**Division 23 – Heating, Ventilating, and Air Conditioning**

**Section 23 81 23 - Computer Room Air Conditioning**

1. **GENERAL**
	1. RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications Sections, apply to these Sections.

* 1. SECTION INCLUDES
		1. Under Floor Rack Cooler (UFRC)
	2. RELATED SECTIONS
		1. 22 05 00 - Common Work Results for Plumbing
		2. 23 20 00 - HVAC Piping and Pumps
		3. 23 05 00 - Common Work Results for HVAC.
		4. 26 05 00 - Common Work Results for Electrical.
	3. SUBMITTALS
		1. Product Data: Manufacturer's data sheets on each product to be used, including:
			1. Preparation instructions and recommendations.
			2. Storage and handling requirements and recommendations.
			3. Installation methods.
		2. Shop Drawings and Wiring Schematics: Provide detailed physical layout and wiring schematics for installation.
		3. Detailed equipment assemblies and indicate, required clearances, method of field assembly, and location and size of each field connection.
		4. Operation and maintenance data.
	4. WARRANTY
		1. Fully executed, issued in [Owner’s] name and registered with the manufacturer, including:
			1. Manufacturer’s Warranty from date of warranty registration and covers defects in materials: 3-year warranty parts.
	5. QUALITY ASSURANCE
		1. Manufacturer Qualifications: Minimum 5-year experience manufacturing related products.
		2. Installer Qualifications: Minimum 5-year experience installing related products.
		3. Unit shall be designed to conform to the latest adopted editions of ANSI/ASHRAE 15, ASHRAE 62, CSA 22.2 and UL Standard 60335.
		4. The unit flame spread rating will be less than 25 and have a Smoke Developed rating of less than 50 per ASTM E84, UL 723, and CAN/ULC S102-M88.
		5. Insulation and adhesive shall meet NFPA 90A requirements for flame spread and smoke generation.
	6. PRE-INSTALLATION MEETINGS
		1. Convene a minimum of two weeks prior to starting work of this section.
	7. DELIVERY, STORAGE, AND HANDLING
		1. Deliver and store products in manufacturer's unopened packaging bearing the brand name and manufacturer's identification until ready for installation.
		2. Handle materials as recommended by the manufacturer to avoid damage.
	8. PROJECT CONDITIONS
		1. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by the manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.
	9. SEQUENCING
		1. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.
1. **PRODUCTS**
	1. MANUFACTURERS
		1. Acceptable Manufacturer: Global IFS, 3700 32nd Street SE, Kentwood, Michigan 49512. www.globalifs.com
		2. Requests for substitutions will be considered in accordance with the provisions of Section 01 60 00 - Product Requirements.
	2. UNDER FLOOR RACK COOLER (UFRC)
		1. UFRC System: as manufactured by Global IFS, shall consist of the following components:
			1. Fan Cube – QTY 1
			2. Coil Cube – QTY 1
			3. Connecting cube (with straight fabric duct) – QTY1
			4. Connecting cube (with elbow fabric duct) – QTY1
			5. Raised Access Floor (RAF) TecCrete 2500 panel – QTY 2
			6. Airflow panel – QTY2
			7. Pod Controller – QTY 1 per pod
		2. Underfloor cube support system for UFRC units
			1. Cube construction
				1. Understructure 24”x24”x24” (WxDxH) cube frame configured to hold and support a complementary flooring panel, and mechanical components. Cube frame is constructed from 4x steel pedestals (7/8” square tube), connected by 3/16”x1” steel straps. Steel straps are welded to the steel pedestals at various heights which creates multiple tiers to manage under-floor plenum services.
				2. Pedestal assemblies shall be of hot-dip galvanized steel, and gold powder coated.
				3. The base shall be a minimum of 1 square inches and shall be stamped and/or embossed on its underside. The base shall provide an adjustment range of +/- 1” (25mm), adjustable at 1/64" (.4mm) increments
				4. The threaded stud shall be 3/4" (19mm) diameter steel.
				5. The head assembly shall be designed so that the panels will be held in place with or without corner-lock fasteners.
				6. Pedestal assembly shall provide an adjustment range of +/- 1” (25mm), adjustable at 1/64" (.4mm) increments.
				7. The assembly shall provide a mechanical means to lock the floor in a level plane and adjustments shall be capable of being made without special tools.
				8. For corner-lock system, the head of the all-steel assembly shall be designed to accept a metal fastener to mechanically lock the panels in place.
				9. Pedestal assembly shall support not less than 6,000 lb. axial load and shall resist an average 1,000 inch-pound overturning moment when bonded to a clean concrete slab.
			2. Stringers:
				1. Stringer shall capture panels and be capable of supporting a 450-lb. concentrated load at mid span with less than 0.010” permanent set after the load is removed.
				2. Stringers shall be individually and rigidly fastened to the pedestal with one machine screw for each foot of stringer length. Bolts shall provide positive electrical contact between the stringers and pedestals. Connections depending on gravity or spring action are unacceptable.
				3. Stringer shall be either 2’x 2’ or 4’x 4’ pattern and shall be secured by a fastener.
		3. Fan Cube consists of the following components
			1. Blower
				1. Fan blower shall be galvanized steel construction with forward curved blades and a dynamically balanced wheel.
			2. Fan motor
				1. The motor shall be an Electronically Commutated Motor (ECM), and the motor shaft shall be directly connected to the fan.
				2. The brushless DC motor shall be controlled by an integrated controller/inverter that operates the wound stator and senses rotor position to electrically commutate the stator.
				3. Permanent magnet type motor with near-zero rotor losses designed for synchronous rotation.
				4. Designed to maintain a minimum 70 percent efficiency over the entire operating range.
				5. The ECM shall be furnished with factory programming:

Pressure Independent Program

A pressure independent program shall be provided to allow the ECM to compensate for fluctuations in external static pressure, providing constant airflow.

The air volume flow rate shall be maintained to within five percent of desired flow in a system with up to 0.50 inches water gauge of external static pressure.

* + - 1. Discharge collar should be designed to accept installation of a fabric duct at the outlet.
			2. Fan casing should have a flange to accept the fabric duct connection on the outlet.
				1. Casing shall be constructed from a minimum 20 gauge, 0.032 inch galvanized steel, factory-installed on the terminal return with a flanged connection.
			3. Fan Controller (UMCB)
				1. Shall be a dedicated, micro-processor-based controller mounted in the underfloor plenum within the fan cube.
				2. The controller shall house input terminations for the input signals and up to three analog peripheral devices, such as temperature probes, or connection to contact closure night setback.
				3. The controller shall house terminations for ECM fan control, auxiliary digital output and analog, modulating, or three stages of digital heat.
				4. The controller shall have LED display lights to indicate availability of control power, the state of up to three stages of digital heat, state of auxiliary output and box fan.
				5. Technical Specifications:

Inputs: 4 analog inputs – 10 bit plus 2 binary inputs

Outputs: 8 binary triac outputs (24 VAC, max 5A each) plus 3 universal outputs

Power: 24 VAC with visual LED status, 5 VA (not including output loading)

Ambient Ratings: 32 °F to 131 °F (0 to 55°C), 10 to 90% RH (non-condensing)

Technology: 8-bit microprocessor

Connections: 2 RJ45 connectors, 2 MTA156 connectors, 2 MTA100 connectors, and pluggable screw type terminal connectors

* + - * 1. Interfacing to EMS/BMS/BAS:

The BMS shall use BACnet MS/TP network protocol to view points or status of room space. The use of BACnet protocol shall be native to the device and shall not require the use of an external gateway.

* + - * 1. The UMCB shall be fire rated as per UL94V-0 requirements and rated for Part 15 sub part B of FCC compliance.
			1. Electrical Requirements:
				1. Fan powered units shall be provided with single-point power electrical and control connection for the entire unit.
				2. The unit equipment wiring shall comply with the requirements of NFPA 70.
				3. The units shall be ETL listed to meet UL 60335.
				4. All high voltage electrical components shall be enclosed in a single control box with an access panel mounted on the side of the assembly.
				5. Complete with modular power connector.
				6. Power & Voltage requirements **(Choose one: 208V, 240V, 277V)**
			2. Return Plenum
				1. Fan cube shall be supplied with fiberglass filters. When tested in accordance with ASHRAE 52.2, the filter shall have a Minimum Efficiency Reporting Value of MERV 8 filter.
				2. Have a return air temperature probe to measure return air temperature. Temperature probe shall be connected to fan controller (UMCB).
		1. Coil Cube:
			1. All water coils shall be rated and certified in accordance with the current edition of AHRI 410, and shall bear the AHRI seal on the unit casing.
			2. All cooling coils shall optimize rows and circuits to meet the specified capacity.
			3. All standard coils are 12 FPI.
			4. Coils shall have seamless copper tubes and shall be mechanically expanded to provide an efficient, permanent bond between the tube and fin.
			5. Fins shall have a high efficiency aluminum surface optimized for heat transfer, air pressure drop and carryover. The water coil fins shall be 0.0045 inch aluminum fin.
			6. All coils shall be hydrostatically tested at 390 pounds per square inch minimum air pressure, and rated for a maximum of 300 pounds per square inch working pressure at 200 degrees Fahrenheit.
			7. Cooling coils shall be supplied with an integral condensate diverting section to prevent condensate carry over in cases of air velocities over 350 feet per minute. Coils are not recommended to operate above 500 feet per minute.
			8. Drain Pans:
				1. All units with cooling coils shall be supplied with a primary drain pan with single wall, 304 stainless steel for corrosion resistance.
				2. The primary drain pan shall extend under the entire cooling coil.
				3. Drain pans shall be of one-piece construction and be positively sloped for condensate removal.
				4. (Optional): Provide an overflow safety switch on drain pan.
			9. Drain pans shall be mounted to the coil cube mounting brackets.
			10. Coil casing should have a flange to accept the fabric duct connection on the inlet and outlet.
				1. Casing shall be constructed from a minimum 22 gauge, 0.032 inch galvanized steel, factory-installed on the terminal return with a flanged connection.
		2. Connecting Cube (Straight)
			1. Fabric Duct Specifications:
				1. Fabric Air Combi 85 Grade
				2. UL 723 (ASTM E84) Code Compliance (USA)
				3. ULC s102.2 Code Compliance (Canada)
				4. EN ISO 14644-1 Class 3 Code Compliance for cleanroom and associated controlled environments.
				5. UL 2518 Safety Air Dispersion System Performance Certification
				6. Zipper accessible from outside.
		3. Connecting Cube (elbow)
			- 1. Fabric Duct Specifications:
				2. UL 723 (ASTM E84) Code Compliance (USA)
				3. ULC s102.2 Code Compliance (Canada)
				4. EN ISO 14644-1 Class 3 Code Compliance for cleanroom and associated controlled environments.
				5. UL 2518 Safety Air Dispersion System Performance Certification
				6. Zipper accessible from inside.
				7. Transition/ Discharge collar
				8. 20” X 20” Galvanized steel discharge flange.
				9. Have a Supply air temperature probe.
	1. POD CONTROLS
		1. Pod Controller
			1. Controls up to 60 UFRC units via BACnet MS/TP with CAS 6 cable.
			2. Conforms to the BACnet Building Controller (B-BC), BACnet Router (B-RTR) and BACnet Broadcast Management Device (B-BBMD), Standard Profile as defined in ANSI/ASHRAE Standard 135-2012 (BACnet) Annex L, Protocol revision 14. This product is BTL listed with driver version 107-04-2084.
			3. Provides BACnet routing between any supported BACnet communication types
			4. Supports KNX, Modbus TCP, N2 Open, SNMP on the gigabit Ethernet port
			5. Runs control programs
			6. Have two BACnet/IP networks communicating on the Gig-E port
			7. Serve as a BACnet Broadcast Management Device (BBMD) on each of the BACnet/IP networks
			8. Supports Foreign Device Registration (FDR)
			9. Supports DHCP IP addressing on IPv4 networks and DHCPv6 and SLAAC addressing on IPv6 networks
			10. Has built-in network diagnostic capture functionality for troubleshooting
			11. Has network statistics that can be viewed numerically or as trend graphs
			12. Supports Rnet devices
			13. Works with the WebCTRL® v6.5 or later system with the latest cumulative patch
			14. Can serve as a gateway that can act as a:
				1. Master or slave on a Modbus serial network
				2. Server or client on a Modbus TCP/IP network
			15. Complete with Ethernet service port to provide local access for system start-up and troubleshooting
		2. Controls Enclosure
			1. NEMA Type 1, UL Listed Type 1, CSA Type 1, IEC 60529, IP 30
			2. ANSI-61 gold powder coating inside and out.
			3. Carbon steel, spot weld construction.
			4. 1/4-20 Standoffs provided for mounting optional panels.
			5. Doors open 180 degrees.
			6. Black quarter turn latches. Latches are opened or closed with a screwdriver.
			7. Ground stud on door.
	2. SEQUENCE OF OPERATION
		1. Pod Control - Run Conditions:
			1. Control of the pod shall always be indexed to run, unless shutdown by the system operator via the On, Off, Auto Switch.
		2. Pod Chilled Water Energy Valve Lead / Lag Control (Four Valve Systems Only):
			1. Once the pod system is indexed to run via the human machine interface (HMI, user add option) the chilled water valves be indexed to run in a lead/lag fashion.
			2. The four valves shall operate in a lead/lag fashion.
				1. The lead valves shall be indexed open first.
				2. On failure of the lead supply line valve, the lag valve shall be indexed open.
				3. Each supply line lead/lag control shall be independent of each other.
		3. The designated valve shall rotate upon one of the following conditions (user selectable):
			1. manually through a software switch
			2. if valve runtime (adj.) is exceeded
				1. daily
				2. weekly
				3. monthly
		4. Alarm(s) shall be provided as follows:
			1. Chilled Water Supply 1 Valve 1 and 2
				1. Failure: Commanded on, but the status is off.
				2. Running in Hand: Commanded off, but the status is on.
				3. Runtime Exceeded: Status runtime exceeds a user definable limit.
			2. Chilled Water Supply 2 Valve 1 and 2
				1. Failure: Commanded on, but the status is off.
				2. Running in Hand: Commanded off, but the status is on.
				3. Runtime Exceeded: Status runtime exceeds a user definable limit.
		5. Pod Chilled Water Energy Valve Control:
			1. After the pod has been indexed to run the lead supply chilled water energy valve shall be indexed to a minimum of 15% (adj.). From the minimum valve position the valve shall then be modulated to maintain the zone setpoint of 70°F(adj.). Each chilled water energy valve is controlled via the building management system network.
		6. Under-Floor Rack Cooling Fan Control:
			1. Once the pod has been indexed to run each under-floor rack cooling unit’s fan shall be indexed to either the global minimum fan speed setpoint (15%, adj.) or the local minimum fan speed setpoint (15%, adj.). The user shall have the ability to select where the under-floor racking cooling unit shall follow the local or global minimum fan speed setpoint. Once the fan has been indexed on, using each under-floor rack cooling unit’s return air temperature, the associated fan shall be modulated to maintain a setpoint of 90°F(adj.).
		7. Pod Temperature Control / Monitoring (Cold Aisle Containment)
			1. The controller shall monitor each UFRC supply air temperature sensor. Each temperature sensor shall be available on the graphics. Pod Temperature Control Value:
			2. The pod temperature control value shall be user selected; the following methods will be available:
				1. Average: If the pod temperature sensor(s) is valid and does not have an out-of-range alarm, the value(s) shall be included in the average temperature valve and the average temperature shall be used as the control pod temperature.
				2. Low: If the pod temperature sensor(s) is valid and does not have an out-of-range alarm, the lowest of all valid pod temperature will be used as the control pod temperature.
				3. High: If the pod temperature sensor(s) is valid and does not have an out-of-range alarm, the highest of all valid pod temperature will be used as the control pod temperature.
		8. For each pod sensor the following Alarm(s) shall be provided:
			1. High Pod Air Temp: If the supply air temperature is greater than 80°F (adj.).
			2. Low Pod Air Temp: If the supply air temperature is less than 60°F (adj.).
			3. Sensor out of Range: An alarm shall be generated.
		9. Under-Floor Rack Cooling Alarms:
			1. Return Air
				1. Each return air temperature shall be monitored via the building management system.
				2. Alarm(s) shall be provided as follows:

High Return Temp: If the return temperature is greater than 85°F (adj.) and communication to the UFRC’s controller is valid.

Low Return Temp: If the return temperature is less than 65°F (adj.) and communication to the UFRC’s controller is valid.

Out of Range: An alarm shall be generated.

* + - 1. Fan Speed
				1. The fan speed feedback shall be monitored via the building management system and compared to the commanded fan speed.
				2. Alarm(s) shall be provided as follows:

High Fan Speed: If the speed is higher than to be expected (linear

interpolation driven value) by a user definable amount.

Low Return Temp: If the speed is lower than to be expected (linear interpolation driven value) by a user definable amount.

* + 1. Chilled Water Energy Valve Integration
			1. Each chilled water energy valve shall be integrated into WebCTRL via the building management system. The control of the shall is outlined in the Pod Chilled Water Energy Valve Control section of this document. The following shall be also integrated and shall update based on a user adjustable time:
				1. Absolute Flow: The flow though the energy valve as a gallons per minute.
				2. Absolute Position: The feedback position of the valve.
				3. Glycol Concentration (if glycol is present): The percentage of glycol in the system.
			2. Temperature 1 (Remote): The remote probe temperature, typically installed in the supply line of the system.
			3. Temperature 2 (Embedded): The embedded probe temperature. The sensor is embedded into the energy valve body.
			4. Alarm(s) shall be provided as follows:
				1. Abnormal Position: If the commanded position of the valve and the feedback of the valve do not correspond within ±5%(adj.)
				2. High Flow: If the flow is greater than a user definable setpoint.
				3. Low Flow: If the flow is less than a user definable setpoint.
				4. Out of Range Flow: An alarm shall be generated.
		2. General Alarm(s)
			1. UFRC Communication Failure: If communication between the router and any of the UFRC’s controllers is in a failed state an alarm shall be generated.
			2. Energy Valve Communication Failure: if communication between the router and any of the Energy Valves is in a failed state and alarm shall be generated.
	1. FLOOR PANELS
		1. Raised Access Floor (RAF) Solid Panel
			1. Floor Panels: TecCrete 2500lb concentrated load. Panels shall be integrated steel pan construction with exposed top surface of lightweight concrete fill.
			2. Concentrated Load: 2500 lb. on one square inch (25mm) load at any location with a top surface deflection not to exceed 0.10" (2.5mm) and a permanent set not to exceed .010” (0.25mm).
			3. Uniform Load: With a top surface deflection not exceeding 0.040” (1mm), TecCrete can hold 900 pounds per square foot evenly distributed over the surface of the panel with a permanent set not exceeding 0.010” (0.25mm).
			4. Ultimate Load: Panel shall be designed to withstand load of 3100 lbs. applied over one inch at the weakest point on a panel.
			5. Rolling Load: Panels shall withstand a rolling load of 2000 lbs. applied through a 3" diameter (76mm) x 1-13/16" (46mm) wide caster for 10 cycles over the same path with less than 0.040” top surface permanent set. Panels shall withstand a rolling load of 2000 lb. applied through a hard rubber-surfaced wheel 10” (254mm) diameter x 4” (102mm) wide for 10,000 cycles over the same path. Permanent set at the conclusion of the test shall not exceed .040” (1mm).
			6. Panels shall be nominal 24” (610mm) square x 1-1/2” (38mm) deep, manufactured with galvannealed steel pan having shear tabs that integrally bond to the lightweight, high-strength concrete fill.
			7. Panel Finish: Floor panel surface shall be factory standard integral edge and will have top surface finish of ESD laminate, vinyl or TecCrete Stone. Panels shall have a maximum electrical resistance of 10 ohms or less from the top edge of the panel, less surface covering, to the understructure.
		2. Airflow Panel
			1. 56% open aluminum airflow panels shall be standard with no dampers. These panels have a standard load rating of 1500lbs concentrated load.
1. **EXECUTION**
	1. EXAMINATION
		1. Do not begin installation until wall openings and rough-in have been properly prepared.
		2. If preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
	2. PREPARATION
		1. Prepare conditions using the methods recommended by the manufacturer to achieve the best result for the operation under the project conditions.
		2. Installer is to coordinate with other trades to maintain the integrity of the installed access flooring. All traffic on access floor shall be controlled by the installer only. No traffic other than the access floor installation crew shall be permitted on any floor area for 48 hours to allow the pedestal adhesive to set. Access floor panels shall not be removed by other trades for 72 hours after their installation.
		3. Floor system and accessories shall be installed by an authorized factory-trained installation company with a minimum of five (5) years’ experience.
	3. INSTALLATION
		1. Install in accordance with manufacturer's instructions. Test for proper operation and adjust as required until satisfactory results are obtained.
		2. No dust or debris producing operations by other trades shall be allowed in areas where access floor is being installed to ensure proper bonding of pedestals to subfloor.
		3. Installer shall keep the subfloor broom clean as installation progresses.
		4. Finished installation shall be level within +/- 0.060” (2mm) in 10 feet (3m) and +/- 0.100” (3mm) for the entire floor area.
	4. WARRANTY
		1. 3-year limited warranty on all parts.
	5. PROTECTION
		1. Protect installed products until completion of project.
		2. Touch-up, repair or replace damaged products before Substantial Completion.

**END OF SECTION**