SECTION 236413 - ABSORPTION WATER CHILLERS

Manufacturers found in SpecAgent for this Section were identified as representative and not as an endorsement for meeting the 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 the Drawing Coordination Considerations for information needed to coordinate this specification Section with the Drawings.

1. GENERAL
   * + 1. SUMMARY
          1. Section includes complete factory chiller package, charge of water and lithium bromide or ammonia solution, pumps and motors, controls and control connections, chilled water connections, condenser connections, [**hot water**] [**steam and condensate**] [**natural gas**] [**fuel oil**] equipment and related connections.
          2. Related Sections:

Section 033000 - Cast-In-Place Concrete: Execution requirements for concrete housekeeping pads specified by this section.

Section 230513 - Common Motor Requirements for HVAC Equipment: Product requirements for electric motors for placement by this section.

Section 230548 - Vibration and Seismic Controls for HVAC Piping and Equipment: Product requirements for vibration isolators for placement by this section.

Section 230700 - HVAC Insulation: Product requirements for insulation for placement by this section.

Section 230993 - Sequence of Operations for HVAC Controls: Sequences of operation for chillers specified in this section.

Section 231113 - Facility Fuel-Oil Piping: Execution requirements for fuel oil piping connections to chillers specified in this section.

Section 231123 - Facility Natural-Gas Piping: Execution requirements for gas piping connections to chillers specified in this section.

Section 232113 - Hydronic Piping: Execution requirements for chilled water, condenser water and hot water steam, condensate and heating hot water specified by this section.

Section 232116 - Hydronic Piping Specialties: Product requirements for piping specialties for placement by this section.

Section 235100 - Breechings, Chimneys, and Stacks: Execution requirements for breeching, chimney, and stack connections to chillers specified in this section.

* + - 1. REFERENCES

List reference standards included within text of this section. Edit the following for Project conditions.

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

ARI 560 - Absorption Water Chilling and Water Heating Packages.

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

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

* + - * 1. National Electrical Manufacturers Association:

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

* + - * 1. National Fire Protection Association:

NFPA 31 - Installation of Oil Burning Equipment.

NFPA 54 - National Fuel Gas Code.

NFPA 58 - Liquefied Petroleum Gas Code.

* + - 1. DEFINITIONS
         1. Coefficient of Performance (COP) - cooling: The ratio of the rate of heat removal to the rate of energy input, in consistent units, for a complete refrigerating system or some specific portion of that system under designated operating conditions.
         2. Integrated Part-Load Value (IPLV): A single-number figure of merit based on part-load EER, COP, or kW/ton expressing part-load efficiency for air-conditioning and heat pump equipment on the basis of weighted operation at various load capacities for the equipment.
      2. 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: Submittal procedures.
        2. Shop Drawings: Indicate components, assembly, dimensions, weights and loads, required clearances, and location and size of field connections. Indicate equipment, piping and connections, valves, strainers, and thermostatic valves.
        3. Product Data: Submit data on capacities, specialties and accessories, electrical requirements, and wiring diagrams.
        4. Design Data: Indicate energy input versus cooling output from 10 to 100 percent of full load [**at specified and minimum condensing water temperature**].
        5. Test Reports: Indicate results of factory performance test.
        6. Manufacturer's Installation Instructions: Submit assembly, support details, connection requirements, and include start-up instructions.
        7. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
        8. Manufacturer's Field Reports: Submit start-up report [**for each unit**]. Indicate results of leak test and pressure test.
        9. Submittals for this section are subject to the re-evaluation fee identified in Article 4 of the General Conditions.
        10. Manufacturer's installation instructions shall be provided along with product data.
        11. Submittals shall be provided in the order in which they are specified and tabbed (for combined submittals).
      1. CLOSEOUT SUBMITTALS
         1. Section 017716 – Contract Closeout.
         2. Operation and Maintenance Data: Submit start-up instructions, maintenance data, parts lists, controls, and accessories. Include trouble-shooting guide.
      2. QUALITY ASSURANCE
         1. Construction conforming to ARI 560ARI 560 (Absorption Water Chilling and Water Heating Packages) and UL.
         2. Performance Ratings: [**Coefficient of Performance (COP)**] [**and**] [**Integrated Part-Load Value (IPLV)**] not less than prescribed by ASHRAE 90.1ASHRAE 90.1 (Energy Standard for Buildings Except Low-Rise Residential Buildings).
         3. Perform Work in accordance with [**State**] [**Municipality**] of <**\_\_\_\_\_\_\_\_**> [**Highways**] [**Public Work's**] standards.

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

* + - * 1. Maintain [**one copy**] [**<\_\_\_\_\_\_\_\_> copies**] of [**each**] document on site.
      1. QUALIFICATIONS
         1. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years' [**documented**] experience [**, and with service facilities within [100] <\_\_\_\_\_\_\_\_> miles of Project**].
         2. Installer: Company specializing in performing Work of this section with minimum three years' [**documented**] experience [**approved by manufacturer**].
      2. PRE-INSTALLATION MEETINGS
         1. Convene minimum [**one**] <**\_\_\_\_\_\_\_\_**> week prior to commencing work of this section.
      3. DELIVERY, STORAGE, AND HANDLING
         1. Section 016000 - Product Requirements: Product storage and handling requirements.
         2. Comply with manufacturer’s installation instructions for rigging, unloading, and transporting units.
         3. Protect units from physical damage. Leave factory shipping-covers in place until installation.
      4. WARRANTY

this article extends warranty period beyond one year. extended warranties increase construction cost and owner enforcement responsibiities. speciFy warrANTIES WITH CAUTION.

* + - * 1. Furnish [**five**] <**\_\_\_\_\_\_\_\_**>-year warranty to include coverage for [**complete package as manufactured and delivered to site**] <**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**> including [**materials only**] [**labor only**] [**materials and labor**].
      1. MAINTENANCE SERVICE
         1. Section 017716 – Contract Closeout Evaluate need for maintenance and emergency service based Project requirements. If desired, retain the following paragraphs.
         2. Furnish service and maintenance of chiller for [**one**] [**five**] <**\_\_\_\_\_\_\_\_**> years from Date of Substantial Completion.
         3. Include labor and materials required for routine servicing and maintenance as recommended in manufacturers published operating and maintenance data.
         4. Examine unit components [**weekly**] [**semi-monthly**] [**monthly**] [**bi-monthly**]. Clean, adjust, and lubricate equipment.
         5. Include systematic examination, adjustment, and lubrication of unit, including fan belt replacement, and controls checkout and adjustments. Repair or replace parts in accordance with manufacturer's operating and maintenance data. Use parts produced by manufacturer of original equipment.
         6. Perform work without removing units from service during building normal occupied hours.
         7. Provide emergency call back service [**at all hours**] [**during working hours**] for this maintenance period.
         8. Maintain locally, near Place of the 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.
         9. Perform maintenance work using competent and qualified personnel under supervision [**and in direct employ**] of manufacturer or original installer.
         10. Do not assign or transfer maintenance service to agent or subcontractor without prior written consent of [**Director’s Representative.**] <**\_\_\_\_\_\_\_\_.**>
      2. EXTRA MATERIALS
         1. Section 017716 – Contract Closeout.
         2. Furnish <**\_\_\_\_\_\_\_\_**> containers of lithium bromide and inhibitors or ammonia.

1. PRODUCTS
   * + 1. CHILLERS

In this article, list manufacturers acceptable for this Project.

* + - * 1. [Manufacturers:](http://www.specagent.com/Lookup?ulid=3766) 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=123457139276).

[Trane / Thermax](http://www.specagent.com/Lookup?uid=123457139279).

[Yazaki Energy Systems](http://www.specagent.com/Lookup?uid=123457139280).

[YORK; brand of Johnson Controls International plc, Building Solutions North America](http://www.specagent.com/Lookup?uid=123457139277).

Approved equivalent.

Edit the following descriptive specifications to identify Project requirements and to eliminate conflicts with manufacturers specified above.

* + - * 1. Product Description: Factory assembled, packaged, [**water**] [**air**] cooled liquid chillers, consisting of absorber-evaporator assembly, solution heat exchanger, [**fuel-fired generator**], solution pumps, interconnecting piping, crossover piping, refrigeration accessories, instrument and control panel including gages and indicators, auxiliary components and accessories, motor starters, [**steam valve**] [**burners and fuel train**].
      1. PUMPS
         1. Self-contained hermetically sealed centrifugal solution pumps either separate or on common shaft, lubricated and cooled by pumped fluid.
      2. HEAT EXCHANGERS
         1. Construction: Shell and tube type seamless or welded steel in shells with cast iron or welded-steel heads.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Construction: Plate type with stainless steel plates and steel headers.
        2. Absorber, Concentrator, and Evaporator Tubes: [**95/5 Cupro-nickel**] [**copper**].
        3. Condenser Tubes: Seamless copper.
        4. Water Boxes: Tapped drain and vent connections, [**flanged**] [**mechanical joint**] piping connections [**flanged and bolted covers arranged to permit inspection and replacement**] [**Marine water boxes on absorber and condenser**].

Use the following paragraph to specify factory-insulated evaporators. For field insulated evaporators delete this paragraph and use Part 3 reference using 3 inches of mineral wool or equivalent.

* + - * 1. Insulation: Insulate evaporator and cold surfaces with [**0.75**] <**\_\_\_\_\_\_\_\_**> inch ([**20**] <**\_\_\_\_\_\_\_\_**> mm) minimum thick flexible [**expanded polyvinyl chloride**] insulation with maximum K factor of [**0.28.**] [**0.26.**] (KSI value of [**0.04.**] [**0.037.**])

Edit the following paragraphs and articles by eliminating non-applicable ones after deciding on chiller heat source and availability of types from manufacturers depending on machine capacity.

* + - * 1. Generator: Design for [**50 psi (345 kPa)**] [**15 psi (105 kPa)**] maximum working steam pressure. Test at 1.5 times maximum working pressure.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Generator: Design for 250 psi (1 724 kPa) maximum working pressure (hot water). Test at 1.5 times maximum working pressure.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - 1. DIRECT FIRED UNIT BURNER
         1. Forced draft automatic burner integral with front head of generator designed to burn [**natural gas**] [**and**] [**No. 2 oil**] [**No. 4 oil**] [**No. 5 oil**] [**No. 6 oil**], be modulating with low fire ignition position, and maintain fuel-air ratios automatically.
         2. Blower: Statically and dynamically balanced to supply combustion air; direct connected to motor.
         3. Damper Motor: Single motor control combustion air damper and fuel valves.
         4. Oil Burner: Low pressure atomizing forced draft type with electric ignition [**and gas pilot**].

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Gas Burner: Forced draft, high radiant, multi-port power burner with electric ignition.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Combination Gas-Oil Burner: Burner for gas and light oil built as single unit, without need of interchanging. Gas burner and oil burner complete with gas pressure regulator.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Burner: [**Forced draft**] [**Natural draft**] automatic burner designed to burn [**natural**] [**propane**] gas with electronic ignition system.

Include the following articles where they are available in manufacturer?smanufacturer’s capacity range.

* + - 1. PURGE SYSTEM
         1. Automatically or manually purge unit of non-condensable materials, storing them external to unit.
      2. AUTOMATIC DECRYSTALLIZATION
         1. Automatic cycle using lithium bromide solution to prevent crystallization while machine is running or at power failure.

Edit the following article to match heat source and capacity range.

* + - 1. CONTROLS
         1. Electric Control Panels: NEMA 250NEMA 250 (Enclosures for Electrical Equipment (1000 Volts Maximum)), Type 1; factory wired and mounted panel including:

[**Terminal block**] [**circuit breaker**] [**disconnect**] [**fused disconnect**].

Control transformer and separately fused control circuit.

Motor temperature cutout and low temperate cutout.

Dilution cycle time-delay relay.

Motor starters.

External indicators to show operation of unit, pumps, and purge system.

Condenser water flow switch.

* + - * 1. Capacity Control Panel: Factory assembled and mounted panel including:

Chilled water temperature controller.

Temperature gages or indicators.

Start-up demand limit.

Part-load economizer.

* + - * 1. [**Hot water**] [**Steam**] Control Valve: Factory mounted with demand limit to slow valve opening rate to minimum of five-minute cycles.
        2. Solution Throttling Device: To increase part load economy and assure operation to 10 percent full load capacity, at [**55 degrees F (13 degrees C)**] [**65 degrees F (18 degrees C)**] entering condenser water temperature.
      1. CHILLER PERFORMANCE

Select the following paragraphs and insert performance requirements for one or identical units, or repeat paragraphs for each unit. When specifying many units of differing sizes, include schedule.

* + - * 1. Refrigeration Capacity: <**\_\_\_\_\_\_\_\_**> tons (<**\_\_\_\_\_\_\_\_**> W).
        2. Chilled Water:

Flow: <**\_\_\_\_\_\_\_\_**>gpm (<**\_\_\_\_\_\_\_\_**> L/sec).

Entering Temperature: <**\_\_\_\_\_\_\_\_**> degrees F (<**\_\_\_\_\_\_\_\_**> degrees C).

Leaving Temperature: <**\_\_\_\_\_\_\_\_**> degrees F (<**\_\_\_\_\_\_\_\_**> degrees C).

Pressure Drop Through Evaporator: <**\_\_\_\_\_\_\_\_**> feet (<**\_\_\_\_\_\_\_\_**> Pa).

Evaporator Fouling Factor: [**0.00025**] <**\_\_\_\_\_\_\_\_**>.

Evaporator Working Pressure: 150 psi (1 034 kPa); test at 1.5 times maximum working pressure.

* + - * 1. Absorber-Condenser Water:

Flow: <**\_\_\_\_\_\_\_\_**> gpm (<**\_\_\_\_\_\_\_\_**> L/sec).

Entering Temperature: <**\_\_\_\_\_\_\_\_**> degrees F (<**\_\_\_\_\_\_\_\_**> degrees C).

Leaving Temperature: <**\_\_\_\_\_\_\_\_**> degrees F (<**\_\_\_\_\_\_\_\_**> degrees C).

Fouling Factor: [**0.0005**] [**0.001**].

Pressure Drop: <**\_\_\_\_\_\_\_\_**> feet (<**\_\_\_\_\_\_\_\_**> Pa).

Working Pressure: 150 psi (1 034 kPa); test at 1.5 times maximum working pressure.

* + - * 1. [**Concentrator**] [**Generator**]:

Hot Water Input:

Flow: <**\_\_\_\_\_\_\_\_**> gpm (<**\_\_\_\_\_\_\_\_**> L/sec).

Entering Water Temperature: <**\_\_\_\_\_\_\_\_**> degrees F (<**\_\_\_\_\_\_\_\_**> degrees C).

Leaving Water Temperature: <**\_\_\_\_\_\_\_\_**> degrees F (<**\_\_\_\_\_\_\_\_**> degrees C).

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

Saturated Steam:

Flow: <**\_\_\_\_\_\_\_\_**> lb/hr (<**\_\_\_\_\_\_\_\_**> kg/hr).

Inlet Pressure: <**\_\_\_\_\_\_\_\_**> psi (<**\_\_\_\_\_\_\_\_**> kPa).

Inlet temperature: <**\_\_\_\_\_\_\_\_**> degrees F (<**\_\_\_\_\_\_\_\_**> degrees C).

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

[**Natural**] [**Propane**] Gas Input at High Heating Value: <**\_\_\_\_\_\_\_\_**> Btuh (<**\_\_\_\_\_\_\_\_**> kW).

Heated Water Output:

Flow: <**\_\_\_\_\_\_\_\_**> gpm (<**\_\_\_\_\_\_\_\_**> L/sec).

Leaving Water Temperature: [**131**] [**140**] <**\_\_\_\_\_\_\_\_**> degrees F ([**55**] [**60**] <**\_\_\_\_\_\_\_\_**> degrees C).

Entering Water Temperature: <**\_\_\_\_\_\_\_\_**> degrees F (<**\_\_\_\_\_\_\_\_**> degrees C).

* + - 1. ELECTRICAL CHARACTERISTICS AND COMPONENTS

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

* + - * 1. Electrical Characteristics: In accordance with Section 260503 and the following:

[**<\_\_\_\_\_\_\_\_> hp (<\_\_\_\_\_\_\_\_> W).**] [**<\_\_\_\_\_\_\_\_> rated load amperes.**]

<**\_\_\_\_\_\_\_\_**> volts, [**single**] [**three**] phase, 60 Hz.

<**\_\_\_\_\_\_\_\_**> amperes maximum [**fuse size**] [**circuit breaker size**] [**overcurrent protection**].

<**\_\_\_\_\_\_\_\_**> minimum circuit ampacity.

<**\_\_\_\_\_\_\_\_**> percent minimum power factor at rated load.

* + - * 1. Motors: In accordance with Section 230513.
        2. Disconnect Switch: Factory-mount [**in control panel**] [**on equipment**].
      1. SOURCE QUALITY CONTROL (AND TESTS)
         1. Furnish [**testing**] [**and**] [**analysis**] of package chillers.
         2. Furnish shop [**inspection**] [**and**] [**testing**] of completed chiller.

Use one or both of the following paragraphs to allow Owner’?s inspection or witnessing of tests at factory.

* + - * 1. Make completed chiller available for inspection at manufacturer’s factory prior to packaging for shipment. Furnish [**seven**] <**\_\_\_\_\_\_\_\_**> days notice before packaging is scheduled.
        2. Allow witnessing of factory inspections and tests at manufacturers test facility. Furnish [**seven**] <**\_\_\_\_\_\_\_\_**> days notice before inspections and tests are scheduled.

1. EXECUTION
   * + 1. INSTALLATION
          1. Install chiller on concrete housekeeping base, sized minimum 3-1/2 inches (87 mm) high and 6 inches (150 mm) larger than chiller base. Refer to Section 033000. Align, level, and grout in place. Refer to Section 033000.
          2. Insulate chiller cold and hot surfaces not factory insulated. Refer to Section 230700.
          3. Connect [**chilled water**] [**condenser water**] [**hot water**] [**steam**] [**fuel**] piping to chiller connections.
          4. Arrange piping for easy dismantling to permit tube cleaning.
          5. Install the following piping accessories on evaporator chilled water piping connections. Refer to Section 232116 and Section 232113.

On inlet:

Sensor for temperature controller.

Sensor for low temperature cutout.

Thermometer well and thermometer.

Well for [**control system**] temperature sensor.

Strainer.

Nipple and flow switch.

Flexible pipe connector.

Pressure gage.

Shut-off valve.

On outlet:

Thermometer well and thermometer.

Well for [**control system**] temperature sensor.

Flexible pipe connector.

Pressure gage.

Balancing valve.

Shut-off valve.

* + - * 1. Install the following piping accessories on condenser water piping connections. Refer to Section 232116 and Section 232113.

On inlet:

Sensor for temperature controller.

Thermometer well and thermometer.

Well for [**control system**] temperature sensor.

Strainer.

Nipple and flow switch.

Flexible pipe connector.

Pressure gage.

Shut-off valve.

On outlet:

Thermometer well and thermometer.

Well for [**control system**] temperature sensor.

Flexible pipe connector.

Pressure gage.

Balancing valve.

Shut-off valve.

* + - * 1. Install the following piping accessories on hot water heating piping connections. Refer to Section 232116 and Section 232113.

On inlet:

Thermometer well and thermometer.

Well for [**control system**] temperature sensor.

Strainer.

Nipple and flow switch.

Flexible pipe connector.

Pressure gage.

Shut-off valve.

On outlet:

Thermometer well and thermometer.

Well for [**control system**] temperature sensor.

Flexible pipe connector.

Pressure gage.

Balancing valve.

Shut-off valve.

* + - * 1. Install the following piping accessories on steam piping connections. Refer to Section 232116 and Section 232113.

On steam inlet:

Thermometer well and thermometer.

Well for [**control system**] temperature sensor.

Strainer.

Pressure gage.

Shut-off valve.

On condensate outlet:

Thermometer well and thermometer.

Well for [**control system**] temperature sensor.

Pressure gage.

Strainer.

Steam traps.

Shut-off valve.

Choose among the following 3 paragraphs based on fuel.

* + - * 1. Connect natural gas piping in accordance with NFPA 54NFPA 54 (National Fuel Gas Code).

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Connect propane piping in accordance with NFPA 58NFPA 58 (Liquefied Petroleum Gas Code).

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Connect fuel oil piping in accordance with NFPA 31NFPA 31 (Installation of Oil Burning Equipment).

Choose among the following 3 paragraphs based on fuel.

* + - * 1. Connect natural gas piping to chiller, full size of chiller gas train inlet. Arrange piping with clearances for burner removal and service.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Connect propane piping to chiller, full size of chiller gas train inlet. Arrange piping with clearances for burner removal and service.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Connect fuel oil piping to boiler, full size of boiler gas train inlet. Arrange piping with clearances for burner removal and service.

Edit the following based on Project conditions.

* + - * 1. Install the following piping accessories on natural gas piping connections. Refer to Section 231123.

Strainer.

Pressure gage.

Shutoff valve.

Check valve.

Pressure reducing valve.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Install the following piping accessories on fuel oil piping connections. Refer to Section 231113.

Strainer.

Shutoff valve.

Check valve.

* + - * 1. Pipe relief valves to nearest floor drain.
        2. Pipe rupture disc in accordance with code.
        3. Install chiller accessories furnished loose for field mounting.
        4. Install electrical devices furnished loose for field mounting.
        5. Install control wiring between chiller control panel and field mounted control devices.
        6. Connect flue to burner outlet, full size of outlet.
        7. Provide for connection to electrical service. Refer to Section 260503.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Install Work in accordance with [**State**] [**Municipality**] of <**\_\_\_\_\_\_\_\_**> [**Highways**] [**Public Work's**] standards.
      1. FIELD QUALITY CONTROL
         1. Test for leaks under pressure and evacuate and dehydrate at 35 degrees F (2 degrees C) wet bulb or absolute pressure of not over 0.24 inches (0.82 kPa) of mercury.

The following paragraph may be deleted when test is performed on single package units at manufacturer's test facility.

* + - * 1. Upon completion of installation, and within 60 days after initial operation, conduct performance tests in presence of Director’s Representative. Correct equipment defects or performance deficiencies and repeat. Determine water flows from pressure drop across chiller, condenser, concentrator, and from pump curves. Furnish calibrated test instruments.
        2. Furnish cooling season start-up, winter season shutdown service, for first year of operation. When initial start-up and testing takes place in winter and machines are to remain inoperative, repeat start-up and testing operation at beginning of first cooling season.
      1. MANUFACTURER'S FIELD SERVICES
         1. Furnish services of factory trained representative for minimum [**one**] <**\_\_\_\_\_\_\_\_**> days to leak test, pressure test, start-up, calibrate controls, and instruct Director’s Representative on operation and maintenance.
         2. Furnish initial charge of ammonia or lithium bromide. Adjust concentration to recommended levels.
      2. DEMONSTRATION AND TRAINING
         1. Section 017000 - Execution and Closeout Requirements: Requirements for demonstration and training.
         2. Demonstrate system operations and verify specified performance.
      3. SCHEDULES

Include schedule when Project contains more than one unit. Complete schedule in conjunction with identification method used on Drawings or include schedule on Drawings. No units of measurement are indicated; these may be added to schedule legend or included within each insert. Coordinate equipment tags and abbreviations with project specific requirements.

Consider the following examples when developing Project schedule.

* + - * 1. Absorption Water Chillers Schedule:

Equipment Tag: <ACH-1>:

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

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

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

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

Unit COP (HHV) - Full Load: <**\_\_\_\_\_\_\_\_**>.

Evaporator:

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

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

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

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

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

Condenser:

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

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

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

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

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

Generator:

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

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

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

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

Entering Steam Pressure: <**\_\_\_\_\_\_\_\_**>.

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

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

Generator:

Fuel: <**\_\_\_\_\_\_\_\_**>.

Fuel Input: <**\_\_\_\_\_\_\_\_**>.

Gaseous Fuel Supply Pressure: <**\_\_\_\_\_\_\_\_**>.

Heating Hot Water: <**\_\_\_\_\_\_\_\_**>.

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

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

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

Length: <**\_\_\_\_\_\_\_\_**>.

Width: <**\_\_\_\_\_\_\_\_**>.

Height: <**\_\_\_\_\_\_\_\_**>.

Shipping Weight: <**\_\_\_\_\_\_\_\_**>.

Operating Weight: <**\_\_\_\_\_\_\_\_**>.

Clearances: <**\_\_\_\_\_\_\_\_**>.

Equipment Tag: <ACH-2>:

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

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

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

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

Unit COP (HHV) - Full Load: <**\_\_\_\_\_\_\_\_**>.

Evaporator:

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

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

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

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

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

Condenser:

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

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

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

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

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

Generator:

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

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

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

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

Entering Steam Pressure: <**\_\_\_\_\_\_\_\_**>.

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

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

Generator: <**\_\_\_\_\_\_\_\_**>.

Fuel: <**\_\_\_\_\_\_\_\_**>.

Fuel Input: <**\_\_\_\_\_\_\_\_**>.

Gaseous Fuel Supply Pressure: <**\_\_\_\_\_\_\_\_**>.

Heating Hot Water: <**\_\_\_\_\_\_\_\_**>.

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

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

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

Length: <**\_\_\_\_\_\_\_\_**>.

Width: <**\_\_\_\_\_\_\_\_**>.

Height: <**\_\_\_\_\_\_\_\_**>.

Weight:

Shipping: <**\_\_\_\_\_\_\_\_**>.

Operating: <**\_\_\_\_\_\_\_\_**>.

Clearances: <**\_\_\_\_\_\_\_\_**>.

END OF SECTION 236413