SECTION 23 65 00

COOLING TOWERS AND REMOTE EVAPORATIVELY-COOLED CONDENSERS
11/16

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

JAPANESE STANDARDS ASSOCIATION (JSA)

JIS C 4203	(2010) Single Phase Induction Motors for General Purpose (Amendment 1)
JIS C 4212	(2010; R 2022) Low-Voltage Three-Phase Squirrel-Cage High-Efficiency Induction Motors (Amendment 1)
JIS G 3302	(2022) Hot Dip Zinc Coated Steel Sheet and Strip
JIS G 5501	(2020) Grey Iron Castings
JIS H 8641	(2021) Hot Dip Galvanized Coatings
JIS K 7013	(2009)Fibre Reinforced Plastic Pipes (Amendment 1)
JIS Z 2371	(2015) Methods of Salt Spray Testing
JIS Z 8106	(2000) International Electrotechnical Vocabulary Chapter 801 : Acoustics and Electroacoustics

MINISTRY OF LAND, INFRASTRUCTURE, TRANSPORT AND TOURISM (MLIT)

MLIT-M	(2019) Public Building Construction Standard Specification

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.][for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Cooling Towers; G[, [_____]]

Remote Evaporatively-Cooled Condensers

[Packaged Cooling Tower - Field Acceptance Test Plan; G[, [_____]]

][Field-Erected Cooling Tower - Field Acceptance Test Plan; G[, [_____]]

][Packaged Cooling Tower - Field Acceptance Test Report; G[, [_____]]

][Field-Erected Cooling Tower - Field Acceptance Test Report; G[, [_____]]

] SD-07 Certificates

Cooling Tower

Remote Evaporatively-Cooled Condensers

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals

Remote Evaporatively-Cooled Condensers

1.3 SAFETY REQUIREMENTS

Exposed moving parts, parts that produce high operating temperature, parts which may be electrically energized, and parts that may be a hazard to operating personnel must be insulated, fully enclosed, guarded, or fitted with other types of safety devices. Safety devices must be installed so that proper operation of equipment is not impaired. Welding and cutting safety requirements must be in accordance with Occupational Safety and Health Act Enforcement Regulations (Roudou-Anzen-Eiseihou-Sekou-kisoku) for Japanese Standard. [[Catwalk,] [ladder,] [and guardrail] must be provided where indicated and in accordance with[Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS][Section 05 51 33 METAL LADDERS][Section 05 52 00 METAL RAILINGS][Section 05 51 00 METAL STAIRS].]

1.4 DELIVERY, STORAGE, AND HANDLING

Stored items must be protected from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Proper protection and care of all material both before and during installation shall be the Contractor's responsibility. Any materials found to be damaged shall be replaced at the Contractor's expense. During installation, piping and similar openings must be capped to keep out dirt and other foreign matter.

1.5 PROJECT/SITE CONDITIONS

1.5.1 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

1.5.2 Drawings

Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. The

Contractor must carefully investigate the plumbing, fire protection, electrical, structural and finish conditions that would affect the work to be performed and must arrange such work accordingly, furnishing required offsets, fittings, and accessories to meet such conditions.

PART 2 PRODUCTS

2.1 STANDARD COMMERCIAL PRODUCTS

Materials and equipment must be standard commercial catalogued products of a manufacturer regularly engaged in the manufacturing of such products, which are of a similar material, design and workmanship. The standard products must have been in satisfactory commercial or industrial use in field service for two years prior to bid opening. The two year use must include applications of equipment and materials under similar circumstances and of similar size. Products having less than a two year field service record will be acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown. This 6000 hour record must not include any manufacturer's prototype or factory testing. Records of satisfactory field use must be completed by a product that had been, and presently is, sold, or offered for sale on a commercial market through the following copyrighted means: advertisements, manufacturer's catalogs, or brochures. Products must be supported by a service organization located in Japan. System components must be environmentally suitable for the indicated locations.

2.2 MANUFACTURER'S STANDARD NAMEPLATES

Major equipment including cooling towers, cooling tower gear drive assemblies, fans, and motors must have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the item of equipment. Plates must be durable and legible throughout equipment life. Plates must be fixed in prominent locations.

2.3 ELECTRICAL WORK

a. Provide motors, controllers, integral disconnects, contactors, and controls with their respective pieces of equipment, except controllers indicated as part of motor control centers. Provide electrical equipment, including motors and wiring, as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Manual or automatic control and protective or signal devices required for the operation specified and control wiring required for controls and devices specified, but not shown, must be provided. For packaged equipment, the manufacturer must provide controllers including the required monitors and timed restart.

b. For single-phase motors, provide high-efficiency type, fractional-horsepower alternating-current motors, including motors that are part of a system, in accordance with JIS C 4203.

c. For polyphase motors, provide squirrel-cage medium induction motors, including motors that are part of a system, and that meet the efficiency ratings for premium efficiency motors in accordance with JIS C 4212.

d. Provide motors in accordance with JIS C 4212 and of sufficient size to drive the load at the specified capacity without exceeding the

nameplate rating of the motor. Motors must be rated for continuous duty with the enclosure specified. Motor duty requirements must allow for maximum frequency start-stop operation and minimum encountered interval between start and stop. Motor torque must be capable of accelerating the connected load within 20 seconds with 80 percent of the rated voltage maintained at motor terminals during one starting period. Provide motor starters complete with thermal overload protection and other necessary appurtenances. [Motor bearings must be fitted with grease supply fittings and grease relief to outside of the enclosure.] Motor enclosure type may be either TEAO or TEFC.

e. [Where two-speed motors are indicated, variable-speed controllers may be provided to accomplish the same function.][Use adjustable frequency drives for all variable-speed motor applications.] Provide variable frequency drives for motors as specified in Section 26 29 23 VARIABLE FREQUENCY DRIVE SYSTEMS UNDER 600 VOLTS.

f. Provide inverter duty premium efficiency motors for use with variable frequency drives.

2.4 COOLING TOWER MATERIALS

2.4.1 Fiberglass Reinforced Plastic (FRP)

FRP components must be inert, corrosion resistant, and fire-retardant with a thickness of 3.66 kg per square meter. FRP components must contain an ultraviolet (UV) ray inhibitor. Components manufactured of polystyrene will not be permitted.

2.4.2 Zinc-Coated Steel

Components fabricated of zinc-coated steel must be not lighter than 16 gauge 1.613 mm steel, protected against corrosion by a zinc coating. The zinc coating must conform to JIS G 3302, as applicable and have an extra heavy coating of not less than 760g per square meter of surface. Galvanized surfaces damaged due to welding must be coated with zinc rich coating.

2.4.3 High Density Polyethylene (HDPE)

Components manufactured from HDPE must be seamless with a minimum thickness of 10 mm. The material must have the appropriate inhibitors to protect the component from any UV degradation. Tanks and cooling tower shells must be seamlessly molded to minimize water loss/consumption.

2.4.4 Stainless Steel Sheets

Type [304][316].

2.4.5 Concrete

Concrete must conform to Section 03 30 00 CAST-IN-PLACE CONCRETE. Exposed concrete must be rub-finished for smooth and uniform surfaces free of form marks and defects. Honeycomb concrete will not be permitted.

2.4.6 Hardware

Bolts must be cadmium-plated, zinc-coated steel, or Type 304 stainless steel. Each bolt must be provided with neoprene and cadmium-plated steel

washers under the heads. Nails must be silicon bronze, commercial bronze, or stainless steel. Hardware must meet the salt-spray fog test as defined by JIS Z 2371. Angle brackets and similar parts must be zinc-coated steel. Zinc coatings must conform to JIS H 8641 and JIS H 8641, as applicable, and must have an extra heavy coating of not less than 760g per square meter of surface. Nails must be silicon bronze, commercial bronze, or stainless steel. Subject hardware to a salt-spray fog test in accordance with JIS Z 2371. No signs of corrosion must be evident after continuous exposure to a salt spray.

2.5 COOLING TOWERS

2.5.1 Factory Assembled Towers

2.5.1.1 Description

The cooling tower must be of the [induced mechanical draft][or forced mechanical draft] type. The cooling tower must include frames and casings, louvers, drift eliminators, partitions, windbreak baffles, drift-check walls, cold water basin equipment, fans and fan walls, blowers, drives, electric motors, access doors, [working platforms,] inspection plates, and panels.

2.5.1.2 Construction

Tower must be constructed to withstand a wind pressure of not less than 1.44 kilopascal (kPa) on any external surface. Fan deck must be constructed to withstand a live load of not less than 2.87 kPa in addition to the concentrated or distributed loads of equipment mounted on the fan deck.

The hot water distribution system must be of the open basin gravity feed type or the pressurized spray header type design.

2.5.1.3 Tower Frame and Louvers

Provide frame constructed from [galvanized steel][_____]. Intermediate structural members must be provided for rigidity and support of casings, louvers, fill, distribution systems, fan decks, and other equipment. Inlet air louvers must permit free air passage but no splashout, and must be designed to prevent debris and sunlight from entering the cold water basin.

2.5.1.4 Air Inlet And Discharge Connections

On forced draft centrifugal type units, the air inlet and discharge connections must have flanged or lipped projections for connecting to ductwork.

2.5.1.5 Fill

The fill must support expected loads without sag or failure and arranged to effectively break up the water. The fill must be manufactured and performance tested by the cooling tower manufacturer. The fill must be of the materials as specified. Polyvinyl chloride (PVC) fill is suitable for inlet temperatures to 51.7 degrees C on cross flow type units and temperatures to 54.4 degrees C on counterflow type units. Chlorinated polyvinyl chloride(CPVC) fill must be used for applications where inlet temperatures are greater than 54.4 degrees C. Fill must be in accordance

with MLIT-M.

2.5.1.6 Drift Eliminators

Provide drift eliminator sections designed and arranged to effectively trap water droplets entrained in the discharge airstream. Sections must be assembled in easily removable sections for forced mechanical drift tower and counterflow induced mechanical draft tower. Drift eliminators must be constructed of Polyvinyl chloride (PVC) in accordance with MLIT-M.

2.5.1.7 Cold Water Basin Equipment.

Include [galvanized steel] [Type 304 stainless steel] sump with stainless steel removable screen and vortex breaker, float valves, and necessary pipe connections and fittings within the tower. [Provide float valves with adjustable arms. Valve sizes larger than 13 mm pipe size must be the balanced piston type. Valve seats and disks must be replaceable.] [Electronic water level control must be provided.]

Provide cold water basins and casings suitably sealed and flashed at joints and connections to ensure watertight construction.

2.5.1.7.1 Electric Basin Heater

Heater must be the electric immersion type with water-tight junction boxes mounted in the basin with sufficient capacity to maintain the basin water temperature above 12.8 degrees C at an ambient temperature of 4.4 degrees C. Heater must be complete with control thermostat, transformer, contactor, and low water level heater protection.

2.5.1.8 Fans, Blowers, and Drives.

The towers must have axial propeller-type fans having not less than four aluminum alloy or glass-reinforced polypropylene blades or squirrel-cage, centrifugal-type blowers, as applicable. Fans and blowers must be designed and constructed to withstand 50 percent overspeed above normal maximum operating speeds.

If belt drives are utilized, multi-grooved solid back single belt design must be used to avoid uneven belt stretch. Adjustment must be provided for belt tension and drive centers. Belt drives must be designed and constructed for 150 percent overload. Sheaves located in the airstream must be corrosion-resistant material. Shafting for gear drives must have flexible-type couplings requiring no lubrication. The gear assemblies must be enclosed in an oil filled housing provided with fill and drain plugs.

2.5.1.9 Tower Piping

Piping must be schedule 40 PVC and conform to JIS K 7013. Fittings for other piping materials must be of the same material or equal and of the same class and grade as the pipe.

2.5.1.10 Electric Motors

Requirements are specified in paragraph ELECTRICAL WORK.

2.5.1.11 Vibration Cutout Switch.

Provide [electronic vibration cutout switch with auxiliary contacts in a protected position and most effective location, interlocked with the fan wiring to electrically open the motor circuit under excessive fan vibration.]

2.5.1.12 Performance

The factory assembled tower must have Cooling Tower Institute certification that the cooling tower will perform thermally at the rating published by the tower manufacturer in his copyrighted literature.

2.5.1.13 Sound Power Level

Sound power levels, in decibels (dB)with a reference pressure of 0.0002 microbars, of the cooling tower must be not greater than the maximum permitted dB levels for the designated octave band as set forth in Table I or Table II. The sound power level data for the cooling tower must have been verified in tests conducted in accordance with JIS Z 8106.

Table I. Sound Power Level For Induced Mechanical Draft Type

Octave Band (Hz)	63	125	250	500	1000	2000	4000	8000
Sound Power Level (dB)	112	112	110	108	102	98	93	90

Table II. Sound Power Level For Forced Mechanical Draft Type

Octave Band (Hz)	63	125	250	500	1000	2000	4000	8000
Sound Power Level (dB)	112	112	110	108	102	98	93	90

2.5.1.14 Drift Loss

Drift loss must be not greater than 0.005 percent of the water circulated.

2.5.2 Lubrication

The lubricating points must be extended to the outside of the unit for easy accessibility. Where use of high pressure lubricating equipment, 6894 kPa or higher, will damage grease seals or other parts, a suitable warning must be affixed to the equipment in a conspicuous location.

2.5.3 Factory Finish System

[Factory painting system] must have been proven to withstand 125 hours in a salt-spray fog test, except that equipment located outdoors must withstand 500 hours in a salt-spray fog test. Equipment located in a sea coast environment must withstand 3,000 hours in a salt-spray fog test. Salt-spray fog test must be in accordance with JIS Z 2371. For salt-spray

fog test, the acceptance criteria must be as follows: immediately after completion of the test, the paint must show no signs of blistering, wrinkling, or cracking, and no loss of adhesion; and the specimen must show no signs of rust creepage beyond 3 mm on either side of the scratch mark.

The film thickness of the factory painting system applied on the equipment must not be less than the film thickness used on the test specimen. If manufacturer's standard factory painting system is being proposed for use on surfaces subject to temperatures above 50 degrees C, the factory painting system must be designed for the temperature service and must have been proven to pass the specified salt-spray test.

2.5.4 Field-Assembled Cooling Towers

Factory fabricated, factory-assembled towers which are shipped to the job site in separate cells or modules must be provided with all appropriate manufacturer's hardware for assembly in the field. Factory fabricated, field-assembled towers must be assembled and adjusted at the job site by a factory representative.

2.5.4.1 Framework, Casing, and Supports

Towers must be designed and constructed to withstand a wind pressure of not less than [1.4] [_____] kPa on external surfaces. Framework, structural supports, and equipment supports must be [zinc-coated steel,] [Type 304 stainless steel,] [air-entrained concrete] [FRP,] [or] [lumber]. Casing (exterior enclosing walls) must be constructed of [zinc-coated steel], [Type 304 stainless steel], [air-entrained concrete] [FRP]. Materials provided for framework, casings and equipment supports must be compatible. Structural supports must be provided in accordance with the recommendations of the manufacturer of the tower unless otherwise indicated.

2.5.4.2 Foundations

Cooling tower foundations must meet the requirements of the cooling tower manufacturer and wind and seismic loads, wind and seismic loads and be as indicated. Foundation design must be based on the load conditions and soil bearing value indicated. Foundation calculations must be submitted with the equipment drawings.

2.5.4.3 Stairways and Ladders

Provide stairs, 60-degree ship ladders or straight-rung ladders of standard design, starting at [ground] [roof] level and extending as high as required to gain access to fan decks and water distribution systems. Stairways and ladders must be hot-dip, zinc-coated steel. Ladders higher than 3.66 meters must have a safety cage.

2.5.4.4 Hand Railings

Steel hand railings must be not less than 1067 mm high around the exterior of each working surface that is 3.66 m or more above the ground, roof, or other supporting construction. Railings must be not smaller than 32 mm zinc-coated steel pipe with standard zinc-coated steel railing.

2.5.4.5 Access Doors

Each tower must be provided with access doors at grade level to provide entry to the interior for service maintenance without removal of the fill. Doors must be provided on each endwall of each cooling tower cell. Frame and brace access doors to prevent damage when opening and closing. Doors must be located adjacent to float controls.

2.5.4.6 Louvers

Air inlets for each cooling tower must be provided with individually removable louvers arranged to prevent the escape of water. Louvers must be constructed of [PVC], [fiberglass reinforced polyester], [zinc-coated steel], [Type 304 stainless steel] [FRP]. Materials provided for casings and louvers must be compatible; one material must not produce stains upon the other. Air intakes must be provided with 25 mm zinc-coated steel mesh.

2.5.4.7 Fan Deck and Cylinder

Each fan must be mounted in a fan cylinder (or stack) to elevate the fan discharge air. Total extension height must not exceed the fan diameter. Each fan cylinder must be provided with a zinc-coated steel, 12 gauge 2.753 mm wire mesh securely mounted to the top of the cylinder in accordance with manufacturer's recommendations. Fan decks must be designed to withstand a live load of not less than [1.9] [2.9] kPa in addition to the concentrated or distributed loads of equipment mounted on the fan decks. [Fan deck and cylinders must be constructed of zinc-coated steel, lumber, Type 304 stainless steel, or FRP and be compatible with the entire tower construction.] [Fan deck must be constructed of precast, reinforced lightweight concrete, in multiple sections, forming a complete, vibration-free base for mounting fan, speed reducer, drive shaft, motor, and fan stacks. Fan cylinders (or stacks) must be constructed of precast, reinforced lightweight concrete in multiple sections, constrained with bands of zinc-coated steel conforming to JIS H 8641, not less than 3 by 75 mm, and bolted to form a compressive load on stack perimeter. Fan cylinder must be secured in place on the fan deck with Class A mortar.]

2.5.4.8 Fans

Fans must be the [centrifugal] [or] [adjustable-pitch propeller] type, constructed of zinc-coated steel, Type 304 stainless steel, aluminum or an aluminum alloy, or FRP. Propeller type fans must have a maximum tip speed of 330 m/minute. Fan blade assembly must be both statically and dynamically balanced after assembly of the cooling tower. Fan hub must be constructed of [zinc-coated steel], [stainless steel], [cast aluminum] with adequate surface protection against corrosion. Complete fan assembly (fan and mounting) must be designed to give maximum fan efficiency and long life when handling saturated air at high velocities. Each cooling tower fan must be provided with a ball and pedestal type vibration limit switch which must stop the corresponding fan motor in the event of sensing excessive fan vibration.

2.5.4.9 Speed Reducers Gears and Drive Shaft

Speed reducer gears must be rated. Reducer must be mounted in accordance with manufacturer's recommendations. Each reducer must be provided with an oil level cutoff switch interlocked to the fan motor. Each reducer must be provided with an oil level sight glass, fill, drain, and vent lines located in a readily accessible position. Drive shafts must be the

full floating type with flexible couplings at both ends and have a service factor of 1.0 or greater. Drive shafts must be of stainless steel, fitted each end with flexible couplings (stainless steel plate type). Each drive shaft must be provided with a galvanized steel guard, to prevent damage to surrounding equipment in case of shaft failure. Provision must be made for lubrication of all bearings. Bearings must be accessible to the extent that each bearing can be lubricated without dismantling fan.

2.5.4.10 Electric Motors

Each motor must be a [single speed], [two speed] [variable speed], totally enclosed, insulation JIS C 4212, continuous-rated type which conforms to JIS C 4212. Motors must have [open], [dripproof], [totally enclosed], [explosion proof] enclosures and be located outside the discharge airstream. Motors must be mounted according to manufacturer's recommendations. Motors must be provided specifically for either pump or fan application and must comply with the requirements of paragraph ELECTRICAL WORK.

2.5.4.11 Cold Water Basin

Basin must be completely watertight and constructed of [zinc-coated steel] [Type 304 stainless steel] [FRP]. Basin must be constructed and installed to ensure that air will not be entrained in outlets when operating and no water will overflow on shutdown. Each individual sump must be provided with an individual outlet. Each outlet must be provided with a 13 mm stainless steel wire mesh, securely mounted to prevent trash from entering the outlet. Each basin must be provided with overflow and drain valve connections. Each basin must be provided with a float-controlled, makeup water valve as indicated. The makeup water must discharge not less than 50 mm or two pipe diameters, whichever is greater, above the top of the basin.

2.5.4.12 Electric Basin Heater

Heater must be the electric immersion type with water-tight junction boxes mounted in the basin with sufficient capacity to maintain the basin water temperature above 4.4 degrees C at an ambient temperature of [_____] degrees C. Heater must be complete with control thermostat, transformer, contactor, and low water level heater protection.

2.5.4.13 Hot Water Distribution System

Water distribution must be the [pressurized-flow] type system which distributes waters evenly over the entire fill surface. Each tower cell must be designed so that a water flow of 140 percent capacity will not cause overflowing or splashing. The distribution system for each cell must include adjustable flow control valves. The entire distribution system must be self-draining and nonclogging. Piping must be either cast iron, ductile iron, threaded-glass-fiber reinforced epoxy pipe, polypropylene, PVC or Schedule 80 black steel.

a. Gravity-Flow System: System must be provided with open basins which include a splash box or baffles to minimize splashing of incoming hot water and holes that evenly distribute the water over the entire decking area. Holes used in a water basin must be provided with ceramic or plastic orifice inserts.

b. Pressurized-Flow System: System must include piping, fittings,

branches, and spray nozzles. Spray nozzles must be schedule 40 PVC. Nozzles must be cleanable, nonclogging, removable, and spaced for even distribution.

c. Basin Cover: Hot water distribution basins must be provided with the tower manufacturer's standard removable, [zinc-coated galvanized steel] [304 stainless steel] [FRP] covers. Covers must prevent airborne debris from entering the basin.

2.5.5 Drift Eliminators

Eliminators must be provided in the tower outlet to limit drift loss to not over [0.005] percent of the circulating water rate. Eliminators must be constructed of polyvinyl chloride (PVC). Eliminators sections must be supported on PVC or FRP tee sections.

2.5.6 Cold Water Basin Equipment.

Include sump with removable screen and vortex breaker, float valves, and necessary pipe connections and fittings within the tower. Provide float valves with adjustable arms. Valve sizes larger than 13 mm pipe size must be the balanced piston type. Valve seats and disks must be replaceable. [Electric water level control must be provided.]

Provide cold water basins and casings suitably sealed and flashed at joints and connections to ensure watertight construction.

2.5.7 Fill (Heat Transfer Surface)

Tower fill must be the [splash] [or] [film] type. Fill material must be free to expand or contract without warping or cracking. No plasticized wood cellulose must be provided for fill material. Fill must be removable or otherwise made accessible for cleaning. Space supports must be corrosion resistant and must prevent warping, sagging, misalignment, or vibration of the fill material. Fill material and supports must be designed to provide for an even mixing of air and water. Fill material must be constructed of [aluminum] [stainless steel] [tile of multi-cell design, set without mortar] [PVC formed sheets, zinc-coated steel] in a pattern, and of sufficient height to meet the performance specifications. [Tile fill must be vitreous, with a low water absorption that will pass a freeze-thaw test conducted. Tile fill must have a minimum crushing strength of 13.8 MPa over the gross area of the tile when the load is applied parallel to the cells. Cast iron tee section lintels supporting the tile fill must conform to JIS G 5501, Class 25, 3.2 mm additional thickness for corrosion. Lintels must be designed with a safety factor of 2 minimum.]

2.5.8 Meters and Controls

Tower must be provided with makeup and blowdown meters, conductivity controller, and overflow alarm.

2.6 REMOTE EVAPORATIVELY-COOLED CONDENSERS

Condenser must include fans, water pump with suction strainer, electric motor and drive equipment, water eliminators if required, condensing coil, liquid receiver if required, water pan or sump, spray nozzles or water-distribution pan, water strainer, water make-up assembly, bleeder with flow valve of the needle valve type sized for the flow required or a

fixed orifice, enclosure with suitable access doors, and air-inlet and outlet openings. No water may carry over into the unit discharge outlet.

2.6.1 Condenser Casing

Enclosure must be constructed of not lighter than 18 gauge 1.311 mm[hot-dip galvanized steel][304 stainless steel], reinforced and braced. Access doors or panels suitably sized and located must be provided for access to water nozzles or distribution pan, coils, and valves for cleaning, repair, or removal of the item. Access doors or panels must be gasketed with synthetic rubber, or equivalent gasket material, and locked in place with thumb screws or catches. One-half inch mesh hot-dip galvanized steel or copper air-inlet screens must be provided on each air inlet.

2.6.2 Refrigerant Section

Condenser coil must be constructed of unfinned copper or steel tubes hot-dip galvanized after fabrication. A refrigerant charging valve must be installed in the liquid line between the receiver cut-off valve and the expansion device. Refrigerant section must be tested in accordance with Japanese Refrigeration Safety Regulations (Nihon-Reitou-Hoan-Kisoku) for the refrigerant employed in the system. CFC-based refrigerants are prohibited.

2.6.3 Fans

Fans must be centrifugal or propeller type as best suited for the application. Fans must be direct or V-belt driven. Belt drives must be completely enclosed within the unit casing or equipped with a guard. When belt drive is provided, an adjustable sheave to furnish not less than 20 percent fan-speed adjustment must be provided. Sheave set must be matched and selected to provide the capacity indicated at the approximate midpoint of the adjustment. Fans must be statically and dynamically balanced. Fan motor must be totally enclosed type or open drip-proof and located within an enclosure to be fully protected from the weather.

2.6.4 Water Section

Water eliminators must be constructed of nonferrous metal, of an approved nonmetallic material, or of not lighter than 24 gauge 0.701 mm steel, hot-dip galvanized after fabrication. Spray nozzles must be brass non-clogging type designed to permit easy disassembly, and must be arranged for easy access. Water pump must be bronze-fitted centrifugal or turbine type, and may be mounted as an integral part of the evaporative condenser or remotely on a separate mounting pad. Pump suction must be fully submerged and provided with screened inlet. Water pan or sump must be constructed of not lighter than 14 gauge 1.994 mm steel, hot-dip galvanized after fabrication, or molded acid-resistant glass-fiber-reinforced polyester. Water distribution pan must be constructed of not lighter than 16 gauge 1.613 mm steel, hot-dip galvanized after fabrication. Joints must be watertight. Water pan or sump must be provided with drain, overflow, and make-up water connection with stop valve and float valve. A bleed line with a flow valve of the needle type sized for the flow required or fixed orifice must be provided in the pump discharge line and must be extended to the nearest drain for continuous discharge.

2.7 FABRICATION

Equipment and component items, must have been proven to withstand 125 hours in a salt-spray fog test, except that equipment located outdoors must withstand 500 hours in a salt-spray fog test. Equipment located in a sea coast environment must withstand 3,000 hours in a salt-spray fog test. Salt-spray fog test must be in accordance with JIS Z 2371. Cut edges of galvanized surfaces where hot-dip galvanized sheet steel is used must be coated with a zinc-rich coating conforming to JIS H 8641.

2.8 SUPPLEMENTAL COMPONENTS/SERVICES

2.8.1 Condenser Water Piping and Accessories

Condenser water piping and accessories must be provided and installed in accordance with Section 23 64 26 CHILLED, CHILLED-HOT, AND CONDENSER WATER PIPING SYSTEMS.

2.8.2 Cooling Tower Water Treatment Systems

Cooling tower water treatment systems must be provided and installed in accordance with Section 23 64 26 CHILLED, CHILLED-HOT AND CONDENSER WATER PIPING SYSTEMS.

2.8.3 Temperature Controls

Cooling towers must be fully coordinated with and integrated [into the temperature control system specified in [Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC][Section 23 09 23.01 LONWORKS DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS] [or] [Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS]] [into the existing air-conditioning system].

PART 3 EXECUTION

3.1 DEMONSTRATIONS

Contractor must conduct a training course for the operating staff as designated by the Contracting Officer. The training period must consist of a total [__8___] hours of normal working time and start after the system is functionally completed but prior to final acceptance tests. The training course must cover all of the items contained in the approved Operation and Maintenance Manuals as well as demonstrations of routine maintenance operations.

Provide a schedule, at least [2] [_____] weeks prior to the date of the proposed training course, which identifies the date, time, and location for the training.

3.2 INSTALLATION

Installation of cooling tower systems including materials, installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing must be in compliance with the manufacturer's written installation instructions, including the following:

(1) Packaged cooling tower - installation instructions

(2) Field-erected cooling tower - installation instructions

3.2.1 Installation Instructions

Provide manufacturer's standard catalog data, at least [5] [_____] weeks prior to the purchase or installation of a particular component, highlighted to show features such as materials of construction, dimensions, options, performance and efficiency. Data must include manufacturer's recommended installation instructions and procedures. Data must be adequate to demonstrate compliance with contract requirements.

3.2.2 Vibration Isolation

If vibration isolation is specified for a unit, vibration isolator literature must be included containing catalog cuts and certification that the isolation characteristics of the isolators provided meet the manufacturer's recommendations.

3.2.3 Posted Instructions

Provide posted instructions, including equipment layout, wiring and control diagrams, piping, valves and control sequences, and typed condensed operation instructions. The condensed operation instructions must include preventative maintenance procedures, methods of checking the system for normal and safe operation, and procedures for safely starting and stopping the system. The posted instructions must be framed under glass or laminated plastic and be posted where indicated by the Contracting Officer.

3.2.4 Verification of Dimensions

Provide a letter including the date the site was visited, conformation of existing conditions, and any discrepancies found.

3.2.5 Demonstrations

Provide a schedule, at least [2] [_____] weeks prior to the date of the proposed training course, which identifies the date, time, and location for the training.

3.2.6 Certificates

Where the system, components, or equipment are specified to comply with requirements of JIS or other Japanese requirements, proof of such compliance must be provided. The label or listing of the specified agency must be acceptable evidence. In lieu of the label or listing, a written certificate from an approved, nationally recognized testing organization equipped to perform such services, stating that the items have been tested and conform to the requirements and testing methods of the specified agency may be submitted.

3.2.7 Operation and Maintenance Manuals

Provide [Six] [_____] complete copies of an operation manual in bound 216 by 279 mm booklets listing step-by-step procedures required for system startup, operation, abnormal shutdown, emergency shutdown, and normal shutdown at least [4] [_____] weeks prior to the first training course. The booklets must include the manufacturer's name, model number, and parts list. The manuals must include the manufacturer's name, model number, service manual, and a brief description of all equipment and their basic

operating features. [Six] [_____] complete copies of maintenance manual in bound 216 by 279 booklets listing routine maintenance procedures, possible breakdowns and repairs, and a trouble shooting guide. The manuals must include piping and equipment layouts and simplified wiring and control diagrams of the system as installed.

3.2.8 Connections to Existing Systems

Notify the Contracting Officer in writing at least 15 calendar days prior to the date the connections are required. Obtain approval before interrupting service. Furnish materials required to make connections into existing systems and perform excavating, backfilling, compacting, and other incidental labor as required. Furnish labor and tools for making actual connections to existing systems.

3.3 RELATED FIELD TESTING

3.3.1 Test Plans

a. Manufacturer's Test Plans: Within [120] [_____] calendar days after contract award, submit the following plans:

(1) Packaged cooling tower - field acceptance test plan

(2) Field-erected cooling tower - field acceptance test plan

Field acceptance test plans must developed by the cooling tower manufacturer detailing recommended field test procedures for that particular type and size of equipment. Field acceptance test plans developed by the installing Contractor, or the equipment sales agency furnishing the equipment, will not be acceptable.

The Contracting Officer will review and approve the field acceptance test plan for each of the listed equipment prior to commencement of field testing of the equipment. The approved field acceptance test plans must be the plan and procedures followed for the field acceptance tests of the cooling towers and subsequent test reporting.

b. Coordinated testing: Indicate in each field acceptance test plan when work required by this section requires coordination with test work required by other specification sections. Furnish test procedures for the simultaneous or integrated testing of tower system controls which interlock and interface with controls for the equipment provided under [Section 23 09 53.00 20, SPACE TEMPERATURE CONTROL SYSTEMS] [Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC][Section 23 09 23.01 LONWORKS DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS] [or] [Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS].

c. Prerequisite testing: Cooling towers for which performance testing is dependent upon the completion of the work covered by Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC must have that work completed as a prerequisite to testing work under this section. Indicate in each field acceptance test plan when such prerequisite work is required.

d. Test procedure: Indicate in each field acceptance test plan each equipment manufacturers published installation, start-up, and field

acceptance test procedures. Include in each test plan a detailed step-by-step procedure for testing automatic controls provided by the manufacturer.

Each test plan must include the required test reporting forms to be completed by the Contractor's testing representatives. Procedures must be structured to test the controls through all modes of control to confirm that the controls are performing with the intended sequence of control.

Controllers must be verified to be properly calibrated and have the proper set point to provide stable control of their respective equipment.

e. Performance variables: Each test plan must list performance variables that are required to be measured or tested as part of the field test.

Include in the listed variables performance requirements indicated on the equipment schedules on the design drawings. Tower manufacturer must furnish with each test procedure a description of acceptable results that have been verified.

Tower manufacturer must identify the acceptable limits or tolerances within which each tested performance variable must acceptably operate.

f. Job specific: Each test plan must be job specific and must address the particular cooling towers and particular conditions which exist with this contract. Generic or general preprinted test procedures are not acceptable.

g. Specialized components: Each test plan must include procedures for field testing and field adjusting specialized components, such as hot gas bypass control valves, or pressure valves.

3.4 TESTING

a. Each cooling tower system must be field acceptance tested in compliance with its approved field acceptance test plan and the resulting following field acceptance test report submitted for approval:

(1) Packaged cooling tower - field acceptance test report

(2) Field-erected cooling tower - field acceptance test report

b. Manufacturer's recommended testing: Conduct the manufacturer's recommend field testing in compliance with the approved test plan. Furnish a factory trained field representative authorized by and to represent the equipment manufacturer at the complete execution of the field acceptance testing.

c. Operational test: Conduct a continuous 24 hour operational test for each item of equipment. Equipment shutdown before the test period is completed must result in the test period being started again and run for the required duration. For the duration of the test period, compile an operational log of each item of equipment. Log required entries every two hours. Use the test report forms for logging the operational variables.

d. Notice of tests: Conduct the manufacturer's recommended tests and the operational tests; record the required data using the approved reporting forms. Notify the Contracting Officer in writing at least 15 calendar days prior to the testing. Within 30 calendar days after acceptable completion of testing, submit each test report for review and approval.

e. Report forms: Type data entries and writing on the test report forms. Completed test report forms for each item of equipment must be reviewed, approved, and signed by the Contractor's test director. The manufacturer's field test representative must review, approve, and sign the report of the manufacturer's recommended test. Signatures must be accompanied by the person's name typed.

f. Deficiency resolution: The test requirements acceptably met; deficiencies identified during the tests must be corrected in compliance with the manufacturer's recommendations and corrections retested in order to verify compliance.

g. Towers with thermal performance must have their thermal performance verified by field testing.

-- End of Section --