

SECTION 16

MACHINERY AND MECHANIZED EQUIPMENT

16.A GENERAL

16.A.01 Before any machinery or mechanized equipment is placed in use, it shall be inspected and tested in accordance with the manufacturer's recommendations and requirements of this manual and shall be certified in writing by a competent person to meet the manufacturer's recommendations and requirements of this manual. Subsequent reinspections will be conducted at least annually thereafter. All safety deficiencies noted during the inspection shall be corrected prior to the equipment being placed in service at the project. If at anytime the machinery or mechanized equipment is removed and subsequently returned to the project (other than equipment removed for routine off-site operations as part of the project), it shall be reinspected and recertified prior to use.

a. The Contractor shall keep records of tests and inspections. These records shall be made available in a timely manner upon request of the GDA and, when submitted, shall become part of the official project file.

b. The Contractor shall provide the GDA ample notice in advance of any equipment entering the site so that he/she may observe the Contractor's inspection process and so that spot checks may be conducted.

16.A.02 Daily/shift inspections and tests.

a. All machinery and equipment shall be inspected daily (when in use) to ensure safe operating conditions. The employer shall designate competent persons to conduct the daily inspections and tests.

b. Tests shall be made at the beginning of each shift during which the equipment is to be used to determine that the brakes

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and operating systems are in proper working condition and that all required safety devices are in place and functional.

16.A.03 Whenever any machinery or equipment is found to be unsafe, or whenever a deficiency that affects the safe operation of equipment is observed, the equipment shall be immediately taken out of service and its use prohibited until unsafe conditions have been corrected.

a. A tag indicating that the equipment shall not be operated, and that the tag shall not be removed, shall be placed in a conspicuous location on the equipment. **>See Section 8.** Where required, lockout procedures shall be used. **> See Section 12.**

b. The tag shall remain in its attached location until it is demonstrated to the individual deadlining the equipment that it is safe to operate.

c. When corrections are complete, the machinery or equipment shall be retested and re-inspected before being returned to service.

16.A.04 Machinery and mechanized equipment shall be operated only by designated qualified personnel.

a. Machinery or equipment shall not be operated in a manner that will endanger persons or property nor shall the safe operating speeds or loads be exceeded.

b. Getting off or on any equipment while it is in motion is prohibited.

c. Machinery and equipment shall be operated in accordance with the manufacturer's instructions and recommendations.

d. The use of headphones for entertainment purposes (e.g., AM/FM radio or cassette) while operating equipment is prohibited.

16.A.05 When the manufacturer's instructions or recommendations are more stringent than the requirements of this manual, the manufacturer's instructions or recommendations shall apply.

16.A.06 Inspections or determinations of road and shoulder conditions and structures shall be made in advance to assure that clearances and load capacities are safe for the passage or placing of any machinery or equipment.

16.A.07 Equipment requirements.

- a. Seats or equal protection must be provided for each person required to ride on equipment.
- b. Equipment operated on the highway shall be equipped with headlights, taillights, brake lights, backup lights, and turn signals that are visible from the front and rear.
- c. All equipment with windshields shall be equipped with powered wipers. Vehicles that operate under conditions that cause fogging or frosting of windshields shall be equipped with operable defogging or defrosting devices.
- d. Mobile equipment, operating within an off-highway job site not open to public traffic, shall have a service brake system and a parking brake system capable of stopping and holding the equipment while fully loaded on the grade of operation. In addition, it is recommended that heavy-duty hauling equipment have an emergency brake system that will automatically stop the equipment upon failure of the service brake system. This emergency brake system should be manually operable from the driver's position.

16.A.08 Maintenance and repairs.

- a. Maintenance, including preventive maintenance, and repairs shall be in accordance with the manufacturer's recommendations and shall be documented. Records of

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maintenance and repairs conducted during the life of a contract shall be made available upon request of the GDA.

b. All machinery or equipment shall be shut down and positive means taken to prevent its operation while repairs or manual lubrications are being done. Equipment designed to be serviced while running are exempt from this requirement.

c. All repairs on machinery or equipment shall be made at a location that will protect repair personnel from traffic.

d. Heavy machinery, equipment, or parts thereof that are suspended or held apart by slings, hoist, or jacks also shall be substantially blocked or cribbed before personnel are permitted to work underneath or between them.

16.A.09 Bulldozer and scraper blades, end-loader buckets, dump bodies, and similar equipment shall be either fully lowered or blocked when being repaired or when not in use. All controls shall be in a neutral position, with the engines stopped and brakes set, unless work being performed on the machine requires otherwise.

16.A.10 Stationary machinery and equipment shall be placed on a firm foundation and secured before being operated.

16.A.11 All mobile equipment and the areas in which they are operated shall be adequately illuminated while work is in progress.

16.A.12 Equipment powered by an internal combustion engine will not be operated in or near an enclosed area unless adequate ventilation is provided to ensure the equipment does not generate a hazardous atmosphere.

16.A.13 All vehicles that will be parked or are moving slower than normal traffic on haul roads shall have a yellow flashing light or four-way flashers visible from all directions.

16.A.14 No one shall be permitted in the truck cab during loading operations except the driver, and then only if the truck has a cab protector. > **See also 18.B.17a.**

16.A.15 Mechanized equipment shall be shut down before and during fueling operations. Closed systems, with an automatic shut-off that will prevent spillage if connections are broken, may be used to fuel diesel powered equipment left running.

16.A.16 Towing.

- a. All towing devices used on any combination of equipment shall be structurally adequate for the weight drawn and securely mounted.
- b. Persons shall not be permitted to get between a towing vehicle and the piece of towed equipment until both have been completely stopped with all brakes set and wheels chocked on both vehicle and equipment.

16.A.17 All machinery or equipment operating on rails, tracks, or trolleys (except railroad equipment) shall be provided with substantial track scrapers or track clearers (effective in both directions) on each wheel or set of wheels.

16.A.18 Parking.

- a. Whenever equipment is parked, the parking brake shall be set.
- b. Equipment parked on an incline shall have the wheels chocked or track mechanisms blocked and the parking brake set.
- c. All equipment left unattended at night, adjacent to a highway in normal use or adjacent to construction areas where work is in progress, shall have lights or reflectors, or barricades equipped with lights or reflectors, to identify the location of the equipment.

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16.A.19 No modifications or additions that affect the capacity or safe operation of machinery or equipment shall be made without the manufacturer's written approval.

a. If such modifications or changes are made, the capacity, operation, and maintenance instruction plates, tags, or decals shall be changed accordingly.

b. In no case shall the original safety factor of the equipment be reduced.

16.A.20 Steering or spinner knobs shall not be attached to the steering wheel unless the steering mechanism prevents road reactions from causing the steering handwheel to spin. When permitted, the steering knob shall be mounted within the periphery of the wheel.

16.A.21 Safeguards shall be provided to prevent machinery and equipment operating on a floating plant from going into the water.
> **See also 16.F.06.**

16.A.22 All powered-industrial trucks shall meet the requirements of design, construction, stability, inspection, testing, maintenance, and operation defined in ANSI/ASME B56.1.

16.A.23 All powered-industrial trucks, lift trucks, stackers, and similar equipment shall have the rated capacity posted on the vehicle so as to be clearly visible to the operator. When the manufacturer provides auxiliary removable counterweights, corresponding alternate rated capacities also shall be clearly shown on the vehicle. The ratings shall not be exceeded.

16.A.24 Only trained and authorized operators shall be permitted to operate a powered-industrial truck. Training must be both classroom and practical operation of the same type of truck the student uses on the job. Training shall be provided in accordance with OSHA Standard 29 CFR 1910.178. The employer must certify that the operator has been trained and evaluated as required by the standard. The certification shall include the name of the operator.

the date of the training, the date of the evaluation, and the identity of the person(s) performing the training or evaluation. Refresher training shall be provided as indicated by the standard.

16.A.25 When a powered-industrial truck is left unattended, load engaging means shall be fully lowered, controls shall be neutralized, power shall be shut off, and brakes shall be set. Wheels shall be blocked if the truck is parked on an incline.

16.A.26 An overhead guard shall be used as protection against falling objects. It should be noted that an overhead guard is intended to offer protection from the impact of small packages, boxes, bagged material, etc., representative of the job application, but not to withstand the impact of a falling capacity load.

16.A.27 Dock board or bridge plates shall be properly secured before they are driven over. Dock board or bridge plates shall be driven over carefully and slowly and their rated capacity shall never be exceeded.

16.A.28 Under all travel conditions the powered-industrial truck shall be operated at a speed that will permit it to be brought to a stop in a safe manner.

16.A.29 On all grades the load and load engaging means shall be tilted back if applicable, and raised only as far as necessary to clear the road surface.

16.A.30 When ascending or descending grades in excess of 10%, loaded powered-industrial trucks shall be driven with the load upgrade.

16.A.31 The controls of loaders, excavators, or similar equipment with folding booms or lift arms shall not be operated from a ground position unless so designed.

16.A.32 Personnel shall not work in, pass under, or ride in the buckets or booms of loaders in operation.

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16.A.33 Tire service vehicles shall be operated so that the operator will be clear of tires and rims when hoisting operations are being performed. Tires large enough to require hoisting equipment will be secured from movement by continued support of the hoisting equipment unless bolted to the vehicle hub or otherwise restrained.
> **Also see 16.B.06.**

16.A.34 Each bulldozer, scraper, dragline, crane, motor grader, front-end loader, mechanical shovel, backhoe, and other similar equipment shall be equipped with at least one dry chemical or CO₂ fire extinguisher with a minimum rating of 5-B:C.

16.A.35 Fill hatches on water haul vehicles shall be secured or the opening reduced to a maximum of 8 in (20.3 cm).

16.B GUARDING AND SAFETY DEVICES

16.B.01 Reverse signal (back-up) alarm.

a. All self-propelled construction and industrial equipment, whether moving alone or in combination, shall be equipped with a reverse signal alarm. > **Equipment designed and operated so that the operator is always facing the direction of motion does not require a reverse signal alarm.**

b. Reverse signal alarms shall be audible and sufficiently distinct to be heard under prevailing conditions.

c. Alarms shall operate automatically upon commencement of backward motion. Alarms may be continuous or intermittent (not to exceed 3-second intervals) and shall operate during the entire backward movement.

d. Reverse signal alarms shall be in addition to requirements for signal persons.

16.B.02 A warning device or signal person shall be provided where there is danger to persons from moving equipment, swinging loads, buckets, booms, etc.

16.B.03 Guarding.

- a. All belts, gears, shafts, pulleys, sprockets, spindles, drums, flywheels, chains, or other reciprocating, rotating, or moving parts of equipment shall be guarded when exposed to contact by persons or when they otherwise create a hazard.
- b. All hot surfaces of equipment, including exhaust pipes or other lines, shall be guarded or insulated to prevent injury and fire.
- c. All equipment having a charging skip shall be provided with guards on both sides and open end of the skip area to prevent persons from walking under the skip while it is elevated.
- d. Platforms, foot walks, steps, handholds, guardrails, and toe boards shall be designed, constructed, and installed on machinery and equipment to provide safe footing and access ways.
- e. Equipment shall be provided with suitable working surfaces of platforms, guard rails, and hand grabs when attendants or other employees are required to ride for operating purposes outside the operator's cab or compartment. Platforms and steps shall be of nonskid material.
- f. Substantial overhead protection shall be provided for the operators of forklifts and similar material handling equipment.

16.B.04 Fuel tanks shall be located in a manner that will not allow spills or overflows to run onto engine, exhaust, or electrical equipment.

16.B.05 Exhaust or discharges from equipment shall be so directed that they do not endanger persons or obstruct the view of the operator.

16.B.06 A safety tire rack, cage, or equivalent protection shall be provided and used when inflating, mounting, or dismounting tires

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installed on split rims, or rims equipped with locking rings of similar devices. > ***Also see 16.A.33.***

16.B.07 No guard, safety appliance, or device shall be removed from machinery or equipment, or made ineffective, except for making immediate repairs, lubrications, or adjustments, and then only after the power has been shut off. All guards and devices shall be replaced immediately after completion of repairs and adjustments and before power is turned on.

16.B.08 Seatbelts and anchorages meeting the requirements of 49 CFR 571 shall be installed and worn in all motor vehicles (installation and usage on buses is optional). Two-piece seat belts and anchorages for construction equipment shall comply with applicable Federal specifications or Society of Automotive Engineers (SAE) Standard J386.

16.B.09 All high rider industrial trucks shall be equipped with overhead guards that meet the structural requirements defined in paragraph 4.21 of ANSI/ASME B56.1.

16.B.10 Suitable protection against the elements, falling or flying objects, swinging loads, and similar hazards shall be provided for operators of all machinery or equipment. Glass used in windshields or cabs shall be safety glass.

16.B.11 Falling object protective structures (FOPS).

a. All bulldozers, tractors, or similar equipment used in clearing operations shall be provided with guards, canopies, or grills to protect the operator from falling and flying objects as appropriate to the nature of the clearing operations.

b. FOPS for other construction, industrial, and grounds-keeping equipment will be furnished when the operator is exposed to falling object hazards.

c. FOPS will be certified by the manufacturer or a licensed engineer as complying with the applicable recommended practices of SAE Standards J231 and J1043.

16.B.12 Rollover protective structures (ROPS).

a. In addition to the requirements of 16.B.08 and 16.B.11, seat belts and ROPS shall be installed on:

- (1) Crawler and rubber-tire tractors including dozers, push and pull tractors, winch tractors, and mowers;
- (2) Off-the-highway self-propelled pneumatic-tire earth movers such as trucks, pans, scrapers, bottom dumps, and end dumps;
- (3) Motor graders;
- (4) Water tank trucks having a tank height less than the cab; and
- (5) Other self-propelled construction equipment such as front-end loaders, backhoes, rollers, and compactors.

b. ROPS are not required on:

- (1) Trucks designed for hauling on public highways;
- (2) Crane-mounted dragline backhoes;
- (3) Sections of rollers and compactors of the tandem steel-wheeled and self-propelled pneumatic tired type that do not have an operator's station;
- (4) Self-propelled, rubber-tired lawn and garden tractors and side boom pipe laying tractors operated solely on flat terrain (maximum 10° slope; 20° slope permitted when off-loading from a truck) not exposed to rollover hazards; and

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(5) Cranes, draglines, or equipment on which the operator's cab and boom rotate as a unit.

c. ROPS may be removed from certain types of equipment when the work cannot be performed with the ROPS in place and when ROPS removal is justified and delineated in an AHA and accepted in writing by the GDA.

d. The operating authority shall furnish proof from the manufacturer or certification from a licensed engineer that the ROPS complies with SAE Standards J167, J1040, J1042, J1084, and J1194, as applicable.

e. ROPS shall also be acceptable if they meet the criteria of any State that has a Department of Labor approved OSHA program or meet Water and Power Resources Service requirements.

f. The following information permanently affixed to the ROPS is acceptable in lieu of a written certification:

(1) Manufacturer's or fabricator's name and address;

(2) ROPS model number, if any; and

(3) Machine make, model, or series number that the structure is designed to fit.

g. Field welding on ROPS shall be performed by welders who are certified by the contractor as qualified in accordance with ANSI/AWS D1.1, Naval Sea Systems Command (NAVSEA) S9074-AQ-GIB-010/248, or the equivalent.

16.B.13 All points requiring lubrication during operation shall have fittings so located or guarded to be accessible without hazardous exposure.

16.B.14 All machinery or equipment and material hoists operating on rails, tracks, or trolleys shall have positive stops or limiting devices either on the equipment, rails, tracks, or trolleys to prevent overrunning safe limits.

16.B.15 Under the following circumstances, long-bed end-dump trailers used in off-road hauling should be equipped with a roll-over warning device. The device should have a continuous monitoring display at the operator station to give the operator a quick and easily read indicator and audible warning of an unsafe condition.

- a. The material being dumped is subject to being stuck or caught in the trailer rather than exiting the bed freely, and
- b. The dumpsite cannot be maintained in a nominally level condition (lateral slope less than 1° - 2°).

16.C CRANES AND DERRICKS - GENERAL

16.C.01 Unless otherwise specified, the requirements of this Section are applicable to all cranes and derricks of the types listed in Table 16-1.

16.C.02 Every crane shall have the following documents with them (in the cab) at all times they are to be operated:

- a. A copy of the operating manual developed by the manufacturer for the specific make and model of the crane; a copy of the operating manual for any crane operator aids with which the crane is equipped.
- b. A copy of the load-rating chart for the crane/derrick in use (separate or included in the operating manual), which shall include:
 - (1) The crane make and model, serial number, and year of manufacturer;

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- (2) Load ratings for all crane operating configurations, including optional equipment;
- (3) Recommended reeving for the hoist line; and
- (4) Operating limits in windy or cold weather conditions.

c. A durable load chart with legible letters and figures shall be fixed at a location visible to the operator while seated at the control station.

d. The crane's log book, which shall be used to record operating hours and all crane inspections, tests, maintenance, and repair. The log shall be updated daily as the crane is used and shall be signed by the operator and supervisor. Service mechanics shall sign the log after conducting maintenance or repairs on the crane.

16.C.03 Responsibilities in crane operations.

a. The operator shall not engage in any activity that will divert his/her attention while operating the crane.

b. The operator shall not leave the controls while a load is suspended.

c. Before leaving the crane unattended, the operator shall:

- (1) Land any load, bucket, lifting magnet, or other device;
- (2) Disengage the master clutch;
- (3) Set travel, swing, boom brakes, and other locking devices;
- (4) Put the controls in the off or neutral position;

(5) Secure the crane against accidental travel; and

(6) Stop the engine.

Exception: When crane operation is frequently interrupted during a shift and the operator must leave the crane. Under these circumstances, the engine may remain running and the following conditions (including those in paragraphs (1) thru (5)) shall apply:

(a) The operator shall be situated where unauthorized entry of the crane can be observed; and

(b) The crane shall be located within an area protected from unauthorized entry.

d. The operator shall respond to signals from the person who is directing the lift or an appointed signal person. When a signal person is not used in the crane operation, the operator shall ensure he/she has full view of the load and the load travel paths at all times the load is rigged to the crane.

e. Each operator is responsible for those operations under his/her direct control, including those items under f, below. Whenever there is any doubt as to safety, the operator shall consult his/her supervisor before commencing the operation.

f. Except for critical lifts, when these duties will be carried out by the lift supervisor, the rigger shall ensure that:

(1) The crane is level and, where necessary, blocked;

(2) The load is well secured and balanced in the sling or lifting device before it is lifted more than a few inches;

(3) The lift and swing path is clear of obstructions and adequate clearance is maintained from electrical sources;
and

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(4) All persons are clear of the swing radius of the counterweight.

g. When two or more cranes are used to lift one load, one designated person shall be responsible for the operation.

(1) The designated person shall analyze the operation and instruct all personnel involved in the proper positioning, rigging of the load, and the movements to be made.

(2) The designated person shall make such determinations as the necessity to reduce crane ratings, load position, boom location, ground support, and speed of movement, which are required to safely make the lift.

(3) The designated person shall ensure that all prescribed communication (including signaling) personnel and/or equipment are on hand and properly functioning, and that all personnel involved with the crane operation understand the communication systems and their responsibilities associated with communications.

16.C.04 Operator designation.

a. Only qualified, designated persons may operate cranes or derricks. Only those operators qualified to operate a particular type of crane or derrick may operate that type of machinery: proof of qualification shall be in writing. In addition to fully qualified crane operators, the following personnel may be designated to operate cranes under limited conditions:

(1) Trainees under the direct supervision of the designated operator of the crane;

(2) Maintenance personnel who have completed all operator trainee qualification requirements. Operation is limited only to those functions necessary to perform maintenance or verify performance of a crane; and

(3) Inspectors who have completed all operator trainee qualification requirements. Operation is limited only to functions necessary to accomplish inspection.

b. Each USACE Command with USACE employees designated as crane or derrick operators shall designate a qualified individual(s) (in-house or contract) to administer examinations and to qualify USACE (but not Contractor) operators.

c. Contractor crane and derrick operators shall be designated as qualified by a professional crane/derrick training or certification source that qualifies crane and derrick operators (e.g., an independent testing and qualifying company, a union, a governmental agency, or a qualified consultant (can be an in-house resource)).

16.C.05 Operator qualifications and training.

a. Proficiency qualifications.

(1) All operators, Government or Contractor, shall be instructed in and qualified for each type of crane or derrick he/she is to operate.

(2) Qualification for all crane/derrick operators shall be by written (or oral) and practical operating examination unless the operator is licensed by a State or city licensing agency for the particular type of crane or derrick. (Qualification for crane or derrick operators shall be valid for no longer than 5 years from the date of issuance. Prior to re-issuance of qualification, crane/derrick operators must have attended at least 8 hours of crane/derrick safety training; passed an operational examination; and pass a physical examination within 2 years.) **>See Appendix G.**

(3) As a minimum, the qualifying examination procedures in Appendix G shall be followed for all crane/derrick operators. When the crane manufacturer recommends operator

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qualifying examination procedures, those procedures shall be in addition to the requirements of Appendix G.

b. All crane/derrick operators shall meet the physical qualifications listed in Appendix G. Physical examinations for operators are required to be conducted at least biennially and any time thereafter if indicated by a medical condition that may impact on the safe operation of a crane/derrick. Written proof, signed by a physician stating that the crane/derrick operator has had a physical examination and meets the medical requirements set forth in Appendix G, shall be submitted to the GDA for acceptance prior to allowing a crane/derrick operator to operate a crane/derrick.

c. USACE crane and derrick operators (not Contractor) shall complete a crane operators' course (that is at least 24 hours in length) that covers general crane operation and safety. Yearly thereafter, operators shall complete an 8-hour refresher course covering safe operation of the type of crane or derrick they operate.

16.C.06 Crane and Derrick Design and Construction Standards.

a. Cranes and derricks shall be designed and constructed in accordance with the applicable ANSI/ASME standards in effect at the time of initial construction listed in Table 16-1, and the additional requirements of this manual, whichever is more stringent.

b. Modification of existing cranes and derricks shall be performed in accordance with the current ANSI/ASME standards. It is not the intent of this manual to require immediate retrofitting of existing equipment.

TABLE 16-1

CRANE DESIGN AND CONSTRUCTION STANDARDS

CRANE DESIGN	CONSTRUCTION STANDARDS
Mobile and locomotive cranes	ANSI/ASME B30.5
Portal, tower, and pillar cranes	ANSI/ASME B30.4
Hammerhead tower cranes	ANSI/ASME B30.3
Floating cranes and floating derricks	ANSI/ASME B30.8, <u>or</u> ABS or ANSI/API 2C <u>or</u> SAE Standard J1366
Draglines	Power Crane and Shovel Association Standard No. 4
Articulating boom cranes	ANSI/ASME B30.22
Overhead and gantry cranes (top running bridge, single or multiple girder, top running trolley hoist)	ANSI/ASME B30.2
Overhead and gantry cranes (top running bridge, single girder, underhung hoist)	ANSI/ASME B30.17
Monorails and underhung cranes	ANSI/ASME B30.11
Derricks	ANSI/ASME B30.6
Helicopter cranes	ANSI/ASME B30.12

16.C.07 Cranes and derricks shall be operated, inspected, tested and maintained in accordance with the manufacturer's operating manual for the crane and the applicable ANSI/ASME codes or OSHA requirements, whichever is more stringent.

16.C.08 An AHA shall be developed and implemented for crane set-up and set-down procedures (mobilization, assembly or erection, dismantling, and demobilization).

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16.C.09 Clearances.

a. Adequate clearance shall be maintained from electrical sources. > **See Section 11.**

b. Overhead and gantry cranes clearances shall be in accordance with the Crane Manufacturer's Association of America (CMAA) 70.

c. All other cranes.

(1) Adequate clearance shall be maintained between moving and rotating structures of the crane and fixed objects to allow the passage of employees without harm. The minimum adequate clearance is 16 in (40.6 cm).

(2) Accessible areas within the swing radius of the rear of the crane's rotating superstructure, either permanently or temporarily mounted, shall be barricaded to prevent an employee from being struck or crushed by the crane.

16.C.10 Hoisting ropes shall be installed in accordance with ANSI/ASME standards and the equipment manufacturer's recommendations.

a. Overhead and gantry cranes shall have at least two full wraps of cable on the drums of hoisting equipment at all times.

b. All other cranes shall have at least three full wraps (not layers) of cable on the drums of hoisting equipment at all times.

c. The drum end of the rope shall be anchored to the drum by an arrangement specified by the crane or rope manufacturer.

16.C.11 Communications.

a. A standard signal system shall be used on all cranes and derricks. > **See Section 8.**

b. In situations where the operator cannot see the load, audio (radio) communications shall be used (note that this does not preclude the use of hand signals in addition to audio). In all other operations, audio communications should be used.

16.C.12 Inspections.

a. Inspections of cranes and derricks shall be in accordance with applicable ANSI/ASME standards, OSHA regulations, and the manufacturer's recommendations.

b. A qualified person shall conduct inspections that cover, at the minimum, the items listed in Appendix H.

c. The Contractor shall notify the GDA at least 24 hours prior to any inspections/tests so that the GDA may be available to observe the inspection/test. There are basically five types of inspections:

(1) Initial inspection. Before initial use, a qualified person shall inspect all new and altered cranes to ensure compliance with all applicable standards.

(2) Functional test inspection. Before every operation (at the beginning of each shift) of the crane, the operator or designated person shall conduct start-up (pre-operational) inspections as follows:

(a) Overhead and gantry cranes. A visual and audible examination of the crane shall be conducted. Items to be functionally tested are the controls and the upper limit. Documentation of the test shall be noted in the operator's log.

(b) All other cranes and derricks. If checklists are used for start-up (pre-operational) inspections, a copy of the checklist shall be maintained at the project site. If checklists are not used, the operator or designated person shall indicate the successful completion of the

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inspection (in accordance with the manufacturer's recommendations) in the operator's log

(3) Frequent inspection. A frequent inspection is a visual and audible examination of the crane. The crane operator or designated person shall conduct a frequent inspection as follows:

(a) Normal service – Monthly

(b) Heavy service – Weekly to monthly

(c) Severe service – Daily to weekly

(4) Periodic inspection. A periodic inspection is a visual and audible examination of the crane. The crane operator or designated person shall conduct a periodic inspection as follows:

(a) Normal service – Yearly

(b) Heavy service – Yearly

(c) Severe service – Quarterly

(5) Inspection of cranes not in regular use.

(a) Infrequent service cranes that have been idle for a period of 1 month or more, but less than 1 year, shall be inspected in accordance with 16.C.12c(3).

(b) Infrequent service cranes that have been idle for a period of 1 year or more shall be inspected in accordance with 16.C.05c(4). Infrequent service cranes that are exposed to adverse environmental conditions shall be inspected more frequently, as determined by the GDA or the Contractor with the concurrence of GDA.

16.C.13 Testing. > **See also 16.D.06a.**

a. A qualified person shall conduct performance tests in accordance with ANSI/ASME, OSHA, and the manufacturer's recommendations. At the minimum, performance testing shall meet the requirements listed in Appendix I. Test loads shall not be less than 110% of the anticipated load and shall not exceed 100% of the manufacturer's load rating capacity chart at the configuration of the test, except for manufacturer testing of new cranes, which shall be conducted in accordance with the ANSI/ASME standards B30.1 through B30.17 as appropriate for the crane.

b. Performance testing after the replacement of wire rope is not required.

c. Written reports of the performance test, showing test procedures and confirming the adequacy of repairs or alterations, shall be maintained with the crane or derrick or at the on-site project office.

(1) Operational performance test. Operational tests shall be conducted in accordance with Appendix I:

(a) Before initial use of a crane(s) in which a load bearing (excluding the rope) or load controlling part or component, brake, travel component, or clutch have been altered, replaced, or repaired;

(b) Every time a crane(s) is reconfigured or re-assembled after disassembly (to include booms);

(c) Every time a crane is brought onto a USACE project; and

(d) Every year.

> Under conditions (a) and (b), a selective operational performance test (testing only those components that

have or may have been affected by the alteration, replacement, repair, reconfiguration, or reassembly) may be performed.

(2) Load performance test. Load performance tests shall be conducted in accordance with Appendix I:

(a) Before initial use of cranes in which a load bearing (excluding the rope) or load controlling part or component, brake, travel component, or clutch have been altered, replaced, or repaired;

(b) Every time the crane is reconfigured or reassembled after disassembly (to include booms); and

(c) Every 4 years.

> Under conditions (a) and (b), a selective operational performance test (testing only those components that have or may have been affected by the alteration, replacement, repair, reconfiguration, or reassembly) may be performed. When the load performance test of a powerhouse indoor overhead crane would pose unacceptable risk to generators, the District Commander may waive this requirement.

16.C.14 The manufacturer's specifications and limitations applicable to the operation of any crane or derrick shall be followed. At no time shall a crane or derrick be loaded in excess of the manufacturer's rating, except overhead and gantry cranes in accordance with ANSI/ASME B30.2 when overrated loads shall not exceed 125% of rated load for test purposes or planned engineered lifts for overhead and gantry cranes. > **See 16.C.18.**

a. Where manufacturer's specifications are not available, the limitations assigned to the equipment shall be based on the determinations of a registered engineer competent in this field, and such determinations will be documented and recorded.

- b. Attachments used with cranes shall not exceed the capacity, rating, or scope recommended by the manufacturer.

16.C.15 Riding on loads, hooks, hammers, buckets, material hoists, or other hoisting equipment not meant for personnel handling is prohibited.

16.C.16 When practical and when their use does not create a hazard, tag lines shall be used to control loads.

16.C.17 Whenever a slack line condition occurs, the proper seating of the rope in the sheaves and on the drum shall be checked prior to further operations.

16.C.18 Critical lift plans. Before making a critical lift, a qualified person shall prepare a critical lift plan. (The qualified person preparing the plan may be the crane operator, lift supervisor, or the rigger). The crane operator, lift supervisor, and rigger shall participate in the preparation. The plan shall be documented and a copy shall be provided to the GDA. The plan shall be reviewed and signed by all personnel involved with the lift.

- a. The plan shall specify the exact size and weight of the load to be lifted and all crane and rigging components that add to the weight. The manufacturer's maximum load limits for the entire range of the lift, as listed in the load charts, shall also be specified.
- b. The plan shall specify the lift geometry and procedures, including the crane position, height of the lift, the load radius, and the boom length and angle, for the entire range of the lift.
- c. The plan shall designate the crane operator, lift supervisor and rigger and state their qualifications.
- d. The plan will include a rigging plan that shows the lift points and describes rigging procedures and hardware requirements.

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- e. The plan will describe the ground conditions, outrigger or crawler track requirements, and, if necessary, the design of mats, necessary to achieve a level, stable foundation of sufficient bearing capacity for the lift. For floating cranes or derricks, the plan shall describe the operating base (platform) condition and any potential list.
- f. The plan will list environmental conditions under which lift operations are to be stopped.
- g. The plan will specify coordination and communication requirements for the lift operation.
- h. For tandem or tailing crane lifts, the plan will specify the make and model of the cranes, the line, boom, and swing speeds, and requirements for an equalizer beam.

16.C.19 Environmental considerations .

- a. Cranes/derricks shall not be operated when wind speeds at the site attain the maximum wind velocity recommendations of the manufacturer. Projects shall have adequate means for monitoring local weather conditions, including a wind-indicating device.
- b. Operations undertaken during weather conditions that produce icing of the crane structure or reduced visibility should be performed at reduced functional speeds and with signaling means appropriate to the situation.
- c. When conditions are such that lightning could occur, all crane operations shall cease. **> See 06.J.1.**
- d. For night operations, lighting adequate to illuminate the working areas while not interfering with the operator's vision shall be provided. **> See Section 7.**

16.C.20 Maintenance and repairs.

a. Maintenance and repairs shall be conducted in accordance with the manufacturer's procedures and precautions in accordance with the applicable ANSI/ASME standard.

b. Replacement parts or repairs shall have at least the original design factor; replacement parts for load bearing and other critical parts shall be obtained from the original equipment manufacturer (OEM) or be recertified in accordance with 16.C.14.a.

16.C.21 All cranes and derricks, shall be equipped with an anti-two blocking (A2B) device that will disengage the function that is causing the two-blocking or an A2B damage prevention feature. They shall be tested and certified functional by a competent person prior to operating the crane/derrick. > ***Floating cranes may use an A2B alarm system in lieu of a disengaging device unless they are hoisting personnel. Cranes and derricks used in duty cycle operations are exempt from the requirements for A2B devices. Duty cycle cranes performing occasional lifts shall comply with the procedures in 16.D.05b.(1), (2), and (3).***

16.C.22 All cranes shall be equipped with a fire extinguisher with a basic minimum rating of 10-B:C.

16.D CRAWLER-, TRUCK-, WHEEL-, AND RINGER-MOUNTED CRANES

16.D.01 All lattice boom and hydraulic mobile cranes (except articulating boom cranes) shall be equipped with a boom angle indicator and a load indicating device, or a load moment indicating (LMI) device (rated capacity indicator). Calibration and testing of indicators will be performed in accordance with the manufacturer's recommendations. > ***When cranes are used in duty cycle operations they are exempt from the requirements for load indicating devices and LMI devices.***

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16.D.02 All lattice boom and hydraulic mobile cranes shall be equipped with a means for the crane operator to visually determine the levelness of the crane.

16.D.03 On all lattice boom and hydraulic mobile cranes (except articulating boom cranes), drum rotation indicators shall be provided and located to afford sensing by the operator.

> Equipment manufactured before 1990 is exempt from this requirement, but retrofit is highly recommended.

16.D.04 All lattice boom and hydraulic mobile cranes (except articulating boom cranes) shall be equipped with a boom angle or radius indicator located within the operator's view.

16.D.05 When required on a crane/derrick, A2B devices shall be installed at all points of two-blocking.

a. Lattice boom cranes shall be equipped with an A2B device to stop the load hoisting and boom-down functions before the load block or load contacts the boom tip.

b. Lattice boom cranes that are used exclusively for duty cycle operations are exempt from A2B equipment requirements. When a lattice boom crane engaged in duty cycle work is required to make a non-duty cycle lift (for example, to lift a piece of equipment), it will be exempt from the A2B equipment requirements if the following procedures are implemented:

(1) An international orange colored warning device (warning flag, warning tape, or warning ball) is properly secured to the hoist line at a distance of 8 ft to 10 ft (2.4 m to 3 m) above the rigging;

(2) The signal person acts as a spotter to alert the crane operator with a "STOP" signal when the warning device approaches the boom tip and the crane operator ceases hoisting functions when alerted of this;

(3) While the non-duty cycle lift is underway, the signal person shall not stand under the load, shall have no duties other than as a signal person, and shall comply with the signaling requirements of this manual.

c. For lattice boom cranes with manually activated friction brakes, A2B warning devices may be used in lieu of A2B prevention devices.

d. Telescopic boom cranes shall be equipped with an A2B device to stop the load hoisting function before the load block or load contacts the boom tip and to prevent damage to the hoist rope or other machine components when extending the boom.

e. Telescopic boom cranes that are used exclusively for duty cycle operations shall be equipped with a two-blocking damage prevention feature or warning device to prevent damage to the hoist rope or other machine components when extending the boom.

16.D.06 All mobile cranes with cable-supported booms shall be equipped with:

a. Boom stops that, at the angle specified by the crane manufacturer, limit the movement of that portion of the boom below the point at which the boom stop acts on the boom.

(1) The boom stop manufacturer shall certify that the boom stop has been designed, manufactured, and functionally tested such that it will fulfill the requirement of SAE Standard J220. (Pre-1971 cranes will essentially meet the requirements of SAE Standard J220, except for paragraph 4.1.)

(2) A crane boom stop field test will be conducted to verify the proper setup of the boom stops and functioning of the boom hoist disengaging device. This test will be conducted before initiating the performance test required by 16.C.13.

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Deficiencies noted shall be corrected before the performance test. > **See page 11 of Appendix I for test procedures.**

b. All jibs shall have positive stops to prevent their movement of more than 5° above the straight line of the jib and boom on conventional crane booms.

c. A properly functioning boom hoist-disengaging device that shall automatically and completely disengage the boom hoisting power from the boom hoist drum when the boom has reached its highest rated angle. When power is thus disengaged, the boom hoist drum shall automatically be restrained from motion in the lowering direction under any rated condition.

16.D.07 The crane's foundation shall be evaluated for stability. The evaluation shall consider ground conditions, static and dynamic loads, and operating quadrants. Cribbing shall be provided in accordance with the manufacturer's recommendations.

16.D.08 Boom assembly and disassembly.

a. The manufacturer's boom assembly and disassembly procedures shall be followed. The manufacturer's boom assembly and disassembly procedures shall be reviewed by all members of the assembly/disassembly team before the start of assembly and disassembly.

b. When removing pins or bolts from a boom, workers shall stay out from under the boom. Sections shall be blocked or otherwise secured to prevent them from falling, when necessary.

16.D.09 Outriggers.

a. When the load to be handled and/or the operating radius require the use of outriggers, or anytime when outriggers are used, outriggers shall be fully extended to the appropriate

setting indicated by the load chart. The outriggers will be deployed so that the weight of the machine is totally removed from the wheels at every setting (except locomotive cranes).

b. When outrigger floats are used, they shall be securely attached to the outriggers.

c. Blocking under outriggers floats shall meet the following requirements:

(1) Sufficient strength to prevent crushing, bending, or shear failure;

(2) Such thickness, width, and length as to completely support the float, transmit the load to the supporting surface, and prevent shifting, toppling, or excessive settlement under load; and

(3) Use of blocking only under the outer bearing surface of the extended outrigger beam floats.

16.D.10 Unless the manufacturer has specified an on-rubber rating, mobile cranes shall not pick or swing loads over the side of the crane unless the outriggers (if so equipped) are down and fully extended.

16.D.11 Unless recommended against by the manufacturer, crane booms shall be lowered to ground level or secured against displacement by wind loads or other outside forces when not in use. If the manufacturer recommends against this practice, the manufacturer's recommended practice shall be followed.

16.E PORTAL, TOWER, AND PILLAR CRANES

16.E.01 All load bearing foundations, supports, and rail tracks shall be constructed or installed in accordance with the crane manufacturer's recommendations and the applicable ANSI/ASME standard.

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16.E.02 Cranes shall be erected in accordance with the crane manufacturer's recommendations and the applicable ANSI/ASME standard.

- a. The manufacturer's written erection instructions and a list of the weights of each component to be erected shall be kept at the site.
- b. Erection shall be performed under the supervision of a qualified person.
- c. An AHA shall be developed and implemented for the erection procedures. The analysis will include a plan that shows:
 - (1) The location of the crane and adjacent buildings or towers, overhead power and communication lines, underground utilities;
 - (2) Foundation design and construction requirements; and
 - (3) When the tower is erected within a structure, the plan shall show clearances between the tower and the structure and bracing and wedging requirements.
- d. Wind velocity at the site at the time of erection shall be a consideration and may be a limiting factor that could require suspending the erection operation.
- e. Before crane components are erected, they shall be visually inspected for damage. Damaged members shall not be erected.

16.E.03 After erection, and before placing the crane in service, the following shall be tested in accordance with the manufacturer's recommended procedures and ANSI/ASME B30.3 or B30.4, as applicable:

- a. Crane supports;
- b. Brakes and clutches, limit and overload switches, and locking and safety devices; and
- c. Load hoisting and lowering, boom hoisting and lowering, and swing motion mechanisms and procedures.

16.E.04 A boom angle or radius indicator shall be provided within the operator's view.

16.E.05 Luffing jib cranes shall be equipped with jib stops of a shock absorbing type, a jib hoist limit switch, and a jib angle indicator visible to the operator.

16.E.06 Rail clamps, if used, shall have slack between the point of attachment to the rail and the end fastened to the crane. Rail clamps shall not be used as a means of restraining tipping of a crane.

16.E.07 Raising (climbing or telescoping) hammerhead tower cranes.

- a. The operator of a hammerhead tower crane shall be present during climbing or telescoping operations.
- b. Hammerhead cranes shall not be climbed or telescoped when wind speeds at the top of the crane exceed 20 mph (8.9 m/s) or as recommended by the manufacturer.
- c. Climbing operations shall not be commenced until all support provisions required at the new support level are in place and as specified by a qualified person.

16.E.08 Tower cranes shall weathervane when left unattended; luffing jib cranes shall have the boom elevated to 15° when left unattended.

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16.F FLOATING CRANES, FLOATING DERRICKS, CRANE BARGES, AND AUXILIARY SHIPBOARD MOUNTED CRANES

16.F.01 Construction. Although all other pertinent parts of this manual apply to this Section, the requirements contained herein are specifically focused on floating cranes/derricks, crane barges, and auxiliary shipboard cranes.

16.F.02 The equipment on floating cranes/derricks, crane barges, and auxiliary shipboard cranes shall be designed and constructed in accordance with the applicable following standards:

- a. ANSI/ASME B30.8 .
- b. American Bureau of Shipping (ABS), *Guide for Certification of Cranes.*
- c. ANSI/American Petroleum Institute (API) Specification 2C.
- d. SAE Report J1366.

16.F.03 During lifting operations, the stability of the floating crane/derrick or vessel with an auxiliary shipboard crane shall meet the USCG requirements for "Lifting" set forth in 46 CFR 173.005 through 46 CFR 173.025.

16.F.04 The load rating of a floating crane/derrick shall be the maximum working loads at various radii as determined by the manufacturer or qualified person considering list and trim for each installation. The load rating shall specifically reflect the: design standard; machine trim; machine list; and dynamic/environmental loadings anticipated for the operational envelope of the floating crane/derrick or auxiliary shipboard crane. A Naval Architectural Analysis shall be performed to determine these parameters that shall be used in generating the load rating.

- a. The load rating is dependent upon the structural competence of the crane or derrick, rope strength, hoist capacity, structural attachment to the floating platform, and stability and freeboard of the floating platform.
- b. When deck loads are to be carried while lifting, the situation shall be analyzed for modified ratings.
- c. When mounted on barges or pontoons, the rated loads and radii of land cranes and derricks shall be modified as recommended by the manufacturer or qualified person. The modification shall be evaluated by the qualified person specific to the floating platform mounting the crane.
- d. Load charts shall be generated based on the crane load rating for floating service. In addition, the load charts for floating service shall comply with the specific standard it was designed to (See Table 16-1) and clearly explain the floating platform and dynamic/environmental parameters that apply to the load chart. The load chart should, at a minimum, identify the following:

(1) Naval Architect Notes:

- (a) Draft limits (with deck cargo considered),
- (b) Vessel motion limits,
- (c) Vessel and crane list/trim limits, and
- (d) Vessel condition (e.g., dry bilges, watertight integrity, etc.).
 - (i) Crane manufacturer Notes, or reference to them.
 - (ii) Safe Working Load Chart with:
 - aa. Mode of operation,

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bb. Environmental limits,

cc. Capacity (net or gross),

dd. Load, boom elevation, radius (with list/trim considered), and

ee. Crane configuration, such as:

- Boom length,
- Amount of counterweight,
- Parts of wire, and
- Block size.

e. All crane manufacturer capacity tables should include the boom elevation in degrees from the horizon at each noted capacity. Additionally, the capacity should be clearly defined (i.e., net or gross).

16.F.05 Stability - operating list or trim. Unless the crane or derrick manufacturer recommends a lesser value, operating list or trim shall comply with standards selected from those set forth in Table 16-1. The following shall be the maximum allowable list or trim (if ANSI B30.8 is selected):

- a. Cranes, designed for barge or pontoon mounting, rated at 25 tons (22,680 kg) capacity or less shall have a maximum allowable list or trim of 5°.
- b. Cranes, designed for barge or pontoon mounting, rated at 25 tons (22,680 kg) capacity or more shall have a maximum allowable list or trim of 7°, although 5° is recommended.
- c. Derricks, designed for barge or pontoon mounting, rated at any capacity shall have a maximum allowable list or trim of 10°.

d. Land cranes and derricks mounted on barges or pontoons shall have a maximum allowable list or trim of 5° or the maximum allowed by the crane manufacturer.

16.F.06 Stability - design load conditions. All floating cranes and derricks shall comply with the requirements of 46 CFR 173.005 through 173.025.

a. Cranes or derricks designed for barge or pontoon mounting shall be stable in accordance with standards selected from Table 16-1. The following shall be the minimum allowable freeboard if ANSI B30.8 is selected:

(1) Rated load, 60-mph (26.8-m/s) wind, 2-ft (0.6-m) minimum freeboard;

(2) Rated load plus 25%, 60-mph (26.8-m/s) wind, 1-ft (0.3-m) minimum freeboard;

(3) High boom, no load, 60-mph (26.8-m/s) wind, 2-ft (0.6-m) minimum freeboard;

(4) For backward stability of the boom - high boom, no load, full back list (least stable condition), 90-mph (40.2-m/s) wind.

b. Land cranes and derricks mounted on barges or pontoons:

(1) Barge- or pontoon-mounted land cranes require modified ratings due to increased loading from list, trim, wave action, and wind. This rating will be different for each size of pontoon or barge used. Therefore, the load rating of barge- or pontoon-mounted land cranes and derricks shall not exceed that recommended by the manufacturer for the particular barge or pontoon under the expected environmental conditions.

(2) All deck surfaces of the pontoon or barge shall be above the water.

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(3) The entire bottom area of the barge or pontoon shall be submerged.

(4) Provide tie-downs for derricks to transmit the loading to the barge or pontoon.

(5) Cranes shall be blocked and secured to prevent shifting.

16.F.07 Environmental considerations.

a. The project supervisor shall obtain daily weather forecasts before beginning work and as frequently thereafter as required to monitor any potential weather problems. > **See Section 19.A.**

b. When a local weather storm warning exists, consideration shall be given to the recommendations of the manufacturer for securing the crane.

c. Work shall be halted when environmental conditions exceed those delineated on the load chart.

16.F.08 Truck- and crawler-cranes shall be attached to the barge or pontoon by means of a tie-down system with some slack. Movement during lift operations is not permitted.

16.F.09 When loads approach the maximum rating of the crane or derrick, the person responsible for the job shall ascertain that the weight of the load has been determined within +/- 10% before it is lifted.

16.F.10 Means shall be provided for the operator to visually determine the list and trim of the barge or pontoon, as well as machinery list and trim in rotating crane cabs.

16.F.11 Principal walking surfaces shall be of a skid-resistant type.

16.F.12 Boom stops shall be provided to resist the boom fall backwards.

16.F.13 A boom angle indicator readable from the operator's station shall be provided on all floating cranes.

16.F.14 All floating cranes/derricks and shipboard auxiliary cranes shall be fitted with load limiting devices (LLDs) or load indicating devices (LID) or LMI that meet all the requirements of 29 CFR 1918.66(f). This requirement shall become effective 1 year from the effective date of this manual.

a. Duty cycle operations are exempt from these requirements.

b. Duty cycle cranes performing occasional non-critical lifts shall comply with the following:

(1) Total weight of load and rigging is known or calculated;

(2) Load chart is reviewed for weight and planned radius;

(3) Informal pre-lift meeting is held between all personnel directly involved (operator, rigger, etc.) to review the conditions present for that lift (environmental, configuration, etc.)

16.F.15 All floating cranes/derricks and crane barges shall be equipped with wind speed and direction indicating devices within clear view of the operator's station.

16.F.16 Operational guidance.

a. Operators shall monitor the wire lead from the boom tip carefully to ensure that limits on off-lead and side-lead identified in the load chart are not exceeded.

b. Operators shall monitor environmental criteria for compliance with the criteria set forth in the load chart.

c. Operators should be aware that safety devices such as LLD(s) and LMI(s) do not offer protection against loads

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generated by relative motions between a floating crane and a fixed object to be lifted.

d. Whenever practical, crane use during buoy tending shall be limited to lifting the freely suspended buoy clear of the water onto the vessel.

e. Bilges shall be kept as dry as possible to eliminate the adverse effect of free surface (sloshing liquid).

16.F.17 All lifts must be planned to avoid procedures that could result in configurations where the operator cannot maintain safe control of the lift. (A plan, in this case, might be a quick discussion with the deck crew, and a verification of the proposed operation.) Lifts shall reflect floating operational parameters such as: anticipated values for wire leads unknown load for extractions, and upper limits on crane force.

16.F.18. Anchor handling barge.

a. Vessels meeting the definition of anchor handling barge (see Appendix Q), shall be required to comply with only Sections 16.A01 through 16.A.04; 16.C.02, 16.C.08, 16.C.12, 16.C.13, 16.C.14; 16.F.04, 16.F.16 (ANSI/ASME does not apply to anchor barges), and the following:

(1) All deck surfaces of the pontoon or barge shall be above the water.

(2) Means for limiting the applied load, such as mechanical means or marking the draft of the barge corresponding to the rated load, shall be provided. Calculations shall be available and the barge shall be tested to verify rated load.

(3) A ratchet and pawl shall be provided for releasing the load from the hoisting machinery brake.

(4) An operating manual/procedure shall be available for use by the operator. The operator shall be trained in the anchor handling barge systems operation.

b. If additional external load is superimposed above that which can be hoisted with the onboard hoisting machinery, then a chain stopper shall be used to remove the external load from the A-frame and hoist machinery.

c. An anchor handling barge may be used for anchor handling low lifting of loads such as anchor buoys/weights, dredge pipe, submerged pipeline, pontoons, and other loads provided they do not exceed the load rating of the anchor barge. If used for any other lifting application, the work platform will be considered a floating derrick and all other requirements of Section 16 apply.

16.G OVERHEAD AND GANTRY CRANES

16.G.01 All load bearing foundations, anchorages, runways, and rail tracks shall be constructed or installed in accordance with the crane manufacturer's recommendations and ANSI/ASME B30.2 or B30.17, as applicable.

16.G.02 The rated load of the crane shall be plainly marked on each side of the crane.

a. If the crane has more than one hoisting unit, each hoist shall have its rated load marked on it or its load block.

b. Markings on the bridge, trolley, and load block shall be legible from the ground or floor.

16.G.03 Clearance shall be maintained between the crane, any structure or object, and any parallel running cranes and cranes operating at different elevations.

16.G.04 Contacts with runway stops or other cranes shall be made with extreme caution. The operator shall do so with particular care for the safety of persons on or below the crane, and only after

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making certain that any persons on the other cranes are aware of what is being done.

16.G.05 Operators of outdoor cranes shall secure them when leaving.

16.G.06 When the wind-indicating alarm of a cab-operated outdoor crane sounds, crane operations shall be discontinued and the crane shall be prepared and stored for excessive wind conditions.

16.H MONORAILS AND UNDERHUNG CRANES

16.H.01 Crane runways, monorail tracks, track supports, and track control devices shall be constructed or installed in accordance with the crane manufacturer's recommendations and ANSI/ASME B30.11.

16.H.02 The rated load of the crane shall be plainly marked on each side of the crane.

- a. If the crane has more than one hoisting unit, each hoist shall have its rated load marked on it or its load block.
- b. Markings on the bridge, trolley, and load block shall be legible from the ground or floor.

16.I DERRICKS

16.I.01 For permanent fixed locations, the owner shall provide the following load anchoring data (for nonpermanent installations, this data shall be determined by a qualified person):

- a. Guy derricks.
 - (1) Maximum horizontal and vertical forces when handling rated loads with the particular guy slope and spacing stipulated for the application, and

(2) Maximum horizontal and vertical forces at the guys when handling rated loads with the particular guy slope and spacing stipulated for the application.

b. Stiffleg derricks.

(1) Maximum horizontal and vertical forces at the mast base when handling rated loads with the particular stiffleg slope and spacing stipulated for the application, and

(2) Maximum horizontal and vertical forces at the stifflegs when handling rated loads with the particular stiffleg arrangement stipulated for the application.

16.I.02 Derrick booms, load hoists, and swinger mechanisms shall be suitable for the derrick work intended and shall be anchored to prevent displacement from imposed loads.

16.I.03 When rotating a derrick, sudden starts and stops shall be avoided and rotational speed shall be such that the load does not swing out beyond the radius at which it can be controlled. A tagline shall be used.

16.I.04 Boom and hoisting rope systems shall not be twisted.

16.I.05 Ropes shall not be handled on a winch head without the knowledge of the operator. When a winch head is being used, the operator shall be within reach of the power unit controls.

16.I.06 When securing the boom, dogs or other positive holding mechanisms on the hoist shall be engaged.

16.I.07 When not in use the derrick boom shall be either:

a. Laid down;

b. Secured to a stationary member as nearly under the head as possible by attachment of a sling to the load block;

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- c. Lifted to a vertical position and secured to the mast (for guy derricks); or
- d. Secured against a stiffleg (for stiffleg derricks).

16.J HELICOPTER CRANES

16.J.01 Helicopter cranes shall comply with regulations of the Federal Aviation Administration (FAA).

16.J.02 Before each day's operation, a briefing shall be conducted to set forth the plan of operation for the pilot and ground personnel.

16.J.03 Loads shall be properly slung.

- a. Tag lines shall be of a length that will not permit their being drawn up into rotors.
- b. Pressed sleeve, swedged eyes, or equivalent means shall be used for all freely suspended loads to prevent hand splices from spinning open or cable clamps from loosening.

16.J.04 All electrically operated cargo hooks shall have the electrical activating device so designed and installed as to prevent inadvertent operation.

- a. In addition, these cargo hooks shall be equipped with an emergency mechanical control for releasing the load.
- b. The hooks shall be tested prior to each day's operation to determine that the release functions properly, both electrically and mechanically.

16.J.05 PPE equipment for employees receiving the load shall consist of eye protection and hard hats secured by chinstraps.

16.J.06 Loose-fitting clothing likely to flap in the downwash, and thus be snagged on hoist line, shall not be worn.

16.J.07 Every practical precaution shall be taken to provide for the protection of the employees from flying objects in the rotor downwash. All loose gear within 100 ft (30.4 m) of the place of lifting or depositing the load, and all other areas susceptible to rotor downwash, shall be secured or removed.

16.J.08 The helicopter pilot shall be responsible for the size, weight, and manner in which loads are connected to the helicopter. If, for any reason, the helicopter pilot believes the lift cannot be made safely, the lift shall not be made.

16.J.09 When employees are required to work under hovering craft, safe access shall be provided for employees to reach the hoist line hook and engage or disengage cargo slings. Employees shall not work under hovering craft except to hook, unhook, or position loads.

16.J.10 Static charge on the suspended load shall be dissipated with a grounding device before ground personnel touch the suspended load, or protective rubber gloves shall be worn by all ground personnel touching the suspended load.

16.J.11 The weight of an external load shall not exceed the rated capacity.

16.J.12 Hoist wires or other gear, except for pulling lines or conductors that are allowed to "pay out" from a container or roll off a reel, shall not be attached to any fixed ground structure or be allowed to foul on any fixed structures.

16.J.13 When visibility is reduced by dust or other conditions, ground personnel shall exercise special caution to keep clear of main and stabilizing rotors. Precautions shall also be taken to eliminate reduced visibility.

16.J.14 No unauthorized person shall be allowed to approach within 50 ft (15.2 m) of the helicopter when the rotor blades are turning.

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16.J.15 Whenever approaching or leaving a helicopter with blades rotating, all employees shall remain in full view of the pilot and keep in a crouched position. Employees shall avoid the area from the cockpit or cabin rearward unless authorized by the helicopter pilot to work there.

16.J.16 There shall be constant reliable communication between the pilot and a designated employee of the ground crew who acts as a signal person during loading and unloading. This signal person shall be distinctly recognizable from other ground personnel. > **See *Figure 8-11***.

16.J.17 Good housekeeping shall be maintained in all helicopter loading and unloading areas.

16.K MATERIAL HOISTS

16.K.01 Material hoists shall be designed and constructed or installed in accordance with the requirements of ANSI A10.5.

16.K.02 Material hoist towers, masts, guys or braces, counterweights, drive machinery supports, sheave supports, platforms, supporting structures, and accessories shall be designed by a licensed engineer.

16.K.03 Hoist towers shall be erected and dismantled only under the direct supervision of a qualified individual.

16.K.04 A copy of the hoist operating manual shall be available at all times it is operated.

16.K.05 Material hoists and hoist tower systems shall be inspected in accordance with the manufacturer's recommendations.

- a. Prior to initial use and each time after the tower is extended, all parts of the tower or mast, cage, bucket, boom, platform, hoisting machine, guys, and other equipment shall be inspected by a qualified person to ensure compliance with the manufacturer's inspection guidelines and ANSI A10.5.

b. Prior to initial use on a USACE project, and monthly thereafter, a periodic inspection shall be conducted by a qualified person. Periodic inspections shall cover those items specified by the manufacturer. At the minimum, periodic inspections shall cover all sheaves, racks and pinions, guy ties, bolt connections, miscellaneous clamps, braces, and similar parts.

c. A GDA shall be notified at least 24 hours prior to any of the above inspections and may wish to accompany the contractor's inspector.

d. Pre-operational inspections (start-up procedures) shall be conducted by the operator prior to every operation (shift) of the hoist.

16.K.06 Before a hoist is placed in service and every 4 months thereafter, a car-arresting-device test shall be performed.

a. For rope-supported cars, the test shall be conducted in the following manner:

(1) Pull a loop in the lifting rope and attach the test rope to each side of the loop above the bucket or platform,

(2) Raise the platform or bucket to allow the load to be supported by the test rope, and

(3) Cut the test rope to allow the load to fall and activate the car-arresting device.

b. For car suspension other than rope supported, the test shall be conducted by creating an over speed condition of the car.

c. Structural components shall be inspected for damage after the test and before the hoist is placed in operation again.

16.K.07 Maintenance and repairs.

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- a. Replacement parts for load bearing or critical components shall be either obtained from or certified by the equipment manufacturer.
- b. Maintenance and repairs shall be conducted in accordance with the manufacturer's precautions and procedures.

16.K.08 Landings and runways.

- a. Landing platforms and runways that connect the hoist way or tower to a structure shall be designed and constructed to sustain the maximum intended load without failure.
- b. Floors or platforms that may become slippery shall have slip-resistant surfaces.
- c. When workers may be exposed to falling objects, overhead protection, composed of 2-in (5-cm) planking or the equivalent, shall be provided.
- d. A barricade shall be provided at the open ends of each landing. The barricade shall extend a minimum distance of 6 ft (1.8 m) laterally along the outer edge of the landing from each side of the hoist way, shall extend from the floor a distance of at least 3 ft (0.9 m), and shall be of #19 US gauge wire or the equivalent, with openings not exceeding 0.5 in (1.2 cm).
- e. All hoist way entrances shall be protected by substantial gates or bars that shall guard the full width of the landing entrance. Gates shall be not less than 66 in (167.6 cm) in height, with a maximum under clearance of 2 in (5 cm), and shall be located not more than 4 in (10.1 cm) from the hoist way line. Gates of grille, lattice, or other open work shall have openings of not more than 2 in (5 cm).
- f. Material shall not be stored on landing platforms or runways.

16.K.09 Whenever a slack line condition occurs, the proper seating of the rope in the sheaves and on the drum shall be checked prior to further operations.

16.K.10 Hoisting ropes shall be installed in accordance with the equipment manufacturer's recommendations.

a. There shall be at least three full wraps of cable on the drums of hoisting equipment at all times.

b. The drum end of the rope shall be anchored to the drum by an arrangement specified by the crane or rope manufacturer.

16.K.11 Riding on material hoists or other hoisting equipment not meant for personnel handling is prohibited.

16.K.12 While hoisting equipment is in operation, the operator shall not perform any other work and shall not leave his/her position at the controls until the load has been safely landed or returned to ground level.

16.K.13 Not more than one cage or bucket shall be operated at the same time by any one hoisting machine or operator.

16.K.14 Operating rules shall be established and posted at the operator's station of the hoist. Such rules shall include signal system and allowable line speed for various loads. Rules and notices shall be posted on the car frame or crosshead in a conspicuous location, including the statement "**NO RIDERS ALLOWED.**"

16.K.15 Air-powered hoists shall be connected to an air supply of sufficient capacity and pressure to safely operate the hoist. Pneumatic hoses shall be secured by some positive means to prevent accidental disconnection.

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16.L PILE DRIVERS

16.L.01 Guys, outriggers, thrust outs, counter-balances, or rail clamps shall be provided to maintain stability of pile-driver rigs.

16.L.02 Pile-driver leads.

a. Swinging (hanging) leads.

(1) Swinging (hanging) leads shall have fixed ladders.

(2) Employees shall be prohibited from remaining on leads or ladders while pile is being driven.

b. Fixed leads.

(1) Fixed pile-driver leads shall be provided with decked landings having guard rails, intermediate rails, and toe boards. Fixed ladders or stairs shall be provided for access to landings and head blocks.

(2) Fixed leads shall be provided with rings or attachment points so that workers exposed to falls of 6 ft (1.8 m) or greater may attach their safety belt lanyard to the leads.

c. Landings or leads shall not be used for storage of any kind.

d. Pile-driver leads shall have stop blocks to prevent the hammer from being raised against the head block.

e. A blocking device, capable of supporting the weight of the hammer, shall be provided for placement in the leads under the hammer at all times while employees are working under the hammer.

f. Leads shall be free of projections or snags to minimize line damage and personnel safety hazards.

16.L.03 Dogs, on pile-driver hoist drums, that automatically disengage when the load is relieved or the drum is rotated shall be prohibited.

16.L.04 Guards shall be provided across the top of the head block to prevent cable from jumping out of the sheaves.

16.L.05 All hose connections to pile-driver hammers, pile ejectors, or jet pipes shall be securely attached with an adequate length of at least 1/4-in (0.6-cm) alloy steel chain, having 3,250 lb (1,500 kg) working load limit, or equal strength cable, to prevent whipping if the joint is broken.

16.L.06 Steam-line controls shall consist of two shutoff valves, one of which shall be a quick-acting lever type within easy reach of the hammer operator.

16.L.07 Floating pile drivers.

a. The width of hulls of floating pile drivers shall not be less than 45% of the height of the lead above the water.

b. The operating deck of floating pile drivers shall be so guarded as to prevent piles that are being hoisted into driving position from swinging in over the deck.

16.L.08 Hoisting and moving pile.

a. All employees shall be kept clear when piling is being hoisted into the leads.

b. Hoisting of steel piling shall be done by use of a closed shackle or other positive attachment that will prevent accidental disengagement.

c. Taglines shall be used for controlling unguided piles and free hanging (flying) hammers.

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d. Hammers shall be lowered to the bottom of the leads while the pile driver is being moved.

16.L.09 When driving jacked piles, all access pits shall be provided with ladders and bulk headed curbs to prevent material from falling into the pit.

16.L.10 When it is necessary to cut off the tops of driven piles, pile-driving operations shall be suspended except where the cutting operations are located at least twice the length of the longest pile from the driver.

16.L.11 Pile extraction.

a. If piling cannot be pulled without exceeding the load rating of equipment, a pile extractor shall be used.

b. When pulling piling, cranes shall be equipped with LID devices and the booms shall not be raised more than 60° above the horizontal. (This requirement does not apply to vibrating-type pulling devices.)

c. Piling shall not be pulled by tipping the crane, releasing the load brake momentarily, and catching the load before the crane has settled.

16.M DRILLING EQUIPMENT

16.M.01 Applicability. The requirements of this Section (16.M) are applicable to rock, soil, and concrete drilling operations.

16.M.02 Drilling equipment shall be operated, inspected, and maintained as specified in the manufacturer's operating manual. A copy of the manual will be available at the job site.

16.M.03 Prior to bringing earth drilling equipment on the job site, a survey shall be conducted to identify overhead electrical hazards

and potential ground hazards, such as contact with unexploded ordnance, hazardous agents in the soil, or underground utilities.

- a. The location of any overhead or ground hazards shall be identified on a site layout plan.
- b. The findings of this survey and the controls for all potential hazards shall become a part of the AHA.

16.M.04 The AHA for an earth drilling activity will not be accepted unless:

- a. It contains a copy of the MSDS for the drilling fluids, if required;
- b. It meets the requirements of 01.A.13; and
- c. It indicates that the site layout plan specified in 16.M.03 will become a part of the analysis, and will be covered at the preparatory inspection (pre-activity safety briefing), when the plan has been completed.

16.M.05 Training.

- a. All members of drilling crews shall be trained in:
 - (1) The operation, inspection, and maintenance of the equipment;
 - (2) The safety features and procedures to be used during operation, inspection, and maintenance of the equipment; and
 - (3) Overhead electrical line and underground hazards.
- b. This training will be based on the equipment operating manual and the AHA.

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16.M.06 Drilling equipment shall be equipped with two easily accessible emergency shutdown devices, one for the operator and one for the helper.

16.M.07 Clearance from electrical sources shall be as specified in 11.E.05.

a. Drilling equipment shall be posted with signs warning the operator of electrical hazards.

b. The equipment operator shall ascertain proper clearance before moving equipment. Clearance shall be monitored by a spotter or by an electrical proximity warning device.

16.M.08 Moving equipment.

a. Before drilling equipment is moved, the travel route shall be surveyed for overhead and terrain hazards, particularly overhead electrical hazards.

b. Earth drilling equipment shall not be transported with the mast up. The exception is movement of the equipment required in drilling a series of holes, such as in blasting, if the following conditions are satisfied:

(1) Movement is over level, smooth terrain;

(2) The path of travel has been inspected for stability and the absence of holes, other ground hazards, and electrical hazards; and

(3) The travel distance is limited to short, safe distances.

16.M.09 Equipment set-up.

a. Equipment shall be set-up on stable ground and maintained level. Cribbing shall be used when necessary.

- b. Outriggers shall be extended per the manufacturer's specifications.
- c. When drilling equipment is operated in areas with the potential for classification as a confined space, the requirements of 6.I shall be followed.

16.M.10 Equipment operation.

- a. Weather conditions shall be monitored. Operations shall cease during electrical storms or when electrical storms are imminent. > **See 06.J.01.**
- b. Drill crewmembers shall not wear loose clothing, jewelry, or equipment that might become caught in moving machinery.
- c. Auger guides shall be used on hard surfaces.
- d. The operator shall verbally alert employees and visually ensure employees are clear from dangerous parts of equipment before starting or engaging equipment.
- e. The discharge of drilling fluids shall be channeled away from the work area to prevent the ponding of water.
- f. Hoists shall be used only for their designed intent and shall not be loaded beyond their rated capacity. Steps shall be taken to prevent two-blocking of hoists.
- g. The equipment manufacturer's procedures shall be followed if rope becomes caught in, or objects get pulled into, a cathead.
- h. Drill rods shall neither be ran nor be rotated through rod slipping devices. No more than 1 ft (0.3 m) of drill rod column shall be hoisted above the top of the drill mast. Drill rod tool joints shall not be made up, tightened, or loosened while the rod column is supported by a rod-slipping device.

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- i. Dust shall be controlled. When there is potential for silica exposure, the requirements contained in Appendix C shall be implemented.
- j. Augers shall be cleaned only when the rotating mechanism is in neutral and the auger stopped. Long-handled shovels shall be used to move cutting from the auger.
- k. Open boreholes shall be capped and flagged. Open excavations shall be barricaded.
- l. Means (e.g., guard around the auger; barricade around the perimeter of the auger; electronic brake activated by a presence-sensing device) shall be provided to guard against employee contact with the auger.
- m. The use of side-feed swivel collars on drill rods are restricted to those collars that are retained by either a manufacturer-designed stabilizer or a stabilizer approved by a professional engineer.