

SECTION 23 81 00

DECENTRALIZED UNITARY HVAC EQUIPMENT  
**05/18**

PART 1 GENERAL

1.1 REFERENCES

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.

JAPANESE STANDARDS ASSOCIATION (JSA)

JIS B 8607	(2008) Flare Type and Brazing Type Fittings for Refrigerants
JIS B 8615-1	(2013) Non-ducted Air Conditioners and Heat Pumps-Testing and Rating for Performance
JIS B 8616	(2015) Package Air Conditioners
JIS B 9908-1	(2019) Test Method of Air Filter Units for Ventilation and Electric Air Cleaners for Ventilation-Part 1: Technical Specifications, Requirements and Classification System Based Upon Particulate Matter Efficiency
JIS C 4212	(2010; R 2022) Low-Voltage Three-Phase Squirrel-Cage High-Efficiency Induction Motors (Amendment 1)
JIS C 9730-1	(2019) Automatic Electrical Controls-Part 1: General Requirements
JIS C 9730-2-9	(2010) Automatic Electrical Controls for Household and Similar Use-Part 2-9: Particular Requirements for Temperature Sensing Controls
JIS G 3302	(2022) Hot Dip Zinc Coated Steel Sheet and Strip
JIS H 3300	(2018) Copper and Copper Alloy Seamless Pipes and Tubes
JIS H 3401	(2001) Pipe Fittings of Copper and Copper Alloys
JIS H 8641	(2021) Hot Dip Galvanized Coatings
JIS Z 2371	(2015) Methods of Salt Spray Testing

[ PROJECT TITLE ]  
[ PROJECT LOCATION ], Japan

[ JED TECHNICAL SERVICES REFERENCE NUMBER ]

MINISTRY OF LAND, INFRASTRUCTURE, TRANSPORT AND TOURISM (MLIT)

MLIT-M

(2019) Public Building Construction  
Standard Specification

THE JAPAN REFRIGERATION AND AIR CONDITIONING INDUSTRY ASSOCIATION  
(JRAIA)

JRA Standard

Japan Refrigeration and Air Conditioning

THE JAPAN ELECTRICAL MANUFACTURERS' ASSOCIATION (JEMA)

JEM 1038

AC Electromagnetic Contactor

JEM 1167

High Voltage Electromagnetic Contactor

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval or for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Field-Assembled Refrigerant Piping

Control System Wiring Diagrams

SD-03 Product Data

Room Air Conditioners

Packaged Terminal Units

Heat Pumps, Air to Air

Air Conditioners

Training; G[, [\_\_\_\_\_]]

Posted Instructions

Spare Parts

SD-06 Test Reports

Start-Up and Initial Operational Tests

SD-07 Certificates

Service Organizations

SD-10 Operation and Maintenance Data

[ SOLICITATION NUMBER ]

SEC[CONCEPT/INTERMEDIATE/FINAL/FINAL BACKCHECK/RTA]

Operation and Maintenance Manuals; G[, [\_\_\_\_\_]]

Room Air Conditioners, Data Package 3

Packaged Terminal Units, Data Package 3

Heat Pumps, Air to Air, Data Package 3

Air Conditioners, Data Package 3

Filters, Data Package 2

Thermostats, Data Package 2

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

### 1.3 QUALITY ASSURANCE

#### 1.3.1 Modification of References

Accomplish work in accordance with the referenced publications, except as modified by this section. Consider the advisory or recommended provisions to be mandatory, as though the word "shall" had been substituted for the words "should" or "could" or "may," wherever they appear. Interpret reference to "the Authority having jurisdiction," "the Administrative Authority," "the Owner," or "the Design Engineer" to mean the Contracting Officer.

#### 1.3.2 Detail Drawing

For refrigerant piping, submit piping, including pipe sizes. Submit control system wiring diagrams.

#### 1.3.3 Safety

Design, manufacture, and installation of unitary air conditioning equipment shall conform to Japanese Refrigeration Safety Regulations (Nihon-Reitou-Hoan-Kisoku).

#### 1.3.4 Sizing

Size equipment based on MLIT-M; do not oversize.

#### 1.3.5 Ozone Depleting Substances Technician Certification

All technicians working on equipment that contain ozone depleting refrigerants must be Refrigerant Handling Technician (Reibai-Furontou-Toriatsukai-Gijutsusha) under Japan Refrigeration and Air-Conditioning Industry Association. Provide copies of technician certifications to the Contracting Officer at least 14 calendar days prior to work on any equipment containing these refrigerants.

### 1.4 REFRIGERANTS

Refrigerants must have an Ozone Depletion Potential (ODP) no greater than 0.0, with the exception of R-123. CFC-based refrigerants are prohibited. HCFCs and Halons shall not be permitted.

## 1.5 ENVIRONMENTAL REQUIREMENTS

For proper Indoor Environmental Quality, maintain positive pressure within the building. Meet or exceed filter media efficiency as tested in accordance with JIS B 9908-1.

## PART 2 PRODUCTS

### 2.1 ROOM AIR CONDITIONERS

JIS B 8616. Minimum energy efficiency ratio (EER) shall be in accordance with Room Air Conditioners: Provide units removable from inside the building for servicing without removing the outside cabinet. Construct outside cabinets, including metal grilles to protect condenser coils, of zinc-coated steel or aluminum. Steel and zinc-coated surfaces shall receive at least one coat of primer and manufacturer's standard factory-applied finish. Insulate cabinets to prevent condensation and run off of moisture. Provide mounting hardware made of corrosion-resistant material or protected by a corrosion-resistant finish. Provide air filters of the [throw-away] [or] [permanent washable] type removable without the use of tools and arranged to filter both room and ventilating air. Remove condensate by means of a drain or by evaporation and diffusion. Provide with metal or plastic mounting flanges on each side, top, and bottom of unit. For thru-the-wall installations provide aluminum or shop painted zinc-coated steel flanged telescopic wall sleeves. Design wall sleeves to restrict driving rain. For window mounted units provide shop-painted metal mounting brackets, braces, and sill plates. Mount compressors on vibration isolators. Minimum cooling capacity shall be not less than that indicated.

#### 2.1.1 Units for Operation on 100 Volts

Provide 3-wire cords of manufacturer's standard length. If not existing, provide a receptacle within reach of the standard length cord. Cords shall have a 15- or 20-amp, 3-pole, 125-volt ground type plug to match receptacle.

#### 2.1.2 Units for Operation on 200 Volts

Provide 3-wire cords of manufacturer's standard length. If not existing, provide a receptacle within reach of the standard length cord. Cords shall have a 15-, 20-, or 30-amp, 3-pole, 250-volt or manufacturer's standard ground type plug to match receptacle.

#### 2.1.3 Controls

Mount controls in cabinet. Manual controls shall permit operation of either the fan or the fan and refrigerating equipment. Fan control shall provide two fan speed settings. Automatic controls shall include a thermostat for controlling air temperature. Thermostat shall have an adjustable range, including 18 to 28 degrees C and shall automatically turn the refrigeration system on or off to maintain the preselected temperature within plus or minus 20 degrees C.

## 2.2 PACKAGED TERMINAL UNITS

### 2.2.1 Heat Pumps

JIS B 8616, air-cooled, split type; [Heat pumps shall have a minimum

energy efficiency ratio (EER) of [\_\_\_\_], or a minimum Coefficient of Performance (COP) of [\_\_\_\_], and a minimum integrated part load value (IPLV) of [\_\_\_\_].] [Provide supplemental electric resistance heaters integral with unit.] [Provide units suitable for use with minimal ductwork having a total external static resistance up to 25 Pa.]

#### 2.2.2 Air Conditioners

JIS B 8616, air-cooled, split type. Provide units with [heating only] [cooling only] [combination heating and cooling] section with indicated capacity. Minimum [seasonal] energy efficiency ratio ([S]EER) shall be [[\_\_\_\_]] [S]EER.] [Provide units suitable for use with minimal ductwork having a total external static resistance up to 25 Pa.]

#### 2.2.3 Indoor Noise Rating

Rate in accordance with Japanese manufacturer's standard ratings. Indoor rating shall not exceed [\_\_\_\_] bels while entire unit is operating at any fan or compressor speed.

#### 2.2.4 Wall Sleeves and Mounts

Provide manufacturer's standard wall sleeves and mounts. Wall sleeves shall have seals designed to restrict driving rain and wind. [Provide unit subbase of the same construction and finish as the sleeve to provide for concealed electrical connection, cord storage, and equipped with unit leveling legs.] [Provide subbase with 24-volt remote control circuitry and wall mounted thermostat.]

#### 2.2.5 Heating Section for Air Conditioners

- a. Electric Coils: Electric resistance heating elements with high temperature-limit safety device, factory-mounted, and wired to chassis.
- b. Hot Water Coils: Serpentine type constructed of seamless copper tubes with aluminum fins mechanically or hydraulically bonded to tubes. Provide factory-furnished tee and manual air vent on return connection. Factory test coils at twice maximum operating pressure.
- c. Steam Coils: Serpentine type constructed of red brass or seamless copper tubes with JIS H 3300 mechanically or hydraulically bonded to tubes. Factory test coils at twice the maximum operating pressure.
- d. Heating unit shall have non-flammable and non-combustible manufacturer's standard insulations.

#### 2.2.6 Refrigeration Sections

Completely self-contained, slide-in assembly or removable chassis with welded, hermetically sealed, air-cooled refrigeration system, outdoor fan, indoor fan, control box, and ventilation damper. Provide refrigeration sections capable of installation or removal without the use of tools. Refrigeration sections shall include refrigeration circuit tubing, wiring, and safety controls, and shall operate down to 2 degrees C outdoor temperature and 21 degrees C indoor temperature, without compressor short cycling while delivering not less than 100 percent of rated cooling capacity. Units shall have drains to the building exterior to eliminate excess driving rain. Condensate shall not drain onto building exterior or interior.

- a. Compressors: Hermetic type with vibration isolation devices.
- b. Coils: Constructed of seamless copper or aluminum tubing with copper or aluminum fins bonded to tubes. [Coat outdoor air coils with factory applied corrosion resistant treatment. Coils to be coated shall be part of manufacturer's standard product for capacities and ratings indicated and specified. Provide plate type fins.]
- c. Outdoor Fans: Direct connected centrifugal type with aluminum or plastic wheel and forward curved blades or direct connected aluminum propeller type. Design fans so that condensate will evaporate without drip, splash, or spray on building exterior.
- d. Indoor Fans: Direct connected centrifugal type with aluminum, galvanized steel, or plastic wheel and forward curved blades. Provide minimum two-speed motor with built-in overload protection.

#### 2.2.7 Ventilation Damper Assembly

Operated by automatic actuator. Dampers shall close on unit shutdown or loss of power and shall open on heating or cooling start-up.

#### 2.2.8 Air Filters

Removable without use of tools, and shall filter both recirculated and ventilating air.

#### 2.2.9 Controls

Provide controls including, an adjustable thermostat, and switches, to regulate room air temperature through control of refrigerant compressors or heating elements. Controls shall at least have positions for off, high or low fan speed for [heating] [and] [cooling], and fan only operation. [Provide remote mounted night set-back thermostat.]

### 2.3 HEAT PUMPS, AIR TO AIR

Provide factory assembled units complete with accessories, wiring, piping, and controls. Provide units with [outlet grilles.] [supplemental electric heaters.] [humidifiers.] [air filters as specified in the paragraph FILTERS.]

#### 2.3.1 Energy Performance

[Energy performance shall be in accordance with JIS B 8615-1. ][Heat pumps shall have [a minimum [seasonal] energy efficiency ratio ([S]EER) of [\_\_\_\_\_,] [a minimum Heating Seasonal Performance Factor (HSPF) of [\_\_\_\_\_,] [[\_\_\_\_\_.]]].

#### 2.3.2 Air Coils

Extended-surface fin and tube type with seamless copper or aluminum tubes with copper or aluminum fins securely bonded to the tubes. On coils with all-aluminum construction, provide tubes of aluminum alloy provide fins of aluminum alloy and provide tube sheets of aluminum alloy. [Provide a coating on [outdoor air] [and] [indoor air] coils as specified in the paragraph COATINGS FOR FINNED TUBE COILS. Coils to be coated shall be part of manufacturer's standard product for capacities and ratings

indicated and specified. Provide plate type fins.]

#### 2.3.3 Supplemental Electric Heaters

Provide electrical resistance heaters [integral with the unit] [for remote installation in ductwork]. Heaters shall have a total capacity as indicated. Provide internal fusing for heaters.

#### 2.3.4 Compressors

For compressors above 70 kW, compressor speed shall not exceed 3450 rpm. For equipment over 35 kW, provide automatic capacity reduction of at least 50 percent of rated capacity. Capacity reduction may be accomplished by cylinder unloading, use of multiple, but not more than four compressors, or a combination of the two methods. Units with cylinder unloading shall start with capacity reduction devices in the unloaded position. Units with multiple compressors shall have a means to sequence starting of compressors. Provide compressors with devices to prevent short cycling when shutdown by safety controls. Provide reciprocating compressors with crankcase heaters, and vibration isolators.

#### 2.3.5 Mounting Provisions

Provide units that permit mounting as indicated. [Provide suitable lifting attachment plates to enable equipment to be lifted to normal position.]

#### 2.3.6 Temperature Controls

Provide controls as specified in JIS B 8615-1 and as modified herein. Provide indoor thermostats of the adjustable type that conform to applicable requirements of JIS C 9730-1 and JIS C 9730-2-9. Provide manual means for temperature set-back. Provide thermostats capable of controlling supplemental heat as specified in JIS B 8615-1.

#### 2.3.7 Accessories

In addition to accessories specified in JIS B 8615-1, provide the following accessories for heat pump units.

- a. Protective grille around outside unit coils
- b. Start capacitor kit

### 2.4 AIR CONDITIONERS

#### 2.4.1 Split-System Type

Provide separate assemblies designed to be used together. Base ratings on the use of matched assemblies. Units shall have a minimum [SEER] [EER] of [\_\_\_\_\_] when tested in accordance with JIS B 8616 or JIS B 8615-1 as applicable. Provide capacity, electrical characteristics and operating conditions as indicated. Condensers shall provide not less than 10 degrees F liquid subcooling at standard ratings.

#### 2.4.2 Single Zone Units

Provide single zone type units arranged to [draw] [or] [blow] through coil sections. [Air may be blown or drawn through heating section.]

#### 2.4.3 Multizone Units

Provide multizone type units arranged to [blow through the cooling and heating sections] [draw through the cooling and heating sections] [blow through the individual cooling and heating coils of each zone].

#### 2.4.4 Heaters

Provide as [an integral part of the evaporator-blower unit] [a separate unit for installation in the duct work]. Provide [steam coils] [hot water coils] [gas heaters] [oil heaters] [electric open coils] [electric strip tubular heaters] [electric fin tubular heaters].

#### 2.4.5 Compressors

For compressors over 70 kW, compressor speed shall not exceed 3450 rpm. For systems over 35 kW provide automatic capacity reduction of at least 50 percent of rated capacity. Capacity reduction may be accomplished by cylinder unloading, use of multi- or variable speed compressors, use of multiple, but not more than four compressors, or a combination of the two methods. Units with cylinder unloading shall start with capacity reduction devices in the unloaded position. Units with multiple compressors shall have means to sequence starting of compressors. Provide compressors with devices to prevent short cycling when shut down by safety controls. Device shall delay operation of compressor motor for at least 3 minutes but not more than 6 minutes. Provide a pumpdown cycle for units 70 kW and over. Provide reciprocating compressors with crankcase heaters in accordance with the manufacturer's recommendations. If compressors are paralleled, provide not less than two independent circuits.

#### 2.4.6 Coils

On coils with all-aluminum construction, provide tubes of aluminum alloy; provide fins of aluminum alloy and provide tube sheets of aluminum alloy. Provide a separate air cooled condenser circuit for each compressor or parallel compressor installation. [Provide a coating on [condenser] [and] [evaporator] coils and fins as specified in the paragraph COATINGS FOR FINNED TUBE COILS. Coils to be coated shall be part of manufacturer's standard product for capacities and ratings indicated and specified. Provide plate type fins.]

#### 2.4.7 Condenser Controls

Provide start-up and head pressure controls to allow for system operation at ambient temperatures down to [\_\_\_\_\_] degrees C.

#### 2.4.8 Fans

Provide belt-driven evaporator fans with adjustable pitch pulleys; except for units less than 17 1/2 kW capacity, direct drive with at least two speed taps may be used. Select pulleys at approximately midpoint of the adjustable range.

#### 2.4.9 Filters

Provide filters of the type specified in this section.

#### 2.4.10 Filter Boxes

Provide when filters are not included integral with air conditioning units. Construct of not less than No. 20 US gage steel with track, hinged access doors with latches, and gaskets between frame and filters. Arrange filters to filter outside and return air. Provide removable filter assemblies, replaceable without the use of tools.

#### 2.4.11 Mixing Boxes

Provide of the physical size to match the basic unit and include equal sized flanged openings, sized to individually handle full air flow. Arrange openings as indicated. Provide openings with dampers of parallel or opposed blade type. Provide opposed blade type for modulating dampers and parallel type for two-position dampers. Connect damper shafts together by one continuous linkage bar. Arrange dampers for [automatic] [or] [manual] operation so that when one starts to close from its opened position, the other starts to open from its closed position.

#### 2.4.12 Thermostats

Provide adjustable type that conforms to applicable requirements of JIS C 9730-1 and JIS C 9730-2-9. Provide combination heating-cooling type with contacts hermetically sealed against moisture, corrosion, lint, dust, and foreign material. Design to operate on not more than 0.83 degrees C differential and of suitable range calibrated in degrees C. Provide adjustable heat anticipation and fixed cooling anticipation. Provide two independent temperature sensing elements electrically connected to control the compressor and heating equipment, respectively. Accomplish manual switching for system changeover from heating to cooling or cooling to heating and fan operation through the use of a thermostat subbase. Provide system selector switches to provide "COOL" and "OFF" and "HEAT" and fan selector switches to provide "AUTOMATIC" and "ON." Provide relays, contactors, and transformers located in a panel or panels for replacement and service.

##### 2.4.12.1 Cooling

- a. When thermostat is in "COOL" position with fan selector switch in "AUTO" position, compressor, evaporator fan, and condenser fan shall cycle together.
- b. When thermostat is in "COOL" position with fan selector switch in "ON" position, compressor, and condenser fan shall cycle together and evaporator fan shall run continuously.

##### 2.4.12.2 Heating

- a. When thermostat is in "HEAT" position with fan selector switch in "AUTO" position, heater and supply air fan shall cycle together. Provide a separate thermostat to keep the fan running until the heater cools.
- b. When thermostat is in "HEAT" position with fan selector switch in "ON" position, heater shall cycle and supply air fan shall run continuously.

##### 2.4.12.3 Supply Air Fan

- a. When fan selector switch is in "AUTO" position with thermostat in

- "OFF" position, fan shall not run.
- b. When fan selector switch is in "ON" position, fan shall run continuously.

## 2.5 FILTERS

Provide filters to filter outside air and return air and locate [as indicated] [inside air conditioners] [inside filter box] [inside combination air filter mixing box]. Provide [replaceable (throw-away)] [high efficiency] [cleanable (reusable)] type. Filters shall conform to JIS B 9908-1. Polyurethane filters shall not be used on units with multiframe filters.

### 2.5.1 Replaceable Type Filters

Throw-away frames and media, standard dust holding capacity, 1.79 m/s maximum face velocity, and [ 25 mm] [ 50 mm] thick. Filters shall be in accordance with JIS B 9908-1.

### 2.5.2 High Efficiency Filters

Filters shall have a 99.97% efficiency on 0.30 pm particle when tested in accordance with JIS B 9908-1. Filter assembly shall include; holding frame and fastener assembly, filter cartridge, mounting frame, and retainer assembly. Reinforce filter media with glass fiber mat. Pressure drop across clean filter shall not exceed [\_\_\_\_\_] Pa gage. Precede high efficiency filters with a replaceable type filter.

### 2.5.3 Cleanable Type Filters

Provide sufficient oil to coat filters six times based on one pint of oil per each 0.93 square meter of filter area. Provide washing and charging tanks for cleaning and coating filters. Filters shall be in accordance with JIS B 9908-1.

### 2.5.4 Manometers

Provide inclined-type manometers for filter stations of 944 L/s capacity or larger including filters furnished as integral parts of air-handling units and filters installed separately. Provide sufficient length to read at least 250 Pa with 10 major graduations, and equipped with spirit level. Equip manometers with overpressure safety traps to prevent loss of fluid, and two three-way vent valves for checking zero setting. [Mercury shall not be used as the operating fluid.]

## 2.6 COATINGS FOR FINNED TUBE COILS

Where stipulated in equipment specifications of this section, coat finned tube coils of the affected equipment as specified below. Apply coating at the premises of a company specializing in such work. Degrease and prepare for coating in accordance with the coating applicator's procedures for the type of metals involved. Completed coating shall show no evidence of softening, blistering, cracking, crazing, flaking, loss of adhesion, or "bridging" between the fins.

### 2.6.1 Phenolic Coating

Provide a resin base thermosetting phenolic coating. Apply coating by

immersion dipping of the entire coil. Provide a minimum of two coats. Bake or heat dry coils following immersions. After final immersion and prior to final baking, spray entire coil with particular emphasis given to building up coating on sheared edges. Total dry film thickness shall be 0.064 to 0.076 mm.

#### 2.6.2 Chemical Conversion Coating with Polyelastomer Finish Coat

Dip coils in a chemical conversion solution to molecularly deposit a corrosion resistant coating by electrolysis action. Cure conversion coating at a temperature of 43 to 60 degrees C for a minimum of 3 hours. Coat coil surfaces with a complex polymer primer with a dry film thickness of 0.025 mm. Cure primer coat for a minimum of 1 hour. Using dip tank method, provide three coats of a complex polyelastomer finish coat. After each of the first two finish coats, cure the coils for 1 hour. Following the third coat, spray a fog coat of an inert sealer on the coil surfaces. Total dry film thickness shall be 0.064 to 0.076 mm. Cure finish coat for a minimum of 3 hours. Coating materials shall have 300 percent flexibility, operate in temperatures of minus 46 to plus 104 degrees C, and protect against atmospheres of a pH range of 1 to 14.

#### 2.6.3 Vinyl Coating

Apply coating using an airless fog nozzle. For each coat, make at least two passes with the nozzle. Materials to be applied are as follows:

Total dry film thickness, 0.165 mm maximum.

Vinyl Primer, 24 percent solids by volume: One coat 0.051 mm thick

Vinyl Copolymer, 30 percent solids by volume: One coat 0.114 mm thick.

### 2.7 MOTORS AND STARTERS

JIS C 4212 or JEM 1038, and JEM 1167. Variable speed. Motors less than 3/4 kW shall meet JIS C 4212 requirements. Motors 3/4 kW and larger shall meet JIS C 4212 requirements. Determine specific motor characteristics to ensure provision of correctly sized starters and overload heaters. Provide motors to operate at full capacity with a voltage variation of plus or minus 10 percent of the motor voltage rating. Motor size shall be sufficient for the duty to be performed and shall not exceed its full load nameplate current rating when driven equipment is operated at specified capacity under the most severe conditions likely to be encountered. When motor size provided differs from size indicated or specified, the Contractor shall make the necessary adjustments to the wiring, disconnect devices, and branch circuit protection to accommodate equipment actually provided. [Provide reduced voltage type motor starters.] Provide [general-purpose] [weather-resistant] [watertight] [explosion proof] type starter enclosures.

### 2.8 REFRIGERANT PIPING AND ACCESSORIES

Provide accessories as specified in [JIS B 8615-1 and] this section. Provide suction line accumulators as recommended by equipment manufacturer's installation instructions. [Provide a filter-drier in the liquid line.]

#### 2.8.1 Factory Charged Tubing

Provide extra soft, deoxidized, bright annealed copper tubing conforming to JIS H 3300, factory dehydrated and furnished with a balanced charge of refrigerant recommended by manufacturer of equipment being connected. Factory insulate suction line tubing with 9.52 mm minimum thickness of closed cell, foamed plastic conforming to manufacturer's standard close cell foamed plastic material with a permeance rating not to exceed 1.0. Provide quick-connectors with caps or plugs to protect couplings. Include couplings for suction and liquid line connections of the indoor and outdoor sections.

#### 2.8.2 Field-Assembled Refrigerant Piping

Material and dimensional requirements for field-assembled refrigerant piping, valves, fittings, and accessories shall conform to in accordance with Japanese Refrigeration Safety Regulations (Nihon-Reitou-Hoan-Kisoku) for Japanese product and JIS H 3300 and JIS B 8607, except as herein specified. Factory clean, dehydrate, and seal piping before delivery to the project location. Provide seamless copper tubing, hard drawn, Type K or L, conforming to JIS H 3300, except that tubing with outside diameters of 6.35 mm and 9.52 mm shall have nominal wall thickness of not less than 7.62 mm and 0.81 mm, respectively. Soft annealed copper tubing conforming to JIS H 3300 may be used where flare connections to equipment are required only in nominal sizes less than one inch outside diameter.

#### 2.8.3 Fittings

JIS H 3401 for solder-joint fittings. Recommended by manufacturer for flared tube fittings.

#### 2.8.4 Pipe Hangers and Supports

Pipe hangers and supports shall be in accordance with MLIT-M.

#### 2.8.5 Pipe Sleeves

Provide sleeves where piping passes through walls, floors, roofs, and partitions. Secure sleeves in proper position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, floors, roofs, and partitions. Provide not less than 6.35 mm space between exterior of piping or pipe insulation and interior of sleeve. Firmly pack space with insulation and caulk at both ends of the sleeve with plastic waterproof cement which will dry to a firm but pliable mass, or provide a segmented elastomeric seal.

##### 2.8.5.1 Sleeves in Masonry and Concrete Walls, Floors, and Roofs

Provide Schedule 40 or Standard Weight zinc-coated steel pipe sleeves. Extend sleeves in floor slabs 80 mm above finished floor.

##### 2.8.5.2 Sleeves in Partitions and Non-Masonry Structures

Provide zinc-coated steel sheet sleeves having a nominal weight of not less than 4.39 kg per square meter, in partitions and other than masonry and concrete walls, floors, and roofs.

## 2.9 FINISHES

Provide steel surfaces of equipment including packaged terminal units, heat pumps, and air conditioners, that do not have a zinc coating conforming to JIS H 8641, JIS G 3302 or a duplex coating of zinc and paint, with a factory applied coating or paint system. Provide a coating or paint system on actual equipment identical to that on salt-spray test specimens with respect to materials, conditions of application, and dry-film thickness.

## 2.10 SOURCE QUALITY CONTROL

### 2.10.1 Salt-Spray Tests

Salt-spray test the factory-applied coating or paint system of equipment including packaged terminal units, heat pumps, and air conditioners in accordance with JIS Z 2371.

## 2.11 MANUFACTURER'S STANDARD NAMEPLATES

Major equipment including compressors, condensers, receivers, heat exchanges, fans, and motors must have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the item of equipment. Plates must be durable and legible throughout equipment life. Plates must be fixed in prominent locations.

## PART 3 EXECUTION

### 3.1 EQUIPMENT INSTALLATION

Install equipment and components in a manner to ensure proper and sequential operation of equipment and equipment controls. Install equipment not covered in this section, or in manufacturer's instructions, as recommended by manufacturer's representative. Provide proper foundations for mounting of equipment, accessories, appurtenances, piping and controls including, but not limited to, supports, vibration isolators, stands, guides, anchors, clamps and brackets. Foundations for equipment shall conform to equipment manufacturer's recommendation, unless otherwise indicated. Set anchor bolts and sleeves using templates. Provide anchor bolts of adequate length, and provide with welded-on plates on the head end embedded in the concrete. Level equipment bases, using jacks or steel wedges, and neatly grout-in with a nonshrinkage type of grouting mortar. Locate equipment to allow working space for servicing including shaft removal, disassembling compressor cylinders and pistons, replacing or adjusting drives, motors, or shaft seals, access to water heads and valves of shell and tube equipment, tube cleaning or replacement, access to automatic controls, refrigerant charging, lubrication, oil draining and working clearance under overhead lines. Provide electric isolation between dissimilar metals for the purpose of minimizing galvanic corrosion.

#### 3.1.1 Packaged Terminal Air Conditioners and Heat Pumps

Wall sleeve installation shall provide a positive weathertight and airtight seal.

#### 3.1.2 Unitary Air Conditioning System

Install as indicated, in accordance with requirements in accordance with Japanese Refrigeration Safety Regulations (Nihon-Reitou-Hoan-Kisoku) for

Japanese product, and the manufacturer's installation and operational instructions.

### 3.1.3 Room Air Conditioners

Install units in accordance with manufacturer's instructions. Provide structural mountings, closures, and seals for weathertight assembly. Pitch unit as recommended by manufacturer to ensure condensate drain to drain pan without overflow.

## 3.2 PIPING

Brazing, bending, forming and assembly of refrigerant piping shall conform to JIS H 3300 and JIS B 8607.

### 3.2.1 Pipe Hangers and Supports

Design and fabrication of pipe hangers, supports, and welding attachments shall conform to MLIT-M. Installation of hanger types and supports for bare and covered pipes shall conform to MLIT-M. Unless otherwise indicated, horizontal and vertical piping attachments shall conform to MLIT-M.

### 3.2.2 Refrigerant Piping

Cut pipe to measurements established at the site and work into place without springing or forcing. Install piping with sufficient flexibility to provide for expansion and contraction due to temperature fluctuation. Where pipe passes through building structure pipe joints shall not be concealed, but shall be located where they may be readily inspected. Install piping to be insulated with sufficient clearance to permit application of insulation. Install piping as indicated and detailed, to avoid interference with other piping, conduit, or equipment. Except where specifically indicated otherwise, run piping plumb and straight and parallel to walls and ceilings. Trapping of lines will not be permitted except where indicated. Provide sleeves of suitable size for lines passing through building structure. Braze refrigerant piping with silver solder. Inside of tubing and fittings shall be free of flux. Clean parts to be jointed with emery cloth and keep hot until solder has penetrated full depth of fitting and extra flux has been expelled. Cool joints in air and remove flame marks and traces of flux. During brazing operation, prevent oxide film from forming on inside of tubing by slowly flowing dry nitrogen through tubing to expel air. Make provisions to automatically return oil on halocarbon systems. Installation of piping shall comply with JIS H 3300 and JIS B 8607.

### 3.2.3 Returning Oil From Refrigerant System

Install refrigerant lines so that gas velocity in the evaporator suction line is sufficient to move oil along with gas to the compressor. Where equipment location requires vertical risers, line shall be sized to maintain sufficient velocity to lift oil at minimum system loading and corresponding reduction of gas volume. Install a double riser when excess velocity and pressure drop would result from full system loading. Larger riser shall have a trap, of minimum volume, obtained by use of 90- and 45-degree ells. Arrange small riser with inlet close to bottom of horizontal line, and connect to top of upper horizontal line. Do not install valves in risers.

### 3.2.4 Refrigerant Driers, Sight Glass Indicators, and Strainers

Provide refrigerant driers, sight glass liquid indicators, and strainers in refrigerant piping in accordance with [this section] when not furnished by the manufacturer as part of the equipment. Install driers in liquid line with service valves and valved bypass line the same size as liquid line in which dryer is installed. Size of driers shall be determined by piping and installation of the unit on location. Install dryers of 820 mL and larger vertically with the cover for removing cartridge at the bottom. Install moisture indicators in the liquid line downstream of the drier. Indicator connections shall be the same size as the liquid line in which it is installed. These devices shall be provided as optional accessories.

### 3.2.5 Strainer Locations and Installation

Locate strainers close to equipment they are to protect. Provide a strainer in common refrigerant liquid supply to two or more thermal valves in parallel when each thermal valve has a built-in strainer. Install strainers with screen down and in direction of flow as indicated on strainer's body.

### 3.2.6 Solenoid Valve Installation

Install solenoid valves in horizontal lines with stem vertical and with flow in direction indicated on valve. If not incorporated as integral part of the valve, provide a strainer upstream of the solenoid valve. Provide service valves upstream of the solenoid valve, upstream of the strainer, and downstream of the solenoid valve. Remove the internal parts of the solenoid valve when brazing the valve.

## 3.3 AUXILIARY DRAIN PANS, DRAIN CONNECTIONS, AND DRAIN LINES

Provide auxiliary drain pans under units located above finished ceilings or over mechanical or electrical equipment where condensate overflow will cause damage to ceilings, piping, and equipment below. Provide separate drain lines for the unit drain and auxiliary drain pans. Trap drain pans from the bottom to ensure complete pan drainage. Provide drain lines full size of drain opening. Traps and piping to drainage disposal points shall conform to Section 22 00 00 PLUMBING, GENERAL PURPOSE.

### 3.4 ACCESS PANELS

Provide access panels for concealed valves, controls, dampers, and other fittings requiring inspection and maintenance.

### 3.5 AIR FILTERS

Allow access space for servicing filters. Install filters with suitable sealing to prevent bypassing of air. Perform and document that proper Indoor Air Quality During Construction procedures have been followed; this includes providing documentation showing that after construction ends, and prior to occupancy, new filters were provided and installed.

### 3.6 IDENTIFICATION TAGS AND PLATES

Provide equipment, gages, thermometers, valves, and controllers with tags numbered and stamped for their use. Provide plates and tags of brass or suitable nonferrous material, securely mounted or attached. Provide

minimum letter and numeral size of 3.18 mm high.

### 3.7 FIELD QUALITY CONTROL

#### 3.7.1 Leak Testing

Upon completion of installation of air conditioning equipment, test factory- and field-installed refrigerant piping with an electronic-type leak detector. Use same type of refrigerant to be provided in the system for leak testing. When nitrogen is used to boost system pressure for testing, ensure that it is eliminated from the system before charging. Minimum refrigerant leak field test pressure shall be as specified in accordance with Japanese Refrigeration Safety Regulations (Nihon-Reitou-Hoan-Kisoku) for Japanese standard. If leaks are detected at time of installation or during warranty period, remove the entire refrigerant charge from the system, correct leaks, and retest system.

#### 3.7.2 Evacuation, Dehydration, and Charging

After field charged refrigerant system is found to be without leaks or after leaks have been repaired on field-charged and factory-charged systems, evacuate the system using a reliable gage and a vacuum pump capable of pulling a vacuum of at least 133 Pa absolute. Evacuate system in accordance with the triple-evacuation and blotter method or in accordance with equipment manufacturer's printed instructions and recharge system.

#### 3.7.3 Start-Up and Initial Operational Tests

Test the air conditioning systems and systems components for proper operation. Adjust safety and automatic control instruments as necessary to ensure proper operation and sequence. Conduct operational tests for not less than 8 hours.

#### 3.7.4 Performance Tests

Upon completion of evacuation, charging, startup, final leak testing, and proper adjustment of controls, test the systems to demonstrate compliance with performance and capacity requirements. Test systems for not less than 8 hours, record readings hourly. At the end of the test period, average the readings, and the average shall be considered to be the system performance.

### 3.8 TRAINING

Conduct a training course for the operating staff as designated by the Contracting Officer. The training period must consist of a total [8] [\_\_\_\_] hours of normal working time and start after the system is functionally completed but prior to final acceptance tests.

- a. Submit a schedule, at least [2] [\_\_\_\_] weeks prior to the date of the proposed training course, which identifies the date, time, and location for the training.
- b. Submit the field 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 must 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 must be framed under glass or laminated plastic and be posted where indicated by the Contracting Officer.

- c. The posted instructions must cover all of the items contained in the approved operation and maintenance manuals as well as demonstrations of routine maintenance operations. [Submit [6] [\_\_\_\_\_] complete copies of an operation manual in bound 216 by 279 booklets listing step-by-step procedures required for system startup, operation, abnormal shutdown, emergency shutdown, and normal shutdown at least [4] [\_\_\_\_\_] weeks prior to the first training course. The booklets must include the manufacturer's name, model number, and parts list. The manuals must include the manufacturer's name, model number, service manual, and a brief description of all equipment and their basic operating features.]
- d. Submit [6] [\_\_\_\_\_] complete copies of maintenance manual in bound 216 by 279 mm booklets listing] routine maintenance procedures, possible breakdowns and repairs, and a trouble shooting guide. The manuals must include piping and equipment layouts and simplified wiring and control diagrams of the system as installed.

### 3.9 MAINTENANCE

#### 3.9.1 EXTRA MATERIALS

Submit spare parts data for each different item of equipment specified, after approval of detail drawings and not later than [2] [\_\_\_\_\_] months prior to the date of beneficial occupancy. Include in the data a complete list of parts and supplies, with current unit prices and source of supply, a recommended spare parts list for 1 year of operation, and a list of the parts recommended by the manufacturer to be replaced on a routine basis.

#### 3.9.2 Maintenance Service

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

-- End of Section --