INCH-POUND

MIL-C-3998E
31 March 1994
Superseding
MIL-C-3998D
16 February 1988

MILITARY SPECIFICATION
CRANE TRUCKS, WAREHOUSE, DIESEL ENGINE, PNEUMATIC RUBBER TIRES

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers diesel-engine-driven, wheel mounted, self-propelled, rotating and telescoping boom, warehouse and industrial handling cranes.

1.2 Classification. Cranes shall be one of the following sizes and ratings as specified in 6.2 and defined in 3.9.1.

Size A -- 10,000 lbs. at 8 FT. (4550 kg @ 240 cm)

Size B -- 16,000 lbs. at 10 FT. (7250 kg @ 300 cm)

Size C -- 20,000 lbs. at 10 FT. (9100 kg @ 300 cm)

Size D -- Pounds at Distance Specified (See 6.2)
(kg at cm specified)

2. APPLICABLE DOCUMENTS

2.1 The following documents, of the issue in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: "Commanding Officer, Navy Ships Parts Control Center, Post Office Box 2020, Attention: Code 0341, Mechanicsburg, Pa. 17055-0788 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A FSC 3950

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SPECIFICATIONS

FEDERAL

GG-P-455 - Plates and Foils, Photographic (Photosensitive Anodized Aluminum)

VV-F-800 - Fuel Oil, Diesel.

MILITARY

MIL-P-514 - Plates, Identification, Instruction and Marking, Blank.

MIL-B-46176 - Brake Fluid, Silicone, Automotive, All Weather, Operational and Preservative.

STANDARDS

FEDERAL

FED-STD-595 - Colors

MILITARY

MS-51118 - Pintle Assembly, Towing: 40,000 lbs. Capacity, Manual

MIL-STD-162 - Materials Handling Equipment: Preparation for Shipment, Storage, Cyclic Maintenance Routine Testing and Processing.

MIL-STD-209 - Slinging and Tiedown Provisions for Lifting and Tying Down Military Equipment.

MIL-STD-1474- Noise Limits For Army Materials

(Copies of specifications and standards required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

DEPARTMENT OF LABOR OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (DOL)

Occupational Safety and Health Act (OSHA) with Supplemental Revisions.

(Application for copies should be addressed to the Superintendent of Documents, Government Printing Office, Washington, DC 20402.)

AMERICAN NATIONAL STANDARDS INSTITUTE, INC. (ANSI/ASME)
B30.5 -- Mobile and Locomotive Cranes.

(Application for copies should be addressed to the American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018.)

AMERICAN SOCIETY OF TESTING AND MATERIALS (ASTM)

ASTM D3951 - Packaging, Commercial

(Application for copies should be addressed to: American Society for Testing and Materials, 1961 Race Street, Philadelphia, PA 19103)

SOCIETY OF AUTOMOTIVE ENGINEERS, INC. (SAE)

SAE J159 - Load Moment System

SAE J185 - Access Systems for Off-Road Machines

SAE J375 - Radius-of-Load or Boom Angle Indicating System

SAE J376 - Load Indicating Devices in Lifting Crane Service

SAE J534 - Lubrication Fittings

SAE J551 - Performance Levels and Methods of Measurement of Electromagnetic Radiation from Vehicles and Devices (30 to 1000 Mhz)

SAE J765 - Crane Load Stability Test

SAE J833 - Human Physical Dimensions

SAE J898 - Control Locations for Off-Road Work Machines

SAE J925 - Minimum Service Access Dimensions for Off-Road Machines

SAE J931 - Hydraulic Power Circuit Filtration

SAE J1063- Cantilevered Boom Crane Structures-Method of Test

SAE J1152- Braking Performance-Rubber-Tired Construction Machines

SAE J1180- Telescoping Boom Length Indicating System

SAE J1305- Two-Block Warning and Limit Systems In Lifting Crane Service

(Application for copies should be addressed to the Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096.)

THE TIRE AND RIM ASSOCIATION, INC. (T & RA Yearbook)

(Application for copies should be addressed to "THE TIRE AND RIM ASSOCIATION, INC., 3200 W. Market St., AKRON, OH 44313.)

(Technical society and technical association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.)

2.3 Order of Precedence. In the event of a conflict between the text of this document and the references cited herein, (except for related associated detail specifications, specification sheets, or MS standards), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 First Article Unit. When specified (see 6.2), a first produced crane shall be subjected to a first article inspection (see 6.2) in accordance with 4.3.

3.2 Standard Commercial Product. The crane shall be in accordance with the requirements of this specification and shall be the manufacturer's standard commercial product. The crane shall be equipped with instruments, components and accessories required for the operations specified herein.

3.3 Materials. Materials used shall be free from defects which would adversely affect the performance or maintainability of individual components or of the overall assembly. Materials not specified herein shall be of the same quality used for the intended purpose in commercial practice.
Unless otherwise specified herein, all equipment, material, and articles incorporated in the work covered by this specification are to be new.

3.4 Interchangeability. All units of the same classification furnished with similar options under a specific contract shall be identical to the extent necessary to insure interchangeability of component parts, assemblies, accessories, and spare parts.

3.5 Maintainability. The crane design, together with component and accessory location and installation, shall permit ready accessibility to all items requiring periodic maintenance service in the field, which will be accomplished with the use of conventional general-purpose tools associated with equipment of this nature. The replacement and adjustment of components and accessories shall be accomplished with minimum disturbance to other elements of the crane. Drainage of lubricants shall be to a waste container without draining onto any part of the truck.

3.6 Safety. The crane shall comply with Federal OSHA regulations. All rotating or reciprocating parts and all parts subject to high operational temperatures, that are of such nature or are so located as to be or become a hazard to the operating or attending personnel, shall be substantially guarded, or insulated, to the extent necessary to eliminate the hazard. The principal platform walking surfaces shall be of an anti-skid type. Ladders, steps, and handholds shall be provided in such quantity and of such size on the sides of the crane cab or superstructure that entrance thereto and exit therefrom may be unhampered and nonhazardous. Engine cooling fans shall have heavy grille or ring type guards. All cranes shall be provided with a back-up alarm.

3.6.1 Load rating chart. A load rating chart in accordance with ANSI B30.5 shall be provided.

3.6.2 Nuclear safety. When specified (see 6.2) the crane shall comply with the following requirements for lifting nuclear loads:

(a) Controls shall ensure that the load is under positive operator control.

(b) The crane shall have features that ensure prompt and automatic stop (except for cable swing) in case of operating mechanism failure.

(c) The design of the crane shall permit completely synchronized operations.

(d) The crane shall have features that will automatically neutralize controls in the absence of a manual force.

(e) The maximum nuclear certified lift capacity, positioning limits, and rates of the crane shall be identified by separate load charts, based on the following criteria:

1. The crane shall have a minimum safety factor of three (3) for all load sustaining (basic structure) parts, based on the material minimum yield strength.

2. The crane shall have a minimum safety factor of ten (10) for blocks and rope falls, fiber rope, and webbing, based on the material ultimate strength.

3. The crane shall have a minimum safety factor of five (5) for all accessory parts, such as hooks, rings, shackles slings, and wire rope based on the material ultimate strength.

(f) Hooks shall be equipped with throat-opening devices.

(g) The crane shall have stops or limit switches to stop the wire rope when the hook reaches its upper limit.

3.7 Human factors. The characteristics of the crane shall provide for operation and maintenance by personnel ranging from the small person clothed through the large person clothed in accordance with SAE J833 and SAE J925. The size and location of access/egress passages shall be in accordance with SAE J185. The locations of controls shall be in accordance with SAE J898. components and equipment removed, disassembled or relocated for operation or transportability, which must be lifted or carried by operating personnel shall not exceed 50 pounds (23 kilograms) in weight for one person lifts and 100 pounds (46 kilograms) for two or more person lifts and shall be provided with suitable handles or grasp areas.

3.8 Lubrication. Lubrication shall be in accordance with the equipment manufacturer's recommendations. Lubrication fittings shall be in accordance with SAE J534. Pressure lubrication shall not damage seals or other parts. All parts requiring lubrication shall be lubricated prior to delivery and tagged to show the type and temperature rating of the lubricant used. In addition a chart shall be provided showing all lubrication points.

3.9 Performance

3.9.1 Minimum Lifting Capacities.

Center Line of Load to Center Line of Rotation	Stabilized (360°)	On Rubber (360°)
Size A Crane		
8 Feet (240cm)	10,000 Pounds (4550kg)	5,000 Pounds (2250kg)
18 Feet (540cm)	4,000 Pounds (1800kg)	1,000 Pounds (450kg)
Size B Cranes		
10 Feet (300cm)	16,000 Pounds (7250kg)	11,000 Pounds (4990kg)
25 Feet (750cm)	6,000 Pounds (2770kg)	2,000 Pounds (900kg)
Size C Cranes		
10 Feet (300cm)	20,000 Pounds (9100kg)	12,000 Pounds (5440kg)
40 Feet (1200cm)	4,500 Pounds (2020kg)	1,000 Pounds (450kg)
Size D Cranes: (As specified in 6.2)		
XX feet (xxkg)	XX,XXX lbs. (xxkg)	X,XXX lbs. (xxkg).
XX feet (xxkg)	XX,XXX lbs. (xxkg)	X,XXX lbs. (xxkg).

All loads must be tested according to SAE J765,however, tests are to be based on 75% of tipping load on outriggers as well as on rubber. Contractor shall provide certification of tipping point.

3.9.2 Travel speed. The crane without load shall be capable of attaining and maintaining a travel speed on level, paved roads of not less than 15 mph (24 kph).

3.9.3 Longitudinal gradeability. The crane without load shall be capable of ascending a 15-percent grade on hard packed surfaces, without engine stall, in forward gear at a speed of not less than 2 mph (3.2 kph).

3.9.4 Lateral gradeability. The crane without load shall be capable of ascending a 15-percent side slope on hard packed surfaces, without engine stall, in forward gear at a speed of not less than 2 mph (3.2 kph).

3.9.5 Power load lowering. Power load lowering by hydraulic control shall be provided for the main winch to facilitate controlled load lowering or lifting at any boom length or elevation.

3.9.6 Controls. All carrier, and crane controls, lockouts, and indicators shall be located within easy reach of the operator in the operator's cab, and shall be readily accessible under all conditions of operations. All controls shall be clearly marked as to their use and function. All controls must provide for slow smooth operation without jerking.

3.9.7 Brakes. The crane carrier shall be provided with the manufacturer's standard, foot controlled, service brakes. The service brakes shall be capable of bringing the crane to a complete safe stop in accordance with SAE J1152. A parking brake capable of holding the crane, on a longitudinal slope of not less than 15 percent without slippage, shall be provided. Maximum allowable operator force required to actuate braking systems shall be 200 pounds(92 kg) for service brakes and 100 pounds (46 kg) for the parking brake.

3.9.8 Lifting and tying down provisions. Unless otherwise specified (see 6.2), the cranes shall be equipped with lifting and tying down provisions that meet the requirements of MIL-STD-209 for type III equipment. The contractor shall have the option of specifying "hard points" that meet this military standard requirement for lifting and tiedown provisions. The contractor shall provide complete lifting instructions (with diagrams) and calculations to prove provision design strength. If a crane must be sectionize, coomnponents weighing 2,500 pounds or more shall also be equipped witbn lifting and tiedown provisions. Transport date plates shall be furnished for each size crane. Data plates shall show the crane gross vehicle weight (GVW) and axle weights. A crane side and end view shall be used to indicate overall dimensions, lifting and tiedown provisions, and center of gravity locations. Procedures for lifting and rail tiedown shall be depicted.

3.9.9 Noise limits. The sound level at the operator's station shall not exceed 85 dB(A).

3.9.10 Electromagnetic interference suppression. The crane shall comply with the requirements of SAE J551 for electromagnetic interference.

3.9.11 Boom stress. Design of the completely assembled crane shall be such that the maximum unit stress imposed will not exceed the minimum strength margins contained in SAE J1063.

3.9.12 Stability. Cranes when tested to 110% of rated capacity as listed on the capacity chart, shall meet stability requirements as defined by SAE J765.

3.9.13 Endurance. The crane shall be capable of completing the endurance test described in 4.6.13.

3.10 Crane structure.

3.10.1 Boom. The boom shall be of the hydraulically operated telescoping type, and of alloy steel consisting of a base section and sliding extensions. All extensions, retractions, and elevations of the boom shall be accomplished by hydraulic controls from the operator's cab without manual assist except as noted in paragraph 3.10.15. Boom shall be capable of rotating 360°.

3.10.2 Hook block. The running block and hook shall have adequate weight to insure payout of the cable without load on the hook when the hook is in any position. The hook shall be a swivel type with a safety factor of 4:1 based on ultimate tensile strength, and shall include a safety latch on the hook. The hook shall not be painted. Block assembly shall be capable of reeving the number of parts of line necessary to lift the maximum rated load. The hook block furnished shall permit disassembly for visual and nondestructive testing.

3.10.3 Rope. Load hoist rope(s) shall be improved plow steel, Independent Wire Rope Center, (IWRC or WSC) with a safety factor not less than 5:1. Unless otherwise specified, (see 6.2) the manufacturer's standard length of wire cable shall be furnished.

3.10.4 Sheaves. All sheaves shall have a pitch diameter at least 18 times the rope diameter. Sheaves shall be adequately guarded to prevent the wire rope from leaving the sheave during operation. All sheaves shall be smooth and of the proper size for the wire rope furnished.

3.10.5 Hydraulic system. The hydraulic system shall include a pump(s), hydraulic rams, rods, full flow filter, reservoir, pressure relief valve, and all necessary lines, lockouts, restrictor, and control valves to insure positive control of boom hoist and rope hoist in all operations or loss of hydraulic power due to ruptured hoses. Hydraulic line circuit and filtration shall be in accordance with SAE J931 with a 25 micron filter. The pump(s) shall be driven by the crane engine and shall have sufficient capacity to operate all hydraulically powered components as specified herein. Means shall be provided in the hydraulic system for bleeding all air trapped in the system. All rods, which will be exposed during operation, shall have a hard chromium plate finish. All high pressure hydraulic hoses and fittings shall be capable of withstanding a bursting test pressure of four times the working pressure, and a maximum operating pressure of at least two times the working pressure.

3.10.6. Dimensional characteristics. When required (see 6.2) the following dimensions shall be as specified:

Overall Crane Length (Max)	_____
Overall Chassis Length (Max)	_____
Overall Height (Max)	_____
Overall Width (Max)	_____
Turning Radius (Max)	_____
Ground Clearance (Min)	_____

3.10.7 Cab. The cab shall be fabricated from sheet steel or fiberglass, having sufficient windows and glazed doors to permit at least 270 degree vision for the driver or operator in normal position. All glass shall be not less than 3/16-inch (4.8mm) nominal thickness, safety type, and held in place by rubber or metal channels for easy replacement. Windows shall be arranged for easy opening and removal when required. All cab doors, whether of the sliding or swinging type, shall be adequately restrained from accidently opening or closing when the crane is traveling or operating. All doors shall be provided with means for securely locking in the closed position. An adjustable, cushion seat with backrest shall be provided in the cab and located for maximum unobstructed visibility of the operator. The cab shall be equipped with heater, defroster, interior dome light, and air or electric operated windshield wiper. Electric or air horn, hand or foot operated, shall be provided. A positive swing lock for traveling shall be provided for the cab if the cab is mounted on the revolving superstructure or upper structure.

3.10.8 Carrier. Carrier frame shall be fabricated of steel with necessary braces and reinforcements to provide rigid support for the revolving superstructure, under maximum load, when the telescopic boom is extended at minimum through maximum radii at any position within the specified rotation. The revolving superstructure shall be so positioned in a location on the carrier frame permitting maximum efficiency for all purpose crane operations. All wheels shall be equipped with pneumatic tires of compatible size for the load imposed and shall be in accordance with the Tire and Rim Association Yearbook. Power assisted or full hydraulic steering shall be provided.

3.10.9 Transmission. When required the crane carrier shall be equipped with a torque converter, a full power shift or automatic transmission with selective gear to provide not less than three forward and one reverse speed. Gearing shall allow a maximum speed in the lowest forward and reverse gear of not more than 9 mph (14.5km/h). and in the highest gear forward of at least the travel speed specified in 3.9.2 with the engine operating at engine governed speed. Hydrostatic drives may be provided, giving progressive speed selection.

3.10.10 Special brakes. When specified, (see 6.2) the brake system shall be compatible with MIL-B-46176, Brake Fluid, Silicone, Automotive, All Weather, Operational and Preservative.

3.10.11 Tires. Unless otherwise specified (see 6.2), tires shall be manufacturer's standard normally supplied on unit. Tires shall have a rated capacity at least equal to the load imposed on each tire, measured at each wheel, at the ground, with the crane loaded with the maximum safe load. Tire ratings shall conform to Tire and Rim Association recommendations for the type and size of tires furnished.

3.10.12 Lights and reflectors. The following lights shall be furnished and installed and shall be powered by a 12- or 24-volt electrical system:

(a) Two sealed beam headlights.
(b) Taillights.
(c) Stoplights.
(d) Turn signal lights.
(e) Instrument panel light.
(f) Weatherproof automotive type work spotlights or floodlights. (Two on rotating superstructure and one on boom or two on the boom and one on the cab).
(g) Emergency 4-way flashing lights.

3.10.13 Engine. The carrier engine furnished shall be diesel powered having horsepower, torque, and speed characteristics to meet satisfactorily all the crane performance requirements specified herein. The engine shall be capable of meeting the performance requirements using diesel fuel conforming to VV-F-800. The diesel engine shall start within 5 minutes and be ready for full load operation within 15 minutes in any ambient temperature from +120°F (+43°C) to 0°F (-18°C). When a fluid priming system is required, it shall be of the measured shot type with storage capacity of at least 12 fluid ounces. The engine shall be furnished complete with at least the following accessories:

(a) An instrument panel in the cab complete with a lubricating oil pressure gage, a fuel gage, a cooling liquid-temperature gage and a battery charge and discharge rate indicator or voltmeter.
(b) A fuel tank with sufficient capacity for 8 hours normal operation.
(c) A 12-volt or 24-volt electric cranking system.
(d) Battery (ies) shall be shipped, wet and charged to CONUS activities.
(e) A charging alternator with a visible or audible safety device of the warning type.
(f) A cooling-liquid high temperature visible or audible safety device of the warning type.
(g) A lubricating low oil pressure visible or audible safety device of the warning type.
(h) An engine housing so designed as to facilitate the maintenance of engine.
(i) A transmission temperature gage.
(j) An engine hour meter.

3.10.14 Axle assembly. The rear axle assembly shall be of the manufacturer's standard design.

3.10.15 Jib boom section. When required (see 6.2) a fly or jib boom section shall be provided. Jib or fly boom shall be specified as to length and shall be manufacturer's standard section available for the size crane ordered. The extra boom need not be controlled hydraulically. Load charts shall show capacities at all positions with jib boom attached and a single part line operation.

3.10.16 Pintle assembly. When specified (see 6.2), a pintle assembly shall be provided at the rear of the crane carrier. The pintle shall be installed on the carrier frame with reinforcements to transfer pintle loads directly to the carrier frame.

The pintle type and pintle towing capacity shall be as specified by MS 51118.

3.10.17 Fenders. The manufacturer's standard steel fenders shall be provided over each wheel.

3.10.18 Toolbox. The crane shall be provided with a metal toolbox. The toolbox shall have a hinged lid with a padlock closing device, less lock and key. The toolbox shall be securely fastened to the crane in a readily accessible and protected position.

3.10.19 Oil sampling valves. When specified (see 6.2) an oil sampling valve shall be provided on the engine and transmission. The valve shall be manually operated and shall automatically close after release. It shall be made of material resistant to corrosion such that it will not contaminate the sample. The discharge of the valve shall be covered with a captive, chained metal threaded cap, which provides a positive seal of the sampling port. The valve shall be located in such a way as to insure that personnel will not be exposed to danger when taking a sample with the engine running. The location of the oil taps shall be such that when samples are taken, it shall be a true representation of the oil that is flowing while engine is running. The sampling valve shall either be labeled or tagged to indicate the type of oil being sampled,(engine or transmission).

3.10.20 Outriggers. Unless otherwise specified (see 6.2) cranes are required to have hydraulic outriggers, operated from the operator's position, either separately or in any combination. Outriggers shall not collapse due to loss of hydraulic power and, when fully extended, shall be capable of supporting the crane and its maximum rated load, with wheels off the ground. The power load lowering means shall provide positive control of a single live load equal to the maximum rated crane capacity divided by the recommended number of parts of hoist line reeving.

3.10.21 Rotation. The power transmission system used to rotate the superstructure shall be a hydraulic mechanical arrangement. Swing speed within range shall be smooth and constant, and adequate control shall be provided to insure smooth starting and stopping. An automatic or manual type swing lock or brake, capable of locking the superstructure in any desired position shall be provided on non-self-locking swing gear systems. The manual swing lock or brake controls shall be located within easy reach of the operator, while seated.

3.10.22 Main hoist capacity. The main hoist shall have sufficient capacity to make maximum rated lifts with longest boom length and with the length of rope installed on the winch as specified in 3.10.3. In addition, there shall be sufficient cable length at the maximum specified reach of boom and lowered hook to have two complete wraps remaining on drum. An anti two-block system shall be installed to prevent the hook block from contacting boom tip.

3.10.23 Indicators. All cranes shall be provided with a load moment indicating device (LMI) with control lever lockout for overload conditions. These indicators must be so located as to be easily read by the operator from his normal operating position. The LMI shall comply with SAE J159, J375, J1180 and J1305. Indicator readings shall correspond to the load chart data; that is the units of measurement and divisions shall be the same on each.

3.11 Identification plate. Each crane shall be furnished with an identification plate conforming to MIL-P-514, Type III, composition C (GG-P-455 Type 1, Grade A, Class 1) material. The plate shall be located in a conspicuous place on the crane and shall include the words "Crane, Hyd. Warehouse DED, Cap._____ Tons." It shall also contain manufacturer's name, crane serial number, Navy registration number (USN number), model number, delivery date (month and year), contract number, service weight and name of the government inspection office. The words "(Manufacturer's Name) certifies this crane meets the applicable design, construction and testing prescribed in ANSI B30.5."

3.12 Instruction plates. The crane shall be equipped with instruction plates suitably located, describing any special or important procedure to be followed in operating and servicing the equipment. Plates shall be of a durable material and shall be securely attached.

3.13 Vehicle markings. The gross weight of each equipment shall be stenciled on each side of the crane in such a manner as to be readily legible. The assigned United States Navy, (USN) registration numbers for each unit shall appear in 3 inch high, (7.5mm) block numbers in black enamel paint on each side of the boom and on the front and rear of the carrier(chassis). The prescribed tire pressure shall be stenciled on the chassis by block or stencil type letters not more than 1 inch high.

3.14 Cleaning, treatment, and painting. Surfaces normally painted in good commercial practice shall be cleaned, treated, and painted as specified herein.

Surfaces to be painted shall be cleaned and dried to insure that they are free from contaminants, such as oil, grease, welding slag and spatter, loose mill scale, water, dirt, corrosion products, or any other interfering substances. As soon as practicable, after cleaning, and before any corrosion product or other coating interfering material can result, the surface shall be prepared or treated to insure the adhesion of the coating system. The painting shall consist of at least one coat of primer and two finish coats. The primer shall be applied to a clean, dry surface as soon as practicable after cleaning and treating. Painting shall be with manufacturer's current materials according to manufacturer's current processes and the total dry film thickness shall be not less than 2.5 mils over the entire surface. The paint shall be lead free and chromate free and shall not contain runs, sags, "orange peel", or other defects. The color of the finish coat shall comply with FED STD 595, Color 13538 or 23538 unless otherwise specified (see 6.2). Hazard stripes shall be applied to the rear of the carrier, boom point and hook block cheek plates. Stripes shall be manufacturers standard black, 2 inches (5mm) wide, 2 inches (5mm) apart, applied to a 45-degree angle, using the crane yellow paint as background. All cables, drums, sheaves and sockets shall be paint free. Crane shall be identified with the words "Painted with lead free and chromate free paint on (date) by (manufacturer)" with black letters 1.5 inches high on a conspicuous and protected location on the crane.

3.15 Workmanship.

3.15.1 Steel fabrication. The steel used in fabrication shall be free from kinks, sharp bends, and other conditions which would be deleterious to the finished product. Manufacturing processes shall not reduce the strength of the steel to a value less than intended by the design. Manufacturing processes shall be done neatly and accurately.
All bends shall be made by controlled means to insure uniformity of size and shape.

3.15.2 Bolted connections. Bolt holes shall be accurately punched or drilled and shall have the burrs removed. Washers or lockwashers shall be provided in accordance with good commercial practice, and all bolts, nuts, and screws shall be tight.

3.15.3 Riveted connections. Rivet holes shall be accurately punched or drilled and shall have the burrs removed. Rivets shall be driven with pressure tools and shall completely fill the holes. Rivet heads, when not countersunk or flattened, shall be of approved shape and of uniform size for the same diameter of rivet.

Rivet heads shall be full, neatly made, concentric with the rivet holes, and in full contact with the surface of the member.

3.15.4 Welding. Welding procedures shall be in accordance with a nationally recognized welding code. The surface of parts to be welded shall be free from rust, scale, paint, grease, or other foreign matter. Welds shall be of sufficient size and shape to develop the full strength of the parts connected by the welds. Welds shall transmit stress without permanent deformation or failure when the parts connected by the weld are subjected to proof and service loadings.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in this specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items shall meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of the manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

4.2 Classification of inspections.

a. First article inspection (see 4.3)

b. Quality conformance inspection (see 4.4)

4.3 First article inspection. First Article inspection shall be performed on one complete crane when a first article sample is required (see 3.1 and 6.2).

This inspection shall include the examination of 4.5 and the tests marked "X" in the first column of Table II.

4.4 Quality conformance inspection. Quality conformance inspection shall include the examination of 4.5 and the tests marked "X" in the second column of Table II.

4.5 Examination. First article examination shall include those items marked "X" in the first column of Table I. All cranes shall be examined as marked "X" in the second column of Table I. Any redesign or modification of the contractor's standard product to comply with specified requirements, or any necessary redesign or modification following failure to meet specified requirements shall receive particular attention for adequacy and suitability. This element of inspection shall encompass all visual examinations and dimensional measurements. Noncompliance with any specified requirements or presence of one or more defects preventing or lessening maximum efficiency shall constitute cause for rejection.

Table I. Examination Schedule

First Produced Inspection	Quality Conform.	Defect	Requirement Paragraph
X		Material not as specified	3.3
X		Interchangeability not as specified	3.4
X		Maintainability not as specified	3.5
X	X	Safety not as specified	3.6
X	X	Load rating chart not as specified	3.6.1
X		Nuclear safety not as specified	3.6.2
X	X	Human factors not as specified	3.7
X	X	Lubrication not as specified	3.8
X		Boom not as specified	3.10.1
X		Hook block not as specified	3.10.2
X		Rope not as specified	3.10.3
X		Sheaves not as specified	3.10.4
X		Hydraulic system not as specified	3.10.5
X		Dimensions not as specified	3.10.6
X	X	Cab not as specified	3.10.7
X		Carrier not as specified	3.10.8
X		Transmission not as specified	3.10.9
X		Special brakes not as specified	3.10.10
X		Tires not as specified	3.10.11
X	X	Lights and reflectors not as specified	3.10.12
X	X	Engine not as specified	3.10.13
X		Axle assembly not as specified	3.10.14
X	X	Jib boom section not as specified	3.10.15
X	X	Pintle assembly not as specified	3.10.16
X	X	Fenders not as specified	3.10.17
X	X	Toolbox not as specified	3.10.18
X	X	Oil sampling valves not as specified	3.10.19
X	X	Outriggers not as specified	3.10.20

Table I. Examination Schedule(con't)

First Produced Inspection	Quality Conform.	Defect	Requirement Paragraph
X		Rotation not as specified	3.10.21
X		Main hoist capacity not as specified	3.10.22
X	X	Indicator not as specified	3.10.23
X	X	Identification plate not as specified	3.11
X	X	Instruction plates not as specified	3.12
X	X	Vehicle markings not as specified	3.13
X	X	Cleaning, treatment and painting not as specified	3.14
X	X	Steel fabrication not as specified	3.15.1
X	X	Bolted connections not as specified	3.15.2
X	X	Riveted connections not as specified	3.15.3
X	X	Welding not as specified	3.15.4

Table II Test Schedule

First Produced	Quality Conform.	Test	Reqmts Para .	Test Para.
X	X	Minimum lifting capacity	3.9.1	4.6.1
X	X	Travel speed	3.9.2	4.6.2
X		Longitudinal gradeability	3.9.3	4.6.3
X		Lateral gradeability	3.9.4	4.6.4
X		Power load lowering	3.9.5	4.6.5
X	X	Travel control	3.9.6	4.6.6
X	X	Service brake and parking brake	3.9.7	4.6.7
X		Lifting and tying down attachments	3.9.8	4.6.8
X		Noise level	3.9.9	4.6.9
X		Electromagnetic interference	3.9.10	4.6.10
X		Boom stress	3.9.11	4.6.11
X		Stability	3.9.12	4.6.12
X		Endurance	3.9.13	4.6.13

4.6 Tests.

4.6.1 Minimum lifting capacity test. The crane shall be completely serviced and subjected to the manufacturer's recommended break-in. The safe load capacity test shall be performed on a level, paved surface by connecting a Baldwin SR4 load cell or equal between the lifting hook and a dead weight or the direct use of calibrated weights. The crane shall then lift the safe loads specified in the least stable direction. The crane, with safe load raised, shall be rotated 360 degrees clockwise and counterclockwise. Actual tipping loads, where tipping load is the controlling factor, for each of the load conditions stated in 3.9.1 shall be determined in accordance with SAE J765. These typing loads shall be shown to meet the stability requirements of ANSI B30.5. This test shall be recorded in the format of figure 1 of SAE J765. Seventy-five percent of each determined tipping load shall be compared with the applicable safe load for Navy cranes. Inability to meet the requirements of 3.9.1 shall constitute failure of this test.

4.6.1.1 Nuclear safety certification.

(a) An engineering analysis shall be performed to verify compliance with all requirements of 3.6.2.

(b) Operation of the fail-safe and synchronization features shall be demonstrated.

(c) Safety devices (such as braking devices, locking pawls, safety catches, rail stops, limit switches and valves) shall be tested at the rated load.

Inability to meet the requirements of 3.6.2 shall constitute failure of this test.

4.6.2 Travel speed tests. Speed tests shall be taken over a zero percent grade on a paved road. Time shall be recorded with a stopwatch accurate to 1 second. The average speed shall be recorded for the unit. Maximum average speed not less than that specified in 3.9.2 when calculated by the following formula shall be attained:

$$V = 0.682 \times D/T \quad (3.6 \times D/T)$$

Where: V = speed in mph (k/h)
D = distance in feet (m)
T = time in seconds

A fifth wheel type recorder may be used.

Inability to meet the requirements of 3.9.2 shall constitute failure of this test.

4.6.3 Longitudinal gradeability. The crane unit shall be tested for gradeability in compliance with 3.9.3. The crane unit, without load and with mounted attachments, shall negotiate a 15% percent grade on paved road without engine stall. Inability to meet the requirements of 3.9.3 shall constitute failure of this test.

4.6.4 Lateral gradeability. The crane unit shall be tested for gradeability in compliance with 3.9.4. The crane unit, without load and with mounted attachments, shall negotiate a 15% percent grade on paved road without engine stall. Inability to meet the requirements of 3.9.4 shall constitute failure of this test.

4.6.5 Power load lowering test. General inspection of the powerdown system shall be made for adequate lubrication, ease of operation of controls, safety precautions, and for good manufacturing practices. The power load lowering system shall be tested as follows to determine conformance to 3.9.5:

(a) With the crane equipped with a boom of a length as specified in 3.9.1, 3.10.15 and, with outriggers set, position the revolving superstructure in the most stable craning position and assemble a single line load equal to the maximum rated load divided by the recommended number of parts of hoist line reeving.

(b) Position the boom angle for the minimum specified working radius.

(c) Hoist the load 20 feet (600cm) above the ground level, +/-3 inches,(7.5cm) or until interference with the crane boom is obvious.

(d) Prepare the crane for power-down operation on the load line.

(e) Operate the power load lowering system in accordance with manufacturer's instructions, and lower the load under power. Vary the speed of the load.

(f) When the load reaches the ground, immediately repeat operations (c), (d), and (e). These operations shall be repeated until 20 cycles have been completed.

Inability to meet the requirements of 3.9.5 shall constitute failure of this test.

4.6.6 Travel control test. To demonstrate workability of the travel controls (see 3.9.6), the crane shall be operated forward and backward in two figure-8 patterns with hard right and left turns. Inability to meet the requirements of 3.9.6 shall constitute failure of this test.

4.6.7 Service and parking brake test. Service brakes of the crane shall be tested for compliance with 3.9.7. On a concrete roadway, the crane shall be accelerated at maximum rate to a speed of not less than 15 mph (24 kph), and stop in not less than 33 feet (10 meters). The service brakes shall be applied bringing the crane to a complete halt to determine conformance to 3.9.7. Immediately after the crane comes to a halt, this test cycle shall be repeated for six additional cycles. Following these cycles, all shoes, drums, and other brake components shall be disassembled and examined for any indication of damage. It shall be shown that with engine failure or broken brake line, the crane shall stop in 85 feet (25 meters), (initial speed of 15 mph (24kph)). A fifth wheel type recorder shall be used. The parking brake shall be tested for compliance with 3.9.7. Inability to meet the requirements of 3.9.7 shall constitute failure of this test.

4.6.8 Lifting and tiedown provisions. When required, (see 6.2) the lifting and tying down attachments shall be tested according to paragraph 3.9.8. Inability to meet the requirements of 3.9.8 shall constitute failure of this test.

4.6.9 Noise level measurement. The maximum steady state noise level shall be measured at the operator's station (microphone located no more than six (6)inches (150 mm) from operator's approximate ear location) and at 3.28 feet (one meter) from the perimeter of the truck. Noise level measurement shall be in accordance with MIL-STD-1474 with engine operating at maximum (no load) governed speed and at the speed required for the rated brake power necessary to lift the rated load. Nonconformance to 3.9.8 shall require that a hazard warning plate conforming to MIL-STD-1474 be located in clear view of the operator. Warning plates shall include the requirement for hearing protection. In no case shall the noise level exceed 90 dB(A) maximum.

4.6.10 Electromagnetic interference measurement. The vehicle shall be tested in accordance with SAE J551 to show compliance with 3.9.10. Inability to meet the requirements of 3.9.10 shall constitute failure of this test.

4.6.11 Boom stress test. Tests of pertinent structures in accordance with 3.9.11 and recorded in the format stated in J1063. Inability to meet the requirements of 3.9.11 shall constitute failure of this test.

4.6.12 Stability test. Verify, with the use of load cells, that the first article meets the requirements of 3.9.12. Inability to meet the requirements of 3.9.12 shall constitute failure of this test.

4.6.13 Endurance test. The crane shall lift the maximum rated pick and carry load at a 10-foot radius. The load shall be carried a distance of not less than five (5) miles (8 km) at an average speed of 1.5 mph (2.4 kph). At the conclusion of the durability test, the crane shall be inspected for any damage. Inability to meet the requirements of 3.9.13 shall constitute failure of this test.

4.7 Production sample. Upon acceptance of the first article, the first article shall remain at the manufacturing facilities as a production sample, and shall be the last crane delivered on the contract. The first article shall be reconditioned, including replacement of abnormally worn parts and paint touch-up or repainting prior to delivery to enable it to be accepted as a contract item. The contractor shall maintain the first article in a serviceable condition for the duration of the contract.

5. PREPARATION FOR DELIVERY

5.1 Preservation, packaging and packing,. Shall be in accordance with MIL-STD-162 or ASTM D3951 as specified (see 6.2).

6. NOTES:

6.1 Intended use. The crane trucks covered by this specification are intended for use on paved or semi paved surfaces where rugged, stable design is required to ensure safe, efficient and economical operation under extended service conditions.

6.2 Ordering data.

6.2.1 Acquisition requirements. Acquisition documents should specify the following:

(a) Title, number, and date of this specification.
(b) Size of crane required. (see 1.2)
(c) When First Article Test, Inspection, and Approval are required. (see 3.1)

(d) When nuclear safety is required (see 3.6.2)
(e) When "Size D crane is required, list capacities at distances as shown in 1.2, and 3.10.6.
(f) When lifting and tie down attachments and tests are not required. (see 3.9.8)
(g) When cable length shall be other than manufacturer's standard length. (see 3.10.3)
(h) When overall crane dimensions shall be as specified, list as shown in paragraph 3.10.6
(i) When brake system must comply with MIL-B-46176. (3.10.10)
(j) When tires shall be other than standard provided. (see 3.10.11)
(k) When jib or fly boom is required. (3.10.15)
(l) When pintle assembly is required. (3.10.16)
(m) When oil sampling valves are required. (3.10.19)
(n) When outriggers are not required. (see 3.10.20)
(o) When color of finish paint is other than specified. (see 3.14)
(p) Level of preservation, packaging and packing required. (see 5.1)
(q) What tests are required when First Article Testing is not required.

6.3 First article. When a first article inspection is required, the item(s) should be a first production item. The first article should consist of one or two units.
The contracting officer should include specific instructions in acquisition documents regarding arrangements for examinations, approval of first article test results and disposition of first articles. Invitations for bids should provide that the Government reserves the right to waive the requirement for samples for first article inspection to those bidders offering a product which has been previously acquired or tested by the Government, and that bidders offering such production or test, must furnish evidence with the bid that prior Government approval is presently appropriate for the pending contract.

6.4 Conditions for use of level B preservation. When level B preservation is specified (see 5.1), this level of protection should be reserved for the acquisition of crane trucks for resupply worldwide under known favorable handling, transportation and storage conditions.

6.5 Subject term (key word) listing

Boom, jib
Capacities, lifting
Engine
Transmission
Truck, crane, warehouse

6.6 Changes from previous issue. Asterisks are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

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STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER	2. DOCUMENT DATE (YYMMDD)
	MIL-C-3998E	940331

3. DOCUMENT TITLE

Crane Trucks, Warehouse, Diesel Engine, Pneumatic Rubber Tires

4. NATURE OF CHANGE *(Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)*

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME (Last, First, Middle Initial)	b. ORGANIZATION	
c. ADDRESS (Include Zip Code)	d. TELEPHONE (Include Area Code) (1) Commercial (2) AUTOVON (If applicable)	7. DATE SUBMITTED (YYMMDD)

8. PREPARING ACTIVITY

a. NAME	b. TELEPHONE (Include Area Code) (1) Commercial (2) AUTOVON
c. ADDRESS (Include Zip Code) Post Office Box 2020 Mechanicsburg, PA 17055-0788	**IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT:** Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466 Telephone (703) 756-2340 AUTOVON 289-2340