UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated 19 March 2007

Latest change indicated by CHG tags
****

SECTION TABLE OF CONTENTS

DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING

SECTION 23 72 26.00 10

DESICCANT COOLING SYSTEMS

07/06

-- End of Section Table of Contents --

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USACE / NAVFAC / AFCESA / NASA | **UFGS-23 72 26.00 10 (July 2006)**

Preparing Activity: USACE | **Superseding UFGS-42 31 16.00 10 (April 2006)**

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated 19 March 2007

Latest change indicated by CHG tags
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SECTION 23 72 26.00 10

DESICCANT COOLING SYSTEMS
07/06

****
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.

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 and suggestions on this guide specification are welcome and should be directed to the technical proponent of the specification. A listing of technical proponents, including their organization designation and telephone number, is on the Internet.

Recommended changes to a UFGS 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 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.

****

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 AND REFRIGERATION INSTITUTE (ARI)

ARI 210/240	(2006) Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment
ARI 700	(2004) Specifications for Fluorocarbon Refrigerants

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

ASHRAE 15	(2004; Errata 2006; Addenda B 2006; Supp to Addenda B 2006) Safety Code for Refrigeration
ASHRAE 34	(2004; Addendas a,b,c,e,f,k,n,o,p,q,r,s,u 2006; Supp to Addendas 2006; Addendas g,h 2006) Designation and Safety Classification of Refrigerants

ASME INTERNATIONAL (ASME)

ASME B31.1	(2004; Addenda 2005) Power Piping
ASME BPVC SEC IX	(2004; 2005 Addenda; 2006 Addenda) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications

ASTM INTERNATIONAL (ASTM)

ASTM A 307	(2004e1) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM B 209	(2006) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 209M	(2006) Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM B 210	(2004) Aluminum and Aluminum-Alloy Drawn Seamless Tubes

ASTM B 210M	(2005) Aluminum and Aluminum-Alloy Drawn Seamless Tubes (Metric)
ASTM D 1784	(2006a) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM F 104	(2003) Nonmetallic Gasket Materials

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(2006) Motors and Generators

1.2 SUBMITTALS

****
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. Submittals should be kept to the minimum required for adequate quality control.

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" 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, Air Force, and NASA projects.

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" designation; submittals not having a "G" designation are for [Contractor Quality Control approval.] [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

Drawings[; G][; G, [_____]]

Drawings, at least [5 weeks] [_____] prior to beginning construction, providing adequate detail to demonstrate compliance with contract requirements.

SD-03 Product Data

Verification of Dimensions

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.

Standard Products[; G][; G, [_____]]

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. Performance charts and curves shall provide performance data over the full range of outdoor conditions for which dehumidification will be required, with the conditions defined by the Contracting Officer. Manufacturer shall supply data on all energy recovery methods and equipment available for the system. Data shall include manufacturer's recommended installation instructions and procedures. If vibration isolation is specified for a unit, vibration isolator literature shall be included containing catalog cuts and certification that the isolation characteristics of the isolators provided meet the manufacturer's recommendations.

Spare Parts

Spare parts data for each different item of material and equipment specified.

Qualifications

[_____] copies of qualification procedures, and list of names and identification symbols of qualified welders and welding operators, prior to non-factory welding operations.

Field Instructions

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. The condensed operation instructions shall 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 shall be framed under glass or laminated plastic and be posted where indicated by the Contracting Officer.

Performance Tests

Test schedules, at least 2 weeks prior to the start of the field tests and the system performance test. The schedules shall identify the date, time, and location for the performance test.

Demonstrations

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.

SD-06 Test Reports

Performance Tests[; G][; G, [_____]]

A report documenting the data taken versus the specified performance criteria, upon completion of installation and performance testing of the system. [Six] [_____] copies of the bound report (216 x 279 mm (8-1/2 x 11 inches) 8-1/2 x 11 inches) shall be provided. The report shall document compliance with the specified performance criteria upon completion and testing of the system. The report shall indicate the number of days covered by the tests and any conclusions as to the adequacy of the system. The report shall also include the following information and shall be taken at least three different times at outside dry-bulb temperatures that are at least 5 degrees C F apart.

Inspections

A bound inspection report (216 x 279 mm (8-1/2 x 11 inches) 8-1/2 x 11 inches) at the completion of one year of service. The report shall identify the condition of the desiccant system and shall include a comparison of the condition of the desiccant system with the manufacturer's recommended operating conditions.

SD-07 Certificates

Standard Products[; G][; G, [_____]]

Proof of compliance with ARI, ASHRAE, ASME, or UL requirements where specified for the system, components, or equipment. The label or listing of the specified agency shall 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, shall 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 ARI rating conditions, computer printouts, catalog, or other application data certified by ARI or a nationally recognized laboratory as described above shall be included. If ARI does not have a current certification program that encompasses such application data, the manufacturer shall self certify that his application data complies with project performance requirements.

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals;G, [_____]

[Six] [_____] complete bound copies (216 x 279 mm (8-1/2 x 11 inches) 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 shall include

the manufacturer's name, model number, parts list, service manual, and a brief description of all equipment and their basic operating features. The manual shall include routine maintenance procedures, possible breakdowns and repairs, and a trouble shooting guide. The manuals shall include piping and equipment layouts and simplified wiring and control diagrams of the system as installed.

1.3 QUALIFICATIONS

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

Piping shall be welded in accordance with the qualified procedures, using performance qualified welders and welding operators in accordance with ASME BPVC SEC IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer may be accepted as permitted by ASME B31.1. The Contracting Officer shall be notified 24 hours in advance of tests and the tests shall be performed onsite, if practical. The welder or welding operator shall apply the assigned symbol near each weld personally made as a permanent record. Structural members shall be welded in accordance with [Section 05 05 23.00 14 WELDING, STRUCTURAL] [welding and nondestructive testing procedures specified in Section 43 02 00 WELDING PRESSURE PIPING].

1.4 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.
****

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 shall be insulated, fully enclosed, guarded, or fitted with other types of safety devices. Safety devices shall be installed so that proper operation of equipment is not impaired. [[Catwalk] [Ladder] [Guardrail] shall be provided where indicated and in accordance with Section 05 50 00 METAL: MISCELLANEOUS AND FABRICATIONS.]

1.5 DELIVERY, STORAGE, AND HANDLING

All equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, or other contaminants.

1.6 PROJECT REQUIREMENTS

1.6.1 Verification of Dimensions

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

1.6.2 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 shall carefully investigate the plumbing, fire protection, electrical, structural and any other features or conditions that would affect the work to be performed and shall arrange such work accordingly, furnishing required offsets, fittings, and accessories to meet such features or conditions. The Contractor shall submit Drawings 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.

1.6.3 Spare Parts

The Contractor shall submit spare parts data for each different item of material and equipment specfied, after approval of the detail drawings and not later than [_____] months prior to the date of beneficial occupancy. The data shall 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.

****

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacturing of such products and shall

essentially duplicate equipment which is similar in material, design, and workmanship. The standard products shall have been in satisfactory commercial or industrial use for two years prior to bid opening. The two-year use shall include applications of equipment and materials under similar circumstances and of similar size. The two years experience shall 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 shall be supported by a service organization. The Contractor shall submit a certified list of qualified, permanent service organizations for support of the equipment including their addresses and qualifications. These service organizations shall be reasonably convenient to the equipment installation and shall be able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract. The system shall 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 shall be a part of the system, except external heat sources may be used under the following conditions: connections to external heat sources shall be fully coordinated with the system manufacturer, and connecting equipment such as pumps, piping, traps, etc., shall be as shown on the drawings and schedules. The desiccant shall be of the [solid type on a rotary wheel] [liquid type utilizing spray coils].

2.2 NAMEPLATES

Each major component of equipment shall have the manufacturer's name, address, type or style, and catalog or serial number on a plate securely attached to the item of equipment. Nameplates shall be secured to the cabinet of dry desiccant units, indicating the equipment enclosed within the cabinet behind the nameplate. Cabinets shall have hinged panels, as specified, to facilitate maintenance of the component described on the nameplate secured to the cabinet.

2.3 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 shall be in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Electrical motor driven equipment specified shall be provided 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 shall be as shown, and unless otherwise indicated, all motors of 1 horsepower and above with open, dripproof, or totally enclosed fan cooled enclosures, shall be high efficiency type. Field wiring shall be in accordance with manufacturer's instructions. Each motor shall 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 shall be continuous duty with the enclosure specified. Motor starters shall be provided complete with thermal overload protection and other appurtenances necessary for the motor control indicated. Motors

shall be furnished with a magnetic across-the-line or reduced voltage type starter as required by the manufacturer. Motor starter shall be provided with [NEMA 1] [NEMA 3R] [NEMA [_____]] enclosures. 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, shall be provided.

2.4 MATERIALS

2.4.1 Gaskets

Gaskets shall conform to ASTM F 104 classification for compressed sheet with nitrile binder and acrylic fibers for maximum 371 degrees C 700 degrees F service.

2.4.2 Bolts and Nuts

Bolts and nuts, except as required for piping applications, shall be in accordance with ASTM A 307. The bolt head shall be marked to identify the manufacturer and the standard with which the bolt complies in accordance with ASTM A 307.

2.5 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.

****

2.5.1 Solid Desiccant System

****

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.

****

The unit shall be a complete, factory assembled and tested system, suitable for outdoor installation. Each unit shall produce a capacity as rated in accordance with ARI 210/240. It shall be designed for either curb mounting or structural steel support. The unit shall 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

2.5.1.1 Control Package

Each unit shall be factory wired and equipped with a central electrical control panel mounted inside the service compartment. Variable-speed drive controller, if provided, shall also be mounted inside the service compartment. Switched lighting shall be provided in the service compartment so that the panel can be easily seen. Compartment shall be ventilated, if necessary, for cooling variable speed drive controller. A single power supply shall be required. All internal wiring shall be in accordance with the National Electrical Code. All electrical components required for automatic operation, based on signals from remotely mounted humidity and temperature sensors/controllers, shall be included. Connections to remote devices shall be made at the marked terminals. The internal control panel shall report discharge temperature and humidity. Additional reporting of all control data shall be available to a central control station, as specified in Section 23 09 23 DIRECT DIGITAL CONTROL FOR HVAC AND OTHER LOCAL BUILDING SYSTEMS.

2.5.1.2 Unit Mounting

The unit shall be [curb mounted] [structural steel supported]. The entire unit shall be isolated from the building structure on vibration isolators with submitted and published load ratings. Vibration isolators shall have isolation characteristics as recommended by the manufacturer for the unit supplied and the service intended.

2.5.2 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 shall be a complete, factory assembled and tested, system suitable for outdoor installation. Each unit shall produce a capacity as rated in accordance with ARI 210/240. It shall be designed for [curb mounting] [structural steel support]. The unit shall 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

2.5.2.1 Control Panel

Each unit shall be factory wired and equipped with a central electrical control panel mounted inside the service compartment. A single power supply shall be required. All internal wiring shall be in accordance with the National Electrical Code. All electrical components required for automatic operation, based on signals from remotely mounted humidity and temperature sensors/controllers, shall be included. Connections to remote devices shall be made at the marked terminals. The internal control panel shall report discharge temperature and humidity. Additional reporting of all control data shall be available to a central control station, as specified in Section 23 09 23 DIRECT DIGITAL CONTROL FOR HVAC AND OTHER LOCAL BUILDING SYSTEMS.

2.5.2.2 Equipment Mounting

Liquid desiccant systems shall have the conditioner and regenerator units set on level concrete floor or slab. Before the equipment is set in place, the floor shall be sealed with epoxy sealant. Unit shall be surrounded by a curb.

2.6 SYSTEM COMPONENTS

2.6.1 Desiccant Rotor

Dehumidifiers shall be non-cyclic adsorption type with a single desiccant rotary structure designed for continuous operation. Construction arrangement shall provide counter flow 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 shall 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. The design shall ensure laminar air flow through the structure for minimum pressure loss. The rotor shall be complete with an electric motor with over-current protection and a speed reducer assembly driving the rotor through a flexible circumferential drive belt. A slack side belt tensioner shall be included for automatic take-up.

2.6.2 Heat Exchanger

2.6.2.1 Thermal Rotor

The thermal rotor shall be of the rotary, non-hygroscopic type, to minimize the transfer of water vapor between the process and regeneration sides of the unit. The rotor shall be constructed and sized 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 shall be counter flow and the component fitted with full face contact seals on both sides to prevent leakage.

2.6.2.2 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.

****

Heat pipe coils shall be of the extended-surface fin-and-tube type and shall be constructed of seamless [copper] [or] [aluminum] tubes with compatible [copper] [or] [aluminum] fins. On heat pipes with all aluminum construction, tubes shall conform to ASTM B 210M ASTM B 210, alloy 1100 and aluminum alloy conforming to chemical requirements of ASTM B 209M ASTM B 209; alloy 7072 shall be used for the fins and end sheets. Fins shall be soldered or mechanically bonded to the tubes and installed in a metal casing. Coils shall be tested after assembly at pressure specified in

ASHRAE 15 for the refrigerant employed in the system. [After testing of the heat pipe coils, coils shall be dried to remove free moisture, and capped to prevent entrance of foreign matter.]

2.6.2.3 Refrigerants

Refrigerants shall be one of the hydrocholrofluorocarbon or hydrofluorocarbon gases. Refrigerants shall have number designations and safety classifications in accordance with ASHRAE 34. Refrigerants shall meet the requirements of ARI 700 as a minimum. Refrigerants shall have an Ozone Depletion Potential (ODP) of less than or equal to 0.05 and shall be in compliance with pertinent EPA regulations. The unit shall be factory leak tested and dehydrated, as specified in Section [23 64 26 CHILLED, CHILLED-HOT, AND CONDENSER WATER PIPING SYSTEMS] [23 23 00 REFRIGERANT PIPING] [[_____]].

2.6.3 Fans (Solid Desiccant System) For Supply and Regeneration

The unit shall be equipped with two belt driven backward inclined blowers. A drive belt rated for minimum 150% of motor horsepower shall be used on each motor. The supply fan motor shall have sheaves for air balancing. The motors shall be nominal 3500 RPM, NEMA B with open dripproof housings and a minimum service factor of 1.15.

2.6.4 Heating System (Solid Desiccant System)

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

2.6.5 Filters (Solid Desiccant System)

Outside air inlets and return air plenums shall be equipped with 50 mm 2 inch, 30% minimum efficiency filters. Filters shall be pleated and disposable.

2.6.6 Indirect Evaporative Cooling System (Solid Desiccant System)

****
NOTE: Where water is of high hardness (alkalinity), 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.
****

Evaporative cooling shall be used to indirectly cool the supply air. The system shall include: An evaporative cooling media of cellulose paper impregnated to resist degradation and PVC piping.

2.6.7 Gas Fired Boiler (Solid Desiccant System)

****
NOTE: Boiler regeneration capacity, as determined by the manufacturer, may be based on the regeneration capacity required under "design day" conditions, or 1% or 2.5% 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).

****

The boiler shall be a gas-fired water heater suitable for delivering fluid temperatures of 99-104 degrees C 210-220 degrees F. It shall have a copper tube exchanger and cast iron wet walls. It shall be complete 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. The hydronic system shall include properly sized diaphragm type expansion tank. Diaphragm shall be flexible butyl securely attached to inner tank wall. Maximum allowable working pressure shall be at least 791 kPa 100 psig, and 116 degrees C 240 degrees F temperature.

2.6.8 Circulating Pumps (Solid Desiccant System)

Evaporative cooling pump shall be a submersible pump with a hooded intake, polypropylene screen, and thermal overload protection. Boiler pump shall be an in-line close coupled single stage centrifugal.

2.6.9 Refrigeration Section (Solid Desiccant System)

****

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 shall be integral to the unit, and factory charged. The condenser section shall provide the heat required to regenerate the desiccant rotor, and the evaporator section shall provide additional cooling/dehumidification. Refrigerants shall be one of the hydrocholrofluorocarbon or hydrofluorocarbon gases. Refrigerants shall have number designations and safety classifications in accordance with

ASHRAE 34. Refrigerants shall meet the requirements of ARI 700 as a minimum. Refrigerants shall have an Ozone Depletion Potential (ODP) of less than or equal to 0.05 and shall be in compliance with EPA regulations. The unit shall be factory leak tested and dehydrated, as specified in Section [23 64 26 CHILLED, CHILLED-HOT, AND CONDENSER WATER PIPING SYSTEMS] [23 23 00 REFRIGERANT PIPING] [or] [Section 23 82 02.00 10 UNITARY HEATING AND COOLING EQUIPMENT].

2.6.10 Conditioner unit (Liquid Desiccant System)

****
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.
****

The conditioner unit shall 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. The housing and pump tank shall be fabricated from corrosion resistant materials resistant to the desiccant solution. Internal parts shall be made of cupronickel or nonmetallic corrosion-proof materials. The desiccant solution pump and all other wetted parts shall be made with corrosion resistant materials. Fiberglass reinforced plastic surfaces shall be pigmented and U.V. stabilized for exposure to direct sunlight.

2.6.10.1 Humidity Conditioning

The humidity conditioning system shall be of the liquid desiccant type. The system shall be capable of simultaneous air cooling and dehumidification as indicated on the drawings. The system shall automatically, fully modulate the usage of conditioner coolant and regenerator heat to match the system cooling and dehumidification loads. The humidity conditioning system shall deliver 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.

2.6.10.2 Desiccant Solution

The desiccant solution shall be stable and non-toxic and the desiccant shall not exist in the vapor phase in the conditioned air stream. The maximum loss rate of desiccant to the conditioned air stream shall not exceed two parts lithium per billion parts air, by weight. The manufacturer shall 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.

2.6.11 Conditioner Cooler (Liquid Desiccant System)

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

shipped loose for field installation.

2.6.12 Regenerator (Liquid Desiccant System)

The regenerator units shall 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. The housing and pump tank shall be fabricated of corrosion resistant materials resistant to the desiccant solution. Internal parts shall be made of cupronickel or nonmetallic corrosion-proof materials. The desiccant solution pump and all other wetted parts shall be made with corrosion resistant materials resistant to the desiccant solution. Fiberglass reinforced plastic surfaces shall be pigmented and U.V. stabilized for exposure to direct sunlight.

2.6.12.1 Humidity Conditioner

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

2.6.12.2 Fan Assembly

The regenerator shall be supplied with a separate field-mounted fan and fan box assembly, consisting of housing, forward-curved fan motor, and drive. The fan wheel shall be made of steel. The fan box shall be made of galvanized steel. The fan wheel and fan box interior shall be heresite coated. The fan box exterior shall be painted with a prime and finish coat of industrial-grade acrylic machine enamel.

2.6.12.3 Equipment Location

The equipment shall be so designed 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.

2.6.13 Regenerator Heater (Liquid Desiccant System)

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

2.6.14 Level Control (Liquid Desiccant System)

The level control panel shall 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. The level control panel shall be shipped mounted to the unit.

2.6.15 Filter Screening (Liquid Desiccant System)

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

2.6.16 Freestanding Pump Assemblies (Liquid Desiccant System)

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

2.6.17 Make Up Water System (Liquid Desiccant System)

The unit shall be equipped with piping, valving, and controls to automatically maintain solution level in the conditioner section. The level control panel shall 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 shall be shipped mounted to the unit.

2.6.18 Conditioner Fan (Liquid Desiccant System)

The unit shall be equipped 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 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM.

2.6.19 Regeneration Fan (Liquid Desiccant System)

The regeneration fan shall be supplied with a separate field-mounted fan and assembly rated for the requirements of the regeneration system. The fan and assembly shall be of such design and construction to be resistant to the chemicals within the regenerator, as specified in Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM.

2.7 UNIT CONSTRUCTION

2.7.1 Solid Desiccant System

Unit shall be suitable for outdoor installation. It shall be designed for either structural or curb mounting without field modification. The enclosure system shall be air-tight (2% maximum leakage at 150% design static pressure from section to section). The unit base shall be constructed of formed minimum 10 GA steel coated with red- oxide primer. Cross members shall be located to support each major component. Lifting lugs shall be fitted to appropriate structural members. Unit exterior shall be painted with a low-gloss enamel.

2.7.1.1 Housing

The unit housing and internal partitions shall be constructed of minimum 18 GA galvanized steel with the exterior panels treated to allow for painting. All external walls shall be insulated with foil-faced fiber glass insulation at least 25 mm 1 inch thick and secured by permanent mechanical fasteners welded to the panels. Adjoining panels shall be sealed by permanent mechanical fasteners welded to the panels. Adjoining panels

shall be sealed to one another with silicone compound, as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.7.1.2 Service Panels

Removable service access panels shall be provided for all components. The openings shall be of sufficient size to allow service to all maintenance items. All service panels shall be provided with resilient gaskets and hardware to assure compression. Access doors shall be provided for boiler and control sections and shall have continuous hinges. Roof panels shall be sealed to provide a weather-tight enclosure.

2.7.2 Liquid Desiccant System

The unit shall 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 shall be of the plate-and-frame type, with carbon steel frame carrier bars and tiebolts; titanium plates and nitrile or EPDM gaskets.

2.7.2.1 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 shall be FRP or CPVC rated for continuous service at 107 degrees C 225 degrees F with the desiccant solution. FRP piping shall be used for the regenerator. Blackiron, galvanized and stainless steel shall not be used. CPVC piping shall be Schedule 80, Type IV, Grade 1, 4120, in accordance with ASTM D 1784, as specified in Section 22 00 00 PLUMBING, GENERAL PURPOSE. The piping shall be supported so that no stress is placed on connections to the equipment. Piping shall be installed 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. The pump discharge piping shall incorporate a 90 degree elbow or a vertical spool piece at least 1.2 m 4 ft long so the pump can be lifted vertically from the tank. All piping shall be pressure tested for leaks before insulating. If possible, equipment start-up should be completed before the insulation is applied.

2.7.2.2 Valves and Thermowells

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

2.7.2.3 Insulation

Conditioners shall be insulated whenever a coolant other than cooling tower water is used to prevent surface condensation. The entire unit including the solution and coolant piping shall be insulated. Flexible rubber, rigid

foam plastic, or other non-permeable, vapor-tight insulation material shall be used for conditioners. When the equipment is installed outside, an ultraviolet and weather protective coating should be applied to the insulation. Regenerators and steam or hot water piping should be insulated with 50 mm 2 inch of rigid, foil- or plastic-faced, fiberglass board. Solution piping shall be insulated if required for personnel protection. If the equipment is installed outside, weather protective covering shall be applied. The outer casing of the conditioner and regenerator shall not be penetrated with insulation fasteners. Contact cement or other adhesive as recommended by the insulation manufacturer for use with an FRP substrate shall be used for insulation fastening. Insulation shall conform to Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.8 DUCT WORK

2.8.1 Plenums and Ductwork

Desiccant units shall be provided with flanges on the air openings for duct connection. Inlet and outlet plenums shall be bolted to the flange with a gasket between the connection. Access doors, for servicing diffusers and eliminators, shall be provided 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. Plenum and ductwork sizes shall be as shown and specified in Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM.

2.8.2 Regenerator Exhaust Ductwork

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

2.9 SUPPLEMENTAL COMPONENTS/SERVICES

2.9.1 Drain and Makeup Water Piping

****
NOTE: All drain and makeup water piping should be indicated on the drawings.
****

Piping shall comply with the requirements of Section 22 00 00 PLUMBING, GENERAL PURPOSE. Drains which connect to sanitary sewer system shall be connected by means of an indirect waste.

2.9.2 Steam Piping and Accessories

Steam piping and accessories shall be provided and installed in accordance with Section 23 52 00.00 10 WATER AND STEAM HEATING; OIL, GAS OR BOTH; UP TO 20 MBTUH.

PART 3 EXECUTION

3.1 INSTALLATION

All work shall be performed in accordance with the manufacturer's published diagrams, recommendations, and equipment warranty requirements.

3.2 EQUIPMENT

****

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.

****

Necessary supports shall be provided for all equipment, appurtenances, and pipe as required, including frames or supports. Housings shall be isolated from the building structure. If mechanical vibration isolators are not provided, vibration absorbing foundations shall be furnished. Each foundation shall include isolation units consisting of machine and floor or foundation fastenings, together with intermediate isolation material. Other floor-mounted equipment shall be set on not less than a 150 mm 6 inch concrete pad doweled in place. Concrete foundations for floor mounted pumps shall 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 shall be of mass not less than three times the combined pump, motor, and base weights. Isolators shall be selected and sized based on load-bearing requirements and the lowest frequency of vibration to be isolated. Isolators shall limit vibration to [_____] percent at lowest equipment rpm. Lines connected to pumps mounted on pedestal blocks shall be provided with flexible connectors. Foundation drawings, bolt-setting information, and foundation bolts shall be furnished prior to concrete foundation construction for all equipment indicated or required to have concrete foundations. Concrete for foundations and concrete-structured or cast-cooling towers shall be as specified in Section 03 31 00.00 10

CAST-IN-PLACE STRUCTURAL CONCRETE. Equipment shall be properly leveled, aligned, and secured in place in accordance with manufacturer's instructions.

3.2.1 Conditioner Solution Concentration

Contractor shall provide the conditioner solution concentration capable of maintaining the humidity level specified on the drawings.

3.2.2 Automatic Controls

****

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.

****

Automatic controls for the specified desiccant system shall be provided with the desiccant equipment. These controls shall operate automatically to balance the equipment capacity with the load on the air conditioning system, and shall be fully coordinated with and integrated into the [temperature control system specified in Sections 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM and 23 09 23 DIRECT DIGITAL CONTROL FOR HVAC AND OTHER LOCAL BUILDING SYSTEMS] [existing air-conditioning system].

3.2.3 General Piping, Valves, and Duct Installation

All piping, valve, and duct installation shall be made in accordance with the desiccant equipment manufacturers recommendation or in accordance with Sections 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM, [23 64 26 CHILLED, CHILLED-HOT, AND CONDENSER WATER PIPING SYSTEMS] [23 23 00 REFRIGERANT PIPING] [[_____]], and 22 00 00 PLUMBING, GENERAL PURPOSE.

3.3 PERFORMANCE TESTS

****

NOTE: Performance data should be provided at other than or in addition to "design day" conditions, or the 1% or 2.5% 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% or 2.5% 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, tests to demonstrate the general operating characteristics of all equipment shall be conducted by a registered professional engineer or an approved manufacturer's startup representative experienced in system startup and testing, at such times as directed. The tests shall measure quantities listed below. Tests shall cover a period of not less than [_____] days for each system and shall demonstrate that the entire system is functioning in accordance with the drawings and specifications. Corrections and adjustments shall be made as necessary and tests shall be re-conducted to demonstrate that the entire

system is simultaneously functioning as specified. A report shall be prepared for each desiccant system, including the information outlined below. Data for the tests shall be taken at least three different times at outside wet-bulb temperatures which are at least 3 degrees C 5 degrees F apart.

3.3.1 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.

3.3.2 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.

3.4 PIPE COLOR CODE MARKING

****
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.
****

Color code marking of piping shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.5 INSPECTIONS

****
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.
****

The manufacturer of the liquid desiccant system shall 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 shall inspect the systems after one year of operation to insure the systems are operating properly.

3.6 MANUFACTURER'S FIELD SERVICE

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

3.7 CLEANING AND ADJUSTING

Equipment shall be wiped clean, with all traces of oil, dust, dirt, or paint spots removed. Temporary filters shall be provided for all fans that are operated during construction, and new filters shall be installed after all construction dirt has been removed from the building. System shall be maintained in this clean condition until final acceptance. Bearings shall be properly lubricated with oil or grease as recommended by the manufacturer. Belts shall be tightened to proper tension. Control valves and other miscellaneous equipment requiring adjustment shall be adjusted to the setting indicated or directed. Fans shall be adjusted to the speed indicated by the manufacturer to meet specified conditions.

3.8 DEMONSTRATIONS

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

-- End of Section --