate on an inclined plane, such as the rotate function on floating and barge mounted cranes, and a trolley on a luffing boom.

Re-certification Not Required

Re-certification is not required when the adjustment, repair, etc., of a load bearing part, load controlling part, or operational safety device does not require a load test for verification of satisfactory work but requires only an operational test. This includes work performed on rotate and travel brakes, friction clutches, and travel components where the load travels in a horizontal plane. Work documents for all such work shall be approved by a designated inspector or the activity engineering organization prior to starting the work. Work documents shall include a requirement for an operational test. All completed work shall be inspected, and the operational test witnessed, by a designated inspector. These requirements do not apply to routine maintenance, servicing, or adjustments on diesel engines or generators recommended by the OEM, however, the re-inspection requirements of NAVFAC P-307, section 2 apply. After all the work is completed. and prior to returning the crane to service, the work document shall be signed by the chief engineer or the certifying official.

Voiding of Certifications

Here are the conditions which will void the certification of the crane. All certifications are automatically void after one year (after two years for biennial certifications); after exceeding the certified capacity during operation; upon discovery of a major deficiency; or after an adjustment, repair, disassembly, replacement, or alteration of a load bearing or load controlling part or operational safety device which requires a load test for verification of satisfactory work.

EXCEPTIONS

There are several exceptions to the rule about voiding crane certifications. The following exceptions apply under very specific conditions; consult NAVFAC P-307, section 3 for the full text. Some exceptions to this policy include:

- A deficiency, adjustment, alteration, etc., to one function will not necessarily void the entire crane certification.
- Exceeding the certified capacity in a load test of a sample crane during a Navy Crane Center WHE audit or during a third party certification.
- Extension of certification for emergent conditions.
- Controlled disassembly and reassembly of components for inspection [specific conditions apply].
- Re-reeving of mobile cranes and installation of ancillary equipment [specific conditions apply].
- Exception for continuance for productive service (i.e., recertifying the crane prior to the expiration of the current certification and while the crane is in productive service specific conditions apply).
- Re-calibration of indicating devices

EXTENSION OF CERTIFICATION

Extension of Certification

- Emergent conditions
- Commanding Officer and Certifying Official approval
- Not to exceed 45 days
- Authority shall not be delegated
- CCIR required
- Authorization must be filed in WHE history file

When an emergent or other contingent condition exists precluding the timely certification of a crane, the commanding officer of the activity using the crane, with concurrence by the certifying official, may approve in writing a temporary extension (not to exceed 45 calendar days) of the current annual certification. Authority to extend a certification shall not be delegated. Before extending the certification, the crane shall pass a complete condition inspection including functional testing through all motions at normal operating speed. Each authorization to extend a certification shall be filed in the crane's equipment history file. Note: Navy Crane Center third party certifications will not be extended.

CRANE CONDITION INSPECTION REPORT

The Crane Condition Inspection is another type of inspection the crane inspector must be familiar with. A condition inspection shall be performed before, during, and after the load test. For cranes idle for a period greater than six months, a condition inspection shall be performed prior to placing the crane in service. A CCIR shall be used to record results of the inspection. The inspection shall, in general, be by sight, sound, and touch with the depth and detail limited to that necessary to verify the overall condition. It is not intended to be in the same detail as a maintenance inspection. Each item on the CCIR shall be marked as either

satisfactory or unsatisfactory. A description of unsatisfactory conditions shall be noted in the "Remarks" portion of the form. The completed CCIR shall be included with the crane certification form submitted to the certifying official. There are exceptions for category 3 jib cranes, pillar cranes, monorails, and fixed overhead hoists.

Exceptions for Cat 3

There are some exceptions to the CCIR requirements for certain types of Cat 3 cranes. The requirement that a condition inspection shall be performed prior to placing the crane in service for cranes idle for a period greater than six months does not apply to category 3 jib cranes, pillar cranes, monorails or fixed overhead hoists. For category 3 jib cranes, pillar cranes, monorails, and fixed overhead hoists, if no major deficiencies are found in the maintenance inspection, and if no work is done between the maintenance inspection and the load test, the maintenance inspection may serve as the “before” portion of the condition inspection. Both inspection forms shall be fully completed.

Load Tests

The procedures for load testing are covered in a separate module which will be presented for those who are or will b e designated as test directors. In general: Load tests are conducted by a Load Test director. As an inspector, you will be required to sign the Certification of Load Test and Condition Inspection, verifying that you have conducted inspections of the crane.

Review and Summary

This module covered NAVFAC P-307 requirements for the certification of cranes, the conditions which void the certification of a crane and the procedures for crane condition inspection reports

NOTES

NAVFAC P-307 INSPECTIONS 2 MODULE EXAM

Online exam questions may appear in a different order than those shown below.

1. What action will void a crane's certification?

A. re-calibration of electronic load/moment indicating devices
B. None of the actions listed
C. re-calibration boom angle indicators by comparing with measured distances and angles
D. controlled disassembly and re-assembly of components
E. observing a minor deficiency

2. Which of the statements below about crane condition inspection reports is FALSE?

A. CCIRs are not intended to be of the same depth as a maintenance inspection
B. CCIRs are filled out anytime a crane has been idle for more than 6 months
C. CCIRs are filled out daily by the operator
D. CCIRs are submitted with the crane certification form to the certifying official
E. CCIRS are made before, during and after a load test

3. Which of the items listed below is NOT required to certify a crane?

A. OEM acceptance criteria
B. load test record for the crane (except biennial cat 3 on off-years)
C. signature of certifying official
D. CCIR
E. Signatures of test director and inspection personnel

4. Re-certification is required after _____.

A. routine maintenance and servicing of diesel engines
B. routine maintenance and servicing of diesel generators
C. none of the listed conditions
D. work performed on travel brakes
E. work that can be fully evaluated by an operational test

5. Which of the following events will void the certification of a crane?

A. all listed activities
B. exceeding the rated capacity
C. the passage of one year
D. discovering a major deficiency
E. performing work on a LB/LC component which requires a load test

BASIC INSPECTION TECHNIQUES

ROUTINE INSPECTIONS

Routine inspections play an essential part in establishing and maintaining the quality of Weight Handling Equipment maintenance, and, are divided into three areas:

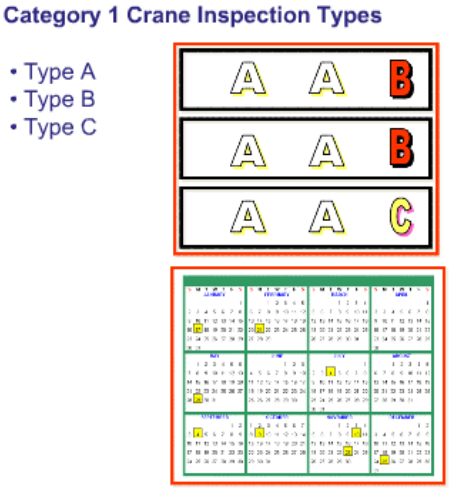
- Pre-inspections are performed to detect and document conditions that can affect the safe and reliable operation of the equipment. In-process inspections are performed on those items that require extensive disassembly or items that are impractical to post-inspect.
- Post-inspections are performed to ensure that repairs to and maintenance on the equipment are in compliance with applicable specifications and requirements.

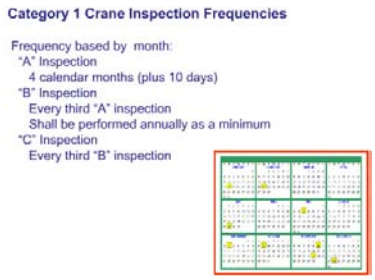
CAT 1 CRANE INSPECTIONS

Category 1 cranes have three types of inspections, Types A, B and C, and two distinct bases for defining the frequency of inspections calendar or engine hours. Note: If engine hours are used as the basis for inspection frequency, a Type B inspection must still be performed annually in conjunction with the annual certification.

Category 1 Crane Inspection Types

Type “A”, “B”, and “C” inspections for category 1 cranes are found in Appendix C of NAVFAC P-307. The appropriate inspection shall be performed and documented in accordance with the directives of Section 2 of NAVFAC P-307. In addition to the routine maintenance inspections prescribed in Section 2 of NAVFAC P-307, repairs to load bearing, load controlling or operational safety items made during the certification period must be inspected.





Category 1 Crane Inspection Frequencies

Each command has the ability to choose between category 1 crane maintenance inspections based on the calendar or by engine hours. Calendar based inspections are as follows: "A" Inspections are conducted every 4 months, plus 10 days. "B" Inspections are conducted every third "A" inspection, but annually as a minimum. "C" Inspections are conducted every third "B" inspection.

Category 1 Crane Inspection Frequencies

If the category 1 crane inspection frequency is measured by engine hours: A 'Type A' inspection is required every 500 engine operating hours, plus 50 hours. A 'Type B' inspection is required every 2,000 engine operating hours plus 200 hours or annually as a minimum. A 'Type C' inspection is required every 8,000 engine operating hours plus 800 operating hours.

Inspection Frequencies for Category 2, 3 and 4 Cranes:

Inspect category 2, 3 and 4 cranes annually, in conjunction with the annual certification. For cranes certified every two years, the first annual inspection shall be within plus or minus 30 days of the certification anniversary date.

Inspection Aids

An inspector must be able to recognize abnormal conditions by understanding normal conditions and characteristics of the equipment. This involves knowing what the equipment looks, sounds, feels, and smells like. This involves knowing how the equipment properly operates and knowing when unusual conditions exist. Learn to recognize the noise caused by metal-to-metal contact, which may indicate a bad bearing, or abnormal odors, which can indicate scorching insulation. Feel the bearing housing for evidence of vibration and excessive heat. Also inspect the bearing housings for the possibility of creeping grease on the inside of the motor which might harm the insulation.

COMMON ATTRIBUTES

Some common attributes that apply to both pre-inspection and post-inspection and are applicable to all types of electrical equipment are damaged wiring, proper lubrication, cleanliness, loose or missing hardware and loose connections. The maintenance inspection specification and record found in Appendices C and D of NAVFAC P307 should be used as a guideline and the above elements can be applied to each item inspected.

Wiring

Many electrical items on NAVFAC P-307 maintenance inspection specification and record also known as the MISR for category 1 cranes or AMISR for annual inspections performed on Cat 2, 3 and 4 cranes, require that wiring be inspected for damage or deterioration. This applies to cables that enter into the machinery, wiring between the cable entry point and components including flexible shunts and connections including jumpers and risers. Damage or deterioration can be found on the conductor's insulation, or the conductor itself.

Proper Lubrication Frequency and Type

Most motors, generators, and alternators are properly lubricated at the time of manufacture, and it is not necessary to lubricate them at the time of installation. However, if they have been in storage for a period of 6 months or longer, they should be re-lubricated before starting. The type of grease is important. Unless specified otherwise by the unit's manufacturer or your local engineering group, Mobil Product 28 or equivalent shall be used on all motors. This type of grease does not break down the winding insulation in the unit.

Proper Lubrication Quantity

The quantity of grease is important. Remember, too much grease is as detrimental as insufficient grease. Ball Bearings that are correctly lubricated upon installation could be expected to run continuously under full load for 15 years without further lubrication, so, insufficient grease tends not to be a problem. Too much grease, on the other hand, usually spreads to the windings of these rotating machines where it decreases the unit's life and reliability. For this reason, a lubrication procedure that insures that grease is available to the bearing and that does not force grease into the unit under pressure must be used.

CLEANING

It's important for electrical equipment to be kept clean. The dirtier the environment, the more often cleaning will have to be performed by maintenance personnel. Inspect and verify that electrical components, cabinets, and air filters are clean and free of dirt, grit, water, oil, grease, paint and other foreign material.

CONNECTIONS

Most of the electrical connections for rotating machinery are made in the cable entry box. To completely inspect for the loose connections specified in many of the electrical items found in NAVFAC P-307 Maintenance Inspection Specification and Record, the applied insulation must removed. If these leads are to be disturbed for repair, the connections should be inspected after the lugs are crimped on the cables; the fasteners have been installed and torqued per specifications as addressed in the Fasteners Lesson, and before the insulating tape is applied.

HARDWARE

Electrical machinery is usually made up of components that are fastened together. In this equipment in the component are electrical hardware, mechanical hardware, stationary and moving components. In this illustration of an alternator exciter and a contactor there are examples of each. It is imperative that all hardware is installed properly.

Alternator Exciter

Contactor

INSPECTOR DISCIPLINES

If one person is to perform both the electrical and the mechanical inspections, their training and background shall reflect both disciplines.
If both electrical and mechanical inspectors perform an inspection, then they should address the appropriate elements of NAVFAC P-307 MISR.

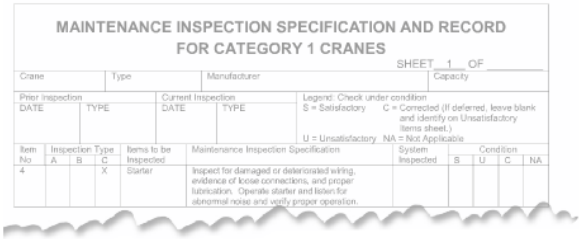
SHARED ITEMS

There is a group of items in NAVFAC P-307 Maintenance Inspection Specification and Record that are electrical in nature; but, are associated with engines, are low voltage, and are usually maintained by mechanics. They can be inspected by either discipline. These items are the starter, the battery charging system including the battery and cables, engine wiring, gauges and engine alarm safety devices.

Engine Starters

Inspect the engine starter for damaged or deteriorated wiring, evidence of loose connections and proper lubrication. Operate the starter and listen for abnormal noise and verify proper operation.

Engine Starters


MAINTENANCE INSPECTION SPECIFICATION AND RECORD
FOR CATEGORY 1 CRANES

SHEET 1 OF

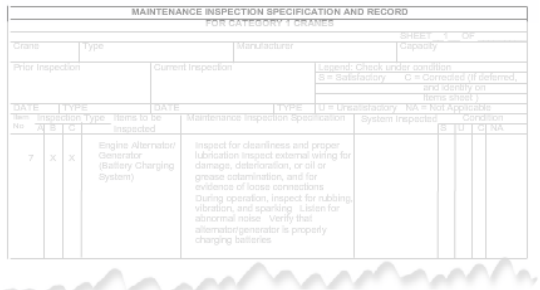
Crane	Type	Manufacturer	Capacity

Prior Inspection		Current Inspection		Legend: Check under condition
DATE	TYPE	DATE	TYPE	S = Satisfactory C = Corrected (If deferred, leave blank and identify on Unsatisfactory Items sheet.) U = Unsatisfactory NA = Not Applicable

Item No	Inspection Type A	B	C	Items to be Inspected	Maintenance Inspection Specification	System Inspected	Condition S	U	C	NA
4			X	Starter	Inspect for damaged or deteriorated wiring, evidence of loose connections, and proper lubrication. Operate starter and listen for abnormal noise and verify proper operation.					

- Inspect engine starters for:
  - damaged or deteriorated wiring
  - evidence of loose connections
  - proper lubrication
- Operate starter and:
  - listen for abnormal noise
  - verify proper operation

Engine Alternator / Generator


MAINTENANCE INSPECTION SPECIFICATION AND RECORD
FOR CATEGORY 1 CRANES

SHEET 1 OF

Crane	Type	Manufacturer	Capacity

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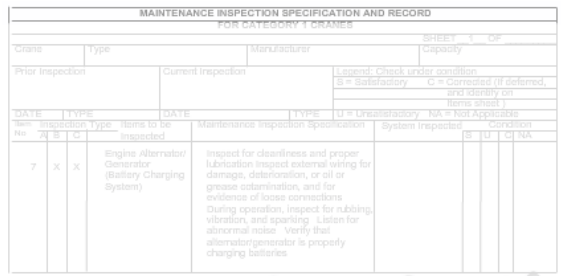
Item No	Inspection Type A	B	C	Items to be Inspected	Maintenance Inspection Specification	System Inspected	Condition S	U	C	NA
7	X	X		Engine Alternator/ Generator (Battery Charging System)	Inspect for cleanliness and proper lubrication Inspect external wiring for damage, deterioration, or oil or grease contamination, and for evidence of loose connections During operation, inspect for rubbing, vibration, and sparking. Listen for abnormal noise. Verify that alternator/generator is properly charging batteries					

- Inspect the alternator or generator for:
  - cleanliness
  - proper lubrication

Engine Alternator/Generator

Inspect the alternator or generator for cleanliness and proper lubrication.

Inspect External Wiring


MAINTENANCE INSPECTION SPECIFICATION AND RECORD
FOR CATEGORY 1 CRANES

SHEET 1 OF

Crane	Type	Manufacturer	Capacity

Prior Inspection		Current Inspection		Legend: Check under condition
DATE	TYPE	DATE	TYPE	S = Satisfactory C = Corrected (If deferred, leave blank and identify on Items sheet.) U = Unsatisfactory NA = Not Applicable

Item No	Inspection Type A	B	C	Items to be Inspected	Maintenance Inspection Specification	System Inspected	Condition S	U	C	NA
7	X	X		Engine Alternator/ Generator (Battery Charging System)	Inspect for cleanliness and proper lubrication Inspect external wiring for damage, deterioration, or oil or grease contamination, and for evidence of loose connections During operation, inspect for rubbing, vibration, and sparking. Listen for abnormal noise. Verify that alternator/generator is properly charging batteries					

- Inspect external wiring for:
  - damage
  - deterioration
  - oil or grease contamination
  - evidence of loose connections

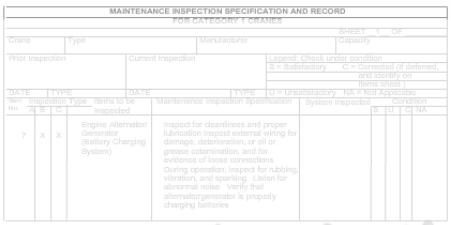
EXTERNAL WIRING

Inspect external wiring for damage, deterioration, oil or grease contamination and evidence of loose connections.

ENGINE ALTERNATOR/GENERATOR-DURING OPERATIONS

During operation, inspect for rubbing, vibration, sparking and abnormal noise.

Inspection During Operation



- During operation, inspect engine alternator / generator for :
  - rubbing
  - vibration
  - sparking
  - abnormal noise.

Engine Alternator/Generator - Verify Battery Charge

Verify alternator/generator is properly charging batteries.

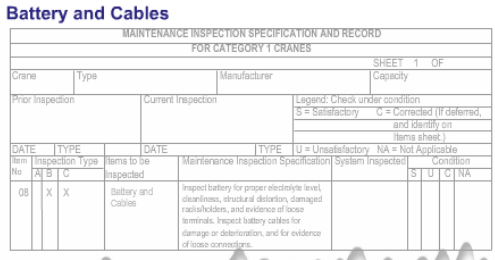
Engine Alternator/Generator

Verify that alternator or generator is properly charging the batteries.

Battery and Cables

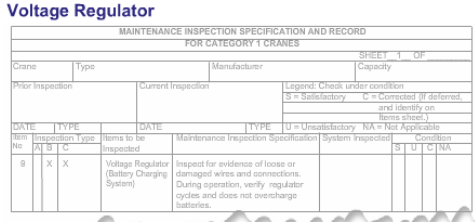
Inspect battery for proper electrolyte level, cleanliness, structural distortion, damaged racks/holders and evidence of loose terminals.
Inspect the battery cables for damage, deterioration and evidence of loose connections.

Battery and Cables



- Inspect battery for proper:
  - electrolyte level
  - cleanliness
  - structural distortion
  - damaged racks/holders
  - evidence of loose terminals
- Inspect battery cables for:
  - damage
  - deterioration
  - evidence of loose connections

Voltage Regulator



- Inspect voltage regulator for evidence of loose or damaged wires and connections
- During operation, verify regulator:
  - cycles properly
  - does not overcharge batteries

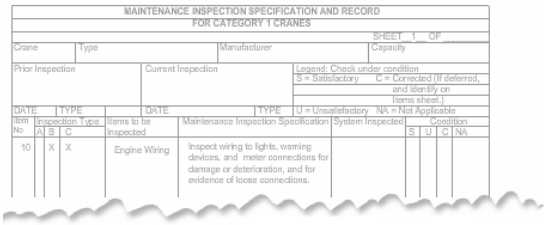
Voltage

Inspect for evidence of loose or damaged wires and connections. During operation, verify the regulator cycles properly and does not overcharge batteries.

Engine Wiring

Inspect wiring to lights, warning devices, and meter connections for damage, deterioration and evidence of loose connections.

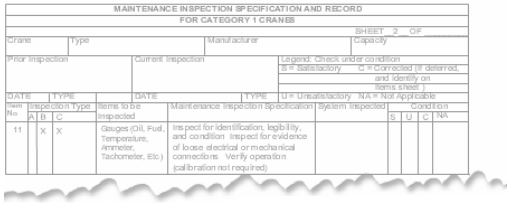
Engine Wiring


MAINTENANCE INSPECTION SPECIFICATION AND RECORD
FOR CATEGORY 1 CRANES

Item No	Inspection Type A	B	C	Items to be Inspected	Maintenance Inspection Specification	System Inspected	Condition S	U	C	NA
10	X	X		Engine Wiring	Inspect wiring to lights, warning devices, and meter connections for damage or deterioration, and for evidence of loose connections.					

- Inspect wiring to lights, warning devices, and meter connections for
  - damage
  - deterioration
  - evidence of loose connections

Gauges


MAINTENANCE INSPECTION SPECIFICATION AND RECORD
FOR CATEGORY 1 CRANES

Item No	Inspection Type A	B	C	Items to be Inspected	Maintenance Inspection Specification	System Inspected	Condition S	U	C	NA
11		X	X	Gauges (Oil, Fuel, Temperature, Ammeter, Tachometer, Etc.)	Inspect for identification, legibility, and condition. Inspect for evidence of loose electrical or mechanical connections. Verify operation (calibration not required)					

- Inspect gauges for:
  - identification
  - legibility
  - condition
  - evidence of loose connections
- Verify operation of gauges - calibration not required

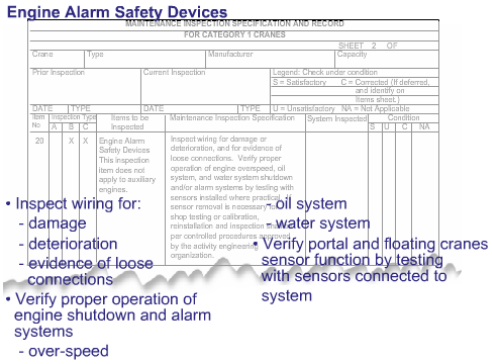
Gauges

Inspect gauges for identification, legibility, condition and evidence of loose electrical or mechanical connections. Verify operation. Calibration is not required.

Engine Alarm Safety Devices

Inspect wiring for damage, deterioration and evidence of loose connections. Verify proper operation of engine over-speed shutdown, oil and water system shutdown and alarm systems. Verify sensors function properly by testing with sensors connected to system. If sensor removal is necessary for shop testing or calibration, reinstallation and inspection shall be per controlled procedures approved by the activity engineering organization.

Engine Alarm Safety Devices


MAINTENANCE INSPECTION SPECIFICATION AND RECORD
FOR CATEGORY 1 CRANES

Item No	Inspection Type A	B	C	Items to be Inspected	Maintenance Inspection Specification	System Inspected	Condition S	U	C	NA
20		X	X	Engine Alarm Safety Devices This inspection item does not apply to auxiliary engines.	Inspect wiring for damage or deterioration, and for evidence of loose connections. Verify proper operation of engine overspeed, oil system, and water system shutdown and/or alarm systems by testing with sensors installed where practical. If sensor removal is necessary for shop testing or calibration, reinstallation and inspection shall be per controlled procedures approved by the activity engineering organization.					

- Inspect wiring for:
  - damage
  - deterioration
  - evidence of loose connections
- Verify proper operation of engine shutdown and alarm systems
  - over-speed
  - oil system
  - water system
- Verify portal and floating cranes sensor function by testing with sensors connected to system

Review and Summary

Basic Inspection Techniques identified areas of concern associated with electrical inspection and general NAVFAC P-307 electrical requirements and discussed electrical inspection items that can be addressed by a mechanical inspector.

NOTES

BASIC INSPECTION TECHNIQUES MODULE EXAM

Online exam questions may appear in a different order than those shown below.

1. Common inspection attributes include all the following except _____.

A. damaged wiring
B. loose connections
C. proper lubrication
D. cleanliness
E. high megger readings

2. Some common attributes that apply to both pre-inspection and post-inspection and are applicable to all types of electrical equipment are:

A. proper gap
B. damaged wiring
C. proper lubrication
D. loose or missing hardware
E. cleanliness
F. misalignment

3. Which of the following statements BEST describes the calibration requirements for meters and gauges?

A. they are calibrated only when the crane has been out of service for more than 6 months
B. they are calibrated after the crane has received a direct lightning strike
C. there is no requirements for annual calibration; they are inspected for overall condition and function
D. none of the listed statements is correct

4. To completely inspect for loose connections:

A. all listed items are correct
B. lugs must be crimped on the cables
C. fasteners must be installed and torqued properly
D. insulation must be removed.

5. Where one person performs an inspection on both mechanical and electrical components, what determines suitability to the task?

A. training and background
B. grades and certifications
C. pay grade and step
D. resume and employment contract

6. To perform a pre-inspection on a motor wiring circuit, an inspector should open up the motor connection box and _____.

A. remove the tape
B. perform none of the listed actions
C. perform all listed actions
D. torque check the fasteners
E. check for signs of overheating

7. If sensor removal is necessary for shop testing or calibration, reinstallation and inspection shall be per _____.

A. none of the items listed
B. controlled procedures approved by the activity engineering organization
C. NAVFAC P-307, Appendix C
D. National Electric Code specifications

8. What lubricant or its equivalent is satisfactory for use in electrical equipment?

A. Mobil product 28
B. 100% vegetable oil
C. castor oil
D. all listed lubricants
E. mollilube

9. Who authorizes the proper lubricant for motors and generators?

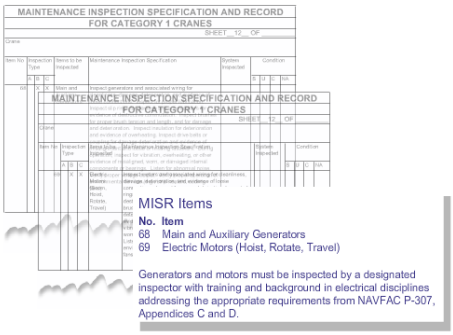
A. Navy Crane Center
B. crane engineering
C. Mobil oil
D. original equipment manufacturer

10. The following is an important factor in the life and reliable operation of motors and generators.

A. cooling
B. proper and timely inspection
C. lubrication
D. all listed factors
E. cleanliness

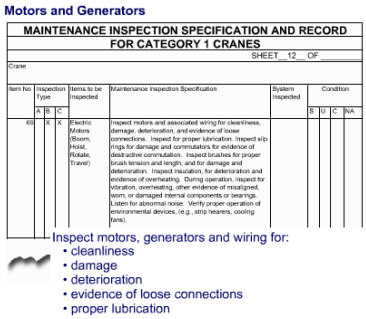
ROTATING EQUIPMENT INSPECTIONS

Recommended Items
Generators and motors must be inspected by a designated inspector with training and background in electrical disciplines. They must use the appropriate requirements from the NAVFAC P-307, Appendices C and D and record the findings on the applicable MISR or AMISR.



GENERAL CONDITIONS

When inspecting the general conditions of electrical machinery pay attention to the wiring, lubrication, cleanliness, hardware and connections.



Motors and Generators

Inspect motors and generators and associated wiring for cleanliness, damage, deterioration evidence of loose connections and proper lubrication.

BEARING MAINTENANCE

Proper lubrication of motor bearings is essential for reliable motor operation. Minimum lubrication may be sufficient. Over lubrication that forces grease into the motor windings is more detrimental then under lubrication. A formal lubrication process will insure proper lubrication and guard against over lubrication. If necessary, use in-process inspection to verify proper lubrication. A sound minimum process is shown.

SLIP RINGS AND COMMUTATORS

Inspect slip rings and commutators for damage and evidence of destructive commutation.

SLIP RING EVALUATION

The slip rings are the collectors that electrically connect the wound rotor to external circuits. To insure good electrical conductivity, a proper film must be maintained on the face of the slip rings. If the slip ring is true and free of blemishes, a clear, varnish like film should build up. The face of the slip rings must be round and true to the axis of rotation. If the ring is more than a few thousandths out of round, brush wear will be greatly increased. In such cases the ring may need to be removed and machined. Minor grooves, pits, and gouges can be stoned in place. If the surface is grooved, the brush tension is too high, the brush is too hard, or the brush has contamination in its face. If the surface is chalky, the brush tension is too light or there are contaminants in the atmosphere.

Perfect Commutator

A perfect commutator film is clear, tan and shiny. To achieve this film, the proper brush with the proper tension must be run at a constant load in one direction with clean air at constant humidity. Most motors on cranes are not constant load, must turn in both directions, and ran in a contaminated atmosphere having large variances in humidity. An experienced inspector realizes that a perfect film is not possible and judges crane commutators accordingly

NORMAL COMMUTATOR –BLEMISHED

A normal commutator is lightly mottled with dark patches in a random pattern caused by airborne contamination. No action is required.

Normal Commutator - Heavy Film

A heavy dark film over the entire surface can be cleaned with folded canvas applied to the running commutator.

Normal Commutator – Slot Bar Marking

Slot Bar Marking is noted by a slightly darker film on one bar in a pattern caused by a slight imbalance in multi coil armature windings. No action is required.

Commutator Needing Repair-Streaking

Streaking is characterized by fine lines in the film finish. It is the beginning of copper transfer to the brush face. An electrician should lightly stone the commutator and reseat the brushes.

COMMUTATOR NEEDING REPAIR-THREADING

Threading is characterized by lines in the film finish resulting from copper being transferred to brush face. An electrician should stone and chamfer the commutator and replace the brushes

COMMUTATOR NEEDING REPAIR-GROOVING

Grooving is noted by a distinct loss of material in the brush path. This condition can be caused by improper brush-hardness or brush tension, to current balance. This can be corrected by machining the commutator to restore an even surface and replacing the brushes with the correct brushes adjusted to match the current ratio.

COMMUTATOR NEEDING REPAIR-COPPER DRAG

Copper Drag is the build-up of copper on the trailing edge of the commutator bars resulting from poor film maintenance. Correct by slotting, chamfering and stoning the commutator and, replacing brushes.

COMMUTATOR NEEDING REPAIR-PITCH BAR MARKING

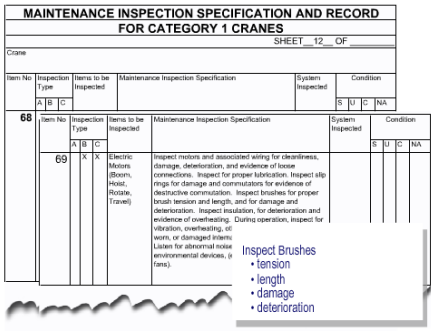
Pitch bar marking is indicated by burned spots. It is caused by instantaneous armature over-current on one brush. Clean the commutator with canvas and check all brush rigging connections.

COMMUTATOR NEEDING REPAIR-HEAVY SLOT BAR MARKING

Heavy slot bar marking is the etching of the trailing edge of the commutator bar caused by armature winding unbalance. This is a serious condition requiring rewinding the rotor, and re-machining the commutator.

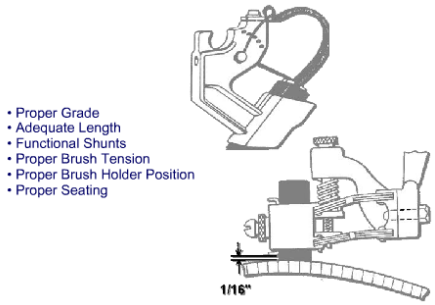
BRUSH INSPECTION

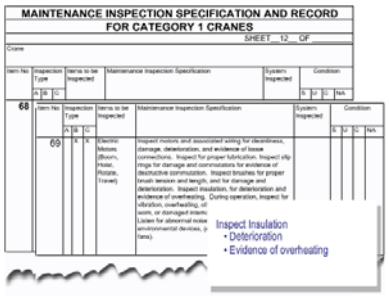
Inspect brushes for proper tension, length, damage and deterioration.



BRUSH EVALUATION

Brushes are the consumable component of motors and generators. They must be the proper grade as recommended by the manufacturer. They must be adequate length to provide enough brush material to accommodate the predicted wear for one maintenance period. The shunts must be in good electrical condition. The brush tensioning device must provide the correct pressure for the brush used. The brush holder must be positioned correctly to provide adequate support for the brush. The standard recommendation is 1/16th of an inch from the surface of the commutator or slip ring unless the OEM specifies a different clearance. The brush must be properly seated. The surface of the brush next to the slip ring or commutator must be smooth, without chipped edges and without imbedded impurities.



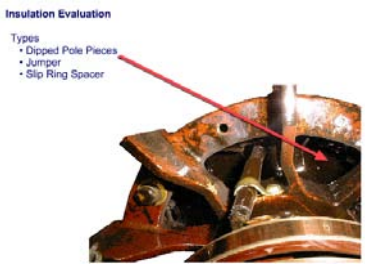


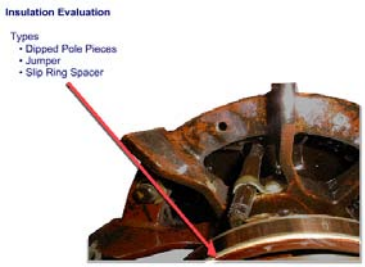
INSULATION INSPECTION

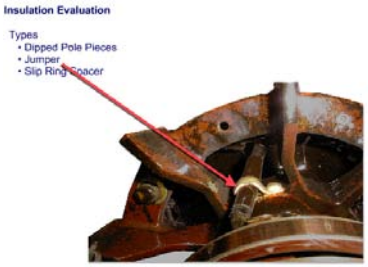
Inspect insulation for deterioration and evidence of overheating.

INSULATION EVALUATION

Insulation comes in different forms. These dipped pole pieces are varnish insulated. Insulation is used on internal jumpers. The slip ring spacers are made of a solid insulating material.

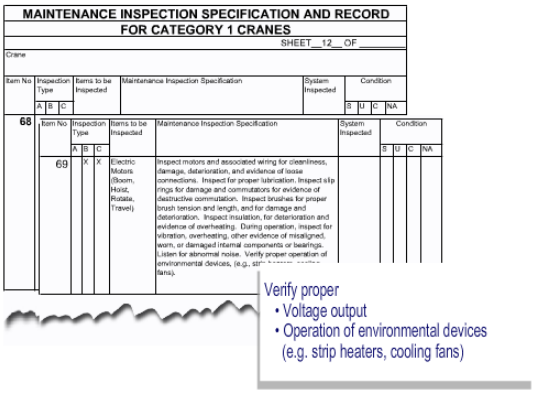






VERIFY OUTPUT

Verify proper voltage output. Generators and alternators should produce the name plate rated voltage, and should not drop appreciably when brought to full load. Check the operation of environmental devices such as strip heaters and cooling fans.

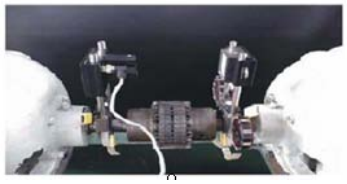


Drive Belts or Coupling

Inspect drive belts or coupling for damage deterioration evidence of misalignment and loose or missing fasteners.

COUPLING ALIGNMENT

Poorly aligned couplings will get hot, throw grease, and make noise. However, to be aligned to specifications, precision instruments are required. For this reason verification of alignment is best done as an in-process inspection. The Equipment History File must include coupling alignment data with verification signatures for load bearing or load controlling couplings.



COUPLING ALIGNMENT OPERATIONAL CHECK

During operation, inspect for vibration, overheating and other evidence of misalignment. Also, check for worn or damaged internal components or bearings and abnormal noise.

REVIEW AND SUMMARY

This module identified inspection items applicable to motors and generators and associated the appropriate inspection techniques with the applicable NAVFAC P-307 specifications.

NOTES

ROTATING EQUIPMENT INSPECTIONS MODULE EXAM

Online exam questions may appear in a different order than those shown below.

1. In addition to the maintenance inspection specifications listed for motors, the inspector shall also verify a generator's _____.

A. bearing temperatures
B. megger readings
C. voltage output
D. full load current

2. Which of the following commutator conditions poses the most concern?

A. blemishes
B. heavy film
C. grooving
D. slot bar marking
E. perfect film

3. The brush condition that produces poor commutation is _____.

A. improper brush tension
B. all listed conditions
C. none of the condition listed
D. improper brush seating
E. improper brush hardness

4. Which of the following commutator conditions poses the least concern?

A. streaking
B. pitch bar marking
C. slot bar marking
D. threading
E. copper drag

5. What condition would an electrical inspector normally relate to a questionable shaft alignment?

A. none of the conditions listed
B. coupling gets hot
C. coupling throws grease
D. coupling makes noise
E. all of the listed conditions

6. Which characteristic of DC motors used on crane functions prevents an ideal commutating film from forming?

A. varying load
B. none of the characteristics listed
C. all of the characteristics listed
D. reversing
E. varying speed

7. Motor winding insulation is generally _____.

A. THHN
B. solid mica
C. dipped varnish
D. PVC Thermoset
E. dipped Plastisol

8. Slip rings shall be inspected to evaluate _____.

A. the condition of the faces
B. for all conditions listed
C. for none of the conditions listed
D. the condition of the film
E. out or found conditions

CONTROLLER INSPECTIONS

DEFINITIONS - CONTROLLER

A controller is the device that connects motor leads to power or regulates the power to those motor leads. A drum controller is a multiple connection, manually operated switch that provides control switching. A magnet controller employs relays and contactors to provide control switching.

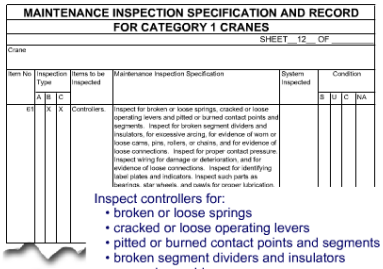
Definitions - Continued

An electronic drive employs solid state devices to provide control switching. A master-switch is a multiple connection, manually operated switch that provides a low voltage, low current signal to operate a controller.

CONTROLLERS - INSPECTION

Inspect for broken or loose springs, cracked or loose operating levers, pitted or burned contact points and segments, broken segment dividers and insulators and excessive arcing. Look for evidence of worn or loose cams, pins, rollers, or chains.

Controllers - Inspection



MAINTENANCE INSPECTION SPECIFICATION AND RECORD
FOR CATEGORY 1 CRANES

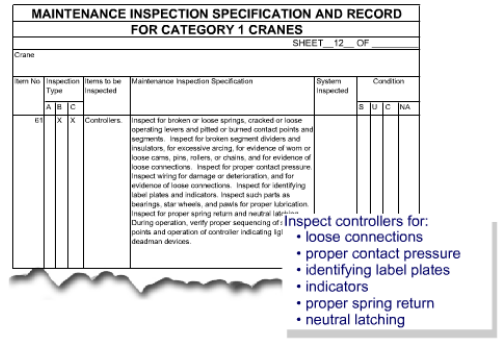
SHEET__12__ OF _____

Crane

Item No	Inspection Type A	Inspection Type B	Inspection Type C	Items to be Inspected	Maintenance Inspection Specification	System Inspected	Condition B	Condition U	Condition C	Condition NA
E1		X	X	Controllers.	Inspect for broken or loose springs, cracked or loose operating levers and pitted or burned contact points and segments. Inspect for broken segment dividers and insulators, for excessive arcing, for evidence of worn or loose cams, pins, rollers, or chains, and for evidence of loose connections. Inspect for proper contact pressure. Inspect wiring for damage or deterioration, and for evidence of loose connections. Inspect for identifying label plates and indicators. Inspect such parts as bearings, star wheels, and pawls for proper lubrication.					

Inspect controllers for:
- broken or loose springs
- cracked or loose operating levers
- pitted or burned contact points and segments
- broken segment dividers and insulators
- excessive arching
- evidence of worn or loose cams, pins, rollers, or chains

Controllers - Inspection



MAINTENANCE INSPECTION SPECIFICATION AND RECORD
FOR CATEGORY 1 CRANES

SHEET__12__ OF _____

Crane

Item No	Inspection Type A	Inspection Type B	Inspection Type C	Items to be Inspected	Maintenance Inspection Specification	System Inspected	Condition B	Condition U	Condition C	Condition NA
E1		X	X	Controllers.	Inspect for broken or loose springs, cracked or loose operating levers and pitted or burned contact points and segments. Inspect for broken segment dividers and insulators, for excessive arcing, for evidence of worn or loose cams, pins, rollers, or chains, and for evidence of loose connections. Inspect for proper contact pressure. Inspect wiring for damage or deterioration, and for evidence of loose connections. Inspect for identifying label plates and indicators. Inspect such parts as bearings, star wheels, and pawls for proper lubrication. Inspect for proper spring return and neutral latching. During operation, verify proper sequencing of points and operation of controller indicating lgt deadman devices.					

Inspect controllers for:
- loose connections
- proper contact pressure
- identifying label plates
- indicators
- proper spring return
- neutral latching

Controller - Inspections (Continued)

Inspect controllers for loose connections, proper contact pressure, function labels, indicators, proper spring return and neutral latching.

Controller - Inspections (Continued 2)

Inspect wiring for damage, deterioration and evidence of loose connections. Inspect bearings, star wheels, and pawls for proper lubrication. During operation, verify proper sequencing of speed points, operation of controller indicating lights and dead-man devices.

Controllers - Inspections (Continued 2)

MAINTENANCE INSPECTION SPECIFICATION AND RECORD FOR CATEGORY 1 CRANES

SHEET 1 OF

Crane	Type	Manufacturer	Capacity

Prior Inspection		Current Inspection		Legend: Check under condition
DATE	TYPE	DATE	TYPE	S = Satisfactory C = Corrected (If deferred, leave blank and identify on Unsatisfactory Items sheet.) U = Unsatisfactory NA = Not Applicable

Item No	Inspection Type A	B	C	Items to be Inspected	Maintenance Inspection Specification	System Inspected	Condition S	U	C	NA
4			X	Starter	Inspect for damaged or deteriorated wiring, evidence of loose connections, and proper lubrication. Operate starter and listen for abnormal noise and verify proper operation.					

Inspect wiring for:
- damage
- deterioration
- evidence of Loose Connections

Inspect for proper lubrication of:
- bearings
- star wheels
- pawls

During operation, verify proper:
- sequencing of Speed Points
- operation of controller Indicating Lights
- Deadman Devices

Controller Springs

In drum controllers:
- springs hold contact points against the segments

In master switches:
- springs hold the switch actuators against the cams

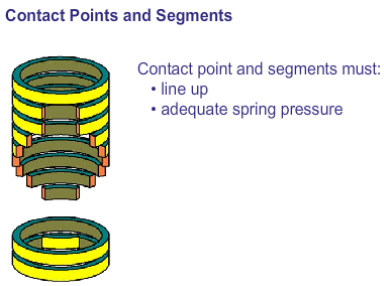
In drum controllers and master switches:
- detent spring holds the pawl against star wheel

Controller Springs

In drum controllers contact points are held against the segments by springs. In master switches springs hold the switch actuators against the cams. In both controllers the detent spring holds the pawl against the star wheel.

Operating Leavers

Operating levers should be tight enough to assure positive speed control but loose enough to be easily operated. Both drum controllers and master switches can have spring return to the off position. Levers should return to neutral from any speed point when released. The operating lever shall have a positive latch, in the neutral position that resists accidental movement. If the unit is stepped, then each speed point should have positive detent so as to clearly indicate the location of each point.



Contact Points and Segments

The contact points and the segments that form the drum, must line up to provide a good electrical connection. They must have adequate spring pressure as to prevent arcing on the segments and be loose enough as to prevent damaging the leading edges of the contact points.

Segment Dividers and Insulators

The segment dividers and insulators within the controller shall be correctly installed, tightly mounted, free of contaminants and cracks.

Cams, Pins, Rollers and Chains

Cams, pins, rollers, or chains shall be correctly installed, tightly mounted and properly lubricated.

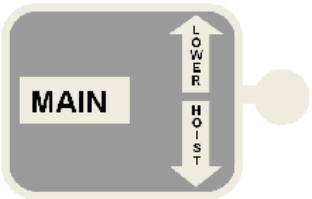
Loose Wiring and Connections

Inspect all wiring and connections including jumpers, contacts, conductors and shunts for tight connections, deterioration and damage.

Identifying Label Plates

Each controller and master switch shall be clearly marked to indicate function and direction.

Operational Check



Operate controllers and master switches to verify:
- sequencing
- speed points
- indicator lights
- operation

Operational Check

Operate each controller and master switch and verify proper sequencing, speed points, indicating lights and operation.

Speed Points

Each type of controller has unique characteristics. Knowledge of these characteristics is necessary to correctly evaluate the performance of the function. Constant voltage DC resistive controls have positive control when lowering. The hoist runs up about twice as fast as when lowering and an empty hook travels twice as fast as a fully loaded hook. Wound rotor motors [with mechanical load brakes] exhibit variable speeds, whether hoisting or lowering, depending on the load applied. This speed “curve” needs to be understood when inspecting these types of controls.

Speed Points – Continued

Wound rotor motors with electric load brakes have good speed regulation with a fully loaded hoist, fair speed point definition with an empty hook and good speed regulation when lowering. Electronic drive control modules usually have good speed regulation in both directions.

Controlling Indicating Lights

If the controller is equipped with indicators lights, compare the operation to the schematic to determine that the indicators operate properly.

DEADMAN DEVICES

A deadman device is intended to prevent accidental or inadvertent operation of a crane function due to an incapacitated operator.

Each deadman device prevents operation unless activated. Most prevent operation of all functions. Once a deadman control stops a function, that function should not restart without returning the control to neutral. Some require that all functions be returned to neutral.

CONTROL PANELS, RELAYS, COILS

Inspect transfer switch and disconnect switch contacts for proper alignment, pitting, evidence of excess heating and arcing. Inspect overload devices for evidence of loose connections and overheating. Inspect coil, contact leads and shunts for insulation breakdown and evidence of overheating. Inspect wiring for damage, deterioration, and evidence of loose connections. Inspect fuses and fuse holders for type, rating and proper f

Control Panels, Relays, Coils – (Continued)

Inspect circuit breakers and switches for cleanliness and proper operation. Inspect panel boards and arc shields for cracks, evidence of loose or missing fasteners, cleanliness and moisture. Manually operate relays, switches, contactors, and interlocks, and verify that all moving parts operate freely, without binding or excessive play.

Control Panels, Relays, Coils – (Continued)

Inspect enclosures for cleanliness, damage, evidence of loose or missing fasteners and gaskets. During operation, verify proper operation of panel indicating lights, contactor sequence, and environmental devices such as strip heaters and cooling fans.

Contacts

The contacts must be properly aligned to insure proper electrical contact. They must not be pitted to the point of interfering with the proper operation of the unit or show indications of excessive heat or arcing.

Leads and Shunts

Leads and shunts must be closely examined for signs of insulation breakdown or overheating.

Wiring

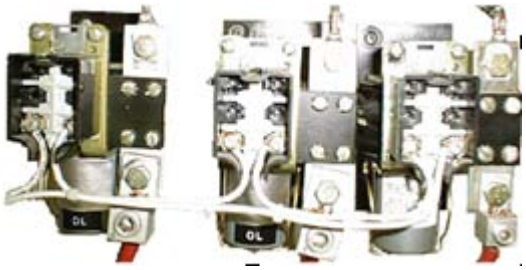
All wiring must be free of damage and deterioration. There should be no evidence of overheating, which can be caused by loose connections.

Fuses

All fuses must be checked against the crane schematic, blueprint, tech manual, and/or name plate data to ensure proper rating and type. Also, the fuse and fuse holder shall be free of evidence of loose connections and overheating.

Overload Devices

Overload devices must not have loose connections or evidence of overheating



Circuit Breakers and Switches

Circuit breakers and switches must be checked for cleanliness and proper operation.

Panel Boards and Arc Shields

Panel boards and arc shields must be free of cracks and have no loose or missing fasteners. Inspect for cleanliness and moisture.

Manually Operate Relays, Switches, Contractors and Interlocks

Manually operate relays, switches, contactors, and interlocks to verify that all moving parts operate freely without binding or excessive play. Contacts on relays and contactors must mate properly. The contactor and relay armature should travel a little further after the contacts close. Contactor contacts should have a rocking action as their armature moves from first contact to fully actuated. Mechanical interlocks between relays and contactors should operate in a manner that prevents both contactors from being closed at the same time.

Enclosures

Inspect enclosures for cleanliness, damage and evidence of loose or missing fasteners and gaskets.

Verify Proper Operation

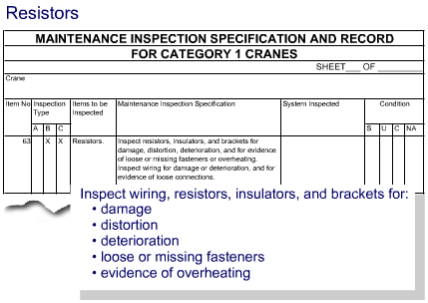
During operation, verify proper operation of panel indicating lights. Check contactor sequence. Each controller should have a schematic and a sequencing chart stored in or on its door, to be used for troubleshooting. Verify sequencing and proper operation of panel indicating lights. Check environmental devices such as strip heaters and cooling fans

Electronic Drive Control Systems

Inspect wiring for damage or deterioration and evidence of loose connections. Visually inspect components for evidence of damage or overheating. Inspect the drive for dust, dirt and debris.

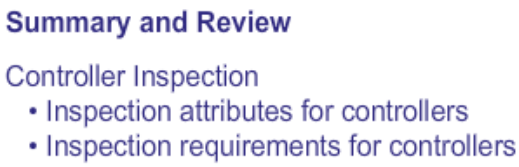
Resistors

The heat makes resistor components brittle and more susceptible to damage. The heat can cause the metal components to deform. Inspect wiring, resistors, insulators, and brackets for damage, distortion, deterioration and evidence of loose or missing fasteners, or overheating. The extreme changes in temperature can cause fasteners to loosen on the resistor. Heat will eventually break down the insulation on the wiring. When the insulation has deteriorated to the point where there is a possibility of shorting, it should be replaced.



Summary and Review

This module covered controller inspection including insp
inspection requirements for controllers.



NOTES

CONTROLLER INSPECTION MODULE EXAM

Online exam questions may appear in a different order than those shown below.

1. A deadman device _____.

A. honors all operators that died in the line of duty
B. prevents accidental or inadvertent operation
C. provides control upon loss of power
D. incapacitates the operator
E. allows only qualified operators to control the crane

2. Inspection of a controller includes checking wiring, hardware and labeling, but also includes _____.

A. contact alignment procedures
B. operational/function test
C. contact air gap measurement
D. checking for residual magnetization
E. all the listed items

3. Each drum controller and masterswitch shall be operated and verified for proper _____.

A. operation
B. sequencing
C. all the listed items
D. controller indicating lights
E. speed points

4. Inspection of fuses shall include the following except _____.

A. proper type
B. proper color code
C. evidence of loose connections
D. proper rating
E. evidence of overheating

5. A drum controller is a manual switch that connects _____.

A. the motor
B. the speed control resistors
C. none of the listed parts
D. all of the listed parts
E. the power

6. Each drum controller and masterswitch shall be marked as to _____.

A. none of the items listed
B. be easily visible to the operator
C. all listed items
D. function
E. direction of motion

7. Relays, switches, contactors and interlocks shall be manually operated to verify that _____.

A. contacts on relays and contactors do not move
B. shunts provide a low resistance current path
C. contactor coils move freely
D. all listed conditions are in place
E. relay armatures operate freely

ASSOCIATED EQUIPMENT INSPECTIONS

ASSOCIATED INSPECTION ITEMS

Low voltage electrical components, like the MISR items listed here, are often maintained and inspected by qualified mechanical personnel. Check with activity management, safety and/or engineering organizations for policies and component ratings regarding allowable low voltage electrical work by mechanical personnel. High voltage electrical work shall only be performed by qualified electrical personnel. Component voltage can vary on different cranes. For example, collector ring assemblies on mobile cranes are usually low voltage while collector ring assemblies on portal cranes are high voltage. Always proceed with caution when working in or around electrical components.

Associated Inspection Items

48 Center Collector Assembly (for mobile cranes)
56 Load Indicators, Warning Devices, Shutdown Devices
57 Drum Rotation Indicators
58 Radius/Boom Angle Indicators
64 Limit and Bypass Switches
65 Warning Devices
66 Electrical Hardware and General Lighting
67 Electrical Cable Reels

Center Collector Assembly

MAINTENANCE INSPECTION SPECIFICATION AND RECORD
FOR CATEGORY 1 CRANES

SHEET 8 OF ___

Crane

Item No	Inspection Type			Items to be Inspected	Maintenance Inspection Specification	System Inspected	Condition			
	A	B	C				S	U	C	NA
48		X	X	Center Collector Assembly (Electrical or Hydraulic)	Inspect for loose or bent supports. Inspect wiring for damage or deterioration, and for evidence of loose connections. Inspect for worn brushes and proper spring tension. Inspect for loose hydraulic connections, defective tubing, and leaks. During operation, verify brush to collector ring alignment. Inspect for hydraulic leaks.					

- Inspect collectors for:
  - loose or bent supports
  - worn brushes
  - proper spring tension
- Inspect wiring for:
  - damage or deterioration
  - evidence of loose connections

CENTER COLLECTOR ASSEMBLY

Inspect the center collector assembly for loose or bent supports, worn brushes and proper spring tension. Inspect wiring for damage or deterioration and evidence of loose connections. During operation, verify brush to collector ring alignment.

LOAD INDICATORS

Inspect wiring on load indicating devices for damage, deterioration and evidence of loose connections. Verify proper operation and ensure that measurements are within tolerance.

Load Indicators

MAINTENANCE INSPECTION SPECIFICATION AND RECORD
FOR CATEGORY 1 CRANES

SHEET 8 OF ___

Crane

Item No	Inspection Type			Items to be Inspected	Maintenance Inspection Specification	System Inspected	Condition			
	A	B	C				S	U	C	NA
56		X	X	Load Indicators, Load Warning Devices, Load Shutdown Devices	Inspect wiring for damage or deterioration, and for evidence of loose connections. These devices shall be tested for proper operation at this inspection or the CCIR/load test (mark N/A if performed at the CCIR/load test). Follow requirements of SAE J-159 for testing of category 1 and 4 mobile cranes. For other cranes, if not specified elsewhere, the accuracy requirement for all devices is plus 10 percent minus 0 percent of the actual weight. Do not test beyond 131.25 percent of rated capacity (115.5 percent for mobile cranes, mobile boat hoists, and rubber-tired gantry cranes).					

- Inspect wiring on load indicating devices for:
  - damage
  - deterioration
  - loose connections
- Verify:
  - proper operation
  - tolerance

Drum Rotation Indicators

MAINTENANCE INSPECTION SPECIFICATION AND RECORD
FOR CATEGORY 1 CRANES

SHEET_11_ OF___

Crane

Item No	Inspection Type			Items to be Inspected	Maintenance Inspection Specification	System Inspected	Condition			
	A	B	C				S	U	C	NA
57		X	X	Drum Rotation Indicators	Inspect wiring for damage or deterioration, and for evidence of loose connections. Verify proper operation.					

Drum Rotation Indicators

Inspect wiring for damage, deterioration and evidence of loose connections. Verify proper operation.

- Inspect wiring for:
  - damage
  - deterioration
  - loose connections
- Verify proper operation

Radius/Boom Angle Indicator

Verify actual radius by comparing to measured radii at the minimum and maximum boom operating positions. Measurements are made from the center line of rotation, to the centerline of the hook. Verify boom angle indications by comparing the indicated boom angle to the boom angle on the load chart corresponding to the boom length and measured radius at the minimum and maximum boom operating positions.

Radius/boom Angle Indicator

MAINTENANCE INSPECTION SPECIFICATION AND RECORD
FOR CATEGORY 1 CRANES

SHEET__11__ OF _____

Crane

Item No	Inspection Type			Items to be Inspected	Maintenance Inspection Specification	System Inspected	Condition			
	A	B	C				S	U	C	NA
58		X	X	Radius /Boom Angle Indicator	Verify radius indications by comparing against measured radii at the minimum and maximum boom operating positions. Verify boom angle indications by comparing the indicated boom angle to the boom angle on the load chart corresponding to the boom length and measured radius. This test shall be accomplished at the minimum and maximum boom operating positions. This may be performed during the CCIR/load test in lieu of this inspection (mark N/A if performed at the CCIR/load test). Follow the requirements of SAE J-159 for testing and tolerance of applicable systems.					

- Verify radius indications by comparing to measured radii
  - minimum boom operating position
  - maximum boom operating position
- Verify boom angle indications by:
  - comparing to the boom angle on the load chart
  - measure at minimum and maximum boom

Limit and Bypass Switches

MAINTENANCE INSPECTION SPECIFICATION AND RECORD
FOR CATEGORY 1 CRANES

SHEET 13 OF _____

Crane

Item No	Inspection Type			Items to be Inspected	Maintenance Inspection Specification	System Inspected	Condition			
	A	B	C				S	U	C	NA
64		X	X	Limit and Bypass Switches	Remove covers and inspect electrical and mechanical components and wiring for damage or deterioration, and for evidence of loose connections. Inspect enclosures for evidence of moisture and arcing. Inspect drive and actuating components for damage or deterioration, for proper lubrication, and for evidence of loose or missing fasteners.					

- Inspect electrical and mechanical components and wiring for:
  - damage
  - deterioration
  - loose connections
- Inspect enclosures for evidence of moisture and arcing

Limit and Bypass Switches

Inspect electrical and mechanical components and wiring for damage, deterioration and evidence of loose connections. Inspect enclosures for evidence of moisture and arcing.

Limit and Bypass Switches

Inspect drive and actuating components for damage, deterioration and proper lubrication. Look for loose or missing fasteners. During operation, verify proper functioning of limit switches, indicator lights and bypass switches.

Limit and Bypass Switches

MAINTENANCE INSPECTION SPECIFICATION AND RECORD
FOR CATEGORY 1 CRANES
SHEET 13 OF _____

Crane

Item No	Inspection Type			Items to be Inspected	Maintenance Inspection Specification	System Inspected	Condition			
	A	B	C				S	U	C	NA
64		X	X	Limit and Bypass Switches	Remove covers and inspect electrical and mechanical components and wiring for damage or deterioration, and for evidence of loose connections. Inspect enclosures for evidence of moisture and arcing. Inspect drive and actuating components for damage or deterioration, for proper lubrication, and for evidence of loose or missing fasteners.					

- Inspect components for:
  - damage
  - deterioration
  - proper lubrication
  - loose or missing fasteners
- During operation, verify proper functioning of:
  - limit switches
  - indicator lights
  - bypass switches

Warning Devices

Inspect components and associated wiring for damage, deterioration and evidence of loose connections. During operation, verify proper functioning of devices.

Warning Devices

MAINTENANCE INSPECTION SPECIFICATION AND RECORD
FOR CATEGORY 1 CRANES
SHEET__13__ OF _____

Crane

Item No.	Inspection Type			Items to be Inspected	Maintenance Inspection Specification	System Inspected	Condition			
	A	B	C				S	U	C	NA
65	X	X	X	Warning Devices (Horns, Bells, Lights, Reflectors, etc.)	Inspect components and associated wiring for damage or deterioration, and for evidence of loose connections. During operation, verify proper functioning of devices.					

- Inspect components and wiring for:
  - damage
  - deterioration
  - evidence of loose connections
- During operation, verify proper functioning of devices

Electrical Hardware and General Lighting

MAINTENANCE INSPECTION SPECIFICATION AND RECORD
FOR CATEGORY 1 CRANES
SHEET__13__ OF _____

Crane

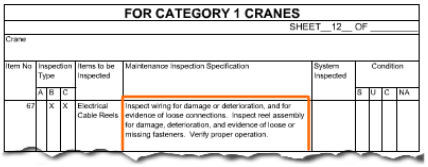
Item No	Inspection Type			Items to be Inspected	Maintenance Inspection Specification	System Inspected	Condition			
	A	B	C				S	U	C	NA
66		X	X	Electrical Hardware and General Lighting	Inspect conduits, raceways, junction boxes, light fixtures, and associated wiring for damage or deterioration, and for evidence of loose connections. Verify operation of lights. The activity engineering organization may reduce the frequency of opening enclosures based on their exposure to weather or based on past findings. The reduced frequency shall be no less frequent than a "C" frequency.					

- Inspect
  - conduits
  - raceways
  - junction boxes
  - light fixtures
  - associated wiring
- Look for evidence of:
  - damage
  - deterioration
  - evidence of loose connections
- Verify operation of lights

Electrical Hardware and General Lighting

Inspect conduits, raceways, junction boxes, light fixtures, and associated wiring for damage, deterioration and loose connections. Verify operation of lights.

Electrical Cable Reels



FOR CATEGORY 1 CRANES

SHEET__12__ OF _____

Crane

Item No	Inspection Type			Items to be Inspected	Maintenance Inspection Specification	System Inspected	Condition			
	A	B	C				B	U	C	NA
67		X	X	Electrical Cable Reels	Inspect wiring for damage or deterioration, and for evidence of loose connections. Inspect reel assembly for damage, deterioration, and evidence of loose or missing fasteners. Verify proper operation.					

- Inspect wiring and reel assembly for:
  - damage
  - deterioration
  - evidence of loose connections
  - missing fasteners
- Verify proper operation

Electrical Cable Reels

Inspect wiring and reel assembly for damage, deterioration evidence of loose connections and missing fasteners. Verify proper operation.

Review and Summary

This module covered identification of electrical inspection criteria, NAVFAC P-307 requirements and electrical inspection items that can be addressed by a mechanical inspector.

NOTES

ASSOCIATED EQUIPMENT INSPECTIONS MODULE EXAM

Online exam questions may appear in a different order than those shown below.

1. To verify indicated load radii, the inspector shall measure for the _____.

A. hook to the ground
B. hook to heal pin
C. head block to heel pin
D. hook to center pin
E. hook to head block

2. A device that allows monitory of the weight being lifted is a _____.

A. limit switch
B. scale
C. potentiometer
D. hoist interlock
E. load indicator

3. Like components installed on different types of cranes (bridge, mobile, portal) will always have the same voltage and ampere ratings; therefore, if mechanical personnel work center collector assemblies on mobile cranes they can also work center collector assemblies on portal cranes.

A. True
B. False

4. Where would mechanical personnel find policies and component ratings regarding low voltage work on cranes?

A. OEM
B. American Society of Mechanical Engineers (ASME)
C. activity safety organization
D. NFPA/NEC
E. activity engineering organization

5. An operational test is required to verify the proper operation of all of the following except _____.

A. limit switches
B. master switches
C. breakers
D. bypass switches
E. indicator lights

6. Radius indicators shall be checked at:

A. maximum boom radius
B. minimum and maximum boom radii
C. minimum boom radius
C. 30°, 45° and 60° boom angle radii

7. A Center Collector Assembly transfers power between _____.

A. the generator and the controller
B. all of the listed connections
C. none of the listed connections
D. the stationary and rotating portion of the crane
E. the controller and the motor

8. You can verify a hoist limit switch setting by comparing the specifications to _____.

A. the angle measured form center of rotation, to the center line of the hook, and that of the center of the shaft of the boom tip sheave
B. measurement of boom length
C. the load chart
D. actual weight being picked
E. physical measurement

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ELECTRICAL CRANE INSPECTOR COURSE EVALUATION

Student Name: _____

Command/Activity/Organization: _____

Instructor: _____ Date: _____

Directions: To assist in evaluating the effectiveness of this course, we would like your reaction to this class. Do not rate questions you consider not applicable.

Please rate the following items:	Excellent	Very Good	Good	Fair	Poor
Content of the course met your needs and expectations.					
Content was well organized.					
Materials/handouts were useful.					
Exercises/skill practices were helpful.					
Training aids (slides, videos, etc) were used effectively.					
Instructor presented the material in a manner, which was easy to understand.					
Instructor was knowledgeable and comfortable with the material.					
Instructor handled questions effectively.					
Instructor covered all topics completely.					
Probability that you will use ideas from the course in your work.					
Your opinion of the course.					
Your overall opinion of the training facilities.					

What were the key strengths of the training? How could the training be improved? Other comments?

_____

_____

_____

_____

List other training topics in which you are interested: _____

_____

_____

Note: If you would like a staff member to follow up and discuss this training, please provide your phone number_____