SECTION 236419 - RECIPROCATING WATER CHILLERS

This Section includes packaged water chillers using reciprocating compressors. Chillers include either water- or air-cooled condensers or have connections for remote air-cooled condensers.

Manufacturers found in SpecAgent for this Section were identified as representative and not as an endorsement for meeting requirements of this Specification.

This Section includes performance, proprietary, and descriptive type specifications. Edit to avoid conflicting requirements.

This Section includes the term "Architect/Engineer." "Architect" is used in AIA contract documents; "Engineer" is used in EJCDC contract documents. Retain appropriate term.

See Drawing Coordination Considerations for information needed to coordinate this Specification Section with Drawings.

1. GENERAL
   * + 1. SUMMARY
          1. Section Includes:

Chiller package.

Charge of refrigerant and oil.

Controls and control connections.

Chilled water connections.

Condenser water connections.

Refrigerant connections.

Auxiliary water connections.

Starters.

* + - * 1. Related Requirements:

List other Sections directly related to or affecting Work of this Section. Include Sections specifying information expected to be found in this Section as well as Sections required to describe complete system or assembly requirements.

Section 033000 - Cast-in-Place Concrete: Requirements for concrete housekeeping pads.

Section 230513 - Common Motor Requirements for HVAC Equipment: Requirements for electric motors.

Section 230548 - Vibration and Seismic Controls for HVAC Piping and Equipment: Requirements for vibration isolators.

Section 230993 - Sequence of Operations for HVAC Controls: Sequences of operation for chillers.

Section 232113 - Hydronic Piping: Requirements for chilled water and condenser water piping.

Section 232116 - Hydronic Piping Specialties: Requirements for piping specialties.

Section 232300 - Refrigerant Piping: Requirements for refrigerant piping.

* + - 1. DEFINITIONS

Limit list of definitions to terms unique to this Section and not provided elsewhere.

* + - * 1. Coefficient of Performance (COP) - Cooling: The ratio of rate of heat removal to rate of energy input, in consistent units, for a complete refrigerating system or some specific portion of that system under designated operating conditions.
        2. Energy Efficiency Ratio (EER): The ratio of net cooling capacity (or heat removed in Btu/h) to the total input rate of electric power applied.
        3. Integrated Part-Load Value (IPLV): A single-number figure of merit based on part-load EER, COP, or kW/ton that expresses part-load efficiency for air-conditioning and heat-pump equipment based on equipment's weighted operation at various load capacities.
      1. REFERENCE STANDARDS

List reference standards included within text of this Section, with designations, numbers, and complete document titles.

* + - * 1. Air-Conditioning, Heating, and Refrigeration Institute:

ARI 550/590 - Performance Rating Of Water-Chilling and Heat Pump Water-Heating Packages Using the Vapor Compression Cycle.

* + - * 1. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings.

* + - * 1. American Society of Mechanical Engineers:

ASME Boiler and Pressure Vessel Code Section VIII - Rules for Construction of Pressure Vessels.

* + - * 1. National Electrical Manufacturers Association:

NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

* + - 1. SUBMITTALS
         1. Submittals for this section are subject to the re-evaluation fee identified in Article 4 of the General Conditions.
         2. Manufacturer’s installation instructions shall be provided along with product data.
         3. Submittals shall be provided in the order in which they are specified and tabbed (for combined submittals).

Only request submittals needed to verify compliance with Project requirements.

* + - * 1. Section 013300 - Submittal Procedures: Requirements for submittals.
        2. Product Data: Submit rated capacities, weights, specialties, and accessories; electrical requirements; and wiring and control diagrams.
        3. Shop Drawings:

Indicate components, assembly, dimensions, weights, loads, required clearances, location, and size of field connections.

Indicate valves, strainers, and thermostatic valves.

* + - * 1. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

Include separate paragraphs for additional certifications.

* + - * 1. Manufacturer Instructions: Submit assembly, support details, connection requirements, and startup instructions.
        2. Source Quality-Control Submittals: Indicate results of [**shop**] [**factory**] tests and inspections.
        3. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
        4. Manufacturer Reports:

Submit startup report [**for each unit**].

Indicate results of leak test and refrigerant pressure test.

* + - * 1. Qualifications Statements:

Coordinate following subparagraphs with requirements specified in QUALIFICATIONS Article.

Submit qualifications for manufacturer and installer.

Submit manufacturer's approval of installer.

* + - 1. MAINTENANCE MATERIAL SUBMITTALS
         1. Section 017716 – Contract Closeout
         2. Extra Stock Materials: Furnish [**two**] <**\_\_\_\_\_\_\_\_**> containers of [**lubricating oil**] <**\_\_\_\_\_\_\_\_**>.
      2. QUALITY ASSURANCE

Include this Article to specify compliance with overall reference standards affecting products and installation included in this Section.

* + - * 1. Comply with ARI 550/590 “Performance Rating Of Water-Chilling and Heat Pump Water-Heating Packages Using the Vapor Compression Cycle” code for testing and rating of reciprocating water chillers.
        2. Performance Ratings: [**Coefficient of Performance (COP)**] [**and**] [**Integrated Part-Load Value (IPLV)**] not less than prescribed by ASHRAE 90.1 “- Energy Standard for Buildings Except Low-Rise Residential Buildings”.

Include following paragraph only when cost of acquiring specified standards is justified.

* + - * 1. Maintain <**\_\_\_\_\_\_\_\_**> [**copy**] [**copies**] of each standard affecting Work of this Section on Site.
      1. QUALIFICATIONS

Coordinate following paragraphs with requirements specified in SUBMITTALS Article.

* + - * 1. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum [**three**] <**\_\_\_\_\_\_\_\_**> years' [**documented**] experience.
        2. Installer: Company specializing in performing Work of this Section with minimum [**three**] <**\_\_\_\_\_\_\_\_**> years' [**documented**] experience [**and approved by manufacturer**].
      1. DELIVERY, STORAGE, AND HANDLING
         1. Section 016500 – Materials and Equipment
         2. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
         3. Store materials according to manufacturer instructions.
         4. Protection:

Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.

Provide additional protection according to manufacturer instructions.

* + - 1. EXISTING CONDITIONS
         1. Field Measurements:

Verify field measurements prior to fabrication.

Indicate field measurements on Shop Drawings.

* + - 1. WARRANTY
         1. Section 017716 – Contract Closeout
         2. Furnish [**five**] <**\_\_\_\_\_\_\_\_**>-year manufacturer's warranty for [**compressor**] [**, evaporator**] [**, and**] [**condenser**] [**complete assembly**], including [**materials only**] [**labor only**] [**materials and labor**].

1. PRODUCTS
   * + 1. PACKAGED WATER CHILLERS

* + - * 1. [Manufacturers:](http://www.specagent.com/Lookup?ulid=3567) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

[Carrier Global Corporation](http://www.specagent.com/Lookup?uid=123457139283).

[Daikin Applied](http://www.specagent.com/Lookup?uid=123457139281).

[Trane](http://www.specagent.com/Lookup?uid=123457139284).

[YORK; brand of Johnson Controls International plc, Building Solutions North America](http://www.specagent.com/Lookup?uid=123457139282).

Approved equivalent.

Insert descriptive specifications below to identify Project requirements and to eliminate conflicts with products specified above.

* + - * 1. Description: Factory-assembled and -tested, packaged, water-cooled, liquid chillers consisting of [**hermetic**] [**semi-hermetic**] reciprocating compressors, compressor motor, condenser(s), evaporator, refrigeration accessories, instrument and control panel that includes gages and indicating lights, auxiliary components and accessories, and motor starters.
      1. HERMETIC COMPRESSORS
         1. Description: Hermetically sealed reciprocating motor-compressor with crankcase heater, suction and discharge service valves, rubber-in-shear isolators, and control panel.
         2. Motor:

Speed: Constant 3,600 rpm.

Suction gas cooled with overheating protection.

* + - * 1. Crankcase Heater: Energized [**continuously**] [**when compressor is not operating**].
      1. SEMI-HERMETIC COMPRESSORS
         1. Description: Serviceable, hermetic, reciprocating motor-compressor with positive displacement oil pump lubrication system, [**spring-loaded heads and replaceable cylinder liners,**] crankcase heater, suction inlet screen, discharge service valves, and control panel.
         2. Automatic Capacity Reduction Equipment:

Operation: [**Solenoid**] [**Gas pressure**].

Capable of unloaded compressor start.

* + - * 1. Motor:

Speed: Constant 1,800 rpm.

Suction gas cooled with electronic overheating protection in each phase.

Starting Voltage: [**Full**] [**Reduced**].

* + - * 1. Crankcase Heater: Energize [**continuously**] [**when compressor is not operating**].
      1. EVAPORATOR
         1. Description:

Type: Shell and tube.

Construction:

Seamless or welded steel with cast iron or fabricated steel heads.

Tubes: Seamless copper or red brass with integral fins, rolled or silver-brazed into tube sheets.

[**Furnish multiple refrigerant circuits on multiple compressor units.**]

* + - * 1. Working Pressure Design, Testing, and Stamp:

According to ASME Section VIII “Rules for Construction of Pressure Vessels”.

Refrigerant Side: 225 psig.

Water Side: 150 psig.

* + - * 1. Insulation:

Material: Flexible [**expanded PVC**] <**\_\_\_\_\_\_\_\_**>.

Minimum Thickness: 0.75 inch.

Maximum Thermal Conductivity:

Comply with ASTM [**C177**] [**or**] [**C518**].

Thermal Conductivity: [**0.28**] [**0.26**] <**\_\_\_\_\_\_\_\_**> Btu/sq. ft. x h x deg. F at 75 deg. F.

* + - * 1. Furnish water drain connection and thermometer wells for temperature controller and low-temperature cutout.

Consider using following Article for water cooled and heat recovery chillers.

* + - 1. CONDENSERS
         1. Description:

Type: Shell and tube.

Construction:

Seamless or welded steel with cast iron or fabricated steel heads.

Tubes: Seamless copper or red brass with integral fins, rolled or silver-brazed into tube sheets.

* + - * 1. Working Pressure Design, Testing, and Stamp:

According to ASME Section VIII “Rules for Construction of Pressure Vessels”.

Refrigerant Side: 450 psig.

Water Side: 150 psig.

* + - * 1. Furnish integral sub-cooling circuit.
        2. Safety Relief Valve:

Operating Pressure: 450 psig.

Location: Condenser shell.

Consider using following Article for air-cooled condensers.

* + - 1. CONDENSER COILS, FANS, AND MOTORS
         1. Configuration: [**Single-refrigeration circuit**] [**Single-refrigeration circuit with receiver**] [**Two refrigeration circuits**] [**Two refrigeration circuits each with receiver**].
         2. Coils:

Description: Aluminum fins mechanically bonded to seamless copper tubing.

Furnish sub-cooling circuits as required.

Air test underwater to 425 psig and [**vacuum**] dehydrate.

Seal with holding charge of [**nitrogen**] [**refrigerant**].

Guard: [**Expanded metal**] [**Louvered**] [**with lint screens**].

* + - * 1. Fans:

Type: Vertical [**direct**] [**belt**]-driven propeller.

Furnish fan guard on discharge.

[**Furnish roller or ball bearings with grease fittings extended to outside of casing.**]

* + - * 1. Motors:

Description: Weatherproof, outdoor use, single- or three-phase permanent-split capacitor.

Bearings: Permanently lubricated ball.

Furnish built-in [**current and**] thermal overload protection [**as specified in Section 230513 - Common Motor Requirements for HVAC Equipment**].

* + - 1. REFRIGERANT CIRCUIT
         1. Description: Factory furnished and piped.
         2. Components for Each Circuit:

Liquid line solenoid valve.

Filter Dryer: Replaceable core type.

Liquid line sight glass and moisture indicator.

Thermal expansion for maximum operating pressure.

Charging valve.

Insulated suction line.

Discharge line check valve.

Compressor discharge service valve.

Pressure relief device.

* + - 1. CONTROLS

Edit following controls for specified type of compressor and coordinate controls as may be packaged for each compressor-chiller type.

* + - * 1. Control Panel:

Material: Steel.

Location: On or near chiller.

Enclosure: NEMA 250 “Enclosures for Electrical Equipment (1000 Volts Maximum)” Type [**1**] <**\_\_\_\_\_\_\_\_**>.

Components: Starters[**, molded case disconnect switch,**] and power and control wiring.

Factory wired with single-point power connection.

* + - * 1. Components for Each Compressor:

[**Across-the-line**] [**Part-winding**] starter.

Non-recycling compressor overload.

Starter relay.

Control power transformer or terminal for control power.

Manual reset.

Current overload protection.

* + - * 1. Control Panel Face-Mounted Devices:

COMPRESSOR RUN lights.

System START-STOP switch.

Control power fuse for circuit breaker.

COMPRESSOR LEAD-LAG switch.

Demand limit switch.

* + - * 1. Safety controls [**with indicating lights**] arranged so machine is shut down and requires manual reset:

Description: Machine is de-energized and requires manual reset.

[**Indicating lights.**]

LOW CHILLED WATER TEMPERATURE switch.

HIGH DISCHARGE PRESSURE switch [**for each compressor**].

LOW SUCTION PRESSURE switch [**for each compressor**].

OIL PRESSURE switch.

Following devices are typically provided as optional safety controls.

Flow Switches: Chilled water and condenser lines.

Relay for remote-mounted emergency shutdown.

* + - * 1. Operating Controls:

Multi-step chilled water temperature controller to cycle compressor and to activate capacity controls [**with remote thermostat**].

Five-minute OFF timer to prevent compressor from short cycling.

Part-winding start timer.

Periodic pump-out timer to limit chilled water flow and evaporator refrigerant pressure.

Following device is typically required for units fitted with heat recovery condenser and receiver.

Solenoid valve between heat recovery condenser and receiver to limit refrigerant level in condenser.

Consider using following subparagraphs for units with integral air-cooled condensers. Edit or delete to suit Project.

Controls for operation down to <**\_\_\_\_\_\_\_\_**> degrees F ambient temperature.

Thermostat to cycle fan motors in response to outdoor ambient temperature.

Head pressure switch to cycle fan motors in response to refrigerant condensing pressure.

Solid-state control to vary speed of one condenser fan motor in response to refrigerant condensing pressure.

Electronic low-ambient control, consisting of mixing damper assembly, to maintain constant refrigerant condensing pressure.

Following devices are typically provided as optional controls.

Load-limit thermostat to limit compressor loading on high return-water temperature.

Three-phase monitor to protect unit by de-energizing compressor in response to undervoltage or phase loss, reversal, or imbalance.

Hot Gas Bypass:

Sized for minimum compressor loading [**on one compressor only**].

Bypasses hot refrigerant gas to evaporator.

Cycle counter.

Run-time meter.

* + - * 1. Furnish pre-piped gage board with pressure gages for suction and discharge refrigerant and oil pressures [**for each compressor**].
        2. Alarms:

Furnish test button and lights indicating control circuit is energized and compressor is running.

Sounds audible alarm and energizes indicating light upon detection of compressor malfunction, low chilled water temperature, or evaporator water flow failure.

* + - * 1. Multiple Units: Furnish remote-mounted sequence panel to allow operation in [**series**] [**parallel**] with lead-lag switching.
      1. CHILLER PERFORMANCE

Select from following paragraphs for air- or water-cooled units with appropriate options, and insert performance requirements. If specifying units of differing sizes, consider using schedule following END OF SECTION.

* + - * 1. Air-Cooled Water Chiller Capacity:

Refrigeration Capacity: <**\_\_\_\_\_\_\_\_**> tons.

[**Air Entering Integral Condenser: <\_\_\_\_\_\_\_\_> degrees F.**]

Condensing Temperature: <**\_\_\_\_\_\_\_\_**> degrees F.

Chilled Water Flow: <**\_\_\_\_\_\_\_\_**> gpm.

Leaving Chilled Water Temperature: <**\_\_\_\_\_\_\_\_**> degrees F.

Entering Chilled Water Temperature: <**\_\_\_\_\_\_\_\_**> degrees F.

Pressure Drop through Evaporator: <**\_\_\_\_\_\_\_\_**> feet.

Evaporator Fouling Factor: [**0.0005**] <**\_\_\_\_\_\_\_\_**>.

Refrigerant: [**HCFC-22**] <**\_\_\_\_\_\_\_\_**>.

Saturated Suction Temperature: <**\_\_\_\_\_\_\_\_**> degrees F.

Power Input: <**\_\_\_\_\_\_\_\_**> kW.

COP: <**\_\_\_\_\_\_\_\_**>.

IPLV: <**\_\_\_\_\_\_\_\_**>.

* + - * 1. Water-Cooled Water Chiller Capacity:

Refrigeration Capacity: <**\_\_\_\_\_\_\_\_**> tons.

Chilled Water Flow: <**\_\_\_\_\_\_\_\_**> gpm.

Leaving Chilled Water Temperature: <**\_\_\_\_\_\_\_\_**> degrees F.

Entering Chilled Water Temperature: <**\_\_\_\_\_\_\_\_**> degrees F.

Pressure Drop through Evaporator: <**\_\_\_\_\_\_\_\_**> feet.

Evaporator Fouling Factor: 0.0005.

Condenser Water Flow: <**\_\_\_\_\_\_\_\_**> gpm.

Leaving Condenser Water Temperature: <**\_\_\_\_\_\_\_\_**> degrees F.

Entering Condenser Water Temperature: <**\_\_\_\_\_\_\_\_**> degrees F.

Pressure Drop through Condenser: <**\_\_\_\_\_\_\_\_**> feet.

Condenser Fouling Factor: 0.0005.

Refrigerant: [**HCFC-22**] <**\_\_\_\_\_\_\_\_**>.

Saturated Suction Temperature: <**\_\_\_\_\_\_\_\_**> degrees F.

Power Input: <**\_\_\_\_\_\_\_\_**> kW.

COP: <**\_\_\_\_\_\_\_\_**>.

IPLV: <**\_\_\_\_\_\_\_\_**>.

* + - * 1. Heat Recovery Condenser:

Capacity: <**\_\_\_\_\_\_\_\_**> Btu/h.

Condenser Water Flow: <**\_\_\_\_\_\_\_\_**> gpm.

Leaving Condenser Water Temperature: <**\_\_\_\_\_\_\_\_**> degrees F.

Entering Condenser Water Temperature: <**\_\_\_\_\_\_\_\_**> degrees F.

Pressure Drop through Condenser: <**\_\_\_\_\_\_\_\_**> feet.

Condenser Fouling Factor: [**0.0005**] <**\_\_\_\_\_\_\_\_**>.

* + - 1. OPERATION
         1. Electrical Characteristics:

Select one or more of following subparagraphs appropriate to equipment requirements.

**[<\_\_\_\_\_\_\_\_> hp] [<\_\_\_\_\_\_\_\_> RLA**].

Voltage: <**\_\_\_\_\_\_\_\_**> V, [**single**] [**three**] phase, 60 Hz.

Maximum [**Fuse Size**] [**Circuit Breaker Size**] [**Overcurrent Protection**]: <**\_\_\_\_\_\_\_\_**> A.

Minimum Circuit Ampacity: <**\_\_\_\_\_\_\_\_**>.

Minimum Power Factor: <**\_\_\_\_\_\_\_\_**> percent at rated load.

* + - * 1. Motors: As specified in Section 230513 - Common Motor Requirements for HVAC Equipment.
        2. Disconnect Switch: Factory mounted [**in control panel**] [**on equipment**].
      1. SOURCE QUALITY CONTROL
         1. Provide shop [**inspection**] [**, analysis**] [**, and**] [**testing**] of package chillers.

Include one or both of following paragraphs to require Owner's inspection or witnessing of test at factory.

* + - * 1. Director’s Representative Inspection:

Make completed chillers available for inspection at manufacturer's factory prior to packaging for shipment.

Notify Director’s Representative at least [**seven**] <**\_\_\_\_\_\_\_\_**> days before inspection is allowed.

* + - * 1. Director’s Representative Witnessing:

Allow witnessing of factory inspections and test at manufacturer's test facility.

Notify Director’s Representative at least [**seven**] <**\_\_\_\_\_\_\_\_**> days before inspections and tests are scheduled.

Include following paragraph if reliance on fabricator's approved quality-control program is sufficient for Project requirements.

* + - * 1. Certificate of Compliance:

If fabricator is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents.

Specified shop tests are not required for Work performed by approved fabricator.

1. EXECUTION
   * + 1. INSTALLATION
          1. Indoor Chiller Housekeeping Pad:

Material: Concrete as specified in Section 033000 - Cast-in-Place Concrete.

Minimum Size: 3-1/2 inches high and 6 inches wider than equipment base on each side.

* + - * 1. Packaged Outdoor Chiller Foundation:

Material: Concrete as specified in Section 033000 - Cast-in-Place Concrete.

Minimum Size: [**6**] <**\_\_\_\_\_\_\_\_**> inches thick and 6 inches wider than equipment base on each side.

* + - * 1. Install units on vibration isolators as specified in Section 230548 - Vibration and Seismic Controls for HVAC Piping and Equipment.
        2. Install following piping accessories on evaporator chilled water piping connections as specified in Sections 232113 - Hydronic Piping and 232116 - Hydronic Piping Specialties:

Inlet Devices:

Thermometer well for temperature controller.

Thermometer.

Strainer.

Flow switch.

Flexible pipe connection.

Pressure gage.

Shutoff valve.

Outlet Devices:

Thermometer.

Flexible pipe connection.

Pressure gage.

[**Shutoff**] [**Balancing**] valve.

* + - * 1. Provide auxiliary water piping for oil cooling units and purge condensers.
        2. Install following piping accessories on condenser water piping connections as specified in Sections 232113 - Hydronic Piping and 232116 - Hydronic Piping Specialties:

Inlet Devices:

Thermometer well for temperature limit controller.

Thermometer.

Strainer.

Flow switch.

Flexible pipe connection.

Pressure gage.

Shutoff valve.

Outlet Devices:

Thermometer well and thermometer.

Flexible pipe connection.

Pressure gage.

[**Shutoff**] [**Balancing**] valve.

* + - * 1. Arrange piping to facilitate dismantling to permit tube cleaning.
        2. Install refrigerant piping connections to air-cooled condensing units as specified in Section 232300 - Refrigerant Piping.
        3. Install piping from chiller safety relief valve to outdoors, and size as recommended by manufacturer.
        4. Install chiller accessories furnished loose for field mounting.
        5. Install electrical devices furnished loose for field mounting.
        6. Install control wiring between chiller control panel and field mounted control devices.
      1. FIELD QUALITY CONTROL
         1. Startup and Shutdown:

Furnish cooling season startup and winter season shutdown service for first year of operation.

If initial startup and testing takes place in winter and machines are to remain inoperative, repeat startup and testing operation at beginning of first cooling season.

Furnish initial charge of refrigerant and oil.

* + - * 1. Manufacturer Services: Furnish services of manufacturer's representative experienced in installation of products furnished under this Section for not less than <**\_\_\_\_\_\_\_\_**> [**days**] [**hours**] on Site to leak test, refrigerant pressure test, evacuate, dehydrate, charge, startup, calibrate controls, and instruct Facility’s personnel in operation and maintenance of equipment.
        2. Equipment Acceptance:

Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.

Make final adjustments to equipment under direction of Company Field Advisor per OGS Spec Section 014216 .

* + - * 1. Furnish installation certificate from equipment manufacturer's representative attesting that equipment has been properly installed and is ready for startup and testing.
      1. DEMONSTRATION
         1. Demonstrate equipment startup, shutdown, routine maintenance, and emergency repair procedures to Director’s Representative's personnel.
         2. Demonstrate system operations and verify specified performance.
         3. Demonstrate low-ambient operation during winter testing for air-cooled condensers.
      2. MAINTENANCE

Evaluate need for maintenance and emergency service based on Project requirements. If desired, retain following paragraphs.

* + - * 1. Provide service and maintenance of chiller for [**one year**] [**five years**] [**<\_\_\_\_\_\_\_\_> years**] from date of Substantial Completion.
        2. Examine unit components [**weekly**] [**semi-monthly**] [**monthly**] [**bi-monthly**] and clean, adjust, and lubricate equipment.
        3. Include systematic examination, adjustment, and lubrication of unit, checkout of controls, and adjustments.
        4. Repair or replace parts according to manufacturer's operating and maintenance data, using parts produced by manufacturer of original equipment.
        5. Perform Work without removing units from service during building's normal occupied hours.
        6. Provide emergency call back service [**at all hours**] [**during working hours**] for specified maintenance period.
        7. Local Access:

Maintain locally, near place of Work, adequate stock of parts for replacement or emergency purposes.

Have personnel available to ensure fulfillment of this maintenance service without unreasonable loss of time.

* + - * 1. Perform maintenance Work using competent and qualified personnel under supervision [**and in direct employ**] of manufacturer or original installer.
        2. Do not assign or transfer maintenance service to agent or subcontractor without prior written consent of [**Director’s Representative**] <**\_\_\_\_\_\_\_\_**>.
      1. SCHEDULES

When relying on separate schedules, tables, illustrations, or forms to specify product requirements, include list of each attachment. Include identical list of attachments in Project Manual table of contents.

Consider including schedule if more than one unit is required. Complete schedule in conjunction with identification method used on Drawings. No units of measurement are indicated; add to schedule legend or include within each insert. Coordinate equipment tags and abbreviations with project specific requirements.

Insert attachments following END OF SECTION. Consider following examples when developing Project schedule.

* + - * 1. Package Water Chillers Schedule - Reciprocating:

Equipment Tag: <WC-1>:

[**Manufacturer: <\_\_\_\_\_\_\_\_>.**]

[**Model: <\_\_\_\_\_\_\_\_>.**]

Location: <**\_\_\_\_\_\_\_\_**>.

Refrigeration Capacity: <**\_\_\_\_\_\_\_\_**>.

Refrigerant: <**\_\_\_\_\_\_\_\_**>.

Compressor Power Input: <**\_\_\_\_\_\_\_\_**>.

COP: <**\_\_\_\_\_\_\_\_**>.

IPLV: <**\_\_\_\_\_\_\_\_**>.

Evaporator: <**\_\_\_\_\_\_\_\_**>.

Water Flow Rate: <**\_\_\_\_\_\_\_\_**>.

Entering Water Temperature: <**\_\_\_\_\_\_\_\_**>.

Leaving Water Temperature: <**\_\_\_\_\_\_\_\_**>.

Pressure Drop: <**\_\_\_\_\_\_\_\_**>.

Fouling Factor: <**\_\_\_\_\_\_\_\_**>.

Water-Cooled Condenser: <**\_\_\_\_\_\_\_\_**>.

Type: <**\_\_\_\_\_\_\_\_**>.

Water Flow Rate: <**\_\_\_\_\_\_\_\_**>.

Entering Water Temperature: <**\_\_\_\_\_\_\_\_**>.

Leaving Water Temperature: <**\_\_\_\_\_\_\_\_**>.

Pressure Drop: <**\_\_\_\_\_\_\_\_**>.

Fouling Factor: <**\_\_\_\_\_\_\_\_**>.

Air-Cooled Condenser:

Entering Air Temperature: <**\_\_\_\_\_\_\_\_**>.

Condensing Temperature: <**\_\_\_\_\_\_\_\_**>.

Condenser Fans:

Number: <**\_\_\_\_\_\_\_\_**>.

RPM: <**\_\_\_\_\_\_\_\_**>.

Motor: <**\_\_\_\_\_\_\_\_**>.

Heat-Recovery Condenser:

Type: <**\_\_\_\_\_\_\_\_**>.

Capacity: <**\_\_\_\_\_\_\_\_**>.

Water Flow Rate: <**\_\_\_\_\_\_\_\_**>.

Entering Water Temperature: <**\_\_\_\_\_\_\_\_**>.

Leaving Water Temperature: <**\_\_\_\_\_\_\_\_**>.

Pressure Drop: <**\_\_\_\_\_\_\_\_**>.

Fouling Factor: <**\_\_\_\_\_\_\_\_**>.

Compressor:

Number: <**\_\_\_\_\_\_\_\_**>.

Steps Unloading: <**\_\_\_\_\_\_\_\_**>.

RPM: <**\_\_\_\_\_\_\_\_**>.

Starter Type: <**\_\_\_\_\_\_\_\_**>.

Equipment Tag: <WC-2>:

[**Manufacturer: <\_\_\_\_\_\_\_\_>.**]

[**Model: <\_\_\_\_\_\_\_\_>.**]

Location: <**\_\_\_\_\_\_\_\_**>.

Refrigeration Capacity: <**\_\_\_\_\_\_\_\_**>.

Refrigerant: <**\_\_\_\_\_\_\_\_**>.

Compressor Power Input: <**\_\_\_\_\_\_\_\_**>.

COP: <**\_\_\_\_\_\_\_\_**>.

IPLV: <**\_\_\_\_\_\_\_\_**>.

Evaporator: <**\_\_\_\_\_\_\_\_**>.

Water Flow Rate: <**\_\_\_\_\_\_\_\_**>.

Entering Water Temperature: <**\_\_\_\_\_\_\_\_**>.

Leaving Water Temperature: <**\_\_\_\_\_\_\_\_**>.

Pressure Drop: <**\_\_\_\_\_\_\_\_**>.

Fouling Factor: <**\_\_\_\_\_\_\_\_**>.

Water-Cooled Condenser: <**\_\_\_\_\_\_\_\_**>.

Type: <**\_\_\_\_\_\_\_\_**>.

Water Flow Rate: <**\_\_\_\_\_\_\_\_**>.

Entering Water Temperature: <**\_\_\_\_\_\_\_\_**>.

Leaving Water Temperature: <**\_\_\_\_\_\_\_\_**>.

Pressure Drop: <**\_\_\_\_\_\_\_\_**>.

Fouling Factor: <**\_\_\_\_\_\_\_\_**>.

Air-Cooled Condenser:

Entering Air Temperature: <**\_\_\_\_\_\_\_\_**>.

Condensing Temperature: <**\_\_\_\_\_\_\_\_**>.

Condenser Fans:

Number: <**\_\_\_\_\_\_\_\_**>.

RPM: <**\_\_\_\_\_\_\_\_**>.

Motor: <**\_\_\_\_\_\_\_\_**>.

Heat-Recovery Condenser:

Type: <**\_\_\_\_\_\_\_\_**>.

Capacity: <**\_\_\_\_\_\_\_\_**>.

Water Flow Rate: <**\_\_\_\_\_\_\_\_**>.

Entering Water Temperature: <**\_\_\_\_\_\_\_\_**>.

Leaving Water Temperature: <**\_\_\_\_\_\_\_\_**>.

Pressure Drop: <**\_\_\_\_\_\_\_\_**>.

Fouling Factor: <**\_\_\_\_\_\_\_\_**>.

Compressor:

Number: <**\_\_\_\_\_\_\_\_**>.

Steps Unloading: <**\_\_\_\_\_\_\_\_**>.

RPM: <**\_\_\_\_\_\_\_\_**>.

Starter Type: <**\_\_\_\_\_\_\_\_**>.

END OF SECTION 236419