UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2014
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SECTION TABLE OF CONTENTS

DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING

SECTION 23 76 00.00 20

EVAPORATIVE COOLING SYSTEM

07/06

-- End of Section Table of Contents --

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USACE / NAVFAC / AFCEC / NASA	UFGS-23 76 00.00 20 (July 2006)
Preparing Activity: NAVFAC	Superseding
UFGS-23 76 00.00 20 (April 2006)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

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SECTION 23 76 00.00 20

EVAPORATIVE COOLING SYSTEM
07/06

****
NOTE: This guide specification covers the requirements for evaporative coolers including roof curbs on which they are mounted.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable items(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).
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NOTE: The coolers covered in this specification are intended for use in areas where climatic conditions generally provide dry-bulb temperatures in excess of 29 degrees C 85 degrees F and concurrent wet-bulb temperatures below 21 degrees C 70 degrees F. Moderate success can be expected with wet-bulb temperatures as high as 24 degrees C 76 degrees F; however, for general practice, use of the coolers with prevailing wet-bulb temperatures above 22 degrees C 72 degrees F is not recommended. Conform to DOD 4270.1-M for the selection of evaporative coolers.
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NOTE: The following information shall be shown on the project drawings:

1. Dry-bulb temperature entering and leaving the evaporator coolers.

2. Wet-bulb temperature entering the evaporator cooler.

3. Air quantity and static pressure.

4. Motor rpm, volts, and amperes.

5. Air outlet velocity in m/s or fpm.

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PART 1 GENERAL

1.1 REFERENCES

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NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a RID outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

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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.

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 52.2	(2012; Errata 2013) Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size
ASHRAE 55	(2010; Errata 2011; Addenda A 2011; Addenda B, C, D, E and F 2012; Errata 2012; Addenda G, H, I, J, K, L, M, N, O, P, Q and R 2013) Thermal Environmental Conditions for Human Occupancy
ASHRAE 62.1	(2013) Ventilation for Acceptable Indoor Air Quality

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	(2013) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A653/A653M	(2011) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B117	(2011) Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM D1654	(2008) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D202	(2008) Sampling and Testing Untreated Paper Used for Electrical Insulation
ASTM D374	(1999; R 2004) Thickness of Solid Electrical Insulation
ASTM D374M	(1999; R 2005) Thickness of Solid Electrical Insulation (Metric)
ASTM E2129	(2010) Standard Practice for Data Collection for Sustainability Assessment of Building Products

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 2	(2000; R 2005; Errata 2008) Standard for Controllers, Contactors, and Overload Relays Rated 600 V
NEMA ICS 6	(1993; R 2011) Enclosures
NEMA MG 1	(2011; Errata 2012) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2014; AMD 1 2013; Errata 2013; AMD 2 2013) National Electrical Code
NFPA 90A	(2012) Standard for the Installation of Air Conditioning and Ventilating Systems

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1966	(2005) HVAC Duct Construction Standards Metal and Flexible, 3rd Edition

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY (TAPPI)

TAPPI T403 OM	(2010) Bursting Strength of Paper

TAPPI T404 CM	(1992) Tensile Breaking Strength and Elongation of Paper and Paperboard (Using Pendulum-Type Tester)
TAPPI T410 OM	(2013) Grammage of Paper and Paperboard (Weight Per Unit Area)
TAPPI T456 OM	(2010) Tensile Breaking Strength of Water-Saturated Paper and Paperboard ("Wet Tensile Strength")
TAPPI T487 PM	(1999) Fungus Resistance of Paper and Paperboard

1.2 GENERAL REQUIREMENTS

Section 23 03 00.00 20 BASIC MECHANICAL MATERIALS AND METHODS, with the following additions and modifications. Provide water treatment and positive water bleed-off for the evaporative cooling system. The color of finished coat, lubrication, and treatment for fungus resistance shall be the manufacturer's standard. Provide solenoid valves in water supply lines. Furnish starting switch separated from coolers, integral with the thermostat control. [Provide manual reset control for motors rated greater than 3/4 kW one hp.] [Provide air filters for air inlets for rotary-type evaporator coolers.]

1.3 SUBMITTALS

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NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project.

The Guide Specification technical editors have designated those items that require Government approval, due to their complexity or criticality, with a "G". Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a "G" to an item, if the submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy projects.

Submittal items not designated with a "G" are considered as being for information only for Army projects and for Contractor Quality Control approval

for Navy projects.
****

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.] The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Evaporative cooling system

SD-03 Product Data

Evaporative coolers

Roof curbs

Vibration isolators

[Local/Regional Materials

Submit documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.]

[Environmental Data]

SD-06 Test Reports

Corrosion protection tests

Cooler efficiency tests

Evaporative coolers tests

SD-10 Operation and Maintenance Data

Evaporative coolers, Data Package 2

Water treatment unit, Data Package 3

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.4 CORROSION PROTECTION TESTS

Comply with [ASTM A123/A123M] [ASTM A653/A653M] or protect the equipment with a corrosion-inhibiting coating or paint system that has proved capable of satisfactorily withstanding corrosion in accordance with ASTM B117. Test 125 hours for equipment installed indoors and 500 hours for equipment installed outdoors or subjected to marine atmosphere. Each specimen shall have a standard scratch as defined in ASTM D1654.

1.4.1 Corrosion Criteria

Upon completion of exposure, coating or paint shall show no indication of deterioration or loss of adhesion, indication of rust, or corrosion extending further than 3 mm 1/8 inch on either side of original scratch.

1.4.2 Thickness of Coating

Thickness of coating or paint system on the equipment shall be identical to that on the test specimens with respect to materials, conditions of application, and dry film thickness.

1.5 LABORATORY TEST

Conduct the test with entering air at 35 degrees C, dry-bulb, plus or minus 2.78 degrees C and a spread between wet-bulb and dry-bulb temperature of minus 4 degrees C plus or minus 3 degrees C. Show the capacity in liter per second (L/s) and efficiency. Meet the following requirements:

Evaporative Cooler	Minimum Efficiency, Percent
Single Stage	80
Two Stage	Indirect Section, 60; Direct Section, 90

$$\text{Efficiency} = \frac{T1-T2}{T1-Tw} \times 100 \text{ percent}$$

where: T1 is the entering dry-bulb temperature in degrees C.
T2 is the leaving dry-bulb temperature in degrees C.
Tw is the entering wet-bulb temperature in degrees C.

Conduct the test with entering air at 95 degrees F, dry-bulb, plus or minus 5 degrees F and a spread between wet-bulb and dry-bulb temperature of 25 degrees F plus or minus 5 degrees F. Show the capacity in cubic feet per minute (cfm) and efficiency. Meet the following requirements:

Evaporative Cooler	Minimum Efficiency, Percent
Single Stage	80
Two Stage	Indirect Section, 60; Direct Section, 90

$$\text{Efficiency} = \frac{T1-T2}{T1-Tw} \times 100 \text{ percent}$$

where: T1 is the entering dry-bulb temperature in degrees F.
T2 is the leaving dry-bulb temperature in degrees F.
Tw is the entering wet-bulb temperature in degrees F.

1.6 ENVIRONMENTAL REQUIREMENTS

For proper Indoor Environmental Quality, maintain positive pressure within the building. Ventilation shall meet or exceed ASHRAE 62.1 and all

published addenda. Meet or exceed filter media efficiency as tested in accordance with ASHRAE 52.2. Thermal comfort shall meet or exceed ASHRAE 55.

1.7 SUSTAINABLE DESIGN REQUIREMENTS

1.7.1 Local/Regional Materials

****
NOTE: Using local materials can help minimize transportation impacts, including fossil fuel consumption, air pollution, and labor.
****

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a [800][_____] kilometer [500][_____] mileradius from the project site, if available from a minimum of three sources.

1.7.2 Environmental Data

****
NOTE: ASTM E2129 provides for detailed documentation of the sustainability aspects of products used in the project. This level of detail may be useful to the Contractor, Government, building occupants, or the public in assessing the sustainability of these products.
****

[Submit Table 1 of ASTM E2129 for the following products: [_____].]

PART 2 PRODUCTS

2.1 SINGLE-STAGE EVAPORATIVE COOLERS

****
NOTE: Efficient cooling equipment and components contribute to the following LEED credits: EA Prerequisite 2; EA1.
****

****
NOTE: Single-stage evaporative coolers are not recommended in areas where temperatures frequently exceed 38 degrees C 100 degrees F.
****

[Drip-type with stationary wetted pad] [Rotary-type] with revolving drum or disk. [Washer (eliminator) type.] System shall be 60 to 85 percent effective.

2.1.1 Evaporative Media (Limited specie of wood)

Refined cellulose fibers. [Impregnate fibers with copper 8-quino-linolate or other equivalent fungicides.] [Rotary filters with maximum 3 m/s 600 FPM and 2 1/2 percent by-pass water flow through the rotary assemblies and minimum 127 mm 5 inch depth of rotary sections.] [Washer media consisting of self-cleaning centrifugal brass spray nozzles, brass flooding nozzles, [copper] [or] [galvanized steel] water piping, centrifugal water pump, strainers, and a minimum 24 gage [galvanized steel] [or] [aluminum]

eliminator with minimum four surfaces and three bends in the airflow direction.]

2.1.2 Water Reservoirs

Fabricate tank from minimum 20 gage zinc-coated steel, bronze, or stainless steel, with a capacity of 19 liters 5 gallons water for each 472 L/s of air 1,000 cubic feet of air per minute passing through the cooler section. Coat the entire water reservoir surfaces with minimum 0.254 mm 10 mils bituminous coating after the fabrication.

2.1.3 Automatic Flush (Electric Dump) Valves and Timers

Provide cast bronze valves with neoprene-diaphragm solenoid and timer.

2.2 TWO-STAGE (COMPOUND) EVAPORATIVE COOLERS

****
NOTE: An indirect-section evaporative cooler is the first stage of cooling, which lowers both dry-bulb and wet-bulb temperatures of the incoming supply air. This supply air is then passed through a direct-section evaporative cooler which provides the second stage of cooling. The first stage of cooling is at constant humidity ratio, while the second stage is at constant wet-bulb temperature. An automatic reservoir purges and drains completely during off cycles to prevent biological growth. This type is suitable for hot-dry climates.
****

Self-contained, packaged, pre-wired, and factory-fabricated evaporative coolers with indirect and direct sections for two-stage cooling. System shall be 100 to 115 percent effective.

2.2.1 Indirect Section

Indirect sensible cooler with a complete secondary evaporative cooling system. Include components of heat exchanger, evaporative media, recirculating pump with suction strainer, sump drain, overflow, automatic fill and level control, secondary air exhaust fan, and distribution head and internal piping. House all components in a common casing.

2.2.1.1 Heat Exchanger

****
NOTE: Shell-and-tube design generally achieves 55 to 60 percent efficiency; and the flat-plate, cross flow air-to-air design generally achieves 65 to 85 percent efficiency. Cooling tower coil design may be the most efficient method of all three choices, generally used in industrial areas where the outdoor wet bulb temperature is 7 degrees C 45 degrees F or below. This third design can maintain space conditions similar to those achieved with mechanical refrigeration.
****

****

NOTE: UV-C emitters improve air quality and reduce energy consumption by removing and inhibiting germicidal growth. Cleaning maintenance costs are also reduced.

****

a. Shell-And-Tube Design: Fabricate tubes and tube sheets from [galvanized steel] [stainless steel] [aluminum] [polystyrene] [or] [copper]. Tube interiors shall be bonded with an epoxy coated crystalline surface or equivalent. Protect tube sheets with a bituminous coating applied after fabrication. Provide the interior of heat exchanger enclosure with 25 mm one inch thick neoprene-coated fiberglass or equivalent insulation.

b. Flat Plate, Cross-Flow Air-To-Air, Design: Fabricate the heat exchanger of [aluminum] [stainless steel] [galvanized steel] [or] [copper] with a water absorbent coating applied to the secondary or wet air surface.

c. Cooling Tower Coil Design: Transport chilled water from the direct evaporative cooler, and circulate this chilled water through a cooling coil fabricated of copper tubing expanded into aluminum fins.

Ultraviolet light C band (UV-C) emitters shall be incorporated downstream of heat exchangers and above drain pans to control airborne and surface microbial growth and transfer. Applied units must be specifically manufactured for this purpose. Safety features shall be provided to limit hazard to operating staff. Units shall not produce ozone. Power output shall be [_____] watts. Power intensity shall be [_____] microwatts per square cm inch.

2.2.1.2 Evaporative Media

Self-cleaning evaporative media capable of withstanding a maximum air face velocity of 3.56 m/s 700 fpm without moisture carryover. Construct media of refined cellulose fibers impregnated with insoluble anti-rot salts and rigidifying saturants.

2.2.1.3 Recirculating Pump

Submersible pump with epoxy-coated cast-iron housing, corrosive resistant base and cover, non-clog impeller, screened intake, and permanently lubricated motor with thermal overload protection.

2.2.1.4 Secondary Air Exhaust Fan

****

NOTE: Propeller fan wheels usually have two or more single thickness blades in a single ring enclosure. Forward curved centrifugal fan wheels have small and curved forward blades in the direction of the wheel's rotation. The wheel type of such centrifugal fans is often called "squirrel cage wheel." Both fans run at a relatively low speed to move a given amount of air. Use propeller fans without attached ductwork; use centrifugal fans with attached ductwork.

****

a. Propeller Fan: Direct-drive propeller fan with all welded frame and statically-dynamically balanced aluminum blades. The exterior and interior of the fan shall be epoxy primed prior to the application of a baked enamel finish. The fan motor shall be totally enclosed with permanently lubricated ball bearings.

b. Centrifugal Fan: Belt-drive or direct-drive centrifugal fan with forward curved blades. Construct scrolls, wheels, and inlet cones of [steel] [or] [aluminum] with corrosion resistant finish. Attach the fan to a welded steel frame designed to support the entire fan and motor assembly. Select V-belt sheaves based on a minimum of 1.3 times the motor nameplate power. Provide these sheaves to have critical speed at least 20 percent higher than the maximum operating speed.

2.2.1.5 Filter Rack

Water resistant permanent frame with 50 mm 2 inch thick disposable fiberglass or equivalent medium.

2.2.1.6 Component Casing

Construct casing of minimum 14 gage galvanized steel panels secured to a welded steel angle frame. Exterior panels shall be removable to permit access to any interior component. Coat with epoxy on frame members, sump drains, entire casing bottom and interior wet surfaces. Exterior steel surfaces shall be primed with epoxy and finished with baked enamel. Terminate all exterior wiring in a weathertight junction box located outside of the casing. Provide hoisting lug for installation.

2.2.2 Direct Section

****
NOTE: For two-stage evaporative cooling systems, major manufacturers often use direct evaporative coolers.
****

Except as modified, direct evaporative cooler [Drip-type with stationary wetted pad] [Rotary-type] with revolving drum or disk. [Washer (eliminator type)].

2.2.2.1 Evaporative Media

Refined cellulose fibers. [Impregnate fibers with copper 8-quino linolate.] [Rotary filters with maximum 3 m/s 600 fpm and 2 1/2 percent by-pass water flow through the rotary assemblies and minimum 127 mm 5 inch depth of rotary sections.] [Washer media consisting of self-cleaning, centrifugal brass spray nozzles, brass flooding nozzles, [copper] [or] [galvanized steel] water piping, centrifugal water pump, strainers, and a minimum 24 gage [galvanized steel] [or] [aluminum] eliminator with minimum four surfaces and three bends in the airflow direction.]

2.2.2.2 Water Reservoirs

Fabricate tank from minimum 20 gage zinc-coated steel, bronze, or stainless steel, with a capacity of 19 liters 5 gallons water for each 472 L/s of air 1,000 cubic feet of air per minute passing through the cooler section. Coat the entire reservoir surfaces with minimum 0.254 mm 10 mils bituminous coating applied after fabrication.

2.2.2.3 Automatic Flush (Electric Dump) Valves and Timers

Provide cast bronze valves with neoprene-diaphragm solenoid and timer.

2.3 FAN PLENUMS

Provide gaskets for plenum covers on all edges which contact sides of sheet-metal plenum with continuous 3 mm 1/8 inch thick butyl-rubber gasket with pressure sensitive backing. Insulate plenum interior, including covers with duct liner. Provide fresh-air intake hoods with bird screens. Install automatic dampers in the fresh-air intake hoods.

2.4 BIRD SCREENS, FRESH-AIR INTAKE HOODS, AND DUCTWORK

Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS.

2.5 THERMOSTATS, AUTOMATIC DAMPERS, AND DAMPER ACTUATORS

Section 23 09 53.00 20 SPACE TEMPERATURE CONTROL SYSTEMS.

2.6 ROOF CURBS

Provide factory-fabricated sheet-steel structural members. The curbs shall have high load-bearing capacities attained by a system of internal bulkheads, welded into position at logical intervals along the length of rails. Provide minimum 100 mm 4 inch cants, 50 by 150 mm 2 by 6 inch factory-installed wood nailers, and fully mitered end sections. Use welded 18 gage galvanized steel shell, base plate, and counterflashing.

2.7 VIBRATION ISOLATORS

[Factory-fabricated, high static and double deflection type. Mold metal parts in oil-resistant neoprene, with color codes by type and size for identification of capacity. Provide bottom steel plates with bolt holes for bolting to equipment bases to prevent movement of equipment.] [Section 22 05 48.00 20 MECHANICAL SOUND VIBRATION AND SEISMIC CONTROL.]

2.8 PLUMBING

Section 22 00 00 PLUMBING, GENERAL PURPOSE.

2.9 MOTORS AND MOTOR STARTERS

****

NOTE: The motor control requirements should be coordinated with the Electrical Section and will depend on field conditions. The following types of motor starters should be used as a guide only. When electrical equipment is connected to heavily loaded, power circuits the starting current may cause excessive voltage drop.

Motor kW	Voltage	Type Starter
Up to 1/4	120	Manual or automatic

Motor kW	Voltage	Type Starter
1/4 to 5 1/2	208-230	Across-the-line magnetic
5 1/2 to 11	208-230	Across-the-line magnetic, part winding or wye-delta
11 to 22	460	Across-the-line magnetic, part winding or wye-delta
Above 11	208-230	Part winding or wye-delta
Above 22	460	Part winding or wye-delta

Motor hp	Voltage	Type Starter
Up to 1/4	120	Manual or automatic
1/3 to 7 1/2	208-230	Across-the-line magnetic
7 1/2 to 15	208-230	Across-the-line magnetic, part winding or wye-delta
15 to 30	460	Across-the-line magnetic, part winding or wye-delta
Above 15	208-230	Part winding or wye-delta
Above 30	460	Part winding or wye-delta

****

NEMA MG 1 and NEMA ICS 2 and NEMA ICS 6 with electrical characteristics as indicated. Motors less than 3/4 kW 1 hp shall meet NEMA High Efficiency requirements. Motors 3/4 kW 1 hp and larger shall meet NEMA Premium Efficiency requirements. Motor shall be [variable speed] [open] [dripproof] [totally-enclosed, [non-ventilated] [or] [fan-cooled]] [explosion-proof]. Motor starters shall be [[manual] [magnetic-across-the-line] [reduced-voltage] [part-winding] [wye-delta] type with [general-purpose] [weather resistant] [watertight] [explosion-proof] enclosure] [manufacturer's standard].

2.10 WATER TREATMENT UNIT FOR THE EVAPORATIVE COOLING SYSTEM

Provide complete and ready for operation, factory packaged water treatment unit for [chemical][ozone] treatment of water, as recommended by the manufacturer of evaporative coolers.

2.11 REFINED CELLULOSE FIBERS' REQUIREMENTS FOR EVAPORATIVE MEDIA

Test	Requirements	Test Method
Basis weight 24 by 36, 500 sheets	21.34 kg plus or minus 0.5 kg	TAPPI T410 OM
Mullen	42 minutes	TAPPI T403 OM
Caliper	0.14 to 0.15 mm	ASTM D374M, Method A
Tensile, dry	18 minutes	TAPPI T404 CM
Tensile, wet	25 percent of dry after 1 minute age at 110 degrees C	TAPPI T456 OM
Absorption	19 mm to 28 mm	ASTM D202
Fungus resistance	Satisfactory at 2 weeks incubation	TAPPI T487 PM

Test	Requirements	Test Method
Basis weight 24 by 36, 500 sheets	47 lb. plus or minus 1 lb.	TAPPI T410 OM
Mullen	42 minutes	TAPPI T403 OM
Caliper	0.0054 to 0.0058-inch	ASTM D374, Method A
Tensile, dry	18 minutes	TAPPI T404 CM
Tensile, wet	25 percent of dry after 1 minute age at 230 degrees F	TAPPI T456 OM
Absorption	12/16 inch to 18/16 inch	ASTM D202
Fungus resistance	Satisfactory at 2 weeks incubation	TAPPI T487 PM

PART 3 EXECUTION

3.1 INSTALLATION

Installation of evaporative coolers shall conform with NFPA 90A, SMACNA 1966, recommendations and printed instructions of the manufacturer, and details and notes indicated. Provide mounting and supporting of thermostats, ducts, piping, roof curbs, equipment, accessories, and appurtenances, including but not limited to structural supports, hangers, vibration isolators, stands, clamp and brackets, and access doors. Electric isolation shall be provided between dissimilar metals for the purpose of minimizing galvanic corrosion. Electrical work shall conform with NFPA 70 and Division 16, Electrical. Equip electric motor-driven equipment with

motor starters, fused-disconnect switches, and controls. Provide manual or automatic control, protective devices, and control wiring for operations as indicated.

3.2 FIELD TESTING AND BALANCING

Verify equipment is properly installed, connected, and adjusted. Adjust evaporative coolers to produce air quantities at the conditions indicated. Use Pitot or electronic instrument to measure air quantities. Set control devices to control at the points indicated. Lubricate bearings and check the speed and direction of rotation of each fan. Check the running current of each motor. Furnish water analysis and sufficient chemicals to initially place the evaporative system in service. [Provide same chemicals used at station's cooling towers.]

3.2.1 Evaporative Coolers Tests

Perform minimum 4-hour cooler efficiency tests of each cooler. Record test data in typed tabulation form, no less than 2 days before the final tests of entire systems indicating the following:

a. Time, date, and duration of test

b. Dry-bulb temperature entering and leaving the evaporizer coolers

c. Wet-bulb temperature entering the evaporizer cooler

d. Air quantity and static pressure

e. Motor rpm - voltmeter and ammeter readings

f. Air outlet velocity m/s fpm

g. Evaporative cooler-make, model and size

3.2.2 Control Sequences

[As indicated] [Section 23 09 53.00 20 SPACE TEMPERATURE CONTROL SYSTEMS].

3.3 WASTE MANAGEMENT

****

NOTE: Diverting waste from the landfill contributes to the following LEED credit: MR2. Coordinate with Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT.

****

Separate waste in accordance with the Waste Management Plan, placing copper materials in designated areas for reuse. Close and seal tightly all partly used adhesives and solvents; store protected in a well-ventilated, fire-safe area at moderate temperature.

3.4 SCHEDULE

Some metric measurements in this section are based on mathematical conversion of inch-pound measurements, and not on metric measurements commonly agreed on by the manufacturers or other parties. The inch-pound and metric measurements shown are as follows:

Products	Inch-Pound	Metric
a. [_____]	[_____]	[_____]

-- End of Section --