UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2026
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RELOCATABLE BUILDING UNITS (RLB)

05/24

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USACE / NAVFAC / AFCEC **UFGS-13 34 23.12 10 (May 2024)**

Preparing Activity: USACE **New**

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SECTION 13 34 23.12 10

RELOCATABLE BUILDING UNITS (RLB)
05/24

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NOTE: This guide specification covers the performance, material, and production requirements for Relocatable Building (RLB) units, which are habitable prefabricated structures that are developed and manufactured to be readily moved (transportable over public roads), erected, disassembled, stored, and reused. Excluded from this specification are tension fabric structures assembled from modular components and air supported structures.

Adhere to UFS 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).

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PART 1 GENERAL

1.1 REFERENCES

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NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date,

and title.

Use the Reference Wizard's Check Reference feature when you add a Reference Identifier (RID) outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

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The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL, INC. (AMCA)

AMCA 99	(2016) Standards Handbook
AMCA 201	(2002; R 2011) Fans and Systems
AMCA 210	(2025) Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating
AMCA 211	(2013; Rev 2017) Certified Ratings Program Product Rating Manual for Fan Air Performance
AMCA 300	(2014) Reverberant Room Method for Sound Testing of Fans
AMCA 301	(2014) Methods for Calculating Fan Sound Ratings from Laboratory Test Data
AMCA CRP	(Online) Directory of Products Licensed Under the AMCA International Certified Ratings Program

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI 210/240	(2023) Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment
AHRI 460	(2024) Performance Rating of Remote Mechanical-Draft Air-Cooled Refrigerant COndensers

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA)

ABMA 9	(2015; R 2020; Errata 2026) Load Ratings and Fatigue Life for Ball Bearings
ABMA 11	(2014; R 2020) Load Ratings and Fatigue Life for Roller Bearings

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 360	(2022) Specification for Structural Steel Buildings

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.22/CSA 4.4	(2015; R 2025) Relief Valves for Hot Water Supply Systems

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

ASHRAE 15 & 34	(2022) ASHRAE Standard 34-2016 Safety Standard for Refrigeration Systems/ASHRAE Standard 34-2016 Designation and Safety Classification of Refrigerants-ASHRAE Standard 34-2016
ASHRAE 52.2	(2025) Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size
ASHRAE 90.1 - IP	(2019) Energy Standard for Buildings Except Low-Rise Residential Buildings
ASHRAE 90.1 - SI	(2019) Energy Standard for Buildings Except Low-Rise Residential Buildings

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A112.6.1M	(1997; R 2017) Floor Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use
ASME A112.6.3	(2022) Floor Drains
ASME A112.14.1	(2003; R 2017; R 2022) Backwater Valves
ASME A112.19.2/CSA B45.1	(2024) Standard for Vitreous China Plumbing Fixtures and Hydraulic Requirements for Water Closets and Urinals
ASME A112.19.3/CSA B45.4	(2022) Stainless Steel Plumbing Fixtures

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1003	(2020) Performance Requirements for Water Pressure Reducing Valves for Domestic Water Distribution Systems - (ANSI approved 2010)
ASSE 1012	(2023) Performance Requirements for Backflow Preventer with an Intermediate Atmospheric Vent
ASSE 1013	(2021) Performance Requirements for Reduced Pressure Principle Backflow

Prevention Assemblies

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA M14	(2024) Manual: Recommended Practice for Backflow Prevention and Cross-Connection Control

AMERICAN WELDING SOCIETY (AWS)

AWS A5.1/A5.1M	(2025) Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding
AWS D1.1/D1.1M	(2025) Structural Welding Code - Steel
AWS D1.3/D1.3M	(2025) Structural Welding Code - Sheet Steel

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	(2024) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A924/A924M	(2022a) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM B117	(2025) Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM B766	(2023) Standard Specification for Electrodeposited Coatings of Cadmium
ASTM C534/C534M	(2025) Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
ASTM C564	(2026) Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM D2564	(2020; R 2024) Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D2855	(2020; R 2024) Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets
ASTM D3138	(2004; R 2016) Standard Specification for Solvent Cements for Transition Joints Between Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Non-Pressure Piping Components

ASTM D3311	(2017) Standard Specification for Drain, Waste, and Vent (DWV) Plastic Fittings Patterns
ASTM E1	(2014; R 2025) Standard Specification for ASTM Liquid-in-Glass Thermometers
ASTM E84	(2026) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E119	(2026) Standard Test Methods for Fire Tests of Building Construction and Materials
ASTM E136	(2026) Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 °C
ASTM F409	(2022) Standard Specification for Thermoplastic Accessible and Replaceable Plastic Tube and Tubular Fittings
ASTM F493	(2022; R 2026) Standard Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings

BRITISH STANDARDS INSTITUTION (BSI)

BS 1363-1	(2023) 13 A Plugs, Socket-Outlets, Adaptors and Connection Units Part 1
BS 1363-2	13 A Plugs, Socket-Outlets, Adaptors and Connection Units Part 2
BS 7671	(2018) Requirements for Electrical Installations
BS EN 13121-3	(2016) GRP Tanks and Vessels for Use Above Ground — Part 3: Design and Workmanship

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

ANSI/BHMA A156.1	(2025) Butts and Hinges

CSA GROUP (CSA)

CSA B45.5-17/IAPMO Z124	(2017; Errata 2017; Errata 2018) Plastic Plumbing Fixtures

EUROPEAN UNION (EU)

Directive 2011/65/EU	(2011) Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment
EN 1990 Eurocode	(2023) Basis of Structural and

	Geotechnical Design
EN 1991 Eurocode	(2005; AMD: Jan 2011) Actions on Structures - Part 1-4
EN 1993 Eurocode	(2023) Design of Steel Structures
EN 1997 Eurocode	(2010; AMD: Jul 2014) Geotechnical Design
EN 1998 Eurocode	(2005; AMD: may 2013) Design of Structures for Earthquake Resistance
EN 1999 Eurocode	(2023) Design of Aluminum Structures

ILLUMINATING ENGINEERING SOCIETY (IES)

IES Lighting Library	IES Lighting Library

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2023; ERTA 1 2023; ERTA 2-3 2025) National Electrical Safety Code

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC	(2024) International Building Code
ICC IPC	(2024) International Plumbing Code
IPC D330	(1992) Design Guide Manual

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(2025) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

IEC 60884-1	(2022) PLugs and Socket-Outlets for Household and Similiar Purposes - Part 1: General Requirements
IEC 60947-4-1	(2023; Corr 1 2026) Low-voltage Switchgear and Controlgear, Part 4-1: Contactors and Motor Starters - Electromechanical Contactor and Motor Starters
IEC 62053-22	(2020) Electricity Metering Equipment (A.C.) - Particular Requirements - Part 22: Static Meters for Active Energy (Classes 0,2 S and 0,5 S)

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58	(2025) Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM AMP 500	(2006) Metal Finishes Manual
NAAMM HMMA 861	(2014) Guide Specifications for Commercial Hollow Metal Doors and Frames
NAAMM HMMA 863	(2014) Guide Specifications for Detention Security Hollow Metal Doors and Frames

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 1	(2022) Standard for Industrial Control and Systems: General Requirements
NEMA ICS 2	(2000; R 2020) Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated 600 V
NEMA ICS 6	(1993; R 2016) Industrial Control and Systems: Enclosures
NEMA MG 00001	(2024) Motors and Generators
NEMA WD 1	(1999; R 2020) Standard for General Color Requirements for Wiring Devices
NEMA WD 6	(2021) Wiring Devices Dimensions Specifications

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2026; TIA 26-1; ERTA 26-1; TIA 26-2; TIA 26-3; TIA 26-4; TIA 26-5; TIA 26-6; TIA 26-7; ERTA 26-2; ERTA 26-3) National Electrical Code
NFPA 72	(2025; TIA 25-1; TIA 25-2; TIA 25-3; TIA 25-4; ERTA 25-1; ERTA 25-2) National Fire Alarm and Signaling Code
NFPA 101	(2024) Life Safety Code
NFPA 780	(2026) Standard for the Installation of Lightning Protection Systems

RUBBER MANUFACTURERS ASSOCIATION (RMA)

RMA IP-20	(2007) Specifications for Drives Using Classical V-Belts and Sheaves. Specifications for A, B, C, and D Cross Sections
RMA IP-22	(2007) Specifications for Drives Using Narrow V-Belts and Sheaves (Joint RMA/MPTA), 4th Edition

STEEL DOOR INSTITUTE (SDI/DOOR)

SDI/DOOR A250.8	(2023) Specifications for Standard Steel Doors and Frames

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 1-201-01	(Digital Version) Non-Permanent DoD Facilities in Support of Military Operations
UFC 3-301-01	(Digital Version) Structural Engineering

U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT (HUD)

24 CFR 3280	(2019) Manufactured Home Construction and Safety Standards

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 82	Protection of Stratospheric Ozone
PL 109-58	Energy Policy Act of 2005 (EPAct05)

UL SOLUTIONS (UL)

UL 20	(2025) UL Standard for Safety General-Use Snap Switches
UL 67	(2018; Reprint Aug 2025) UL Standard for Safety Panelboards
UL 174	(2004; Reprint Nov 2024) UL Standard for Safety Household Electric Storage Tank Water Heaters
UL 580	(2006; Reprint Apr 2024) UL Standard for Safety Tests for Uplift Resistance of Roof Assemblies
UL 723	(2018; Reprint Jun 2025) UL Standard for Safety Test for Surface Burning Characteristics of Building Materials
UL 1449	(2021; Reprint Oct 2025) UL Standard for Safety Surge Protective Devices
UL 1699	(2025) UL Standard for Safety Arc-Fault Circuit-Interrupters
UL 1995	(2015; Reprint Aug 2022) UL Standard for Safety Heating and Cooling Equipment
UL Fire Resistance	(2026) Fire Resistance Directory (Product IQ)

1.2 GENERAL REQUIREMENTS

1.2.1 Relocatable Building Type Options

RLB units and the final assembled facilities must comply with UFC 1-201-01. The Facility Level is [Temporary][Semi-Permanent] as defined in UFC 1-201-01. Provide structural designer's qualifications, electrical designer's qualifications, mechanical designer's qualifications, fire protection designer's qualifications, RLB manufacturer qualifications. In addition provide erection plan, erection procedures, qualifications of installer and shipping, handling, and storage for each RLB type. The list below defines the define RLB Types (areas are nominal, not actual):

a. RLB Type A: Single 14.8 square meters 160 SF units that can be connected together for use as billeting or as an administrative space.

b. RLB Type B: Two 14.8 square meters 160 SF units for use as latrine, shower, and shave (LSS) units. Total of 29.7 square meters 320 SF. These units are to be ground level only.

c. RLB Type C: Single 14.8 square meters 160 SF units for laundry uses. These units are to be ground level only.

d. RLB Type D: Four connected 14.8 square meters 160 SF units to create a 59.5 square meters 640 SF pod. This pod is for medical related uses including health and dental clinics. (Risk category 2.) These units are to be ground level only.

e. RLB Type E: Four connected 14.8 square meters 160 SF units to create a 59.5 square meters 640 SF pod. This pod is for medical related units complying with Emergency Risk category 4. These units are to be ground level only

f. RLB Type F: Four connected 14.8 square meters 160 SF units to create a 59.5 square meters 640 SF pod. This pod is for general types of assembly uses, such as MWR, religious assembly, open space admin, fitness centers, DFAC, and others.

1.2.2 Use of Euro Codes

The following Eurocodes may be used for design: EN 1990 Eurocode; EN 1991 Eurocode; EN 1993 Eurocode; EN 1997 Eurocode; EN 1998 Eurocode; EN 1999 Eurocode; and Directive 2011/65/EU.

1.2.3 Construction Configuration

Are to be single level rectangular configuration. Non-combustible construction in accordance with UFC 1-201-01, except that, for some delivery orders, the Government may require that the Contractor build combustible RLB units in accordance with the Government's own design, which will be required to comply with UFC 1-201-01 as combustible RLB units. Adhere to the following:

a. Use of Spray Plastic Foam Insulation (SPFI) is not allowed. Use of pre-insulated panels (with any surface – metal, wood, plastic or other) containing foam insulation is not allowed.

b. Provide minimum clear height from finished floor to underside of

ceiling assembly no less than 2134 mm84 inches clear ceiling height.

c. Provide a uniform prefinished exterior. The Contracting Officer will select exterior and interior colors from the manufacturer's proposed color offerings.

d. Types A and F are to be capable of being stacked, two high, directly on top of each other.

e. Vertical circulation between stacked units is to be accommodated by the use of independent self-supporting exterior stairs, handrails and railing assemblies that are code compliant and field installed.

f. Units must be able to be joined together to create any of the five RLB types indicated.

g. Provide units with a method to level and plumb that will be manually adjustable with durable support pads, if needed. Restraint anchor systems, if used, must be corrosion resistant.

h. A sound transmission coefficient (STC) of no less than 25.

i. Provide concealed blocking for accessories mounting devices, and do not have screws, nails or bolts penetrating the interior.

j. Fasteners and connections are to have galvanized coating to reduce corrosion and requires no maintenance.

k. Pre-assemble units in the factory and confirm components, including walls, floor, doors and roof are built square and plumb and fit together per design intent.

1.2.4 Components

Components are to be metric standard. Individual components, as shipped, cannot exceed 90.72 kg </Met>200 lbs in weight and be able to be picked up and handled and assembled by able bodied military personnel. The unit and the unit's individual components must be capable of being shipped in standard ISO intermodal containers. Components are to be able to be assembled or disassembled without the use of custom tools.

1.2.5 Interior

Utility systems are to be developed, located, and manufactured to be easily, simply, and quickly connected to the RLB unit's exterior face surface. Adhere to the following:

a. Plumbing will not be permitted on the second floor of stacked RLB facilities.

b. Conduits, if used, for wiring and cables may be exposed on walls and ceiling.

c. Provide electric breaker panel, energy efficient LED light fixtures, and outlets.

d. Provide fire, phone, data conduits and wiring.

1.2.6 Basic Module Interior Envelope

The basic module interior envelope size is limited to no larger than 2300 mm92 inches wide by 5900 mm233 inches long by 2300 mm92 inches high. The minimum requirements for insulation are: Floors R-11+ insulation; Walls R-20+ insulation; Roof and ceilings of lower level stacked units R-40 insulation.

1.2.7 Fire Protection and Life Safety

Provide egress in accordance with UFC 1-201-01. Emergency lighting and exit signs, are to be provided at each facility in accordance with NFPA 101. Provide emergency lighting and exit sign operating and maintenance manuals.

Fire alarm/detection systems conduits are to be marked for their use in accordance with NFPA 72 and NFPA 101. Installation is to be done in the most economical and efficient way.

1.2.8 Structural Performance

Units are to be structurally sound and capable of withstanding the effects of self-weight gravity loads, and the loads and stresses listed in the following paragraph, within the limits and conditions indicated.

a. Guy wires are not permitted.

b. Use Risk Category II, except for Unit Type E which will be assigned Risk Category IV, unless otherwise required by UFC 1-201-01.

c. Comply with UFC 1-201-01.

Permanently mark each component to ensure correct coordination with each envelope. Provide each shipping container with a packing list that is readily visible upon opening the container and indicates how many containers are included in the shipment.

1.2.8.1 Floor Live Loads

Module floor framing systems must be in accordance with UFC 3-301-01. The minimum uniform live load will be 4.8 kPa100 psf.

1.2.8.2 Roof Live Loads

Facility roof framing systems must be in accordance with UFC 3-301-01 and be able to support equipment and materials. The minimum uniform live load for single level units will be 0.96 kPa20 psf.

1.2.8.3 Collateral Loads

Include an additional dead load of 0.50 kPa10 psf to roof loads, other than the weight of the facility building system. Wall framing must be capable of supporting an additional point load of 11 kg24 lbs at wall face to account for shelves or equipment.

1.2.8.4 Wind Loads

Facility structural elements, including components and cladding and main wind force resisting systems, must be in accordance with UFC 3-301-01 using the following minimum criteria: Exposure Category C, Basic Wind

Speed 177 kph110 mph for single and stacked units.

1.2.8.5 Seismic

Single and stacked RLB facilities will be capable of withstanding the effects of earthquake motions determined in accordance with UFC 3-301-01 using the following minimum criteria: Ss 0.57, S1 0.27.

1.2.8.6 Load Combinations

RLB facilities must be able to withstand the most critical effects of load factors and load combinations as required by UFC 3-301-01.

1.2.8.7 Load Application

RLB units must support the worst-case loading conditions assuming units are stacked two high and connected side-by-side or connected side-by-side. Each unit will be able to support dead, live wind, seismic, and collateral loads assuming the worst-case position.

1.2.8.8 Deflection Limits

RLB units must be in accordance with UFC 3-301-01 with regard to deflection limitations. RLB facilities must withstand design loads with deflections no greater than the following:

a. Floor and Roof Framing: vertical deflection of 1/360 of the span.

b. Wall Framing: horizontal deflection of 1/240 of the span.

c. Wall Cladding: horizontal deflection of 1/180 of the span.

1.2.8.9 Thermal Movements

Provide cladding systems that allow for thermal movements resulting from the maximum change (range) in ambient and surface temperatures, 67 degrees C120 degrees F ambient and 100 degrees C180 degrees F material surfaces, preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculations on the surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1.2.8.10 Wind-Uplift Resistance

Provide roof cladding assemblies that comply with UL 580 for Class 60.

1.2.8.11 Foundation Design

The foundation will be designed for a soil bearing capacity of 72 kPa1,500 PSF, [_____].

1.2.9 Heating, Ventilating, and Air Conditioning (HVAC)

****
NOTE: Base selection on the project location with the most extreme temperature.
****

1.2.9.1 HVAC Units

HVAC units are to be able to operate in an ambient temperature of [50 degrees C122 degrees F],[-6.67 degrees C-20degrees F],[_____] and have a seasonal energy efficiency ratio of 16 or greater.

1.2.9.2 Service Labeling

Label equipment with labels made of self-sticking, non-corrosive metal designed for permanent installation. Labels are to be in accordance with the typical examples below:

SERVICE	LABEL AND TAG DESIGNATION
Ductless Mini Split	SU-XXX [_____](Indoor Portion); CU-XXX [_____](Outdoor Portion)
Control and instrument air	CONTROL AND INSTR.
Exhaust Fan Number	EF-XXX [_____]

1.2.9.3 Prevention of Corrosion

Protect metallic materials against corrosion. Manufacturer is to provide rust-inhibiting treatment for components exposed to ambient atmosphere and standard finish for the equipment enclosures for a minimum of ten years. Do not use aluminum in contact with earth, and where connected to dissimilar metal. Protect aluminum by approved fittings, barrier material, or treatment. Ferrous parts such as anchors, bolts, braces, boxes, bodies, clamps, fittings, guards, nuts, pins, rods, shims, thimbles, washers, and miscellaneous parts not of corrosion-resistant steel or nonferrous materials are to be hot-dip galvanized in accordance with ASTM A123/A123Mfor exterior locations and cadmium-plated in conformance with ASTM B766 for interior locations.

1.2.9.4 Asbestos Prohibition

Do not use asbestos and asbestos-containing products, or other hazardous material.

1.2.9.5 Ozone Depleting Substances Used as Refrigerants

Minimize releases of Ozone Depleting Substances (ODS) during repair, maintenance, servicing or disposal of appliances containing ODS's by complying with applicable sections of 40 CFR 82, Subpart F as though every project site were located in the United States. The use of R-22 refrigerant for HVAC systems is expressly prohibited. Persons conducting repair, maintenance, servicing or disposal of equipment containing refrigerants must comply with the following:

a. Do not knowingly vent or otherwise release into the environment, Class I or Class II substances used as a refrigerant.

b. Do not open appliances without meeting the requirements of 40 CFR 82, regarding required practices for evacuation and collection of refrigerants, and 40 CFR 82, regarding standards of recycling and recovery equipment.

c. Only persons who comply with 40 CFR 82, regarding technician certification, can conduct work on appliances containing refrigerant.

1.2.10 Electrical Systems

1.2.10.1 General

Except as noted otherwise, electrical work is to comply with 24 CFR 3280, Subpart I. Additionally, RLB modules are to have a [UL certificate of compliance] Certificate of Inspection as described in the UL White Book for Prefabricated Buildings (QRAR), Commercial and Industrial Prefabricated Buildings and Units (QRXA) or [CE conformite Europeenne]equivalent.

1.2.10.2 Compliance with Codes

[Option 1: 50Hz system. Relocatable Building Units connected to [415/240], [400/230], or [380/220], 50 Hz power systems will comply with the electrical requirements of BS EN 13121-3, BS 7671 and internationally recognized host nation electrical code for the region installed. In addition, the 50 Hz power system will comply with article 545 and article 550 of NFPA 70 as applicable. If there is a conflict BS 7671 will take precedence over other codes listed above. Electrical material and equipment is to be IEC manufactured and type-tested by an independent testing laboratory. The independent testing laboratory must be certified by the Worldwide System for Conformity Testing and Certification of Electrotechnical Equipment and Components (IECEE). Contractor is to supply product-specific testing certification and IECEE certification for IEC manufactured equipment. After construction submittals are to be sent to USACE, product-specific certificates will be verified with the independent testing agency. Material tested and marked by a Nationally Recognized Testing Laboratory (NRTL), such as Underwriters Laboratories (UL) or Canadian Standards Association (CSA) may be used in lieu of IEC-manufactured, type-tested material as long as the material/equipment is rated for use at the system voltage and frequency.]

[Option 2: 60Hz system. Relocatable Building Units connected to [120], [120/240], [208/120], or [208/480] 60 Hz systems will comply with NFPA 70. Electrical material and equipment will be tested and marked by a Nationally Recognized Testing Laboratory (NRTL), such as Underwriters Laboratories (UL) or Canadian Standards Association (CSA). After construction submittals are to be sent to USACE, product-specific certificates will be verified with the independent testing agency.]

1.2.11 Minimum Expected Service Life

The minimum expected service life for RLB units is 15 years from the date of acceptance by the Government, and subsequent to initial assembly, the erected RLB units will be able to be disassembled and re-deployed to other sites a minimum of 3 times within that time span without degradation. Ensure manufacturer supplied documentation is sufficiently detailed such that untrained personnel will be able to perform assembly activities. RLB components (to include fixtures, equipment, accessories, or related items.) are to be new, free of defects, and meet minimum quality standards.

1.3 SUBMITTALS

****

NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals

required for the project. The Guide Specification technical editors have classified those items that require Government approval, due to their complexity or criticality, with a "G." Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a "G" to an item if the submittal is sufficiently important or complex in context of the project.

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy and Air Force projects.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

****

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Structural Designer's Qualifications; G, [_____]

Electrical Designer's Qualifications; G, [_____]

Mechanical Designer's Qualifications; G, [_____]

Fire Protection Designer's Qualifications; G, [_____]

Rlb Manufacturer Qualifications; G, [_____]

Qualifications Of Installer; G, [_____]

SD-02 Shop Drawings

Detail Drawings; G, [_____]

Erection Plan; G, [_____]

Luminaire Drawings

Structural Shop Drawings; G, [_____]

Panelboards; G, [_____]

Cable Trays; G, [_____]

Grounding And Bonding; G, [_____]

SD-03 Product Data

UL Certificate Of Compliance

Ce Conformite Europeenne

Luminaire Warranty; G, [_____]

Catalog Data; G, [_____]

Toilet Enclosures; G, [_____]

Air-Conditioning Systems; G, [_____]

Heating And Ventilating Units; G, [_____]

Circuit Breakers; G, [_____]

Receptacles (Socket-Outlets); G, [_____]

Cable Tray Design; G, [_____]

Light Sources; G, [_____]

Light Source; G, [_____]

Led Drivers; G, [_____]

Emergency Drivers; G, [_____]

Emergency Lighting Egress Units; G, [_____]

Exit Signs; G, [_____]

Switches; G, [_____]

Wire And Cable; G, [_____]

Surge Protection Device (SPD); G, [_____]

SD-04 Samples

Roof Panels, 304.8 mm 12 inches long by actual panel width; G, [_____]

Wall Panels, 304.8 mm 12 inches long by actual panel width; G, [_____]

Fasteners; G, [_____]

Manufacturer's Color Charts and Chips, 101.6 mm by 101.6 mm 4 by 4 inches; G, [_____]

Flooring Systems; G, [_____]

Exterior Panel Finish Material; G, [_____]

Luminaire Samples; G, [_____]

SD-05 Design Data

Lateral Force Calculations; G, [_____]

Photometric Plan; G, [_____]

Interior Finishes Scheme; G, [_____]

Structural Calculations; G, [_____]

SD-06 Test Reports

Mill Test Reports; G, [_____]

Ansi/Ies Lm-79 Test Report; G, [_____]

Ansi/Ies Lm-80 Test Report; G, [_____]

Ansi/Ies Tm-21 Test Report; G, [_____]

Ansi/Ies Tm-30 Test Report; G, [_____]

Emergency Light Test; G, [_____]

600-Volt Wiring Test; G, [_____]

Ground-Fault Receptacle Test; G, [_____]

Arc-Fault Receptacle Test; G, [_____]

Grounding System Test; G, [_____]

SD-07 Certificates

Manufacturer Qualifications; G, [_____]

SD-08 Manufacturer's Instructions

Shipping, Handling, and Storage; G, [_____]

Erection Procedures; G, [_____]

SD-10 Operation and Maintenance Data

Emergency Lighting And Exit Sign Operating And Maintenance Manuals

Electrical System; G, [_____]

SD-11 Closeout Submittals

Manufacturer's Warranty; G, [_____]

Installer's Warranty; G, [_____]

1.4 QUALITY ASSURANCE

1.4.1 Welding

Qualify procedures and personnel for welding according to AWS A5.1/A5.1M, AWS D1.1/D1.1M, and AWS D1.3/D1.3M or Euro code equivalent.

1.4.2 Structural Steel

Comply with AISC 360, for design requirements and allowable stresses.

1.4.3 Fire-Resistance Ratings

Where indicated, provide materials identical to those of assemblies tested for fire resistance per ASTM E119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency. Indicate design designations from UL Fire Resistance or from the listings of another qualified testing agency. Combustion Characteristics must conform to ASTM E136.

1.4.4 Surface-Burning Characteristics

Provide materials having material with Class A fire ratings. The surface-burning characteristics must be determined by testing identical products according to ASTM E84by a qualified testing agency. Identify products with appropriate markings of applicable testing agency showing:

a. Flame-Spread Index: 25 or less.

b. Smoke-Developed Index: 450 or less.

1.4.5 Fabrication

Fabricate and finish roof, floor, and wall components and accessories at the factory, by manufacturer's standard procedures and processes to fulfill indicated performance requirements.

1.4.6 Finishes

Comply with NAAMM AMP 500 for recommendations for applying and designating finishes. Appearance of finished work with noticeable variations in same piece is not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved samples and are assembled or installed to minimize contrast.

1.4.7 Plumbing

1.4.7.1 Regulatory Requirements for Plumbing

Plumbing work will be in accordance UFC 1-201-01. Energy consuming products and systems will be in accordance with [PL 109-58], [ASHRAE 90.1 - SI], or [ASHRAE 90.1 - IP].

1.4.7.2 Accessibility of Equipment

Install work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible.

1.4.8 Mechanical Systems

Provide manufacturer's certificate of compliance, evidence of conformance to [UL certificate of compliance][or][CE conformite Europeenne]. Also submit detail drawings in accordance with Section 23 30 00 HVAC AIR DISTRIBUTION.

1.4.9 Electrical

Provide manufacturer's certificate of compliance, evidence of conformance to [UL certificate of compliance][or][CE Conformite Europeenne], detail drawings and calculations in accordance with UFC 1-201-01 APPENDIX A-3, Luminaire Drawings, and photometric plan in accordance with Section 26 56 00 EXTERIOR LIGHTING.

1.4.10 Interior Finishes

Interior wall and ceiling finish materials will be classified for fire performance and smoke development in accordance with ICC IBC Section 803.1.1 or 803.1.2, except as shown in Sections 803.2 through 803.13. Materials tested in accordance with Section 803.1.2 will not be required to be tested in accordance with Section 803.1.1.

Interior wall and ceiling finish materials are to be classified in accordance with ASTM E84 or UL 723. Such interior finish materials must be classified in the flame spread and smoke-developed index. Class A, flame spread index 0-25; smoke developed index 0-450.

1.5 WARRANTY

Provide material and workmanship warranties meeting specified requirements. Provide revision or amendment to standard manufacturer warranty as required to comply with the specified requirements. Provide a manufacturer's warranty that has no dollar limit, covers full system water-tightness, durability and workmanship that has a minimum duration of [15][_____] years.

1.5.1 Manufacturer's Warranty

****

NOTE: Consult with the end user regarding desired length of warranty. The following is general guidance to facilitate the warranty discussion and decision. Facilities containing sensitive equipment or operations require a warranty of not less than 15 years. Designer may specify 1, 5 or 10 year manufacturer warranty on facilities of minor importance or where the length of use is less than 15 years.

****

Furnish the manufacturer's no-dollar-limit materials and assembly workmanship warranty for the following:

a. Structure - including structural components, fasteners, moisture and thermal protection, exterior finishes, roof, doors, and windows.

b. Interior - including finishes, flooring, walls, and ceiling.

c. Electrical system - including panelboards, circuit breakers, lighting fixtures, wiring, electrical and electronic devices.

d. Mechanical- Heating ventilation and air conditioning system - including components, systems, and devices.

e. Plumbing systems - Provide Luminaire warranty in accordance with Section 26 51 00 INTERIOR LIGHTING, and Section 26 56 00 EXTERIOR LIGHTING for Panelboards, circuit breakers, wiring, electrical and electronic devices in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

f. Communication Systems-including wiring, data outlets, tray system and communication racks.

Write the warranty directly to the Government to commence at the time of the Government's acceptance of the work. The warranty must state that:

a. If within the warranty period listed materials, as installed at the factory or supplied by the manufacturer for field installation becomes non-functional, shows evidence of moisture intrusion within the assembly, splits, tears, cracks, delaminates, separates at the seams, shrinks, or shows evidence of excessive weathering due to defective materials or installation workmanship, the repair or replacement of the defective and damaged materials and correction of defective workmanship is the responsibility manufacturer. The manufacturer is responsible for costs associated with the repair or replacement work.

b. When the manufacturer or its approved repair agent fails to perform the repairs within 72 hours of notification or ship repair parts within 48 hours, emergency temporary repairs performed by others will not void the warranty.

1.5.2 Installer's Warranty

The installer must warrant for a period equal to the manufacturer warranty that the installation and minor construction procured under this contract are free from defects in installation workmanship, to include the structures maintaining level, field installed items. The work warranted includes site civil work performed, and specifically includes a warranty that structures installed will remain level (aligned with a horizontal plane and plumb with the vertical plane). Write the warranty directly to the Government. The installer is responsible for correction of defective workmanship and replacement of materials damaged or adversely affected by installation or construction workmanship. The installer is responsible for costs associated with the repair or replacement work.

1.5.3 Continuance of Warranty

Approve repair or replacement work that occurs within the warranty period and accomplish repairs in a manner so as to ensure or restore, as required, the applicability of the Manufacturer's Warranty for the remainder of the warranty period. The Contractor is obligated to pass these warranty requirements through to RLB manufacturers and installers or suppliers of minor construction services under this Contract, and it guarantees obligations to the Government under subparagraph Warranty.

1.6 MAINTENANCE

1.6.1 Electrical System

Submit operation and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA and as specified herein. Submit operation and maintenance manuals for electrical systems that provide basic data relating to the design, operation, and maintenance of the electrical distribution system for the building. Include the following:

a. Single line diagram of the "as-built" building electrical system.

b. Schematic diagram of electrical control system (other than HVAC, covered elsewhere).

c. Manufacturers' operating and maintenance manuals on active electrical equipment.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Provide standard products (i.e. commercial off the shelf RLB components not specially manufactured for use in this contract) such as hardware, interior finishes, fixtures, and equipment that have been in satisfactory commercial or industrial use. Damaged products will not be accepted. Floors, ceilings, partitions, walls and wall bases will have a smooth, hard, nonabsorbent surface assembly. Interior finishes will have a light colored semi-gloss finish. Provide manufacturer qualifications, interior finishes scheme, and catalog data.

The types of interior finishes selected can not impact the ability of the units to be disassembled and relocated.

2.1.1 Shower Assemblies

Provide 915 mm36 inches by 915 mm36 inches enclosed shower assemblies with individual control valves for hot and cold water. Provide an internal gravity drain system with single above floor exit through exterior wall of unit. Provide method of producing sufficient hot water for all showers to run simultaneously for 10 minutes with no decrease in water flow or change in temperature. Shower assemblies are to provide a means of obscuring the view of the occupant within the shower and between adjacent showers. Plumbing is to be surface mounted, protected, and accessible.

The interior of the shower assembly unit is to resist mold and mildew growth, be easily sanitized, waterproof and have durable surface. The floor is to be slip resistant, reinforced, and sloped to drain.

2.1.2 Latrine Accessories

Accessories such as [grab bars], [paper dispensers], [toilet paper roll holder], [soap dishes], [soiled feminine hygiene products receptacle], [___ _]provided on or within walls, are to be installed and sealed to protect structural elements from moisture and mold. Accessories are to be stainless steel.

2.1.3 Laundry Drains

Washing machines and sinks are to drain into a continuous trench drain sized to accommodate load, sloped to drain and have one code compliant exit from RLB. Size trench drain to accommodate simultaneous drain of all washing machines and sinks.

2.1.4 Lavatory Drains

Lavatories are to be wall hung and have a clear working space of not less than 915 mm36 inches in front and comply with paragraph SHOWER DRAINS and have one code compliant exit from RLB.

2.1.5 Flooring Systems

Floor cavities are to be insulated with flame retardant insulation in accordance with 24 CFR 3280. Floors, ceilings, partitions, walls and wall bases are to have a smooth, hard, nonabsorbent surface assembly and be free of sharp, pointed, or jagged edges. Floor thickness may be thicker to accommodate shower drains and sloped base.

2.1.6 Exterior Walls, Roof, and Underside of RLB Facilities

Prefinished non-corrosive metal or fiberglass sheathing assembly compliant with UL Fire Resistance one hour fire resistant rating. Wall assembly be a waterproof and a vermin proof assembly. Spray-foam insulation is prohibited. Roof assembly is to be insulated with flame retardant insulation in accordance with 24 CFR 3280. Provide the roof with positive drainage to the exterior edge without ponding. Two-story unit assemblies are to be designed to be square, plumb, and attached to the unit below. Provide samples for exterior panel finish material, manufacturer's color charts and chips, roof panels, wall panels, fasteners.

2.1.7 Doors

2.1.7.1 Interior Doors

Doors are to be tight evenly fitting to the jamb, head, and threshold. When in an open position, interior doors are to remain stationary. Each door is to be an industry standard 915 mm36 inches by 2032 mm80 inches by 44 mm1.75 inches insulated prefinished hollow metal door with a minimum RSI-0.6 (R3.5) rated insulation.

Door assemblies are to comply with NAAMM HMMA 861 and NAAMM HMMA 863 and be SDI/DOOR A250.8 certified. Pre-hung door and frame is to be rated for high use and moderate impact resistance, and frame is to be 14 gauge minimum with a consistent frame profile. Door assemblies are to be equipped with three silencers per leaf.

2.1.7.2 Exterior Doors

Each door is to be an industry standard 915 mm36 inches by 2032 mm80 inches by 44 mm1.75 inches insulated prefinished hollow metal door with a minimum RSI-0.6 (R3.5) rated insulation. Door assemblies are to comply with NAAMM HMMA 861 and NAAMM HMMA 863 and be SDI/DOOR A250.8 certified or equivalent. Provide exterior door and frame assembly.

Pre-hung door and frame is to be rated for high use and moderate Impact resistance, frame is to be 14 gauge minimum and have a consistent frame

profile. Exit doors are to have a threshold and be fully weather stripped and have a protective rain shield at door head.

2.1.7.3 Door Hardware

Door Hardware is to be appropriate Grade 1 hardware compliant or equivalent with 08 71 00 DOOR HARDWARE, ANSI/BHMA A156.1, SDI and NFPA. The hardware set is to consist of the following:

a. 1 ½ pair Hinges #A5111.

b. 1 each lockset, Grade 1, Locksets are to be cipher combination locks or an approved equal with levers and key override at all building entrances.

c. Combination or approved equal.

d. 1 each door closer #C02061.

e. 1 each threshold #J32130.

[2.1.7.4 Keys and Locksets

[Provide labeled matching keys, hardware schedules for each RLB unit type, a master key system, five extra keys, and for each five RLB units, a lockable prefinished metal key cabinet sized to accommodate the extra keys for five RLB units regardless of type.]

[Exterior door hinges and lock sets are to be stainless steel with BHMA 630 finish. Interior door hinges are to be steel with BHMA 600 finish.][Exterior door assembly is to comply with wall rating and have compliant hardware and locksets installed with a 62 mm2.75 inch backset.]

]2.1.7.5 Water Closet (Toilet) Partitions

Each water closet is to occupy a separate compartment with non-corrosive privacy partitions and a lockable door enclosing the fixtures to ensure privacy. Compartments clear interior dimension is to be no less than 915 mm36 inches wide by 1820 mm60 inches deep. Door is to have one robe hook and gravity, stainless steel piano 14 gauge, cam close hinges. Provide toilet enclosures.

Solid Phenolic Core Partitions and door assemblies are to have a high-pressure matte surface finish as an integral part of the core material and have structural integrity to resist deflection, warping, cracking or spalling.

2.1.8 Ice and Water Shield

Roof perimeter edges and all exterior penetrations (e.g. doors, vents, lighting, and power outlets) are to be equipped with ice and water shields and sealant.

2.2 STRUCTURAL

2.2.1 Floor and Roof Framing

The floor and roof framing are to meet the requirements of UFC 1-201-01. Floor framing is to be spaced according to the span limitations of the

floor decking. Splicing of the floor framing is not acceptable. A framing member is to be placed around the entire perimeter of the RLB facility floor. Provide structural shop drawings, mill test reports, and structural calculations including lateral force calculations.

2.2.2 Floor Decking

The floor decking is to meet the requirements of UFC 1-201-01. The decking is to be placed perpendicular to the joist span. All decking must be installed and secured so that the ends terminate on structural members for proper securing.

2.2.3 Exterior Walls

The exterior wall framing must meet the requirements of UFC 1-201-01.

2.3 HEATING, VENTILATION, AND AIR CONDITIONING (HVAC)

2.3.1 Energy Efficient Equipment

Exhaust fans and ductless mini splits are to comply with the energy efficiency requirements in UFC 1-201-01, local law, and local building codes.

2.3.2 HVAC Identification Plates

In addition to standard manufacturer's identification plates, provide engraved laminated phenolic identification plates for each piece of mechanical equipment. Identification plates are to designate the function of the equipment. Letters are to be upper case.

2.3.3 Indoor Air Quality

Provide equipment and components that comply with the requirements of UFC 1-201-01 unless more stringent requirements are specified.

2.3.3.1 Ventilation Air

Ventilation air is to be supplied to each room in accordance with UFC 1-201-01 unless more stringent requirements are specified.

2.3.3.2 Latriney Exhaust

Provide exhaust in accordance with UFC 1-201-01 unless more stringent requirements are specified. Exhaust is to be continuous or interlocked with a light switch. Use of a sensible heat recovery unit is to be investigated to determine if they are life cycle cost effective when the 1.0 percent dry bulb occurrence exceeds 32 degrees C90 degrees F or when the 99 percent dry bulb temperature occurrence is less than 10 degrees C 50 degrees F.[Paragraph SENSIBLE HEAT RECOVERY UNIT.]

[A cross-flow, air-to-air (z-duct) heat exchanger must recover the heat in the exhaust and supply air streams. Z-ducts must be constructed entirely of sheet metal.]

2.3.4 Air Systems Equipment

2.3.4.1 Exhaust Fans

2.3.4.1.1 General Performance, Component, and Other Requirements

Fans must have certified performance ratings as evidenced by conformance to the requirements of AMCA 211, and must be listed in AMCA CRP, or must be currently eligible for such listing. Fans must generally be in accordance with AMCA 99 unless superseded by other requirements stated elsewhere herein. Determine performance data for fans in accordance with AMCA 210. Select fans to minimize the exposure of personnel working in or occupying the immediate installation area. The total sound power level of the fan tests must not exceed 85 dBA when tested per AMCA 300 and rated per AMCA 301, or it must be provided with an appropriate attenuation device or devices. Scheduled fan performance is the performance required under specified or indicated installation conditions with specified or indicated accessories. The net installed air performance of the fan, with accessories/appurtenances in place, must be sufficient to meet the scheduled performance within the limits of the fan rating certification tolerance.

Affix the manufacturer's product identification nameplate to each unit. Apply additional requirements for specific service or generic type or class of fan. If non-uniform air flow conditions are likely to be encountered, contact the fan manufacturer to ensure that the fan is rated for the additional fan inlet and outlet effect. Install fans to minimize fan system effect in accordance with AMCA 201. Fans must be listed in the Directory of Products licensed to use AMCA seal.

2.3.4.1.2 Bearings and Lubrication

****
NOTE: Sleeve type bearings are to be specified or indicated on drawings where low noise levels as outlined in Section 23 35 19.00 20 INDUSTRIAL VENTILATION AND EXHAUST SECTION are required.
****

Precision anti-friction or sleeve type with provisions for self-alignment and for radial and thrust loads imposed by the service. Provide water-cooled bearings where required for the service or recommended by the manufacturer.

****
NOTE: Select one of the following: Continuous 8-hour service 20,000, Continuous 24-hour service 40,000, Continuous 24-hour service 80,000 (extreme reliability).
****

2.3.4.1.3 Anti-friction Bearings

Constructed of steel alloys with a certified L-10 minimum rated life of [20,000][40,000][80,000] hours under load conditions imposed by the service. Rated and selected in accordance with ABMA 9 and ABMA 11. Provide with dust-tight seals for environment and lubricant pressures encountered; cast ferrous metal housing, bolted-split pillow block type where located within fan casings; grease lubricated with provisions to

prevent overheating due to excess lubricant; surface ball check type grease supply fittings. Provide manual or automatic grease pressure relief fittings visible from normal maintenance locations. Include lubrication extension tubes where required to facilitate safe maintenance during operation and fill tubes with lubricant prior to equipment operation. Prelubricated, sealed, anti-friction bearings, which conform to above specified materials and L-10 life requirements, may be provided for fans requiring less than 0.37 kW1/2 horsepower.

2.3.4.1.4 Sleeve Bearings

Premounted, self-aligning, continuous oil supply, single or double ring lubricated, insert type, with provisions for shaft expansion and such thrust as may be imposed by service loads. Provide water cooling for shaft surface speed exceeding 6.1 m/s1200 feet per minute. Provide each sleeve bearing with approximately than 473 ml16 ounce capacity constant level oiler and oil level gage. Include on sleeve bearing submittal data: Bearing manufacturing source, type, lubricant, clearances, "L/D" ratio, antifriction metal, belt angle, shaft speed, shaft critical speed, Brinell hardness at journal, and shaft surface finish at journal in micro-inches.

2.3.4.1.5 Motors and Motor Starters

Power (kW)	Voltage (V)	Type Starter
Up to 5 1/2	208-230	Across-the-line magnetic
5 1/2 to 11 delta	208-230	Across-the-line magnetic part winding or wye
11 to 22 3/8 delta	400-460	Across-the-line magnetic part winding or wye
Above 11	208-230	Part winding or wye delta
Above 22 1/2	400-460	Part winding or wye delta

Motor (HP)	Voltage (V)	Type Starter
Up to 7 1/2	208-230	Across-the-line magnetic
7 1/2 to 15 delta	208-230	Across-the-line magnetic part winding or wye
15 to 30 delta	400-460	Across-the-line magnetic part winding or wye
Above 15	208-230	Part winding or wye delta
Part winding or wye delta	400-460	Part winding or wye delta

Conform to NEMA MG 00001, NEMA ICS 1, and NEMA ICS 2. Motors less than 0.75 kWone hp must meet NEMA High Efficiency requirements. Motors 0.75 kW one hp and larger must meet NEMA Premium Efficiency requirements. Motors are not to exceed 1800 rpm, unless otherwise indicated, and must be variable-speed, [[open] [drip proof] enclosure] [totally enclosed fan cooled] [explosion proof] type. Provide [manual] [magnetic-across-the-line] [reduced voltage] [part-winding] [wye-delta]

type motor starters with [general-purpose NEMA 1] [weather resistant NEMA 3R] [watertight NEMA 4] [moisture and dust tight NEMA 12] enclosure in accordance with NEMA ICS 6. Provide single-phase motors with inherent thermal overload protection with manual reset. Provide three-phase motors with thermal overload protection in the control panel. Provide permanently lubricated or grease-lubricated ball or roller bearings; auxiliary lubrication and relief fittings on outside of fan casing; arrange grease lines to minimize pressure on bearing seals. Motor power must not be less than brake power required with blades set at maximum pitch angle at the air delivery from the indicated amount down to 50 percent.

2.3.4.1.6 Guards and Screens

Construct guards and screens to provide, as applicable, required strength and clearance with minimal reduction in free area at fan inlets and discharges. Cooling access panels for tachometer readings ease of sectional disassembly for maintenance and inspection functions where guard total weight exceeds 22.70 kg50 pounds. Weather protection where components are weather exposed. Installed guards and screens must not negate noise control and vibration isolation provisions.[For burn protection, insulate surfaces when service temperatures exceed 60 degrees C 140 degrees F.]

2.3.4.1.7 Fan Drives

Direct or V-belt type as appropriate. V-belt drives must conform to RMA IP-20 and RMA IP-22. Drives must be applied in accordance with the manufacturer's published recommendations, unless specified otherwise. Base power rating of a V-belt drive on maximum pitch diameter of sheaves. Provide classical belt section adjustable sheave type, with a minimum service factor of 1.5 for drives with motors rated up to and including 22 kW30 hp. Provide classical section or narrow section, fixed sheave or adjustable sheave type with a minimum 1.5 service factor for drives with motors rated over 22 kW30 hp. Provide at least two belts for drives with motors rated one hp and above.

2.3.4.1.8 Sheaves

Statically and dynamically balanced, machined cast ferrous metal or machined carbon steel, bushing type, secured by key and keyway. Pitch diameter or fixed sheaves and adjustable sheaves, when adjusted to specified limits, are to be no less than recommended by NEMA MG 00001. Select adjustable sheaves that provide the required operating speed with the sheave set at midpoint of its adjustment range. The adjustment range for various size and type belts must be: 16 percent, minimum for Classical section belts; 12 percent, minimum for Narrow section belts. Belt deflection in adjustable sheave drives must not exceed 1 1/2 degrees. Provide companion sheaves for adjustable sheave drives with wide groove spacing to match driving sheaves, except that standard fixed pitch spacing may be used for all two-through-four groove drives whose center-to-center dimensions exceed the following: "A" and "B" Section 406 mm16 inches, "C" Section 635 mm25 inches, "D" Section 915 mm36 inches. Furnish endless, static dissipating, oil-resistant, synthetic cloth or filament reinforced elastomer construction belts.

2.3.4.2 Mini-Split-System Air Conditioners [Heat Pumps] (Not Exceeding 11 kW40,000 Btu/Hr)

A remote condensing unit includes both the condensing coil and the compressor. A remote condenser includes only the condensing coil. Air-cooled, water-cooled, and evaporatively-cooled air conditioning units with capacities less than 11 kW mm40,000 BTU/hr are to be rated in accordance with AHRI 210/240. Air-cooled heat pump units with capacities less than 11 kW mm40,000 BTU/hrare to be rated in accordance with AHRI 210/240. At a minimum, efficiencies for split-systems will be in accordance with ASHRAE 90.1 - SI.

Provide an air-cooled, split system which employs a remote condensing unit, a separate [floor mounted] [wall mounted] indoor unit, and interconnecting refrigerant piping. Provide the [air conditioning] [heat pump] type unit that meets applicable Underwriters Laboratories (UL) standards including UL 1995. Unit must be rated in accordance with AHRI 210/240. Provide indoor unit with required fans, air filters, and galvanized steel cabinet construction. The remote unit must be as specified in paragraph CONDENSING UNIT. Provide double-width, double inlet, forward curved backward inclined, or airfoil blade, centrifugal scroll type evaporator or supply fans. Provide the manufacturer's standard condenser or outdoor fans for the unit specified and may be either propeller or centrifugal scroll type. Fan and condenser motors must have totally enclosed or explosion proof enclosures. Design unit to operate at outdoor ambient temperatures up to [46][_____] degrees C [115][_____] degrees F. Provide product data for Air-conditioning systems and Heating and ventilating units.

[2.3.4.3 Energy Efficiency

Air Conditioners must have[[a minimum [seasonal]] energy efficiency ratio ([S]EER) of [_____],] [a minimum Heating Seasonal Performance Factor (HSPF) of [_____],] [a minimum Integrated Part Load Value (IPLV) of [_____],] and [a minimum COP of [_____]].

]2.3.4.4 Air-to-Refrigerant Coil

****
NOTE: Delete the copper or aluminum tubes and the coating requirement except in coastal or corrosive environments.
****

Provide condensing coils with [copper][or][aluminum] tubes of 10 mm0.125 inches minimum diameter with [copper][or][aluminum] fins that are mechanically bonded or soldered to the tubes. Casing must be [galvanized steel] [or] [aluminum]. Avoid contact of dissimilar metals. Test coils in accordance with ASHRAE 15 & 34 at the factory and ensure suitability for the working pressure of the installed system. Dehydrate and seal each coil testing and prior to evaluation and charging. Coat [condenser] [evaporator] [condenser and evaporator] coil with a uniformly applied [epoxy electrodeposition] [phenolic] [vinyl] [epoxy electrodeposition, phenolic, or vinyl] type coating to all coil surface areas without material bridging between fins. Apply coating at either the coil or coating manufacturer's factory. Coating process must ensure complete coil encapsulation and be capable of withstanding a minimum [500][1,000][_____] hours exposure to the salt spray test specified in ASTM B117 using a 5 percent sodium chloride solution.

2.3.4.5 Compressor

****
NOTE: Delete this paragraph if a remote condensing unit is specified.
****

Provide direct drive [hermetic reciprocating] [variable speed] [digital scroll] [scroll] type compressor. Provide compressor with internal over temperature and pressure protector, sump heater, oil pump, high pressure and low pressure controls, and liquid line dryer.

2.3.4.6 Refrigeration Circuit

Refrigerant-containing components must comply with ASHRAE 15 & 34 and be factory tested, cleaned, dehydrated, charged, and sealed. Provide each unit with a factory operating charge of refrigerant and oil or a holding charge. Field charge unit shipped with a holding charge. Provide refrigerant charging valves. Provide filter-drier in liquid line.to prevent freeze-up in event of loss of water flow during heating cycle.

2.3.4.7 Unit Controls

****
NOTE: In regards to head pressure control, insert the appropriate minimum or lowest expected ambient temperature. Delete head pressure controls if inapplicable. Delete low cost cooling if inapplicable. In those areas where the outdoor seasonal climatic conditions permit, an outdoor temperature sensing unit (dry bulb) may be used in an external control circuit to take advantage of outside air to satisfy the cooling load. Under such conditions, the control circuit would lock out the compressors and position the outdoor and return air dampers to allow 100 percent fresh air to be circulated. Enthalpy controls will not be used. Ensure that all controls equipment meets the requirements of UFC 4-010-06 CYBERSECURITY OF FACILITY-RELATED CONTROL SYSTEMS.
****

Provide unit internally prewired with a [24][120][_____] volt control circuit powered by an internal transformer. Provide terminal blocks for power wiring and external control wiring. Internally protect unit by fuses or a circuit breaker in accordance with UL 1995. Equip units with three-phase power with phase monitoring protection to protect against problems caused by phase loss, phase imbalance and phase reversal.[Provide unit with microprocessor controls to provide all 24V control functions.][Control unit by a [two stage heating and cooling thermostat] [one stage heating and cooling thermostat] with [manual][automatic] changeover.][Control unit by a programmable electronic thermostat with heating setback and cooling setup with 7-day programming capability.]

2.3.4.8 Condensing Coil

****
NOTE: Delete the copper or aluminum tubes and the

coating requirement except in corrosive environments.
****

Provide coils with [nonferrous] [copper] [or] [aluminum] tubes of 10 mm 0.125 inches minimum diameter with [copper] [or] [aluminum] fins that are mechanically bonded or soldered to the tubes.[Protect coil in accordance with paragraph CORROSION PROTECTION.] Provide galvanized steel or aluminum casing. Avoid contact of dissimilar metals. Test coils in accordance with ASHRAE 15 & 34 at the factory and ensure suitability for the working pressure of the installed system. Dehydrate and seal each coil after testing and prior to evaluation and charging. Provide separate expansion devices for each compressor circuit.

2.3.4.8.1 Remote Condenser or Condensing Unit

Fit each remote condenser coil fitted with a manual isolation valve and an access valve on the coil side. Saturated refrigerant condensing temperature must not exceed 49 degrees C120 degrees F at 40 degrees C104 degrees F ambient. Provide unit with low ambient condenser controls to ensure proper operation in an ambient temperature of [-6][13][_____] degrees C[20][55][_____] degrees F. Provide fan and cabinet construction as specified in paragraph UNITARY EQUIPMENT ACCESSORIES. Fan and condenser motors must have [open] [drip proof] [totally enclosed] [explosion proof] enclosures.[Condensing unit must have controls to initiate a refrigerant pump down cycle at system shut down on each refrigerant circuit.]

2.3.4.8.2 Air-Cooled Condenser

Provide unit in accordance with AHRI 460 and conform to the requirements of UL 1995. Provide factory fabricated, tested, packaged, and self-contained unit. Complete with casing, [propeller] [or] [centrifugal] type fans, heat rejection coils, connecting piping and wiring, and all required accessories.

2.3.4.9 Primary (Supplemental) Heat

Provide heating unit with internal thermal insulation having a fire hazard rating not to exceed 25 for flame spread and 50 for smoke developed in accordance with ASTM E84.

[2.3.4.10 Electric Heating

Provide electric duct heater in accordance with UL 1995 and NFPA 70. Coil must be completely assembled, unit-mounted, and integral to the unit. Provide coil with nickel chromium elements and a maximum density of 258 Watts per square centimeter40 watts per square inch. Provide coil with automatic reset high limit control operating through heater backup contactors. Provide coil casing and support brackets of [galvanized steel] [or] [aluminum].[Mount coil to eliminate noise from expansion and contraction and be completely accessible for service.]

[Construct electric heater of heavy-duty nickel chromium elements. Achieve staging through the unit control processor. Each heater must have automatically reset high limit control. Heaters must be individually fused from the factory and comply with NFPA 70. Power assemblies must provide single point connection. Electric heat modules must be listed and labeled by a national recognized testing laboratory acceptable to authorities having jurisdiction. Electric heater controls must confirm

the supply fan is operating before electric elements are energized. Operate electric heater in [2][3] stages when outdoor ambient is too low to maintain space thermostat setting with compressor operation.]

]2.3.4.11 Air Filters

Provide filters of the [sectional] [or] [panel] [cleanable] type that are capable of filtering the entire air supply. Mount filter(s) integral within the unit and make accessible [by hinged access panel(s)]. [25][50] mm[1][2] inches MERV [7][8][13], provide throwaway filter on all units below 19.6 kW6 tons. Provide filter rack that can be converted to 50 mm2 inchescapability. Filters must have an average dust spot efficiency of [25-35][90-95] percent and an average resistance of [90][_____] percent when tested in accordance withASHRAE 52.2. Provide UL Class 1 filters.

2.3.4.12 Fans

Provide direct driven, statically and dynamically balanced, centrifugal or propeller type fans. Design the outdoor fan so that condensate will evaporate without drip, splash, or spray on building exterior. Provide indoor fan with a minimum two-speed motor with built-in overload protection. Fan motors must be the inherently protected, permanent split-capacitor type.

2.3.5 Factory Painting

Factory paint new equipment, which are not of galvanized construction. Paint with a corrosion resisting paint finish according to ASTM A123/A123M or ASTM A924/A924M.

2.3.6 Supplemental Components and Services

The requirements for refrigerant piping are per manufacturer written specifications.

2.3.7 Condensate Drain Lines

Provide and install condensate drainage for each item of equipment that generates condensate and route to nearest drain or exterior of the facility. If routed to the exterior, condensate will drain within than 200 mm8 inches from the ground on to a standard concrete splash block.

2.4 PLUMBING

2.4.1 Materials

Acceptable materials include PEX, PVC, and CPVC.

2.4.1.1 Pipe Joint Materials

Joints and gasket materials are to conform to the following:

a. Solvent Cement for Transition Joints between ABS and PVC Non-pressure Piping Components: ASTM D3138.

b. Plastic Solvent Cement for PVC Plastic Pipe: ASTM D2564 and ASTM D2855.

c. Plastic Solvent Cement for CPVC Plastic Pipe: ASTM F493.

d. PEX use compatible PEX connectors.

2.4.1.2 Miscellaneous Materials

Miscellaneous materials are to conform to the following:

a. Plumbing Fixture Setting Compound: A preformed flexible ring seal molded from hydrocarbon wax material. The seal material is to be nonvolatile non-asphaltic and contain germicide and provide watertight, gastight, odor proof and vermin proof properties.

b. Thermometers: ASTM E1. Mercury is not to be used in thermometers.

2.4.1.3 Pipe Insulation Material

Insulation for pipes are to be flexible elastomeric cellular insulation that meets ASTM C534/C534M. Insulation thickness must be at least 25 mm1 inch for interior pipes and 50 mm2 inch for exterior pipes. Vinyl cladding is to be installed in areas of high abuse. Sanitary and vent pipes are not to be insulated.

All exposed pipes and drains are to be protected from freezing. Heat tracing is to be provided as required. Provide a protective skirt around the perimeter with appropriately sized, lockable and hinged access panels for maintenance.

2.4.2 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, and supports are to conform to MSS SP-582.4.3 Valves

Valves are to be provided on supplies to equipment and fixtures. Valves are to be acceptable for, and compatible with the piping material. Pressure ratings are to be based upon the application. Grooved end valves may be provided if the manufacturer certifies that the valves meet the performance requirements of applicable MSS standard. Valves are to conform to the following standards:

Description	Standard
Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends	MSS SP-110
Bronze Gate, Globe, Angle, and Check Valves	MSS SP-80
Backwater Valves	ASME A112.14.1
Vacuum Relief Valves	ANSI Z21.22/CSA 4.4
Water Pressure Reducing Valves	ASSE 1003
Water Heater Drain Valves	ASME BPVC SEC IV, Part HLW-810: Requirements for Potable-Water Heaters Bottom Drain Valve
Temperature and Pressure Relief Valves for Hot Water Supply Systems	ANSI Z21.22/CSA 4.4

2.4.4 Fixtures

2.4.4.1 Flush Tank Water Closets (Toilets)

ASME A112.19.2/CSA B45.1, white vitreous china, siphon jet, elongated bowl, closed front, pressure assisted, floor-mounted, comfort height and wall outlet. Provide wax bowl ring including plastic sleeve. Water conservation requirements, such as gallons per flush, are to meet all applicable requirements contained in the ICC IPC. Provide white solid plastic closed-front seat with cover.

2.4.4.2 Wall Hung Lavatories

Meet ASME A112.19.2/CSA B45.1, material is to be white vitreous china, straight back type, minimum dimensions of 483 mm19 inches wide by 432 mm17 inches front to rear. Water conservation requirements, such as gallons per flush, are to meet all applicable requirements contained in ICC IPC. Provide ASME A112.6.1M concealed chair carriers with vertical steel pipe supports and concealed arms for the lavatory. Mount lavatories with the front rim 864 mm34 inches above floor and with 737 mm29 inches minimum clearance from bottom of the front rim to floor.

2.4.4.3 Service Sinks

Meet ASME A112.19.2/CSA B45.1, [white] [_____] vitreous china [ASME A112.19.3/CSA B45.4] 302 stainless steel with integral back and wall hanger supports, minimum dimensions of than 559 mm22 inches wide by 508 mm 20 inches front to rear, with two supply openings in than 254 mm10 inches high back. Provide floor supported wall outlet P-trap and stainless steel rim guards as recommended by service sink manufacturer. Provide back mounted washerless service sink faucets with vacuum breaker and 19 mm0.75 inches external hose threads.

2.4.4.4 Shower Stalls

CSA B45.5-17/IAPMO Z124 four piece [white][_____] solid acrylic, pressure molded fiberglass reinforced plastic shower stalls. Shower stalls assemblies are to be scratch resistant, waterproof, and have reinforced wall panels and base.[Provide flow restrictor in hand shower to flow 6.6 L/min1.75 gpm.][Provide filters for chlorine in supply piping to showerheads.] Provide full height separation wall between shower stalls and recessed type shower stalls 915 mm36 inches wide, 915 mm36 inches front to rear, 1829 mm76 inches high, and 125 mm5 inches curb with shower stall bottom or feet firmly supported by a smooth level floor. Provide PVC shower floor drains and stainless steel strainers. Shower stalls are to meet performance requirements of CSA B45.5-17/IAPMO Z124.

Install shower stall in accordance with the manufacturer's written instructions. Finish installation by covering shower stall attachment flanges with mildew resistant surfaces in accordance with shower stall manufacturer's recommendation. Provide smooth 100 percent silicone rubber [white][_____] mold and mildew resistant caulk between the top, sides, and bottom of shower stalls and bathroom walls and floors.

2.4.5 Backflow Preventers

Comply with ASSE 1012 or ASSE 1013. Reduced pressure principal assemblies, double check valve assemblies, atmospheric (non-pressure) type vacuum breakers, and pressure type vacuum breakers are to meet all

applicable requirements of ICC IPC.

2.4.6 Drains

2.4.6.1 Shower Drains

Provide galvanized body, integral seepage pan, and adjustable perforated or slotted chromium-plated bronze, nickel-bronze, or nickel-brass strainer, consisting of grate and threaded collar. Drains are to be of double drainage pattern for embedding in the floor construction. The seepage pan is to have weep holes or channels for drainage to the drainpipe. The strainer is to be adjustable to floor thickness. A clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or waterproofing membrane is to be provided when required. Drains are to be provided with threaded connection. Between the drain outlet and waste pipe, a neoprene rubber gasket that meets ASTM C564 may be installed, provided that the drain is specifically designed for the rubber gasket compression type joint. Shower drains are to conform to ASME A112.6.3 and drain through the exterior wall. Provide mechanical trap guard seals.

2.4.6.2 Trench Drains

Provide trench drain sized to accommodate load, sloped to drain and have one code compliant exit from RLB.

2.4.7 Traps

Unless otherwise specified, traps are to be [plastic per ASTM F409] [or] [copper-alloy adjustable tube type with slip joint inlet and swivel]. Traps are to be without a clean-out.[Provide traps with removable access panels for easy clean-out at sinks and lavatories.] Tubes are to be copper alloy with walls not less than 0.813 mm0.032 inches thick within commercial tolerances, except on the outside of bends where the thickness may be reduced slightly in manufacture by usual commercial methods. Inlets are to have rubber washer and copper alloy nuts for slip joints above the discharge level. Swivel joints are to be below the discharge level and are to be of metal-to-metal or metal-to-plastic type as required for the application. Nuts are to have flats for wrench grip. Outlets are to have internal pipe thread, except that when required for the application, the outlets are to have sockets for solder-joint connections. The depth of the water seal is to be not less than 50 mm2 inches. The interior diameter is to be no more than 3.2 mm0.125 inches over or under the nominal size, and interior surfaces are to be reasonably smooth throughout. A copper alloy "P" trap assembly consisting of an adjustable "P" trap and threaded trap wall nipple with cast brass wall flange is to be provided for lavatories. The assembly is to be a standard manufactured unit and may have a rubber-gasketed swivel joint.

2.4.8 Water Heaters

Provide hot water to each wet RLB unit. Water heater types and capacities are to be an electric dual element quick recovery water heater designed and sized according to ASHRAE 90.1 - IP and ASHRAE 90.1 - SI. The water heater will be complete with a pressure relief valve, drain pan, and a metal tank drain valve. Each water heater is to have replaceable anodes. The water drip collection pan, relief valve and drain pan is to be separately piped to the exterior. Each primary water heater is to have controls with an adjustable range that includes 32 degrees C90 degrees F

to 71 degrees C160 degrees F.

Electric Type. Electric type water heaters are to conform to UL 174 with dual heating elements. Each element is to be 4.5 KW. The elements are to be wired so that both elements can operate simultaneously.

2.4.9 Expansion Tanks

A factory pre-charged expansion tank is to be installed on the cold water supply to each water heater. Expansion tanks are to be specifically designed for use on potable water systems and are to be rated for 93 degrees C200 degrees F water temperature and 1000kPa150 psi working pressure.

2.4.10 Pipe Sleeves

Provide where piping passes entirely through walls, ceilings, roofs, and floors.

Sleeves Not in Masonry and Concrete. Provide 26 gage galvanized steel sheet or PVC plastic pipe sleeves. Fill remaining voids with sealant.

2.4.11 Pipe Hangers (Supports)

Provide MSS SP-58 Type 1 with adjustable type steel support rods. Provide Type 40 insulation protection shield for insulated piping.

2.4.12 Heat Tape

Each wet unit will be provided with a heat tape receptacle located on the unit and within approximately 600 mm24 inches of the water pipe inlet. Receptacles are to be easily accessible and within 0.3 m1 foot from the edge of the facility. The heat tape receptacle is to be a single outlet with a weatherproof case. The exterior receptacle for the heat tape is to not be protected by a ground fault circuit interrupter.

2.5 FIRE PROTECTION AND LIFE SAFETY

Fire Protection and Life Safety is to be in accordance with UFC 1-201-01. Smoke alarms must be provided and operate in accordance with UFC 1-201-01. Install smoke detectors in accordance with NFPA 72 and carbon monoxide detectors in accordance with NFPA 72. A manual alarm system must be provided when required by UFC 1-201-01.

2.6 ELECTRICAL

2.6.1 Materials

a. Material and equipment installed under this contract is to be for the appropriate application and installed in accordance with manufacturers recommendations.

b. Equipment enclosure types are to be in compliance with the National Electrical Manufacturer's Association (NEMA) or the International Electro-Technical Committee (IEC) standards.

c. Major components of equipment are to have the manufacturer's name, address, type or style, voltage and current rating, and catalog number on a non-corrosive and non-heat sensitive plate, attached to the

equipment. All equipment delivered and placed in storage, prior to installation, is to be protected from the weather, humidity and temperature variation, dirt and dust, and other contaminants. All equipment is to be in new condition, undamaged and unused

d. All material and equipment is to be a standard product of a manufacturer regularly engaged in the manufacture of the product and is to essentially duplicate items that have been in satisfactory use for at least two years prior to bid opening.

2.6.2 Panelboards

a. [UL 67][or][IEC 60947-4-1-manufactured, and type-tested assembly (TTA)].

b. All panelboards are to be circuit breaker 'bolt-on' type panels.

c. Enclosures for exterior and interior applications are to be NEMA Type 3 (IEC Classification IP54) and NEMA Type 1 (IEC Classification IP10) respectively.

d. Circuit breakers are to be connected to copper bus bars within the panelboards. Daisy chain (breaker-to-breaker) connection(s) made with conductor or interconnecting busbar are not acceptable. A 3-pole circuit breaker is to be a single unit and not made up of 3 single pole circuit breakers connected with a wire[or bridge to make a 3-pole breaker].

e. For large panels (225 Ampere and above) provide an ammeter, voltmeter and kilowatt-hour meter to monitor energy usage. Selector switches are to be provided for each meter to read all 3 phases.

f. All panelboards are to be surface mounted. All panels are to be provided with a minimum of 25% spare capacity for future load growth.

g. Buildings with branch circuit breakers larger than 32A, 3 pole are to have at least one distribution panel for the larger breakers.

2.6.3 Circuit breakers

****
NOTE: Provide host nation specified sockets if known and if other than one of these types.
****

a. [UL 67][or][IEC 62053-22-manufactured].

b. Circuit breakers are to be rated no less than 16-amperes.

c. All breakers feeding wet areas are to be Residual Current Breakers with Overload (RCBO) or Ground Fault Circuit Interrupter (GFCI).

2.6.4 Receptacles (Socket-outlets)

[For 60 Hz systems, receptacles are to be heavy duty type, NEMA Type 5-20R in accordance with NEMA WD 6.] or [For 50 Hz systems, socket-outlets are

to be heavy duty type, 13A in accordance with BS 1363-2 or 16A, Type CEE 7/3 ("schuko" type F) in accordance with IEC 60884-1].

2.6.5 Weatherproof Receptacles

Provide in cast metal box with gasketed, weatherproof, cast-metal cover plate and gasketed cap over each receptacle opening. Provide caps with a spring-hinged flap. Receptacle must be listed for IP 66 use in "wet locations with plug in use."

2.6.6 Ground-Fault or Residual-Current Device (RCD) Receptacles

BS 1363-1, duplex type for mounting in standard outlet box. Device must be capable of detecting current leak of 10 milliamperes per requirements of BS 1363-1 for RCD devices. Provide screw-type, side-wired wiring terminals or pre-wired (pigtail) leads.

2.6.7 Arc-Fault Receptacles

UL 1699, duplex type for mounting in standard outlet box. Provide device capable of detecting series arcing current when the current to ground is 5 amperes or higher, and tripping per requirements of UL 1699.

2.6.8 Cable Trays

Provide cable tray product and cable tray design in accordance with Section 26 20 00INTERIOR DISTRIBUTION SYSTEM.

2.6.9 Luminaires

All light fixtures, interior and exterior, are to be LED (light emitting diode) type. All luminaires of the same type must be provided by the same manufacturer. Luminaires must be specifically designed for use with the driver and light sources provided. All lights are to comply with Section 26 51 00 INTERIOR LIGHTING and Section 26 56 00 EXTERIOR LIGHTING. Design levels are to be in accordance with IES Lighting Library at a minimum.

Living room/Quarters	35 FC 350 LUX
Toilets, Showers, Latrines, washrooms	20 FC 200 LUX
Mechanical/Electrical rooms	30 FC 300 LUX
Corridors and Stairways	20 FC 200 LUX
Offices (private)	20 FC 200 LUX
Office areas (open)	30 FC 300 LUX
Kitchens (commercial)	70 FC 700 LUX
Dining Areas	20 FC 200 LUX
Conference	30 FC 300 LUX

Living room/Quarters	35 FC 350 LUX
Video Conference	50 FC 500 LUX
Patient Rooms (general)	Per UFC 4-510-01
Patient Rooms (critical)	Per UFC 4-510-01
Egress path (incl. exterior)	1 FC 10.8 Lux

2.6.9.1 Luminaire Samples

Submit one sample of each luminaire type , complete with light source,LED drivers rated for Multi 120-400 Volt operation, and 2 meters 6 feet pigtail with 3-prong Edison plug. Sample will be returned to the Contractor for installation in the project work. In addition, provide test reports for ANSI/IES LM-79 test report, ANSI/IES LM-80 test report, ANSI/IES TM-21 test report, ANSI/IES TM-30 test report in accordance with Section 26 51 00 INTERIOR LIGHTING and Section 26 56 00 EXTERIOR LIGHTING.

2.6.9.2 Emergency Lighting

Provide emergency drivers, emergency lighting egress units, and exit signs to comply with Section 26 51 00 INTERIOR LIGHTING and Section 26 56 00 EXTERIOR LIGHTING.

2.6.9.3 Switches

2.6.9.3.1 Toggle Switches

****
NOTE: Do not use solderless pressure type toggle switches on Navy projects.
****

NEMA WD 1, UL 20,[single pole][, double pole][, three-way][, and four-way], totally enclosed with bodies of thermoplastic or thermoset plastic and mounting strap with grounding screw. Include the following:

a. Handles: [white][ivory][brown] thermoplastic.

b. Wiring terminals: screw-type, side-wired[or of the solderless pressure type having suitable conductor-release arrangement].

c. Contacts: silver-cadmium and contact arm - one-piece copper alloy.

d. Switches: rated quiet-type ac only, [120/208 volts][or][400/230 volts], with current rating and number of poles indicated.

2.6.10 Wire and Cable

All wiring is to have copper conductors with thermoplastic insulation. Aluminum conductors are not allowed. Provide wires and cables in accordance with NFPA 70 and UL for type of insulation, jacket, and conductors.

2.6.10.1 Color Coding

Color Coding of Conductor Insulation [For 60 Hz systems: Phase conductors are to be black, red and blue with a white neutral for three phase. Phase conductors are to be black or red with a white neutral for single phase.][For 50 Hz systems: Phase conductors are to be brown, black and gray with a blue neutral for three phase. Phase conductors are to be brown with a blue neutral for single phase.][For systems, grounding (earthing) conductors are to be green with a yellow stripe.]

2.6.11 Grounding and Bonding

Grounding and bonding is to comply with the requirements of [BS 7671 for 50 Hz system] [or] [NFPA 70 and NFPA 780 for 60 Hz system]. All raceways are to include insulated equipment grounding conductor (protective earth conductor), and grounding electrodes (earthing) are to be installed at every building or structure. Grounding electrodes are to include, at a minimum:
Concrete encased electrode, bond to building steel, bond to metallic water pipe, and ground rod(s). All grounding electrodes present at a building or structure, including lightning protection and communications electrodes, are to be bonded together, and underground connections are to be exothermally welded.

All exposed non-current carrying metallic parts of electrical equipment in the electrical system are to be grounded. Final measurement of the ground resistance is to not exceed 25 ohms when measured more than 48 hours after rainfall. Ground rods are to be copper clad steel, with minimum diameter of 20 mm0.75 inches and minimum length of 3000 mm118 inches.

2.6.12 Surge Protection Device (SPD)

Provide Surge Protection Device (SPD) or Transient Voltage Surge Suppression (TVSS) in accordance with UL 1449 at the service entrance Main Distribution Panel and communication panels. Provide surge protectors in a NEMA [1][_____] enclosure in accordance with NEMA ICS 6.

PART 3 EXECUTION

3.1 RLB UNIT IDENTIFICATION

Each unit is to have appropriate signage to number and identify each unit's type and components. The Contractor is to provide a legible non-corrosive metal identification plate on each unit to indicate type, serial number, and year of production.

3.2 RLB ENVELOPE

The RLB envelope is to be composed of durable, and fire resistant materials to mitigate issues with weather, termites, vermin, rot, mold, mildew, fumes, swelling, and warping. Individual RLB Types and RLB Types that are combined units, each are to be designed as one independent facility, economically and efficiently connected, code and UFC compliant, and readily connected to utilities including water, sewer, power, and communication.

Individual RLB components are to be developed to be used interchangeably with each type of RLB. This includes but is not limited to exterior door locations, electric meters and panel boxes, switches and outlets,

communication, water service and sewer discharge, wall and roof panels, components, and means and methods of connection. Pipes, conduits, switches, outlets and lights and ductwork are to be mounted and secured to exposed surfaces and readily accessible. Adhere to the following:

a. Pipes, conduits, switches, outlets and lights and ductwork are to be mounted and secured to exposed surfaces and readily accessible.

b. Provide a Class "A" roof assembly on each RLB Type.

c. Manufacture RLB per standard floor plans.

d. Assemble and install fixtures and appliances per standard floor plan and manufacturers' printed installation directions.

e. Penetrations or openings in RLB units for piping, electrical devices, recessed cabinets, showers, soffits, or heating, ventilating or exhaust ducts are to be sealed and rated as required.

3.3 HVAC

3.3.1 Installation

3.3.1.1 Condensate Drain Lines

Condensate lines are to be discharged at the facility exterior near grade according to manufacturer installation requirements.

3.3.1.2 Equipment and Installation

Provide frames and supports for tanks, compressors, pumps, valves, ductless mini-splits, fans, coils, dampers, and other similar items requiring supports.

3.3.1.3 Insulation

Provide thickness and application of insulation materials for piping and equipment according to paragraph HVAC INSULATION.

3.3.2 Cleaning

Clean surfaces of piping and equipment that have become covered with dirt, plaster, or other material before such surfaces are prepared for final finish painting or are enclosed within the structure. Clean mechanical equipment, including piping and fixtures. Deliver free from dirt, grease, and finger marks.

3.3.3 Identification Systems

Provide identification tags made of brass, engraved laminated plastic, or engraved anodized aluminum; indicating service and item number on all valves and dampers. Make indentations black for reading clarity.

3.3.4 Performance Tests

Test each system as a whole, to ensure that all items perform as integral parts of the system. Confirm temperatures and conditions are evenly controlled throughout. Make corrections and adjustments as required to produce the conditions indicated or specified. Conduct capacity tests and

general operating tests by an experienced engineer.

3.4 PLUMBING

3.4.1 General Installation Requirements

The plumbing system is to be installed complete with required fixtures, fittings, traps, valves, and accessories. Provide all fixtures with an adequate drainage system, each connecting to a main sewer line. The exit pipe is to protrude a minimum of than 150 mm6 inches, but no more than 200 mm8 inches and be capped with a removable plastic cap and chain. Water closet privacy partitions and shower partitions are to be continuously fastened to floor, wall, and ceiling. Water closets are to be centered in compartment width in accordance with IPC D330. Shower enclosures (partitions) are to be continuously fastened to floor, wall, and ceiling.

3.4.1.1 Water Pipe, Fittings, and Connections

3.4.1.1.1 Utilities

The piping is to be extended to fixtures and outlets. The hot-water and cold-water piping system is to be arranged and installed to permit draining and easy access. The supply line to each fixture, is to be equipped with a shutoff valve to enable isolation of the item for repair and maintenance without interfering with operation of other equipment or fixtures. Supply piping to fixtures, faucets, hydrants, shower heads, and flushing devices are to be exposed and anchored to prevent movement.

3.4.1.1.2 Pipe Drains

Pipe drains are to consist of 20 mm0.75 inches hose bibb with renewable seat and gate valve ahead of hose bibb.

3.4.1.1.3 Plastic Pipe

PVC and CPVC pipe are to have joints made with solvent cement elastomeric. PEX pipe is to have PEX compatible connectors.

3.4.1.1.4 Pipe Sleeves and Flashing

Pipe sleeves are to be furnished and set in their proper and permanent location.

3.4.1.1.5 Sleeve Requirements

Provide pipe sleeves meeting the following requirements:

a. Secure sleeves in position. Provide sleeves of sufficient length to pass through entire thickness of walls, ceilings, roofs, and floors.

b. Sleeves are to not be installed in structural members. Rectangular and square openings are to be as detailed. Each sleeve is to extend through its respective floor, or roof, and is to be cut flush with each surface. Pipe sleeves passing through floors in wet areas. Lavatories, kitchens, and other plumbing fixture areas are to extend a minimum of than 100 mm4 inches above the finished floor.

c. The annular space between pipe and sleeve, between bare insulation and sleeve or between jacket over insulation and sleeve is to be filled

with fire sealant in all walls, roofs, and floors.

3.4.1.1.6 Waterproofing

Waterproofing is to be in accordance with IPC D330.

3.4.1.1.7 Pipe Penetrations

Provide sealants for all pipe penetrations. All pipe penetrations are to be sealed to prevent infiltration of air, insects, and vermin. Penetrations in fire-resistant rated walls are to use UL listed or FM approved fire stopping.

3.4.1.2 Supports

3.4.1.2.1 General

Pipes, valves and hangars are generally intended to be exposed, installed and be code compliant. Hangers used to support piping than 50 mm2 inches and larger are to be fabricated to permit adequate adjustment after erection while still supporting the load. Pipe guides and anchors are to be installed to keep pipes in accurate alignment, to direct the expansion movement, and to prevent buckling, swaying, and undue strain.

3.4.1.2.2 Pipe Hangers, Inserts, and Supports

Installation of pipe hangers, inserts and supports are to conform to MSS SP-58 except as described below:

a. Types 5, 12, and 26 are to not be used.

b. Type 3 is to not be used on insulated pipe.

c. Type 19 and 23 C-clamps are to be torqued per MSS SP-58 and are to have both locknuts and retaining devices furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.

d. Type 20 attachments used on angles and channels are to be furnished with an added malleable-iron heel plate or adapter.

e. Type 24 may be used only on trapeze hanger systems or on fabricated frames.

f. Horizontal pipe supports are to be spaced as specified in MSS SP-58 and a support are to be installed not over than 300 mm12 inches from the pipe fitting joint at each change in direction of the piping. Pipe supports are not to be spaced over 1500 mm60 inches apart at valves. Operating temperatures in determining hanger spacing for PVC or CPVC pipe are to be 49 degrees C120 degrees Ffor PVC and 82 degrees C180 degrees F for CPVC. Horizontal pipe runs are to include allowances for expansion and contraction.

g. Pipe hangers on horizontal insulated pipe are to be the size of the outside diameter of the insulation. The insulation is to be continuous through the hanger on all pipe sizes and applications.

h. Where there are high system temperatures and welding to piping is not desirable, the type 35 guide are to include a pipe cradle, welded to

the guide structure and strapped to the pipe. The pipe is to be separated from the slide material by at least than 100 mm4 inches or by an amount adequate for the insulation, whichever is greater.

i. Hangers and supports for plastic pipe are not to compress, distort, cut or abrade the piping, and are to allow free movement of pipe except where otherwise required in the control of expansion and contraction.

3.4.2 Water Heaters

Water heaters are to be electric, high efficiency, fast recovery, and sized to accommodate the need based on amount of fixtures in each unit and assumed frequency of use. Water heaters are to be selected and sized, and installed in compliance with current codes and include a plastic drain pan and anti-scald measures.

3.4.2.1 Relief Valves

No valves are to be installed between a relief valve and its water heater. The P&T relief valve is to be installed where the valve actuator comes in contact with the hottest water in the heater. A vacuum relief valve is to be provided on the cold water supply line to the water heater and mounted above and within than 150 mm6 inches above the top of the tank or water heater.

3.4.2.2 Expansion Tank

A pre-charged expansion tank is to be installed on the cold water supply between the water heater inlet and the cold water supply shut-off valve. The Contractor is to adjust the expansion tank air pressure, as recommended by the tank manufacturer, to match incoming water pressure.

3.4.3 Fixtures and Fixture Trimmings

3.4.3.1 Backflow Prevention Devices

Backflow preventers are to be installed in accordance with IPC D330 at all locations required to preclude a cross-connect or interconnect between a potable water supply and non-potable substance. In addition, backflow preventers are to be installed at all locations where the potable water outlet is below the flood level of the equipment, or where the potable water outlet will be located below the level of the non-potable substance. Backflow preventers are to be located so that no part of the device will be submerged. Backflow preventers are to be of sufficient size to allow unrestricted flow of water to the equipment and preclude the backflow of non-potable substances into the potable water system. Bypass piping is to not be provided around backflow preventers. Access is to be provided for maintenance and testing. Each device is to be a standard commercial unit.

3.4.3.2 Access Panels

Access panels are to be provided for concealed valves and controls, or items requiring inspection or maintenance. Access panels are to be of sufficient size and located so that the concealed items may be serviced, maintained, or replaced. Panels are to be attached and match the adjacent material finish.

3.4.3.3 Traps

Each trap is to be placed as near the fixture as possible, and no fixture is to be double trapped. Traps installed on plastic pipe may be plastic that meets ASTM D3311.

3.4.4 Plumbing Identification Tags

The main supply inlet shut-off valve is to have an identification tag made of brass, engraved laminated plastic, or engraved anodized aluminum, indicating service and valve number is to be installed on valves, except those valves installed on supplies at plumbing fixtures.

3.4.5 Escutcheons

Escutcheons are to be provided at finished surfaces where bare or insulated piping, exposed to view, passes through floors, walls, or ceilings, except in boiler, utility, or equipment rooms. Escutcheons are to be fastened to pipe or pipe covering and are to be satin-finish, [corrosion-resisting steel] [polished chromium-plated zinc alloy], or [polished chromium-plated copper alloy].

3.4.6 Tests, Flushing, and Disinfection

3.4.6.1 Plumbing System

The following tests are to be performed on the plumbing system in accordance with ICC IPC, except that the drainage and vent system final test are to include the smoke test. A peppermint test in lieu of the smoke test is optional. If a peppermint test is chosen, a submittal detailing a testing procedure and reasons for choosing this option in lieu of the smoke test must be received.

a. Drainage and Vent Systems Test.

b. The final test is to include a smoke test.

c. Water Supply Systems Tests.

3.4.6.2 Test of Backflow Prevention Assemblies

Backflow prevention assembly is to be tested using gauges specifically designed for the testing of backflow prevention assemblies. Backflow prevention assembly test gauges are to be tested annually for accuracy in accordance with the requirements of State or local regulatory agencies. If there is no State or local regulatory agency requirements, gauges are to be tested annually for accuracy in accordance with the requirements of University of Southern California's Foundation of Cross Connection Control and Hydraulic Research or the American Water Works Association Manual of Cross Connection AWWA M14, or other approved testing laboratory having equivalent capabilities for both laboratory and field evaluation of backflow prevention assembly test gauges. Report form for each assembly are to include, as a minimum, the following:

a. Data on Device Data on Testing Firm

b. Type of Assembly Name

c. Manufacturer Address

d. Model Number Certified Tester

e. Serial Number Certified Tester No.

f. Size Date of Test

g. Size Date of Test

h. Test Pressure Readings Serial Number and Test Data of Gauges

If the unit fails to meet specified requirements, the unit is to be repaired and retested.

3.4.6.3 Defective Work

If inspection or test shows defects, such defective work or material is to be replaced or repaired as required and inspection and tests are to be repeated. Repairs to piping are to be made with new materials.

3.5 ELECTRICAL

3.5.1 Service Entrance and Main Panel

Electrical installation must be in accordance with of NFPA 70 and IEEE C2. The units electrical service entrance is to consist of a circuit breaker type panelboard, complete with main and branch circuit breakers. The panelboard is to be dead-front type, equipped with thermal magnetic molded case circuit breakers having trip indicators and common trip on multiple breakers. A circuit directory is to be permanently affixed to the inside of the panel door. Circuits will be clearly and legibly identified. The service entrance cable is to be sized at a minimum of 125% of the size of the main distribution switchboard or the main circuit breaker ampere rating whichever is larger. The Main distribution switchboard is to include required circuit breakers for RLB electrical loads, plus 15% spare circuit breakers, plus spaces for breakers for the future loads.

When a fire alarm system is required and a circuit breaker is the main shut-off, the circuit breaker is to be red for identification and lockable to prevent unwanted deactivation.

3.5.2 Light Fixtures

Lighting is to be designed for an illumination level required for functional usage of rooms in accordance with IES Lighting Library level criteria by space calculations. In general, indoor lighting for areas will be LED, depending on the ceiling type, be recessed, surface or pendant mounted fixtures. Surface mounted LED light fixtures with photocell will be provided above exterior doors. Recessed light fixtures are to be provided in drop acoustical tile ceilings. Lighting fixtures are to be standard fixtures, no hanging lights are permitted. As a minimum bathroom(s) are to have one lighted exhaust ceiling or wall fan. A minimum of one light switch is provided in every room. Lighting in large rooms or areas may be controlled from multiple switches.

Exterior building lighting for doorway lighting is to be LED low maintenance, high efficiency, wall pack type units at the doorway entrance and provided above each man door. Exterior lights are to be controlled with a single photocell and lighting contactor controlled. The contactor

photocell is generally located on the north side of the building in the shade approximately 1m above exterior building mounted fixtures. Emergency lighting is provided throughout building to facilitate movement and exit of personnel during power failure. Emergency lighting fixtures illuminate points on the path of egress (corridors to exit doors) to an illumination level of 11 Lux in accordance with NFPA 101 requirements.

3.5.3 Lightning Protection

Provide a lightning risk assessment in accordance with NFPA 780 Annex L and document the required level of protection. If lightning protection is a design requirement, provide a lightning protection system in accordance with NFPA 780.

3.5.4 Telecom Service Entrance

Provide than 50 mm2 inches entrance conduit. Provide a proper seal around the telecom service entrance conduit and provide a re-enterable sealant inside the telecom service entrance conduit. Provide the highest rated NEMA enclosure for maximum corrosion resistance and weather-proofing on the exterior of the RLB unit. Provide a NEMA Type 3 with a 3X/IP55 rating in order to satisfy the use of CATV terminal and a wireless access device (WAP) antenna.

3.5.5 Communication Interior Distribution System

a. Type A and Type D - Two communications outlet boxes are to be provided in each room; one outlet on each long wall. In the office space an outlet box is to be installed every 1800 mm71 inches along the interior walls. Conference Rooms are to have three outlet boxes.

b. Outlet boxes are to be installed 610 mm24 inches above finished floor.

c. An electrical receptacle is to be provided within 300 mm12 inches of each communications outlet.

d. Surface-mounted nonmetallic raceway is to be provided for communication cable only (not to be used for electrical wiring), and spaced at least 150 mm6 inches from electrical conduit.

3.6 FIELD QUALITY CONTROL

Provide test equipment and personnel and submit written copies of test results. Give Contracting Officer [5][_____] working days notice prior to[each][_____] test[s]. Where applicable, test electrical equipment in accordance with NETA ATS.

3.6.1 Electrical Systems Test

Perform 600-volt wiring test, ground-fault receptacle test, arc-fault receptacle test, and grounding system test in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEMS and emergency light test in accordance with Section 26 51 00 INTERIOR LIGHTING.

3.7 SHIPPING, HANDLING AND STORAGE

3.7.1 Delivery

Package and deliver RLB components, and other manufactured items so as not

to be damaged or deformed and protected during transportation and handling.

3.7.2 Handling and Storage

Stack, secure, and store RLB components in an organized manner on platforms or pallets, covered with weather-tight and ventilated covering to ensure dryness, with positive slope for drainage of water.

-- End of Section --