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USACE / NAVFAC / AFCEC / NASA **UFGS-23 84 19.00 (February 2018)**

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UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2021
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DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

SECTION 23 84 19.00

DESICCANT COOLING SYSTEMS

02/18

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SECTION 23 84 19.00

DESICCANT COOLING SYSTEMS
02/18

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NOTE: This guide specification covers the requirements for desiccant cooling systems, both solid and liquid types, which offset the latent cooling load by removing moisture from the outside air before it reaches the cooling coil. For Navy projects, use only solid desiccant systems.

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 item(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).

****

PART 1 GENERAL

1.1 REFERENCES

****

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 Reference Identifier (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.

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI 700	(2016) Specifications for Fluorocarbon Refrigerants
ANSI/AHRI 210/240	(2008; Add 1 2011; Add 2 2012) Performance Rating of Unitary Air-Conditioning & Air-Source Heat Pump Equipment

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

ASHRAE 15 & 34	(2013) ASHRAE Standard 34-2016 Safety Standard for Refrigeration Systems/ASHRAE Standard 34-2016 Designation and Safety Classification of Refrigerants-ASHRAE Standard 34-2016
ASHRAE 84	(2020) Method of Testing Air-to-Air Heat Exchangers

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B31.1	(2020) Power Piping
ASME BPVC SEC IX	(2017; Errata 2018) BPVC Section IX-Welding, Brazing and Fusing Qualifications

ASTM INTERNATIONAL (ASTM)

ASTM A307	(2014; E 2017) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM B209	(2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B209M	(2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM B210/B210M	(2019a) Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes

ASTM D1784	(2020) Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM F104	(2011; R 2020) Standard Classification System for Nonmetallic Gasket Materials

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(2018) Motors and Generators

1.2 SUBMITTALS

****

NOTE: Review submittal description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified 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 Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters 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, Air Force, and NASA projects.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

Choose the first bracketed item for Navy, Air Force and NASA projects, or choose the second bracketed item for Army projects.

****

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Drawings; G[, [_____]]

SD-03 Product Data

Verification of Dimensions
Standard Products; G[, [_____]]
Spare Parts
Qualifications
Field Instructions
Performance Tests
Demonstrations

SD-06 Test Reports

Performance Tests
Inspections

SD-07 Certificates

Standard Products

SD-10 Operation and Maintenance Data

Operation and Maintenance Manual; G[, [_____]]
Data Package 5

1.3 QUALITY ASSURANCE

1.3.1 Qualifications

****
NOTE: If the need exists for more stringent requirements for weldments, delete the first bracketed statement, otherwise delete the second.
****

Weld pipe in accordance with the qualified procedures, using performance qualified welders and welding operators in accordance with ASME BPVC SEC IX. Submit [_____] copies of qualification procedures, and list of names and identification symbols of qualified welders and welding operators, prior to non-factory welding operations. Welding procedures qualified by others, and welders and welding operators qualified by another employer may be accepted as permitted by ASME B31.1. Notify the Contracting Officer 24 hours in advance of tests and perform the tests onsite, if practical. The welder or welding operator must apply the assigned symbol near each weld personally made as a permanent record. Weld structural members in accordance with [Section 05 05 23.16 STRUCTURAL WELDING][welding and nondestructive testing procedures specified in Section 40 05 13.96 WELDING PROCESS PIPING].

1.3.2 Drawings

Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. Carefully investigate the plumbing, fire protection, electrical, structural and any other features or conditions that would affect the work to be performed

and arrange such work accordingly, furnishing required offsets, fittings, and accessories to meet such features or conditions. Submit drawings, at least [5 weeks] [_____] prior to beginning construction, providing adequate detail to demonstrate compliance with contract requirements and consisting of:

a. Equipment layouts which identify assembly and installation details to include energy recovery equipment.

b. Piping layouts which identify all valves and fittings.

c. Plans and elevations which identify clearances required for maintenance and operation.

d. Wiring diagrams which identify each component individually, by showing actual location in equipment, and schematically, by showing all interconnected or interlocked relationships between components.

e. Foundation drawings, bolt-setting information, and foundation bolts prior to concrete foundation construction for all equipment indicated or required to have concrete foundations.

f. Details, if piping and equipment are to be supported other than as indicated, which include loading and type of frames, brackets, stanchions, or other supports.

1.4 DELIVERY, STORAGE, AND HANDLING

Store all equipment delivered and placed in storage with protection from the weather, humidity and temperature variations, dirt and dust, or other contaminants.

1.5 EXTRA MATERIALS

Submit spare parts data for each different item of material and equipment specified, after approval of the detail drawings and not later than [_____] months prior to the date of beneficial occupancy. Include a complete list of parts and supplies, with source of supply.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

****

NOTE: Desiccant cooling systems are of two basic types: dry desiccant on a rotor with hot air regeneration and liquid desiccant with spray coils and heated desiccant.

A schematic drawing, sequence of operation, and an equipment schedule must be included on the drawings. Equipment which the basic dehumidification system vendor lists as optional or "provided by others" must be clearly shown and sized.

****

Provide materials and equipment which are the standard products of a manufacturer regularly engaged in the manufacturing of such products and that essentially duplicate equipment which is similar in material, design,

and workmanship. The standard products must have been in satisfactory commercial or industrial use 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. The two years experience must be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturer's catalogs, or brochures. 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. All products must be supported by a service organization.

a. Submit manufacturer's catalog data, at least [5 weeks] [_____] prior to beginning construction, highlighted to show model number, size, options, performance charts and curves, etc., in adequate detail to demonstrate compliance with contract requirements. Provide performance data over the full range of outdoor conditions for which dehumidification will be required, with the conditions defined by the Contracting Officer. Supply data from manufacturer on all energy recovery methods and equipment available for the system. Include manufacturer's recommended installation instructions and procedures. If vibration isolation is specified for a unit, include vibration isolator literature containing catalog cuts and certification that the isolation characteristics of the isolators provided meet the manufacturer's recommendations.

b. Submit a certified list of qualified, permanent service organizations for support of the equipment including their addresses and qualifications. These service organizations must be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

c. The system must be a complete stand alone system with all necessary controls, motors, fans, rotors, motors, drive components, pumps, reactivation components and filtration to provide automatic continuous operation. Internal regeneration heat sources must be a part of the system, except external heat sources may be used under the following conditions: coordinate connections to external heat sources with the system manufacturer, and connecting equipment such as pumps, piping, traps, etc., as shown on the drawings and schedules. The desiccant must be of the [solid type on a rotary wheel] [liquid type utilizing spray coils].

d. Submit proof of compliance with AHRI, ASHRAE, ASME, or UL requirements where specified for the system, components, or equipment. The label or listing of the specified agency is acceptable evidence. In lieu of the label or listing, a written certificate from an approved, nationally recognized testing organization equipped to perform such services, must be submitted stating that the items have been tested and conform to the requirements and testing methods of the specified agency. When performance requirements of this project's drawings and specifications vary from standard AHRI rating conditions, computer printouts, catalog, or other application data certified by AHRI or a nationally recognized laboratory as described above must be included. If AHRI does not have a current certification program that encompasses such application data, the manufacturer must self certify that his application data complies with project performance requirements.

2.2 MATERIALS

2.2.1 Gaskets

Gaskets must conform to ASTM F104 classification for compressed sheet with nitrile binder and acrylic fibers for maximum 371 degrees C 700 degrees F service.

2.2.2 Bolts and Nuts

Bolts and nuts, except as required for piping applications, must be in accordance with ASTM A307. Mark the bolt head to identify the manufacturer and the standard with which the bolt complies in accordance with ASTM A307.

2.3 DESICCANT SYSTEMS

****
NOTE: Desiccant systems are used basically for large latent loads. These systems should be engineered around a total system. They can be used in buildings with humidity requirements lower than mechanical equipment capacity, for preprocessing of OA to lower the load on mechanical systems, and as liquid systems to maintain exact humidity requirements during all seasons. The designer should look at existing energy sources for regeneration when considering a desiccant system to maximize equipment usage and energy savings. Application of desiccant systems should involve manufacturer input when coordinating equipment usage.

Designer should determine the type of DESICCANT SYSTEM required and delete the unwanted systems.
****

2.3.1 Solid Desiccant System

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NOTE: Desiccant cooling system equipment is sized to meet space and ventilation latent cooling loads. Typically, the desiccant dehumidifies ventilation air so that, when the desiccant ventilation air is mixed with return air from the space, the resulting mixture is of sufficiently low specific humidity to satisfy the latent load of the space. The refrigerant-based post-cooling system is sized to reduce the dry-bulb temperature of the mixture to handle the space sensible cooling load. In some cases, an optional pre-cooling coil is placed upstream of the desiccant wheel so that the wheel can more effectively dehumidify the outside air to be introduced for ventilation or makeup. Optional heating coils may be added in the desiccant unit enclosure to partially or totally handle the space heating loads. For Navy projects, use only solid desiccant systems.
****

The unit must be a complete, factory assembled and tested system, suitable for outdoor installation. Each unit must produce a capacity as rated in accordance with [ASHRAE 84] [ANSI/AHRI 210/240]. It must be designed for either curb mounting or structural steel support. Include the following components as defined in paragraph SYSTEM COMPONENTS:

a. Desiccant Rotor
b. Thermal Rotor (or heat pipe)
c. Supply Fan
d. Regeneration Fan
e. Regeneration and Process Heating System
f. Filters
g. Indirect Evaporative Cooling System
h. Gas fired Boiler (optional)
i. Circulating pumps (boiler, evaporative cooling)
j. Refrigeration Section (optional) for pre- and/or post-cooling

2.3.1.1 Control Package

Each unit must be factory wired and equipped with a central electrical control panel mounted inside the service compartment. Mount variable-speed drive controller, if provided, inside the service compartment. Provide switched lighting in the service compartment so that the panel can be easily seen. Compartment must be ventilated, if necessary, for cooling variable speed drive controller. Provide single power supply for the unit. All internal wiring must be in accordance with the National Electrical Code. Include all electrical components required for automatic operation, based on signals from remotely mounted humidity and temperature sensors/controllers. Make connections to remote devices at the marked terminals. The internal control panel must report discharge temperature and humidity. Additional reporting of all control data must be available to a central control station, as specified in Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

2.3.1.2 Unit Mounting

[Curb mount unit] [Support unit with structural steel]. Isolate the entire unit from the building structure on vibration isolators with submitted and published load ratings. Vibration isolators must have isolation characteristics as recommended by the manufacturer for the unit supplied and the service intended.

2.3.2 Liquid Desiccant System

****

NOTE: Liquid desiccant systems are capable of maintaining year round humidity control due to characteristics of the conditioner solution and the units ability to maintain the concentration of the solution. Additionally, these units are capable of lowering the air temperature because the conditioner solution passes through a heat exchanger utilizing a cold liquid such as chilled water. The designer should work with the manufacturer to integrate these systems with the existing mechanical units. One approach would be to use the desiccant system to precondition supply air for several chiller-AHU systems.

****

The unit must be a complete, factory assembled and tested, system suitable for outdoor installation and produce a capacity as rated in accordance with ANSI/AHRI 210/240. It must be designed for [curb mounting] [or] [structural steel support]. Include the following components as defined in paragraph SYSTEM COMPONENTS:

a. Conditioner unit
b. Conditioner cooler
c. Regenerator
d. Regenerator heater
e. Level control
f. Filter screening
g. Freestanding pump assembly
h. Make up water system
i. Conditioner fan
j. Regenerator fan

2.3.2.1 Control Panel

Each unit must be factory wired and equipped with a central electrical control panel mounted inside the service compartment. Provide a single power supply. All internal wiring must be in accordance with the National Electrical Code. Include all electrical components required for automatic operation, based on signals from remotely mounted humidity and temperature sensors/controllers. Make connections to remote devices at the marked terminals. The internal control panel must report discharge temperature and humidity. Additional reporting of all control data must be available to a central control station, as specified in Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

2.3.2.2 Equipment Mounting

Set the conditioner and regenerator units on level concrete floor or slab. Seal the floor with epoxy sealant before the equipment is set in place. Unit must be surrounded by a curb.

2.4 UNIT CONSTRUCTION

2.4.1 Solid Desiccant System

Unit must be suitable for outdoor installation and designed for either structural or curb mounting without field modification. The enclosure system must be air-tight (2 percent maximum leakage at 150 percent design static pressure from section to section). Construct the unit base of formed minimum 10 GA steel coated with red- oxide primer. Locate cross members to support each major component. Fit lifting lugs fitted to required structural members. Paint unit exterior painted with a low-gloss enamel.

2.4.1.1 Housing

Construct the unit housing and internal partitions of minimum 18 GA galvanized steel with the exterior panels treated to allow for painting. Insulate all external walls with foil-faced fiber glass insulation at least 25 mm 1 inch thick and secured by permanent mechanical fasteners welded to the panels. Seal adjoining panels sealed by permanent mechanical fasteners welded to the panels and with silicone compound, as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.4.1.2 Service Panels

Provide removable service access panels for all components. The openings must be of sufficient size to allow service to all maintenance items. Provide all service panels with resilient gaskets and hardware to assure compression. Provide access doors for boiler and control sections with continuous hinges. Seal roof panels to provide a weather-tight enclosure.

2.4.2 Liquid Desiccant System

The unit must consist of conditioner and regenerator watertight housings containing the sump of vinylester FRP with additives to achieve a U.L. Class 1 flame spread rating, or equal. The conditioner cooler, and regenerator heater must be of the plate-and-frame type, with carbon steel frame carrier bars and tiebolts; titanium plates and nitrile or EPDM gaskets.

2.4.2.1 Piping

****
NOTE: Edit Section 22 00 00 to the extent necessary to specify FRP and CPVC piping, valves and pressure testing of piping system.
****

The conditioner piping must be FRP or CPVC rated for continuous service at 107 degrees C 225 degrees F with the desiccant solution. Install FRP piping for the regenerator. Blackiron, galvanized and stainless steel are not acceptable. CPVC piping must be Schedule 80, Type IV, Grade 1, 4120, in accordance with ASTM D1784, as specified in Section 22 00 00 PLUMBING, GENERAL PURPOSE. Support the piping so that no stress is placed on connections to the equipment. Install piping at least 610 mm 2 ft away from all maintenance access openings and belt guards. Solution pump discharge piping must be arranged to allow removal of the pump from the pump tank. Incorporate a 90 degree elbow or a vertical spool piece to the pump discharge piping at least 1.2 m 4 ft long so the pump can be lifted vertically from the tank. Pressure test all piping for leaks before insulating. Where possible, complete equipment start-up before the insulation is applied.

2.4.2.2 Valves and Thermowells

Valves in the conditioner solution piping must be made of CPVC, thermoplastic-lined cast iron, or as recommended by the manufacturer. Thermowells in the solution piping must be monel or TFE-coated steel. Stainless steel thermowells are not acceptable. Install flanged pipe fittings when possible. Avoid threaded fittings and connections. Install red rubber or neoprene full-face gaskets in flanged connections.

2.4.2.3 Insulation

Insulate conditioners whenever a coolant other than cooling tower water is used to prevent surface condensation. Insulate the entire unit including the solution and coolant piping. Install flexible rubber, rigid foam plastic, or other non-permeable, vapor-tight insulation material for conditioners. When the equipment is installed outside, an ultraviolet and weather protective coating must be applied to the insulation. Insulate regenerators and steam or hot water piping with 50 mm 2 inch of rigid,

foil- or plastic-faced, fiberglass board. Insulate solution piping for personnel protection. Apply weather protective covering if the equipment is installed outside. Do not penetrate the outer casing of the conditioner and regenerator with insulation fasteners. Contact cement or other adhesive as recommended by the insulation manufacturer for use with an FRP substrate must be used for insulation fastening. Install insulation in conformance with Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.4.3 Insulation

Insulate conditioners whenever a coolant other than cooling tower water is used to prevent surface condensation. Insulate the entire unit including the solution and coolant piping. Install flexible rubber, rigid foam plastic, or other non-permeable, vapor-tight insulation material for conditioners. When the equipment is installed outside, an ultraviolet and weather protective coating must be applied to the insulation. Insulate regenerators and steam or hot water piping with 50 mm 2 inch of rigid, foil- or plastic-faced, fiberglass board. Insulate solution piping for personnel protection. Apply weather protective covering if the equipment is installed outside. Do not penetrate the outer casing of the conditioner and regenerator with insulation fasteners. Contact cement or other adhesive as recommended by the insulation manufacturer for use with an FRP substrate must be used for insulation fastening. Install insulation in conformance with Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.4.4 Safety Requirements

****
NOTE: Catwalk, ladder and guardrail may be required. Select the applicable bracketed items, delete the others, and indicate on the drawings the selected items. If not applicable, delete the entire sentence within the brackets.
****

Insulate,fully enclose, guard, or fit with other types of safety devices all 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 , fully enclosed, guarded, or fitted with other types of safety devices. Install safety devices installed so that proper operation of equipment is not impaired. Provide [[Catwalk][Ladder][Guardrail] where indicated and in accordance with Section [08 31 00 ACCESS DOORS AND PANELS][05 51 33 METAL LADDERS].]

2.4.5 Electrical Work

****
NOTE: Where motor starters for mechanical equipment are provided in motor-control centers, the references to motor starters will be deleted.
****

Electrical equipment, motors, motor efficiencies, and wiring must be in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide electrical motor driven equipment specified complete with motors, motor starters, and controls (including variable speed control of process air flow for solid units, where applicable). Electrical characteristics and

enclosure type must be as shown, and unless otherwise indicated, all integral size motors with open, dripproof, or totally enclosed fan cooled enclosures, must be premium efficiency type in accordance with NEMA MG 1. Field wire in accordance with manufacturer's instructions. Each motor must conform to NEMA MG 1 and be of sufficient size to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor. All motors must be continuous duty with the enclosure specified. Provide motor starters complete with thermal overload protection and other appurtenances necessary for the motor control indicated. Furnish motors with a magnetic across-the-line or reduced voltage type starter as required by the manufacturer. Provide motor starter with [NEMA 1][NEMA 3R][NEMA [_____]] enclosures. Provide manual or automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and devices specified, but not shown.

2.4.6 Duct Work

2.4.6.1 Plenums and Ductwork

Provide desiccant units with flanges on the air openings for duct connection. Bolt inlet and outlet plenums to the flange with a gasket between the connection. Provide access doors, for servicing diffusers and eliminators, in the inlet and outlet plenums. Inlet ductwork must be designed to allow uniform distribution of air across the entire opening. Outlet plenums and ductwork must allow adequate room for servicing the eliminators and must provide proper airflow through the equipment. Provide plenum and ductwork sizes as shown and specified in Section 23 30 00 HVAC AIR DISTRIBUTION.

2.4.6.2 Regenerator Exhaust Ductwork

The regenerator exhaust ductwork must be made of glass-fiber reinforced polyester (FRP) or monel. FRP must be rated for continuous duty at 82 degrees C 180 degrees F. Construct duct joints watertight. Incorporate a drip collar in the exhaust plenum and duct to capture any condensation that occurs inside the duct. Pitch long horizontal duct runs slightly in the direction of air flow, and incorporate low-point condensate drains.

2.5 SYSTEM COMPONENTS

2.5.1 Desiccant Rotor

Provide and install dehumidifiers of a non-cyclic adsorption type with a single desiccant rotary structure designed for continuous operation. Provide counter flow construction arrangement of process and regeneration air streams with full face pressure seals to prevent cross leakage with static pressure differentials up to 200 mm 8 inches water gauge. The rotary structure must consist of a stable, hygroscopic desiccant material, such as Silica Gel, Titanium Silicate, or a Zeolite, deposited on a honey-combed substrate designed to maximize the desiccant area exposed to the air stream and minimize the thermal carryover from the regeneration side to the adsorption side. Ensure laminar air flow through the structure for minimum pressure loss. The rotor must be complete with an electric motor with over-current protection and a speed reducer assembly driving the rotor through a flexible circumferential drive belt. Include a slack side belt tensioner for automatic take-up.

2.5.2 Heat Exchanger

2.5.2.1 Thermal Rotor

Minimize the transfer of water vapor between the process and regeneration sides of the unit with a rotary, non-hygroscopic type thermal rotor. Construct and size the rotor to maximize the transfer of heat from the supply air stream to the regeneration air stream while minimizing the transfer of moisture back to the supply air stream. Supply and cooling air streams must be counter flow and the component fitted with full face contact seals on both sides to prevent leakage.

2.5.2.2 Heat Pipe

****

NOTE: The designer will research local conditions to determine the effect of corrosive atmosphere on dissimilar metals. Where condenser or evaporator coils are to be installed in corrosive atmospheres, the specification for coils and fins will be rewritten for these specific conditions. Consideration should be given to the following coil and fin combinations based on past experience with the suitability of these materials in dealing with the local conditions.

a. Copper coil and aluminum fins, coated.

b. Copper coil and copper fins, coated.

c. Aluminum coil and aluminum fins, coated.

d. Aluminum coil and aluminum fins, uncoated.

e. Copper coil and copper fins, uncoated.

Coating may be either phenolic or vinyl. For coils with relatively close fin spacing such as those found in most unitary equipment, the phenolic coating is preferred. Phenolic has less tendency to bridge across the fins than vinyl, has better thermal conductivity than vinyl and in many conditions weathers better than vinyl.

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Heat pipe coils must be of the extended-surface fin-and-tube type and be constructed of seamless [15] [18] [25] mm[1/2] [5/8] [one] inch nominal diameter [copper] [or] [aluminum] utilizing wrought aluminum Alloy 3003 or Alloy 5052tubes with compatible [copper] [or] [aluminum] fins. On heat pipes with all aluminum construction, tubes must conform to ASTM B210/B210M, alloy 1100 and aluminum alloy conforming to chemical requirements of ASTM B209M ASTM B209; use alloy 7072 for the fins and end sheets. Solder or mechanically bond fins to the tubes and installed in a metal casing. Test coils after assembly at pressure specified in ASHRAE 15 & 34 for the refrigerant employed in the system. [After testing of the heat pipe coils, dry coils to remove free moisture, and cap to prevent entrance of foreign matter.]

2.5.2.3 Refrigerants

Refrigerants must be one of the hydrochlorofluorocarbon or hydrofluorocarbon gases and have number designations and safety classifications in accordance with ASHRAE 15 & 34. Refrigerants must meet the requirements of AHRI 700 as a minimum. Refrigerants must have an Ozone Depletion Potential (ODP) of less than or equal to 0.05 and be in compliance with pertinent EPA regulations. Factory leak test and dehydrate the unit, as specified in Section [23 64 26 CHILLED, CHILLED-HOT, AND CONDENSER WATER PIPING SYSTEMS] [23 23 00 REFRIGERANT PIPING].

2.5.3 Fans (Solid Desiccant System) For Supply and Regeneration

Equip the unit with two belt driven backward inclined blowers. Provide a drive belt rated for minimum 150 percent of motor horsepower on each motor. Provide sheaves with the supply fan motor for air balancing. Provide nominal 3500 RPM motors, NEMA B with open dripproof housings and a minimum service factor of 1.15.

2.5.4 Heating System (Solid Desiccant System)

Regeneration and process heating coils must be of the finned tube type, and be constructed of 13 mm 1/2 inch OD seamless copper tube mechanically bonded to aluminum fins. Include a flanged, heavy-gauge, galvanized steel housing for mounting the coils to the unit. The coils must be rated for 1135 kPa 150 psig.

2.5.5 Filters (Solid Desiccant System)

Equip outside air inlets and return air plenums with 50 mm 2 inch, 30 percent minimum efficiency filters. Provide pleated and disposable filters.

2.5.6 Indirect Evaporative Cooling System (Solid Desiccant System)

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NOTE: Where water is of high hardness (>121 ppm or mg/L), provisions shall be made to facilitate automatic or manual blowdown to reduce solids build-up. Alternatively, water should be softened prior to use as make-up for the evaporative cooling system.

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Use evaporative cooling to indirectly cool the supply air. Include an evaporative cooling media of cellulose paper impregnated to resist degradation and PVC piping with the system.

2.5.7 Gas Fired Boiler (Solid Desiccant System)

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NOTE: Boiler regeneration capacity, as determined by the manufacturer, may be based on the regeneration capacity required under "design day" conditions, or 1 percent or 2.5 percent summer outdoor design conditions. The supporting rationale behind such sizing is that the specific humidity of the air leaving the desiccant will be fairly

constant over variable outdoor conditions. The boiler will substantially regenerate the desiccant at relatively high outdoor dry-bulb temperatures and specific humidity ratios, while full-capacity regeneration at lower outdoor dry-bulb temperatures and specific humidity ratios will still produce a process air stream with a specific humidity ratio comparable to that achieved at outdoor conditions of higher dry-bulb temperature and specific humidity ratio. This approach minimizes the expense of a higher capacity boiler, boiler short-cycling at light dehumidification loads and the unnecessary expense of excessive dehumidification. If a higher capacity boiler is required, the designer should discuss this with the manufacturer and investigate the possibility of modulating control of regeneration heat (which will be simpler to obtain with an external, rather than internal, heat source for regeneration).

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Provide a gas-fired water heater boiler suitable for delivering fluid temperatures of 99-104 degrees C 210-220 degrees F. Construct boiler with a copper tube exchanger and cast iron wet walls. Provide complete unit with all controls, including an automatic gas valve, automatic pilot spark ignition system, power draft inducer, supply water control temperature sensor, and suitable safety controls. Include properly sized diaphragm type expansion tank for the hydronic system. Diaphragm must be flexible butyl securely attached to inner tank wall. Maximum allowable working pressure must be at least 791 kPa 100 psig, and 116 degrees C 240 degrees F temperature.

2.5.8 Circulating Pumps (Solid Desiccant System)

Provide a submersible type evaporative cooling pump with a hooded intake, polypropylene screen, and thermal overload protection. Provide an in-line close coupled single stage centrifugal boiler pump.

2.5.9 Refrigeration Section (Solid Desiccant System)

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NOTE: The addition or elimination of the refrigeration section to a rotary wheel desiccant should not hinder the designer from selecting additional refrigeration equipment downstream or upstream (pre-cooling coil) of the desiccant unit. The designer can choose this option, but should view the desiccant system as part of the total air delivery system.

****

The refrigeration loop must be integral to the unit, and factory charged. The condenser section must provide the heat required to regenerate the desiccant rotor, and the evaporator section must provide additional cooling/dehumidification. Provide one of the hydrochlorofluorocarbon or hydrofluorocarbon gas type refrigerants with number designations and safety classifications in accordance with ASHRAE 15 & 34. Refrigerants must meet the requirements of AHRI 700 as a minimum. Refrigerants must have an Ozone Depletion Potential (ODP) of less than or equal to 0.05 and

be in compliance with EPA regulations. Factory leak test and dehydrate the unit, as specified in Section [23 64 26 CHILLED, CHILLED-HOT, AND CONDENSER WATER PIPING SYSTEMS] [23 23 00 REFRIGERANT PIPING] [or] [Section 23 81 00 DECENTRALIZED UNITARY HVAC EQUIPMENT].

2.5.10 Conditioner unit (Liquid Desiccant System)

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NOTE: Lithium chloride salt solution is now being used in liquid desiccant systems. If another solution is to be used, the designer must edit those parts that make reference to lithium chloride solution to reflect the properties of the solution used.

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The conditioner unit must consist of a watertight housing containing the sump, inlet air diffusers, desiccant solution-to-air contact surface, desiccant solution distribution system and mist eliminator system; and a free standing pump assembly with tank, vertical seal-less solution pump and motor, and full-flow solution filter screen. Fabricate the housing and pump tank from corrosion resistant materials resistant to the desiccant solution. Construct internal parts made of cupronickel or nonmetallic corrosion-proof materials. Construct the desiccant solution pump and all other wetted parts with corrosion resistant materials. Fiberglass reinforced plastic surfaces must be pigmented and U.V. stabilized for exposure to direct sunlight.

2.5.10.1 Humidity Conditioning

The humidity conditioning system must be of the liquid desiccant type. The system be capable of simultaneous air cooling and dehumidification as indicated on the drawings. The system must automatically, fully modulate the usage of conditioner coolant and regenerator heat to match the system cooling and dehumidification loads. Deliver with the humidity conditioning system air containing not more than 5 microorganisms per 0.3 Cu. m 10 Cu. Ft, as measured by the Six-Plate Andersen Sampling Method, provided the supply air to the system contains not more than 100 organisms per 0.3 Cu. m 10 Cu. Ft.

2.5.10.2 Desiccant Solution

The desiccant solution must be stable and non-toxic and the desiccant not exist in the vapor phase in the conditioned air stream. The maximum loss rate of desiccant to the conditioned air stream must not exceed two parts lithium per billion parts air, by weight. Provide the end user with analysis and recommendations for maintenance of the desiccant solution six times yearly, free of charge, for the life of the equipment.

2.5.11 Conditioner Cooler (Liquid Desiccant System)

Provide conditioner desiccant solution cooler of the plate-and-frame type, with carbon steel frame carrier bars and tiebolts; titanium plates and nitrite or EPDM gaskets. Provide the solution heater complete with heating fluid control valve. The heat exchangers must be shipped loose for field installation.

2.5.12 Regenerator (Liquid Desiccant System)

The regenerator units must each consist of a watertight housing containing the sump, inlet air diffusers, desiccant solution-to-air contact surface, desiccant solution distribution system and mist eliminator system; and a free standing pump assembly with tank, vertical seal-less solution pump and motor, and full-flow solution filter screen. Fabricate the housing and pump tank of corrosion resistant materials resistant to the desiccant solution. Construct internal parts of cupronickel or nonmetallic corrosion-proof materials. Construct the desiccant solution pump and all other wetted parts with corrosion resistant materials resistant to the desiccant solution. Fiberglass reinforced plastic surfaces must be pigmented and U.V. stabilized for exposure to direct sunlight.

2.5.12.1 Humidity Conditioner

The humidity conditioning system must consist of separate conditioning and desiccant regeneration units providing complete separation of conditioned and regeneration air streams. The manufacturer must guarantee that there will be no cross-leakage of conditioner and regenerator air streams under any circumstances.

2.5.12.2 Fan Assembly

Supply the regenerator with a separate field-mounted fan and fan box assembly, consisting of housing, forward-curved fan motor, and drive. Construct the fan wheel of steel. Construct the fan box of galvanized steel. Heresite coat the fan wheel and fan box interior. Paint the fan box exterior with a prime and finish coat of industrial-grade acrylic machine enamel.

2.5.12.3 Equipment Location

Design the equipment so that the conditioner and regenerator units need not be installed in the same location, and may be located wherever convenient. Where units are installed outside, weatherproof insulation is required and adequate freeze protection for water, steam, and condensate piping is required.

2.5.13 Regenerator Heater (Liquid Desiccant System)

The regenerator solution heater must be of the plate-and-frame type, with carbon steel frame carrier bars and tiebolts; titanium plates and nitrite or EPDM gaskets. Supply the solution heater complete with heating fluid control valve. The heat exchangers must be shipped loose for field installation.

2.5.14 Level Control (Liquid Desiccant System)

The level control panel must consist of safety interlock pressure switch, unit pressure drop indicator, bubbler type supply pneumatics, P/I transducer, I/P transducer, and PID single-loop controller, all contained in a NEMA 12 enclosure. Ship the level control panel mounted to the unit.

2.5.15 Filter Screening (Liquid Desiccant System)

Equip the unit with noncorrosive diffuser and filtering system capable of filtering any droplets in the air stream and diffusing the stream for uniform airflow distribution.

2.5.16 Freestanding Pump Assemblies (Liquid Desiccant System)

Equip the conditioner and regenerator with a freestanding seal-less pump and motor. Construct the pumps shaft with an corrosion resistant materials suitable for the desiccant solution and all other wetted parts of vinylester FRP, or equal.

2.5.17 Make Up Water System (Liquid Desiccant System)

Equip the unit with piping, valving, and controls to automatically maintain solution level in the conditioner section. The level control panel must consist of a safety interlock pressure switch, unit pressure drop indicator, bubbler tube ("type" is indicated above) supply pneumatics, P/I transducer, I/P transducer, and PID single-loop controller, all contained in a NEMA 12 enclosure. The level control panel must be shipped mounted to the unit.

2.5.18 Conditioner Fan (Liquid Desiccant System)

Equip the unit with a conditioner fan only to the extent necessary to supply static pressure to existing equipment, or if used as a stand alone unit, as specified in Section 23 30 00 HVAC AIR DISTRIBUTION.

2.5.19 Regeneration Fan (Liquid Desiccant System)

Supply the regeneration fan with a separate field-mounted fan and assembly rated for the requirements of the regeneration system. The fan and assembly must be of such design and construction to be resistant to the chemicals within the regenerator, as specified in Section 23 30 00 HVAC AIR DISTRIBUTION.

2.6 SUPPLEMENTAL ACCESSORIES/SERVICES

2.6.1 Nameplates

Include for each major component of equipment the manufacturer's name, address, type or style, and catalog or serial number on a plate securely attached to the item of equipment. Secure nameplates to the cabinet of dry desiccant units, indicating the equipment enclosed within the cabinet behind the nameplate. Provide cabinets with hinged panels, as specified, to facilitate maintenance of the component described on the nameplate secured to the cabinet.

2.6.2 Drain and Makeup Water Piping

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NOTE: All drain and makeup water piping should be indicated on the drawings.
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Provide and install piping in accordance with the requirements of Section 22 00 00 PLUMBING, GENERAL PURPOSE. Connect drains which connect to sanitary sewer system by means of an indirect waste.

2.6.3 Steam Piping and Accessories

Provide and install steam piping and accessories in accordance with Section 23 52 00 HEATING BOILERS.

2.6.4 Conditioner Solution Concentration

Provide the conditioner solution concentration capable of maintaining the humidity level specified on the drawings.

2.6.5 Automatic Controls

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NOTE: Change paragraph as required to coordinate the central equipment controls with the air-side system controls. In projects where this specification is intended to produce control equipment for existing air-side systems, this paragraph will be edited to secure controls to match existing controls and to properly integrate the specified controls into the existing temperature control system. Designer will be required to put a sequence of control for each cooling tower fan, chilled water pump, condenser water pump, etc. on the contract drawings.

One control measure recommended for consideration by the designer for solid desiccant units is a bypass damper arrangement whereby desiccant unit components are de-energized when the desiccant unit is not performing dehumidification, and a damper in the process air ductwork is closed. At the same time, a (bypass) damper in the outside air ductwork is open so that a central station air handling unit will not have to draw minimum (or economizer cycle) outside air quantities through the desiccant unit; i.e., outside air will bypass the desiccant unit on its way to the central air handler. When dehumidification is called for, the bypass damper will close and the damper in the process air ductwork will open, which will enable desiccant unit components to be energized (the dampers can be near one another and set to assume reversible and opposite positions through mounting on a common jackshaft). This control has numerous advantages: it reduces aggregate flow through desiccant unit filters and rotors, extending their useful lives; it reduces fan head pressure loss from particulate accumulation on filters and rotors, simultaneously reducing desiccant fouling and accompanying loss of dehumidification capacity; also, it reduces electrical energy consumption since the desiccant unit process air fan will not (and cannot) operate to move air through the desiccant unit to the central station air handler when dehumidification is not called for. The differential on the controls must be set; however, so that dampers and desiccant unit components do not short cycle.

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Provide automatic controls for the specified desiccant system swith the desiccant equipment. These controls must operate automatically [in accordance with Section 23 09 93 Sequences of Operation] to balance the

equipment capacity with the load on the air conditioning system, and be fully coordinated with and integrated into the [temperature control system specified in Sections 23 30 00 HVAC AIR DISTRIBUTION and 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC][existing air-conditioning system].

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, perform verification of dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work. Submit a letter, at least 2 weeks prior to beginning construction, indicating the date the site was visited, confirming existing conditions, and noting any discrepancies found.

3.2 INSTALLATION

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NOTE: All pertinent piping and related equipment supports are to be designed and indicated in accordance with UFC 3-301-01 for seismic design.

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Perform all work in accordance with the manufacturer's published diagrams, recommendations, and equipment warranty requirements.

3.2.1 Equipment

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NOTE: Designer will determine, in the initial stages of design, the approximate distances required for maintenance clearances of all new equipment. he maintenance clearances will be used in determining the final layout of the equipment. For installations where noise and vibration transmission to the building must be reduced, the maximum tolerable transmissibility, in percent, should be determined and the blank filled with the appropriate value. When it is not necessary to specify the percent of transmissibility, the item in the brackets will be deleted and brackets removed. Recommended transmissibility in percentages is: 10 percent for equipment mounted in very critical areas; 10 to 20 percent for critical areas; and 20 to 40 percent for noncritical areas. The drawings should be checked to ensure that all structural and equipment connection factors and the conditions surrounding the equipment to be provided with the vibration isolation units favorably influence the effectiveness of the isolators. Where many items of equipment require different transmission values, based on the equipment location, the specification may be revised to indicate the appropriate values on the drawings.

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Provide necessary supports for all equipment, appurtenances, and pipe as required, including frames or supports. Isolate housings from the

building structure. If mechanical vibration isolators are not provided, furnish vibration absorbing foundations. Include isolation units consisting of machine and floor or foundation fastenings, together with intermediate isolation material for each foundation. Set other floor-mounted equipment on not less than a 150 mm 6 inch concrete pad doweled in place. Concrete foundations for floor mounted pumps must have a mass equivalent to three times the weight of the components, pump, base plate, and motor to be supported. In lieu of concrete pad foundation, concrete pedestal block with isolators placed between the pedestal block and the floor may be provided. Concrete pedestal block must be of mass not less than three times the combined pump, motor, and base weights. Select and size isolators based on load-bearing requirements and the lowest frequency of vibration to be isolated. Isolators must limit vibration to [_____] percent at lowest equipment rpm. Provide lines connected to pumps mounted on pedestal blocks with flexible connectors. Furnish foundation drawings, bolt-setting information, and foundation bolts prior to concrete foundation construction for all equipment indicated or required to have concrete foundations. Install concrete for foundations and concrete-structured or cast-cooling towers as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE. Properly level, align, and secure in place all equipment in accordance with manufacturer's instructions.

3.2.2 General Piping, Valves, and Duct Installation

Install all piping, valve, and duct installation in accordance with the desiccant equipment manufacturer's recommendation or in accordance with Sections 23 30 00 HVAC AIR DISTRIBUTION[, 23 64 26 CHILLED, CHILLED-HOT, AND CONDENSER WATER PIPING SYSTEMS][23 23 00 REFRIGERANT PIPING][[_____],] and 22 00 00 PLUMBING, GENERAL PURPOSE.

3.2.3 Pipe Color Code Marking

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NOTE: Designer will coordinate color code marking with Section 09 90 00. Color code marking for piping not listed in Table I of Section 09 90 00, will be added to the table.

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Color code as specified in Section 09 90 00 PAINTS AND COATINGS.

3.3 MANUFACTURER'S FIELD SERVICE

Provide the services of a factory-trained representative for [_____] days. The representative must advise on the proper operation and servicing of the equipment and make any adjustments necessary to insure full compliance with design criteria.

3.4 DEMONSTRATIONS

Conduct a training course for the operating staff as designated by the Contracting Officer. Submit a schedule for training demonstrations, at least 2 weeks prior to the date of the proposed training course, identifying the date, time, and location for the training. The training period must consist of a total [_____] hours of normal working time and start after the system is functionally completed but prior to final acceptance tests.

a. The field instructions must cover all of the items contained in the Operation and Maintenance Manuals as well as demonstrations of routine maintenance operations. Submit posted instructions, at least 2 weeks prior to construction completion, including equipment layout, wiring and control diagrams, piping, valves and control sequences, and typed, condensed, operation instructions. Include preventative maintenance procedures, methods of checking the system for normal and safe operation, and procedures for safely starting and stopping the system in the condensed operation instructions. Post instructions framed under glass or laminated plastic and be post where indicated by the Contracting Officer.

b. Submit [6] [_____] complete bound copies (216 by 279 mm 8-1/2 x 11 inches) of an operation and maintenance manual listing step-by-step procedures required for system startup, operation, maintenance, and shutdown. The manual must include the manufacturer's name, model number, parts list, service manual, and a brief description of all equipment and their basic operating features. Include routine maintenance procedures, possible breakdowns and repairs, and a trouble shooting guide in the manual. Include piping and equipment layouts and simplified wiring and control diagrams of the system as installed in the manuals.

3.5 PERFORMANCE TESTS

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NOTE: Performance data should be provided at other than or in addition to "design day" conditions, or the 1 percent or 2.5 percent outdoor "Summer Design Data - Air Conditioning" dry-bulb (Db) temperature conditions defined in UFC 3-400-02. Peak humidity loads arising from ventilation or makeup air occur when the outdoor specific humidity (Gr./lb) is highest, frequently at dry-bulb temperature conditions other than design day, or 1 percent or 2.5 percent outdoor summer design dry-bulb temperature conditions. Also, there may be significantly more hours occurring annually at conditions of higher outdoor specific humidity than at higher outdoor dry-bulb temperature. However, dry-bulb temperature can be important, as at times during the summer when the regeneration heating required is less than capacity due to a relatively low outdoor dry-bulb temperature that is coincident with a relatively high outdoor specific humidity. The foregoing is predicated on the assumption that outside air would be used as the source of process air and regeneration air. Obviously, other arrangements are possible, such as facility exhaust air providing the source of regeneration air, or a mixture of both return and outside air, providing the source for process air. Designer needs to indicate the range of humidities the equipment should cover in the plans or specifications.

****

Before each desiccant system is accepted, conduct tests to demonstrate the general operating characteristics of all equipment by a registered professional engineer or an approved manufacturer's startup representative

experienced in system startup and testing, at such times as directed. Submit test schedules, at least 2 weeks prior to the start of the field tests and the system performance test. Identify the date, time, and location for the performance test in the schedules. Test and measure quantities listed below. Tests must cover a period of not less than [_____] days for each system and demonstrate that the entire system is functioning in accordance with the drawings and specifications. Make corrections and adjustments necessary and re-conduct tests to demonstrate that the entire system is simultaneously functioning as specified. Submit a report documenting the data taken versus the specified performance criteria, upon completion of installation and performance testing of the system. Submit [6] [_____] copies of the bound report (216 by 279 mm 8-1/2 by 11 inches). Document compliance with the specified performance criteria upon completion and testing of the system in the report and indicate the number of days covered by the tests and any conclusions as to the adequacy of the system. Include the information below recorded at least three different times at outside dry-bulb temperatures that are at least 5 degrees C F apart. Prepare a report for each desiccant system, including the information outlined below. Record data for the tests at least three different times at outside wet-bulb temperatures which are at least 3 degrees C 5 degrees F apart.

3.5.1 Liquid Desiccant System

a. Date and outside weather conditions (at least two parameters to define the state of the outside air: DB (dry bulb temperature), Gr./LB (grains water per LB dry air), Wb (wet bulb temperature), relative humidity).

b. The load on the system based on the following:

(1) CFM entering the system (Process and Regeneration).
(2) Conditioner side - entering air conditions (Db, Gr./LB).
(3) Conditioner side - discharge air conditions (Db, Gr./LB).
(4) Conditioner side - coolant entering temperature.
(5) Regenerator side - entering air conditions (Db, Gr./LB).
(6) Regenerator side - discharge air conditions (Db, Gr./LB).
(7) Regenerator side - heat source temperature (Btu/hr).
(8) Running current, voltage and proper phase sequence for each phase of all motors.
(9) The actual on-site setting of all operating and safety controls.

3.5.2 Solid (Wheel) Desiccant System:

a. Date and outside weather conditions (at least two parameters to define the state of the outside air: DB, Gr./LB, Wb, relative humidity).

b. The load on the system based on the following:

(1) CFM entering the system (Process and Regeneration).
(2) Process side - entering air conditions (Db, Gr./LB).
(3) Process side - discharge air conditions (Db, Gr./LB).
(4) Process side - post coolant capacity (tons).
(5) Regenerator side - entering air conditions (Db, Gr./LB).
(6) Regenerator side - discharge air conditions (Db, Gr./LB).
(7) Regenerator side - heat source capacity (Btu/hr).
(8) Running current, voltage and proper phase sequence for each phase of all motors.
(9) The actual on-site setting of all operating and safety controls.

3.6 INSPECTIONS

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NOTE: It is strongly suggested that the customer obtain a service contract on these units (solid and liquid) to insure proper operation of the desiccant.

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The manufacturer of the liquid desiccant system must supply, free of charge, testing of solution samples sent to them by the customer every two months for the life of the equipment. The manufacturer of each type system must inspect the systems after one year of operation to insure the systems are operating properly. Submit a bound inspection report (216 by 279 mm 8-1/2 x 11 inches) at the completion of one year of service. Identify in the report the condition of the desiccant system and include a comparison of the condition of the desiccant system with the manufacturer's recommended operating conditions.

3.7 CLEANING AND ADJUSTING

Wipe equipment clean, with all traces of oil, dust, dirt, or paint spots removed. Provide temporary filters for all fans that are operated during construction, and install new filters after all construction dirt has been removed from the building. Maintain system in this clean condition until final acceptance. Lubricate bearings with oil or grease as recommended by the manufacturer. Tighten belts to proper tension. Adjust control valves and other miscellaneous equipment requiring adjustment to the setting indicated or directed. Adjust fans to the speed indicated by the manufacturer to meet specified conditions.

-- End of Section --