

NOTICE OF
CANCELLATION

[INCH-POUND]
F-C-2791
NOTICE 1
May 18, 1998

FEDERAL SPECIFICATION

COOLING TOWERS, LIQUID

Federal Specification F-C-2791, dated November 29, 1991, is hereby canceled. Future acquisition of this material should refer to Commercial Item Description A-A-59223.

(Copies of specifications, standards, drawings, and publications required by contractors in connection with the specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

Preparing Activity:

Navy-YD1

(Project 4130-0400)

* INCH-POUND *

F-C-2791
November 29, 1991
SUPERSEDING
MIL-C-16278G(YD)
23 February 1983

FEDERAL SPECIFICATION
COOLING TOWERS, LIQUID

This specification is approved by the Commissioner, Federal Supply Service, General Services Administration, for the use of all Federal agencies.

1. SCOPE

1.1 Scope. This specification covers factory assembled, induced mechanical draft and forced mechanical draft cooling towers for commercial and industrial use.

1.2 Classification. The towers shall be of the following types, as specified (see 6.1.1 and 6.2).

- Type I - Induced mechanical draft
- Type II - Forced mechanical draft

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications and standards. The following specifications and standards, form a part of this document to the extent specified herein. Unless otherwise specified (see 6.2), the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation.

Beneficial comments (recommendations, additions, deletions) and any pertinent
 *data which may be of use in improving this document should be addressed to: *
 *Commanding Officer (Code 156), Naval Construction Battalion Center, Port *
 *Hueneme, CA 93043-5000, by using the self-addressed Standardization *
 *Document Improvement Proposal (DD Form 1426) appearing at the end of this *
 *document or by letter. *

FSC 4130

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

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SPECIFICATIONS

FEDERAL

- TT-P-664 - Primer, Coating, Synthetic, Rust Inhibiting, Lacquer Resisting
- PPP-B-601 - Boxes, Wood, Cleated Plywood
- PPP-B-621 - Boxes, Wood, Nailed, and Lock-Corner

MILITARY

- MIL-V-3 - Valve, Fittings, and Flanges (Except for Systems Indicated Herein), Packaging of
- MIL-P-116 - Preservation, Methods of
- MIL-B-121 - Barrier Material, Greaseproofed, Waterproofed, Flexible
- MIL-V-173 - Varnish, Moisture- and Fungus-Resistant (For the Treatment of Communications, Electronic, and Associated Equipment)
- MIL-C-3774 - Crates, Wood: Open, 12,000 and 16,000 Pound Capacity
- MIL-E-16298 - Electric Machines Having Rotating Parts and Associated Repair Parts, Packaging of
- DOD-P-21035 - Paint, High Zinc Dust Content, Galvanizing Repair (Metric)
- MIL-C-52950 - Crates, Wood, Open, and Covered

STANDARDS

MILITARY

- MIL-STD-129 - Marking for Shipment and Storage
- MIL-STD-461 - Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference
- MIL-STD-462 - Electromagnetic Interference Characteristics, Measurement of

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Standardization Documents Order Desk, Bldg. 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094)

2.1.2 Other Government documents. The following other Government documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

Department of Agriculture (DoA):

- Handbook No. 72 - Wood Handbook
- Technical Bulletin No. 865 - Timber-Connector Joints: Their Strength and Design

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

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Department of Labor (DoL):
Occupational Safety and Health Administration (OSHA):

Occupational Safety and Health Standards

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

2.2 Other publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

American Institute of Steel Construction (AISC):

AISC S326 - Design, Fabrication, and Erection of Structural Steel for Buildings

(Application for copies should be addressed to the American Institute of Steel Construction, 400 North Michigan Ave., Chicago, IL 60611.)

American National Standards Institute, Inc. (ANSI):

ANSI S1.13 - Methods for Measurement of Sound Pressure Levels

(Application for copies should be addressed to the American National Standards Institute, Inc., 11 W. 42nd Street, New York, NY 10036.)

ASTM:

ASTM A 123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A 153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware

ASTM B 117 - Standard Test Method of Salt Spray (Fog) Testing

ASTM D 2996 - Filament-Wound 'Fiberglass' (Glass-Fiber-Reinforced Thermosetting Resin) Pipe

(Application for copies should be addressed to the ASTM, 1916 Race Street, Philadelphia, PA 19103.)

American Society of Mechanical Engineers (ASME):

ASME PTC 23 - Performance Test Code for Atmospheric Water Cooling Equipment

(Application for copies should be addressed to the American Society of Mechanical Engineers, United Engineering Center, 345 East 47th Street, New York, NY 10017.)

Cooling Tower Institute (CTI):

CTI STD-103 - Design of Cooling Towers with Redwood Lumber

CTI ATC-105 - Thermal Testing of Wet/Dry Cooling Towers

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CTI WMS-112 - Pressure Preservative Treatment of Lumber for
Industrial Water-Cooling Towers
CTI STD-114 - Design of Cooling Towers with Douglas Fir Lumber

(Application for copies should be addressed to the Cooling Tower Institute,
530 Wells Fargo, Suite 113, Houston, TX 77090.)

Hydraulic Institute (HI):

Standards of Hydraulic Institute

(Application for copies should be addressed to the Hydraulic Institute,
14600 Detroit Ave., Suite 712, Cleveland, OH 44107.)

National Electrical Manufacturers Association (NEMA):

NEMA MG 1 - Motors and Generators
NEMA ICS 1 - General Standards for Industrial Controls and Systems
NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies

(Application for copies should be addressed to the National Electrical
Manufacturers Association, 2101 L St., N.W. Suite 300, Washington, DC 20037.)

National Fire Protection Association (NFPA):

NFPA 214 - Standard on Water-Cooling Towers

(Application for copies should be addressed to the National Fire Protection
Association, One Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.)

Society of Automotive Engineers, Inc. (SAE):

SAE J534 - Lubrication Fittings

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

(Non-Government standards and other publications are normally available from
the organizations that prepare or distribute the documents. These documents
also may be available in or through libraries or other informational services.)

2.3 Order of precedence. In the event of a conflict between the text of
this document and the references cited herein, 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 Description. The cooling towers shall be of the induced mechanical
draft or forced mechanical draft type as specified (see 1.2 and 6.2), and
shall be comprised of the following components and parts: frames and casings,
louvers, drift eliminators, partitions, cold water basin equipment, fans,
blowers, drives, pumps, electric motors, motor starters, access doors,

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ladders, landings, catwalks, inspection plates, and panels. The cooling towers shall meet all requirements as specified herein.

3.2 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 and fabricated using materials produced from recovered materials to the maximum extent possible without jeopardizing the intended use. The term "recovered materials" means materials which have been collected or recovered from solid waste and reprocessed to become a source of raw materials, as opposed to virgin raw materials. Unless otherwise specified, none of the above shall be interpreted to mean that the use of used or rebuilt products are allowed under this specification.

3.2.1 Wood. Wood used for towers shall be redwood or treated Douglas-fir as specified herein, except that treated west-coast hemlock will be permitted for nonstructural components. Grades and uses of redwood lumber shall comply with CTI STD-103. Grades and uses of Douglas-fir lumber shall comply with CTI STD-114. Hemlock lumber used for nonstructural members shall be of grades equal to the grades of Douglas-fir specified. Plywood shall be in accordance with CTI Standards and shall be marine type, pressure treated, with B grade face and back and C grade inner piles. Plasticized wood cellulose for fill material will not be accepted.

3.2.2 Stainless steel. Stainless steel used for towers shall be series 400 metal used for interior wetted surfaces and supports and series 300 metal for exterior surfaces exposed to the atmosphere. Basins and sump areas shall be constructed of type 304 stainless steel. All fasteners shall be type 304 series; there shall be no self-tapping screws used. Metal thickness shall be the standard gage material used in this construction for the highest quality structural integrity of the cooling tower.

3.2.3 Zinc-coated steel. Zinc-coated steel sheets or plates shall be hot dipped, zinc coated after fabrication conforming to ASTM A 123 with weight coating not less than 2.0 ounces per square foot of surface. All other steel parts conforming to ASTM A 153 as applicable, shall have an extra heavy coating not less than 2.5 ounces per square foot of surface.

3.2.4 Fiberglass reinforced plastic. Plastic used in tower construction shall be an advanced design, corrosion-proof, fire-retardant material. All plastic used for fill, louvers, drift eliminator and distribution sections of plastic towers shall be the manufacturer's standard commercial material to meet all conditions specified herein. Any components manufactured of polystyrene will not be permitted and casing and louvers made of glass reinforced polyester shall be fire retardant.

3.2.5 Dissimilar metals. Contact between dissimilar metals likely to cause deterioration of parts by galvanic corrosion shall be avoided. When such contact cannot be avoided, joints between dissimilar metals shall be protected against galvanic corrosion by plating, coating, insulation, gaskets, or other

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suitable means. Bolts, nuts, pins, screws, and other fastenings shall be of the same material as the metals joined or shall be cathodic to the metals joined.

3.3 First article. When specified (see 6.2), the contractor shall furnish a complete cooling tower for first article inspection and approval (see 4.2.1 and 6.4).

3.4 Standard commercial product. The cooling tower shall, as a minimum, be in accordance with the requirements of this specification and shall be the manufacturer's standard commercial product. Additional or better features which are not specifically prohibited by this specification but which are a part of the manufacturer's standard commercial product, shall be included in the complete cooling tower being furnished. A standard commercial product is a product which has been sold or is being currently offered for sale on the commercial market through advertisements or manufacturer's catalogs, or brochures, and represents the latest production model.

3.5 Design. The design of the cooling tower shall meet the requirements of this specification. Notching structural members is permissible only if the member is increased proportionately in size to provide equivalent strength. All towers shall be designed and constructed to withstand a wind pressure of not less than 30 pounds force per square foot (psf) on any external surface. Fan decks shall be designed to withstand a live load of not less than 40 psf in addition to the concentrated or distributed loads of equipment mounted thereon. When specified (see 6.2), a 15 percent increased loading shall be included for ice or snow load. Design data for wood towers shall conform to applicable requirements of the CTI STD-103 and CTI STD-114 and the Department of Agriculture, Handbook No. 72 and Technical Bulletin No. 865. Design and construction of steel cooling towers shall conform to AISC S326, as applicable. The hot water distribution system shall be of the open reservoir, spray, trough, flume, or slotted pipe design.

3.5.1 Accessibility. All towers shall be designed and constructed to provide ready access for maintenance, servicing, and repair. This requirement includes inspection plates and panels, access doors, ladders, landings, catwalks, and similar devices. Covers or plates which are required for adjusting, servicing, or removing of components shall be equipped with substantial quick-disconnect fasteners or wingnuts, whenever safety permits.

3.5.2 Safety. The towers shall be designed to prevent injury to personnel or damage to the equipment. Heavy-duty metal guards or enclosures shall be provided over all fans and around other rotating or reciprocating parts conforming to OSHA regulations. Inlets and openings other than louvered openings shall be provided with readily removable, stainless steel or heavy-duty, zinc-coated expanded metal or hardware wire cloth screens.

3.5.2.1 Fans. Discharge fans shall be protected by a ruggedly framed screen or guard installed outside the fan and removable for service conforming to OSHA regulations.

3.5.2.2 Ladders. One vertical, hot-dip, zinc-coated steel ladder shall be provided for each tower located outdoors. Ladders higher than 20 feet shall have a safety cage conforming to OSHA regulations. Wood-frame towers shall be equipped with a wood ladder.

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3.5.2.3 Handrailings. Steel handrailings shall be not less than 42 inches high around the exterior of each working surface that is 12 or more feet above the ground, roof, or other supporting construction. Railing shall be not smaller than 1.25-inch, zinc-coated steel pipe with standard, zinc-coated steel-railing type fittings or wood, as appropriate, in accordance with OSHA regulations.

3.6 Construction.

3.6.1 Towers and tower frames. Towers shall be spray filled, spray deck, or deck filled. The tower frame shall be hot-dipped, zinc-coated steel, stainless steel, wood, or corrosion-proof, fire-retardant plastic, as specified (see 6.2).

3.6.2 Cold water basins and casings. Cold water basins shall be hot-dipped, zinc-coated steel of not less than 0.0625-inch nominal thickness or other material specified in this specification. The casings shall be single wall. For steel casings of 150 tons capacity and smaller, the metal thickness shall be not less than 16 gage, 0.0635-inch nominal and over 150 tons capacity. The metal thickness shall be not less than 14 gage, 0.0785-inch nominal. Casings shall have suitable seals and flashings at joints and connections to assure watertight construction and to minimize and control leakage.

3.6.3 Inlet and discharge terminations. When specified (see 6.2), the air inlet and discharge terminations shall have flanged or lipped projections for connecting to duct work.

3.6.4 Frames and louvers. All structural joints shall be bolted, welded, or gusseted. Frames shall be predrilled and provided with cast-iron or steel baseplates or brackets. Intermediate structural members shall be provided, whenever required, for rigidity and support of casings, louvers, fill, distribution system, fan decks, and other equipment. Louvers shall be wood, zinc-coated steel, stainless steel, or fiberglass-reinforced plastic. Zinc-coated steel louvers shall not be less than 0.0625-inch thick. Proper tower design of louvers to permit free air passage and excessive drift loss and splashout is required.

3.6.5 Fill or contact surfaces. The fill shall be designed to support expected loads without sag or failure and arranged to effectively break up the water. The fill shall be manufactured and performance tested by the cooling tower manufacturer. The fill shall be the following materials as specified (see 6.2): polyvinyl chloride (PVC) formed sheets or designed as individual fill batts, zinc-coated steel treated Douglas-fir; or treated hemlock and treated redwood. Zinc-coated steel shall have a minimum of 2.5 ounces of zinc per square foot of surface. PVC fill shall not be used when inlet temperatures exceed 125 degrees Fahrenheit (oF).

3.6.6 Drift eliminators. Drift eliminator sections shall be designed in accordance with commercial practice and shall be arranged to effectively trap water droplets entrained in the discharge airstream. Sections shall be assembled in easily removable racks for type II towers.

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3.6.7 Partitions, windbreak baffles, drift-check walls, and fan walls. Partitions, windbreak baffles, drift-check walls, and fan walls, when provided, shall be installed to suit design and capacity of tower, as ordered.

3.6.8 Cold water basin equipment. The following equipment shall be furnished by the contractor for all towers: sump with removable screen and vortex breaker, float valves, and all necessary pipe connections and fittings within the tower. Makeup waterline, blowdown, overflow, and drainlines shall extend to the outside of the tower for service connections. The outlet of the makeup float valve shall be not less than 2 inches above the top of the basin curb and the overflow. When sump is located outside the basin, the sump unit shall be bolted to permit removal for reduction in shipping cube. Float valves shall be heavy-duty brass; sizes larger than 0.500 inch shall be the balanced piston type. Valve seats and composition disks shall be replaceable. Plastic or copper floats of adequate sizes on adjustable arms shall be included.

3.6.9 Fans, blowers, and drives. The towers shall have propeller-type fans having not less than four blades or squirrel-cage, centrifugal-type blowers, as applicable. Fan assemblies shall be statically balanced. Wood fan blades are not acceptable. Centrifugal type blower fans shall be dynamically balanced. Reinforced plastic fan blades may be utilized provided they are designed and tested for speeds required for normal maximum operating speeds. Metal fans and blowers shall be of stainless or galvanized steel or aluminum, and shall be capable of withstanding 50 percent overspeed above normal maximum operating speeds. Fan and blower tip speeds shall be held within ranges which will permit conformance to sound level requirements specified herein (see 3.7.1). Drive components and supports shall be heavy-duty throughout. Shaft shall be of the hollow type with outboard bearings only for squirrel cage blower type fans on forced draft towers. Shaft- and coupling-type drive assemblies shall be dynamically balanced. Induced draft factory assembled towers smaller than 100 tons nominal capacity shall have solid shafts with oil lubricated sleeve bearings. If belt drives are utilized, multigrooved solid back single belt design shall be used to avoid uneven belt stretch. Adjustment shall be provided for belt tension and drive centers shall not exceed 48 inches. Belt drives shall be designed for not less than 100 percent overload. Shafting for gear drives shall have flexible-type couplings requiring no lubrication. Reduction gears shall be right angle, spiral bevel gear type with a service factor of not less than 2.0, or a service factor of 1.67 for intermittent duty applications. The gear and pinion of the spiral bevel type shall be lapped together. Gears shall be casehardened alloy steel to insure long wear. The gear assembly shall be enclosed in an oil filled, cast-iron or steel housing provided with fill and drainplugs. The housing shall be of rigid construction to maintain precise alignment of gears under all loadings. Gears, bearings, and oil seals shall be designed for a service life of not less than 10 years under continuous moderate shock operation and for seasonal continuous reverse operation with required maintenance.

3.6.10 Pumps. When specified (see 6.2), pumps shall be furnished. The pump shall be V-belt drive or unidrive and pump speed shall not exceed 1,800 revolutions per minute. One pump unit shall be furnished for each tower cell. The pump shall be of centrifugal design with cast-iron body and bronze impeller. The pump shall conform to the Standards of Hydraulic Institute and meet performance requirements.

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3.6.11 Pipe and fittings. Pipe and fittings shall be plastic, galvanized steel or malleable iron, cast iron, copper, brass, or bronze. Plastic pipe shall conform to ASTM D 2996. Fittings for plastic pipe shall be of plastic, bronze, or brass. Plastic fittings shall be of the same kind, class, and grade as the plastic pipe used. Fittings for other pipe shall be of the same material or equal and of the same class and grade as the pipe. Materials used for joint compounds shall be in accordance with commercial practices.

3.6.12 Hardware. When specified (see 6.2), all hardware shall be cadmium plated, galvanized, or stainless steel (type 304), except nails which shall be silicon bronze, commercial bronze, or stainless steel.

3.6.13 Electric motors. All motors used in tower installations shall be of the totally enclosed type with voltage, frequency, and phase characteristics as specified (see 6.2). Fractional horsepower alternating current (ac) motors shall conform to NEMA MG 1. Integral horsepower (hp) ac motors shall conform to NEMA MG 1. Fan motors, 1 hp and above, shall be of the reversible, 2-speed type, when specified (see 6.2), and shall have single winding with variable torque characteristics. Fans (or blowers) and pumps shall not be driven from the same motor.

3.6.13.1 Motor starters. Magnetic motor starters shall be furnished with pushbutton for motors 1 hp and above conforming to NEMA ICS 1 and ICS 2. Unless otherwise specified (see 6.2), all starters for motors 5 hp and above shall be of the reduced voltage type with low voltage protection and thermal overload manual reset relays. When a reversible two-speed motor is specified (see 3.6.13), a reversing switch and speed selecting switch shall be furnished as part of the controller.

3.6.13.2 Vibration cutout switch. When specified (see 6.2), a vibration cutout switch shall be supplied and installed in a protected position and in the most effective location, and interlocked with the fan wiring to electrically open the fan motor circuit under excessive fan vibration.

3.7 Performance. The performance of the towers shall be specified in terms of water flow (gallons per minute) hot water temperature (oF), cold water temperature (oF), and wet bulb temperature (oF), as specified (see 6.2), when tested in accordance with 4.4.1. The performance of the towers shall be based on an ambient wind velocity of 3 miles per hour. Other design and rating requirements and permissible variations from the design conditions shall be in accordance with ASME PTC 23 or CTI ATC-105. Performance guarantees shall be presented as a group or table covering the zone of permissible variations around the design point to allow performance testing at other than design point conditions.

3.7.1 Sound power level. Sound power levels (in decibels (dB) with a reference pressure of 0.0002 microbars) of the cooling tower shall not exceed the maximum permitted dB levels for the designated octave band as set forth in table I. The sound power level data for the cooling tower shall be based on tests conducted in accordance with ANSI S1.13, (see 4.4.2).

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TABLE I. Sound power level.

Octave Band (Hertz)	63	125	250	500	1000	2000	4000	8000
Sound power level (dB)	105	105	100	97	93	90	87	82

3.7.2 Drift loss. Drift loss shall not exceed 0.008 percent of the water circulated.

3.8 Fungus resistance. When specified (see 6.2), electrical components and circuit elements, including terminal and circuit connections, shall be coated with varnish conforming to MIL-V-173, except that:

- a. Components and elements inherently inert to fungi or in hermetically sealed enclosures need not be coated.
- b. Current-carrying contact surfaces, such as relay contact points, shall not be coated.

3.9 Lubrication. Unless otherwise specified (see 6.2), a means for lubrication shall be in accordance with the manufacturer's standard practice. The lubricating points shall be easily visible and accessible. All parts requiring lubrication shall be lubricated as specified in section 5. Hydraulic lubrication fittings shall be in accordance with SAE J534. Where use of high pressure lubricating equipment, 1,000 pounds per square inch or higher, will damage grease seals or other parts, a suitable warning shall be affixed to the equipment in a conspicuous location.

3.10 Electromagnetic interference suppression. When specified (see 6.2), the equipment shall conform to the electromagnetic interference suppression requirements of MIL-STD-461, class 3, group I.

3.11 Cleaning, treatment, and painting. Surfaces normally painted in good commercial practice shall be cleaned, treated, and painted as specified herein. The color of the finish coat shall be as specified (see 6.2). 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 product, or any other contaminating substances. As soon as practicable after cleaning, and before any corrosion product or other contamination can result, the surfaces 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 one finish coat. 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 free from runs, sags, orange peel, or other defects.

3.11.1 Wood treatment. All Douglas-fir and west coast hemlock used in the construction of cooling towers shall have a preservative treatment in accordance with CTI WMS-112. All wood used shall be treated plywood, redwood, and untreated wood exposed as the result of notching, cutting, or drilling shall be saturated with the preservative.

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3.11.2 Anti-corrosion treatment. All punched, sheared, or welded areas shall be treated with a zinc rich cold galvanizing compound in accordance with DOD-P-21035, and zinc-coated surfaces overcoated with a factory coating or paint system that will withstand a salt-spray fog test in accordance with ASTM B 117 (see 4.4.4).

3.12 Fire protection. When specified (see 6.2), towers constructed of wood or other flammable materials shall have a fire protection system and other provisions in conformance with the NFPA 214.

3.13 Identification marking. Identification shall be permanently and legibly marked directly on the tower or on a corrosion-resisting metal plate securely attached to the tower at the source of manufacturer. Identification shall include the manufacturer's model and serial number, name, and trademark to be readily identifiable to the manufacturer.

3.14 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.

3.15 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 that 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. Boltholes 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

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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 document 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 document shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in this document 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 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.

4.1.2 Component and material inspection. Components and materials shall be inspected in accordance with all the requirements specified herein and in applicable referenced documents.

4.2 Classification of inspections. The inspection requirements specified herein are classified as follows:

- a. First article inspection (see 4.2.1).
- b. Quality conformance inspection (see 4.2.2).

4.2.1 First article inspection. The first article inspection shall be performed on one cooling tower, when a first article is required (see 3.3 and 6.2). This inspection shall include the examination of 4.3 and the test of 4.4 under the conditions specified in 4.5. The first article may be either a first production item or a standard production item from the supplier's current inventory provided the item meets the requirements of the specification and is representative of the design, construction, and manufacturing technique applicable to the remaining items to be furnished under the contract.

4.2.2 Quality conformance inspection. The quality conformance inspection shall include the examination of 4.3, the tests of 4.4, and the packaging inspection of 4.6.

4.3 Examination. Each cooling tower shall be examined for compliance with the requirements specified in section 3 of this specification. 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.

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4.4 Tests.

4.4.1 Performance test. After the tower has been found acceptable under the visual and dimensional examinations of 4.3, a performance test under the conditions specified in 4.5 shall be conducted on each tower at the installation site. Cooling towers shall be tested by a qualified independent testing agency in the presence of Government and manufacturer representatives in accordance with either ASME PTC 23 or CTI ATC-105. Nonconformance with performance tests 4.4.2. thru 4.4.4 and 3.7, shall constitute failure.

4.4.2 Measurement of sound power level. When measured in accordance with ANSI S1.13, the sound power level for all towers in operation shall not exceed those specified in 3.7.1 and table I. Nonconformance with 3.7.1 and table I shall constitute failure of the test.

4.4.3 Electromagnetic interference suppression test. When electromagnetic interference suppression is specified, the first article shall be tested in accordance with MIL-STD-462 to verify compliance with the pertinent provisions of MIL-STD-461.

4.4.4 Salt spray test. The salt-spray fog test shall be in accordance with ASTM B 117. No signs of corrosion shall be evident after 1,000 hours continuous exposure to a 5 percent salt spray (see 3.11.2).

4.5 Test conditions.

4.5.1 Testing agency approval. Prior to commencing tests, the testing agency shall have been approved by the contracting officer and shall have submitted adequate documentation to satisfy the contracting officer as to competence of test observers. Reference in CTI ATC-105 to "CTI observer" shall be interpreted to mean testing agency observer, and no arrangements or agreements with CTI are implied or desired.

4.5.2 Calculations. Tests shall be simultaneously observed by Government and manufacturer representatives. All calculations shall be performed immediately following tests and shall be signed by observers. Computations and test results shall be presented in full compliance with particular test procedures employed by the testing agency.

4.5.3 Air temperatures. All air temperatures shall be taken by mechanically aspirated psychrometers. Air temperatures shall be taken in accordance with paragraph 4.07 of ASME PTC 23; such temperatures shall be used as ambient conditions in lieu of measurements indicated in paragraph 4.06. When using the CTI procedure, temperature measurement shall be in accordance with paragraph 3.3 of CTI ATC-105.

4.5.4 Thermometers. Sufficient thermometers shall be provided to read all air and water temperatures simultaneously. Immediately prior to tests, all thermometers shall be calibrated by simultaneous immersion in the hot well (or other mutually agreed upon method). Correction factors and points of utilization for each thermometer shall be noted together with its serial number.

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4.5.5 Cooling tower failure. In the event the cooling tower fails to perform as specified, the contractor shall make corrections or replace the cooling tower. The contractor shall then repeat the tests as specified in 4.4, all at no additional cost to the Government. This procedure shall be repeated until the cooling tower test confirms that the cooling tower performs as specified.

4.6 Packaging inspection. The preservation, packing, and marking of the tower shall be inspected to verify conformance to the requirements of section 5.

5. PACKAGING

5.1 Preservation. Preservation shall be level A or commercial, as specified (see 6.2).

5.1.1 Level A.

5.1.1.1 Disassembly. Disassembly shall be the minimum needed to safeguard parts and assemblies vulnerable to pilferage, damage, and loss; to accomplish reduction in cube; and to meet carrier limitations of height, width, and weight. Removed nuts, screws, pins, and washers shall be installed in mating parts and secured to prevent loss. Gaskets and related items shall be individually preserved method IC or III and placed in the toolbox or packaged with other removable parts. Keys shall be secured in keyways of the primary components, attached with shipping documentation, or packaged separately. Disassembly should be limited to parts and components easily removed and installed using no special tools or skilled personnel. Disassembly required to preserve equipment components shall be the minimum necessary to perform preservation.

5.1.1.2 Matchmarking. Parts removed and mating parts on the equipment and attachments shall be matchmarked to facilitate reassembly. Large parts shall be matchmarked by stenciled letters or numerals using lusterless white enamel overcoated with varnish. Small parts and mating parts on the basic unit and attachments shall be matchmarked with weatherproof tags attached to mating parts and locations with wire or twine. Markings shall be applied to the tags with a waterproof material.

5.1.1.3 Methods of preservation. Cleaning processes, drying procedures, preservatives, and methods of preservation specified in the following paragraphs are listed in MIL-P-116 and shall conform to the requirements of MIL-P-116 and any applicable specifications.

5.1.1.4 Cleaning and drying. Prior to the application of preservative compounds or paint, surfaces shall be cleaned by process C-1 and dried by applicable procedures of MIL-P-116.

5.1.1.5 Unpainted and uncoated surfaces. Unpainted and uncoated exterior ferrous metal surfaces, including threaded surfaces and surfaces exposed by disassembly, shall be coated with type P-1 preservative.

5.1.1.6 Electric motors and controls. The electric motors shall be preserved in accordance with MIL-E-16298 and shall be packaged in accordance with the alternate method described therein. All openings into electrical controls shall be sealed with tape as specified in MIL-E-16298.

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5.1.1.7 Pumps. The interior surfaces of the pumps shall be flushed with type P-10, grade 30 preservative in a manner to insure thorough coating of all interior parts and surfaces. All openings into pumps shall be closed with caps or plugs or with barrier material conforming to MIL-B-121, type I, grade A, class 2 and sealed with waterproof tape. Flanged openings shall be closed with flange covers, inserting barrier material specified herein between flange and cover.

5.1.1.8 Valves. Interior surfaces of ferrous or aluminum valves shall be sprayed or flushed with type P-10, grade 30 preservative. Application of preservative on nonferrous valves, except aluminum, shall not be required. Valves shall be wrapped with barrier material conforming to MIL-B-121, grade C. The packaging shall conform to MIL-V-3.

5.1.1.9 Pipe, fittings, and nozzles. Interior surfaces of ferrous metal pipe, fittings, and nozzles shall be coated with type P-10, grade 30 preservative. Ends of pipe shall be sealed with threaded metal caps or plugs.

5.1.1.10 Drive belts and pulleys. Drive belts shall be released from tension. Unpainted faces of pulley grooves shall be coated with primer conforming to TT-P-664. A weatherproof tag shall be attached to the belts indicating that the belts shall be adjusted before placing unit in operation. Belts removed shall be preserved in accordance with MIL-P-116, method IC-3.

5.1.1.11 Reduction gears. The reduction gears shall be lubricated.

5.1.1.12 Consolidated packaging. Maintenance tools and small, disassembled components, such as gusset plates, connectors, bolts, nuts, and washers for each complete unit, shall be packaged in close-fitting boxes conforming to PPP-B-621, class 2 or PPP-B-601, overseas type.

5.1.2 Commercial. The complete tower shall be preserved and packaged in accordance with the contractor's standard practice.

5.2 Packing. The packing shall be level A or commercial as specified (see 6.2).

5.2.1 Level A. Each complete cooling tower shall be packed in a crate conforming to MIL-C-52950 or MIL-C-3774, style A. The contents shall be anchored, blocked, and braced to prevent movement within the crates and damage to the contents.

5.2.2 Commercial. The complete tower shall be packed in a manner which will insure arrival at destination in satisfactory condition. Containers and packing shall comply with applicable carrier rules and regulations.

5.3 Marking. Marking shall be in accordance with MIL-STD-129.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

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6.1 Intended use. The towers covered by this specification are applicable for both commercial and industrial use with air-conditioning, refrigeration, power plant, and other heat cycle condenser or heat transfer equipment and installations.

6.1.1 Selection factor. Induced draft type of cooling tower should be specified over forced draft type because induced draft towers use less hp and are, therefore, cost effective on a life cycle cost basis.

6.2 Acquisition Requirements. Acquisition documents should specify the following:

- a. Title, number, and date of this specification.
- b. Type of tower required (see 1.2).
- c. Issue of document required, if different than as specified (see 2.1.1).
- d. When a first article is required for inspection and approval (see 3.3, 4.2.1, and 6.4).
- e. If design loading shall be increased for ice and snow conditions (see 3.5).
- f. Tower material required (see 3.6.1).
- g. When flanged or lipped projections is required (see 3.6.3).
- h. Fill material required (see 3.6.5).
- i. When pump is required (see 3.6.10).
- j. Hardware material required (see 3.6.12).
- k. Electric motor characteristics required (see 3.6.13).
- l. When motor starters shall be other than as specified (see 3.6.13.1) and when vibration cutout switch is required (see 3.6.13.2).
- m. Tower performance, in terms of waterflow, hot water temperature, cold water temperature, and wet bulb temperature, required (see 3.7).
- n. When fungus resistance of electrical components is required (see 3.8).
- o. Lubrication requirements, if different than as specified (see 3.9).
- p. Electromagnetic interference suppression requirements (see 3.10).
- q. Color of finish coat required (see 3.11).
- r. When fire protection system is required (see 3.12).
- s. Level of preservation and level of packing required (see 5.1 & 5.2).

6.3 Data requirements. When this specification is used in an acquisition and data are required to be delivered, the data requirements should be developed as specified by an approved Data Item Description (DD Form 1664) and delivered in accordance with the approved Contract Data Requirements List (CDRL), incorporated into the contract. When the provisions of DoD Federal Acquisition Regulations (FAR) Supplement, Part 27, Sub-Part 27.475-1 (DD Form 1423) are invoked and the DD Form 1423 is not used, the data should be delivered by the contractor in accordance with the contract or purchase order requirements.

6.4 First article. When a first article inspection is required, the item should be tested and should be a first production item or it may be a standard production item from the contractor's current inventory as specified in 4.2.1. The first article should consist of one cooling tower. The contracting officer should include specific instructions in acquisition documents regarding arrangements for examination, test, and approval of the first article.

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6.5 Improved design and material. It is not the intent of this specification to prohibit the procurement of towers incorporating newly developed designs and materials having greater reliability, less maintenance, and longer life than those specified herein, provided that such designs and materials have been evaluated and approved for use in towers.

6.6 Supersession data. This specification supersedes MIL-C-16278G(YD) dated 23 February 1983.

6.7 Subject term (key word) listing.

Cooler
Tower
Water

MILITARY INTEREST:

Custodian

Navy - YD

CIVIL AGENCY COORDINATION ACTIVITIES:

GSA - FSS

PREPARING ACTIVITY:

Navy - YD

(Project 4130-0335)