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USACE / NAVFAC / AFCEC / NASA	**UFGS-23 05 48.00 40 (August 2015)**

Preparing Activity: NASA	**Superseding**
	UFGS-23 05 48.00 40 (February 2011)
	UFGS-23 05 48 (November 2010)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2021

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SECTION TABLE OF CONTENTS

DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

SECTION 23 05 48.00 40

VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

08/15

PART 1 GENERAL

1.1 REFERENCES
1.2 ADMINISTRATIVE REQUIREMENTS
1.3 SUBMITTALS
1.4 QUALITY CONTROL

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION
2.1.1 Design Requirements
2.1.1.1 Mountings
2.1.1.2 Bases
2.2 EQUIPMENT
2.2.1 Centrifugal Water Chiller Package Locations
2.2.2 Reciprocating Water Chiller Package Locations
2.2.3 Absorption Water Chiller Package Locations
2.2.4 Reciprocating Compressor/Condenser Locations
2.2.5 Reciprocating Refrigeration Compressor Locations
2.2.6 Centrifugal Pump Locations
2.2.7 Air-Cooled Condensing Unit Locations
2.2.8 Low-Pressure Suspended Air-Handling Unit (AHU) Locations
2.2.9 Low-Pressure AHU Locations
2.2.10 Medium- and High-Pressure AHU Locations
2.2.11 Air-Moving Device Locations
2.2.12 Cross-Flow Cooling Tower Locations
2.2.13 Blow-Through Cooling Tower Locations
2.2.14 Pipe And Duct Vibration Isolation
2.2.14.1 Floor-Mounted Piping
2.2.14.2 Vertical Piping
2.3 MATERIALS
2.4 TESTS, INSPECTIONS, AND VERIFICATIONS

PART 3 EXECUTION

3.1 INSTALLATION
3.2 FIELD QUALITY CONTROL
3.2.1 Tests and Reports

-- End of Section Table of Contents --

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****

SECTION 23 05 48.00 40

VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT
08/15

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NOTE: This guide specification covers the requirements for vibration-isolation systems for air-conditioning equipment.

Provisions of the following specifications should be coordinated with equipment selection, specifications, and the drawings.

For equipment speeds under 250 revolutions per minute (rpm), special consideration is required.

This guide specification is arranged to be used in either of the following two ways:

The part, EQUIPMENT, and selected or rewritten text thereunder may be published as part of the bound specification.

Or, the part, VIBRATION ISOLATION-SYSTEMS APPLICATION, may be deleted when required applicable content is scheduled on the drawings.

Include the following data in drawing schedules:

Equipment number;

Mass of inertia block if different from that specified or if not specified;

Minimum number of isolators for complex applications;

Lowest equipment rpm;

Impeller size; power;

Isolation provisions in the form of "C-CIB-1.75" which includes mounting, base, and minimum deflection in millimeter inches.

This method is recommended in view of anticipated

need to rewrite or supplement this basic specification to ensure suitability of provisions for specific project applications.

Adhere to UFC 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).

****

PART 1 GENERAL

****

NOTE: If Sections 23 30 00 HVAC AIR DISTRIBUTION and Section 23 05 15 COMMON PIPING FOR HVAC are not included in the project specification, applicable requirements therefrom should be inserted and the following paragraphs deleted. Vibration isolation considerations for systems other than A/C equipment should be addressed in each respective section.

****

Section 23 30 00 HVAC AIR DISTRIBUTIONapplies to work specified in this section to the extent applicable.

Section 23 05 15 COMMON PIPING FOR HVAC applies to work specified in this section to the extent applicable.

1.1 REFERENCES

****

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.
****

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.

ACOUSTICAL SOCIETY OF AMERICA (ASA)

ASA S2.71	(1983; R 2006) Guide to the Evaluation of Human Exposure to Vibration in Buildings

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

ASHRAE HVAC APP IP HDBK	(2016) HVAC Applications Handbook, I-P Edition
ASHRAE HVAC APP SI HDBK	(2019) HVAC Applications Handbook, SI Edition

NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)

NEBB PROCEDURAL STANDARDS	(2015) Procedural Standards for TAB (Testing, Adjusting and Balancing) Environmental Systems

1.2 ADMINISTRATIVE REQUIREMENTS

Within ten [_____] working days of Contract Award, submit equipment and performance data for vibration isolator systems including equipment base design; inertia-block mass relative to support equipment weight; spring loads and free, operating, and solid heights of spring; spring diameters; nonmetallic isolator loading and deflection; disturbing frequency; natural frequency of mounts; deflection of working member; and anticipated amount of physical movement at the reference points.

Ensure the data includes information on the following:

a. Mountings

b. Bases

c. Isolators

d. Floor-Mounted Piping

e. Vertical Piping

Five [_____] working days prior to commencement of installation, submit installation drawings for vibration isolator systems including equipment and performance requirements.

Indicate within outline drawings for vibration isolator systems, overall physical features, dimensions, ratings, service requirements, and weights of equipment.

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, Air Force, and NASA 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.

Choose the first bracketed item for Navy, Air Force and NASA projects, or choose the second bracketed item for Army projects.
****

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.][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-02 Shop Drawings

Installation Drawings[; G[, [____]]]

Outline Drawings[; G[, [____]]]

SD-03 Product Data

Equipment and Performance Data[; G[, [____]]]

Isolators[; G[, [____]]]

SD-06 Test Reports

Type of Isolator[; G[, [____]]]

Type of Base[; G[, [____]]]

Allowable Deflection[; G[, [____]]]

Measured Deflection[; G[, [____]]]

1.4 QUALITY CONTROL

Ensure all vibration-control apparatus is the product of a single manufacturing source, where possible. Human exposure levels should be considered using ASA S2.71 and NEBB PROCEDURAL STANDARDS.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

****
NOTE: Select the following paragraphs if text under EQUIPMENT is deleted and required isolation provisions are scheduled on the drawings.
****

Scheduled isolation mounting is in millimeters inches and is a minimum static deflection.

Spans referred to in paragraph EQUIPMENT, means longest bay dimension.

Determine exact mounting sizes and number of isolators by the isolator manufacturer based on equipment that will be installed. Check equipment revolutions per minute (rpm) and spring deflections to verify that resonance cannot occur.

2.1.1 Design Requirements

****
NOTE: Use only those standards as necessary.
****

Design for vibration isolation using [NEBB PROCEDURAL STANDARDS] [ASHRAE HVAC APP SI HDBK, ASHRAE HVAC APP IP HDBK, Chapter 48,] as applicable to the following sections.

2.1.1.1 Mountings

Provide the following mountings:

[Type A: Composite pad, with 6.3 millimeter 0.25-inch thick elastomer top and bottom layers, molded to contain a pattern with nonslip characteristics in all horizontal directions. Elastomer loading is not to exceed 275 kilopascal 40 pounds per square inch (psi). Ensure minimum overall thickness is 25 millimeter 1 inch. Maximum deflections up to 6.3 millimeter 0.25-inch are allowed.

][Type B: Double [rubber-in-shear] [elastomer-in-shear] with molded-in steel reinforcement in top and bottom. Maximum deflections up to 12.7 millimeter 0.50-inch are allowed.

][Type C: Free-standing laterally stable open-spring type for deflections over 12.7 millimeter 0.50-inch, with built-in bearing and leveling provisions, 6.3 millimeter 0.25-inch thick Type A base elastomer pads, and accessories. Ensure outside diameter of each spring is equal to or greater than 0.9 times the operating height of the spring under rated load.

][Type D: Partially housed type, containing one or more vertically restrained springs with at least 12.7 millimeter 0.50-inch clearance maintained around springs, with adjustable limit stops, 6.3 millimeter 0.25-inch thick Type A base elastomer pads, and accessories.

][Type E: Pendulum-suspension configuration with free-standing stable spring with resilient horizontal and vertical restraints to allow maximum movements of 6.3 millimeter 0.25-inch in each direction, 6.3 millimeter 0.25-inch thick Type A base elastomer pads.

][Type F: Combination [spring and rubber-in-shear] [elastomer-in-shear] steel framed for hanger-rod mounting, with minimum total static deflection of 25 millimeter 1-inch.
]

****

NOTE: Use air springs where springs are not practical. Consider use where spring deflection exceeds 89 millimeter 3.5-inches. Mount equipment on type base with "outrigger" brackets. Detail dependable air supply and connection provisions including hose connections where necessary.

Servo-controlled air spring isolators with natural frequencies for most applications can be provided. System loads can range from 227 to 226,796 kilogram 500 to 500,000 pounds. Servo-mechanisms will maintain height of isolated mass within 0.13 millimeter 0.005-inch.

****

[Type G: Air spring with body constructed of reinforced elastomer specifically suitable for application environment. Select air spring to provide a natural frequency equal to 127 millimeter 5-inches of deflection of conventional specified steel springs. Provide facilities for dead-level adjustment and height-control of supported equipment.

]2.1.1.2 Bases

Provide the following bases:

[Type U: Unit isolators without rails, structural-steel bases, or inertia blocks.

][Type R: Rails, [connected] [disconnected] mill-rolled structural steel, of sufficient dimension to preclude deflection at midpoint of unsupported span in excess of 1/1,440th of the span between isolators, power transmission, component misalignment, and any overhung weight. Where Type R bases are specified and the equipment proposed requires additional base support, use a Type S base.

][Type S: Structural-steel bases common to a supported assembly, made from welded-joint mill-rolled structural steel with closed-perimeter configuration, isolators attached to outrigger supports.

] Ensure height of steel members is sufficient to provide stiffness required to maintain equipment manufacturer's recommended alignment and duty efficiency of power-transmission components. Ensure height of steel member does not result in member deflection at midpoint of unsupported span of more than 1/1,440th of the span between isolators. Minimum height is 127 millimeter 5-inches.

****

NOTE: The following concrete inertia-block thickness and mass criteria are of necessity, general in scope and should be reviewed for each application and rewritten to reflect specific job conditions.

Mass of inertia block may range from one to three times the weight of supported equipment. Usually a 1 to 1 ratio is satisfactory and 1-1/2 to 1 ratio is not unusual. It is very difficult to achieve an equal weight between equipment and inertia base on air-handling units, especially where they may be large size.

Due to more complex forming and isolator construction required, blocks with recessed isolator-mounting provisions are more expensive and should be specified only to eliminate hazard to personnel.

****

[Type CIB: Provide concrete inertia blocks common to the entire assembly, with welded-joint construction, mill-rolled structural-steel perimeters, welded-in No. 4 reinforcing bars 200 millimeter 8-inches on center each way near the bottom of the block, outrigger-isolator mounting provisions, anchor bolts. Fill with 20.68 Megapascal 3,000 psi cured-strength concrete.

] Configure rectangular inertia bases to accommodate equipment supported.

Ensure minimum thickness of inertia base, in addition to providing suitable mass, is sufficient to provide stiffness to maintain equipment manufacturer's recommended alignment and duty efficiency of power-transmission components, and is sufficient to result in base deflection at midpoint of unsupported span of not more than 1/1,440th of the span between isolators. Verify minimum thickness, the preceding requirements not withstanding, is 8 percent of the longest base dimension.

****

NOTE: Pump bases should be as stiff as practical. 300 millimeter 12-inch thick bases are common. To attain stiffness, mass to 1-1/2 times weight of assembly may be considered. Modify thickness in the following paragraph as required.

****

Ensure pumps with flexible couplings do not have inertia base less than 200 millimeter 8-inches thick, and the minimum mass of concrete inertia block is equal in weight to supported equipment.

2.2 EQUIPMENT

Vibration isolation design per [NEBB PROCEDURAL STANDARDS][ASHRAE HVAC APP SI HDBK, ASHRAE HVAC APP IP HDBK, Chapter 37,].

****

NOTE: The following empirical recommendations are based on floors 102 to 152 millimeter 4 to 6-inches thick and without sub-base or "housekeeping" pad. Spring deflections may be reduced for floors which are 200 millimeter 8-inches thick. "Basement below grade" is considered as on "undisturbed earth." "On grade" is considered as on some fill.

Review "provisions" for each application.

Where isolator deflection is specified for inside locations and project equipment application is roof-mounted and weather-exposed; add 13 millimeter 1/2-inch to specific deflection, use Type D isolators and type U, R, or S bases.

Reciprocating compressor-condenser (rcc) criteria are for inside location, with water-cooled condenser integrally mounted.

Extreme care should be used in isolating field-erected cooling-tower mechanical-equipment supports. Too much mechanical-equipment support movement may reduce propeller to fan ring clearance, normally about 13 millimeter 1/2-inch, to 0. Type U isolators cannot be used on certain units because construction may be such that adequately spaced support points are not available. Recommendations specified are for package units only. Review all structural-steel supports and vibration-isolation provisions with cooling-tower and vibration-isolator manufacturers for field-erected cooling towers with mountings to be applied as follows:

Type A under basin alone which may suffice in 50 percent of cases.

Type D the under basin or structural-steel supports only, with deflections similar to those specified for package tower springs.

Type E under mechanical-equipment supports with Type A under basin 75 to 100 millimeter 3 to 4-inch Type E deflection.

Wherever practical, avoid putting pumps on vibration isolators.

Where deflections exceed 90 millimeter 3.5 inches,

consider air springs.
****

2.2.1 Centrifugal Water Chiller Package Locations

TYPE EQUIPMENT	BASEMENT BELOW-GRADE PROVISIONS*	ON/ABOVE GRADE 6096 MM FLOOR-SPAN PROVISIONS*	ON/ABOVE GRADE 9144 MM FLOOR-SPAN PROVISIONS*	ON/ABOVE GRADE 12192 MM FLOOR-SPAN PROVISIONS*
Hermetic	A-U-6.3	B-U-13	D-S-44.5	D-S-63
Open Type	B-U-9.7	D-U-25	D-CIB-44.5	D-CIB-63
*TYPE OF MOUNTING, BASE, AND MINIMUM DEFLECTION IN MILLIMETER				

TYPE EQUIPMENT	BASEMENT BELOW-GRADE PROVISIONS*	ON/ABOVE GRADE 20-FOOT FLOOR-SPAN PROVISIONS*	ON/ABOVE GRADE 30-FOOT FLOOR-SPAN PROVISIONS*	ON/ABOVE GRADE 40-FOOT FLOOR-SPAN PROVISIONS*
Hermetic	A-U-0.25	B-U-0.50	D-S-1.75	D-S-2.5
Open Type	B-U-0.38	D-U-1.0	D-CIB-1.75	D-CIB-2.5
*TYPE OF MOUNTING, BASE, AND MINIMUM DEFLECTION IN INCHES				

2.2.2 Reciprocating Water Chiller Package Locations

TYPE EQUIPMENT	BASEMENT BELOW-GRADE PROVISIONS*	ON/ABOVE GRADE 6096 MM FLOOR-SPAN PROVISIONS*	ON/ABOVE GRADE 9144 MM FLOOR-SPAN PROVISIONS*	ON/ABOVE GRADE 12192 MM FLOOR-SPAN PROVISIONS*
500 to 750 rpm	D-U-25	D-U-38	D-S-63	D-CIB-69
750 rpm and Over	D-U-25	D-U-25	D-R-50	D-CIB-63
*TYPE OF MOUNTING, BASE, AND MINIMUM DEFLECTION IN MILLIMETER				

TYPE EQUIPMENT	BASEMENT BELOW-GRADE PROVISIONS*	ON/ABOVE GRADE 20-FOOT FLOOR-SPAN PROVISIONS*	ON/ABOVE GRADE 30-FOOT FLOOR-SPAN PROVISIONS*	ON/ABOVE GRADE 40-FOOT FLOOR-SPAN PROVISIONS*
500 to 750 rpm	D-U-1.0	D-U-1.5	D-S-2.5	D-CIB-2.75
750 rpm and Over	D-U-1.0	D-U-1.0	D-R-2.0	D-CIB-2.5
*TYPE OF MOUNTING, BASE, AND MINIMUM DEFLECTION IN INCHES				

2.2.3 Absorption Water Chiller Package Locations

TYPE EQUIPMENT	BASEMENT BELOW-GRADE PROVISIONS*	ON/ABOVE GRADE 6096 MM FLOOR-SPAN PROVISIONS*	ON/ABOVE GRADE 9144 MM FLOOR-SPAN PROVISIONS*	ON/ABOVE GRADE 12192 MM FLOOR-SPAN PROVISIONS*
Standard	A-U-6	D-U-25	D-U-38	D-U-69
*TYPE OF MOUNTING, BASE, AND MINIMUM DEFLECTION IN MILLIMETER				

TYPE EQUIPMENT	BASEMENT BELOW-GRADE PROVISIONS*	ON/ABOVE GRADE 20-FOOT FLOOR-SPAN PROVISIONS*	ON/ABOVE GRADE 30-FOOT FLOOR-SPAN PROVISIONS*	ON/ABOVE GRADE 40-FOOT FLOOR-SPAN PROVISIONS*
Standard	A-U-0.25	D-U-1.0	D-U-1.5	D-U-2.75
*TYPE OF MOUNTING, BASE, AND MINIMUM DEFLECTION IN INCHES				

2.2.4 Reciprocating Compressor/Condenser Locations

TYPE EQUIPMENT	BASEMENT BELOW-GRADE PROVISIONS*	ON/ABOVE GRADE 6096 MM FLOOR-SPAN PROVISIONS*	ON/ABOVE GRADE 9144 MM FLOOR-SPAN PROVISIONS*	ON/ABOVE GRADE 12192 MM FLOOR-SPAN PROVISIONS*
500 to 750 rpm	D-U-25	D-U-38	D-U-63	D-CIB-69
750 rpm and Over	D-U-25	D-U-25	D-U-50	D-CIB-63
*TYPE OF MOUNTING, BASE, AND MINIMUM DEFLECTION IN MILLIMETER				

TYPE EQUIPMENT	BASEMENT BELOW-GRADE PROVISIONS*	ON/ABOVE GRADE 20-FOOT FLOOR-SPAN PROVISIONS*	ON/ABOVE GRADE 30-FOOT FLOOR-SPAN PROVISIONS*	ON/ABOVE GRADE 40-FOOT FLOOR-SPAN PROVISIONS*
500 to 750 rpm	D-U-1.0	D-U-1.5	D-U-2.5	D-CIB-2.75
750 rpm and Over	D-U-1.0	D-U-1.0	D-U-2.0	D-CIB-2.5
*TYPE OF MOUNTING, BASE, AND MINIMUM DEFLECTION IN INCHES				

2.2.5 Reciprocating Refrigeration Compressor Locations

TYPE EQUIPMENT	BASEMENT BELOW-GRADE PROVISIONS*	ON/ABOVE GRADE 6096 MM FLOOR-SPAN PROVISIONS*	ON/ABOVE GRADE 9144 MM FLOOR-SPAN PROVISIONS*	ON/ABOVE GRADE 12192 MM FLOOR-SPAN PROVISIONS*
500 to 750 rpm	C-U-25	C-U-38	C-U-63	C-CIB-69
750 rpm and Over	C-U-25	C-U-25	C-U-50	C-CIB-63
*TYPE OF MOUNTING, BASE, AND MINIMUM DEFLECTION IN MILLIMETER				

TYPE EQUIPMENT	BASEMENT BELOW-GRADE PROVISIONS*	ON/ABOVE GRADE 20-FOOT FLOOR-SPAN PROVISIONS*	ON/ABOVE GRADE 30-FOOT FLOOR-SPAN PROVISIONS*	ON/ABOVE GRADE 40-FOOT FLOOR-SPAN PROVISIONS*
500 to 750 rpm	C-U-1.0	C-U-1.5	C-S-2.5	C-CIB-2.75
750 rpm and Over	C-U-1.0	C-U-1.0	C-R-2.0	C-CIB-2.5
*TYPE OF MOUNTING, BASE, AND MINIMUM DEFLECTION IN INCHES				

2.2.6 Centrifugal Pump Locations

TYPE EQUIPMENT	BASEMENT BELOW-GRADE PROVISIONS*	ON/ABOVE GRADE 6096 MM FLOOR-SPAN PROVISIONS*	ON/ABOVE GRADE 9144 MM FLOOR-SPAN PROVISIONS*	ON/ABOVE GRADE 12192 MM FLOOR-SPAN PROVISIONS*
Close-couple through 3728 watts	None	-R-8.9	C-S-25	C-S-25
Bedplate-mounted through 3728 watts	None	C-CIB-25	C-CIB-38	C-CIB-44.5
5592 watt	None	C-CIB-25	C-CIB-44.5	C-CIB-44.5

TYPE EQUIPMENT	BASEMENT BELOW-GRADE PROVISIONS*	ON/ABOVE GRADE 6096 MM FLOOR-SPAN PROVISIONS*	ON/ABOVE GRADE 9144 MM FLOOR-SPAN PROVISIONS*	ON/ABOVE GRADE 12192 MM FLOOR-SPAN PROVISIONS*
*TYPE OF MOUNTING, BASE, AND MINIMUM DEFLECTION IN MILLIMETER				

TYPE EQUIPMENT	BASEMENT BELOW-GRADE PROVISIONS*	ON/ABOVE GRADE 20-FOOT FLOOR-SPAN PROVISIONS*	ON/ABOVE GRADE 30-FOOT FLOOR-SPAN PROVISIONS*	ON/ABOVE GRADE 40-FOOT FLOOR-SPAN PROVISIONS*
Close-couple through 5 hp	None	-R-0.35	C-S-1.0	C-S-1.0
Bedplate-mounted through 5 hp	None	C-CIB-1.0	C-CIB-1.5	C-CIB-1.75
7-1/2 hp	None	C-CIB-1.0	C-CIB-1.75	C-CIB-2.5
*TYPE OF MOUNTING, BASE, AND MINIMUM DEFLECTION IN INCHES				

2.2.7 Air-Cooled Condensing Unit Locations

TYPE EQUIPMENT	6096 MM ROOF-SPAN PROVISIONS*	9144 MM ROOF-SPAN PROVISIONS*	12192 MM ROOF-SPAN PROVISIONS*
Through 5 hp over 900 rpm	B-U-13	D-U-25	D-U-44.5
Over 5 hp to 500 rpm	B-U-13	D-U-44.5	D-U-63
500 rpm and over	B-U-13	D-U-25	D-U-44.5
*TYPE OF MOUNTING, BASE, AND MINIMUM DEFLECTION IN MILLIMETER			

TYPE EQUIPMENT	20-FOOT ROOF-SPAN PROVISIONS*	30-FOOT ROOF-SPAN PROVISIONS*	40-FOOT ROOF-SPAN PROVISIONS*
Through 5 hp over 900 rpm	B-U-0.5	D-U-1.0	D-U-1.75
Over 5 hp to 500 rpm	B-U-0.5	D-U-1.75	D-U-2.5
500 rpm and over	B-U-0.5	D-U-1.0	D-U-1.75
*TYPE OF MOUNTING, BASE, AND MINIMUM DEFLECTION IN INCHES			

2.2.8 Low-Pressure Suspended Air-Handling Unit (AHU) Locations

Vibration-isolation provisions apply to ceiling-suspended Air Moving and Conditioning Association Class A packaged central-station units.

TYPE EQUIPMENT	6096 MM ROOF-SPAN PROVISIONS*	9144 MM ROOF-SPAN PROVISIONS*	12192 MM ROOF-SPAN PROVISIONS*
Through 3728 watt	F-U-25	F-U-25	F-U-25
5592 watt and over 250 to 500 rpm	F-U-44.5	F-U-44.5	F-U-44.5
500 rpm and over	F-U-25	F-U-31.8	F-U-39.4
*TYPE OF MOUNTING, BASE, AND MINIMUM DEFLECTION IN MILLIMETER			

TYPE EQUIPMENT	20-FOOT ROOF-SPAN PROVISIONS*	30-FOOT ROOF-SPAN PROVISIONS*	40-FOOT ROOF-SPAN PROVISIONS*
Through 5 hp	F-U-1.0	F-U-1.0	F-U-1.0
7-1/2 hp and over 250 to 500 rpm	F-U-1.75	F-U-1.75	F-U-1.75
500 rpm and over	F-U-1.0	F-U-1.25	F-U-1.55
*TYPE OF MOUNTING, BASE, AND MINIMUM DEFLECTION IN INCHES			

2.2.9 Low-Pressure AHU Locations

Vibration-isolation provisions apply to floor-mounted Air Moving and Conditioning Association Class A packaged central-station units.

TYPE EQUIPMENT	BASEMENT BELOW-GRADE PROVISIONS*	ON/ABOVE GRADE 6096 MM FLOOR-SPAN PROVISIONS*	ON/ABOVE GRADE 9144 MM FLOOR-SPAN PROVISIONS*	ON/ABOVE GRADE 12192 MM FLOOR-SPAN PROVISIONS*
Through 3728 watts	B-U-8.9	C-U-25	C-U-25	C-U-25
5592 watt and over to 250 to 500 rpm	B-U-8.9	C-U-44.5	C-U-44.5	C-CIB-44.5
500 rpm	B-U-8.9	C-U-25	C-U-38	
*TYPE OF MOUNTING, BASE, AND MINIMUM DEFLECTION IN MILLIMETER				

TYPE EQUIPMENT	BASEMENT BELOW-GRADE PROVISIONS*	ON/ABOVE GRADE 20-FOOT FLOOR-SPAN PROVISIONS*	ON/ABOVE GRADE 30-FOOT FLOOR-SPAN PROVISIONS*	ON/ABOVE GRADE 40-FOOT FLOOR-SPAN PROVISIONS*
Through 5 hp	B-U-0.35	C-U-1.0	C-U-1.0	C-U-1.0

TYPE EQUIPMENT	BASEMENT BELOW-GRADE PROVISIONS*	ON/ABOVE GRADE 20-FOOT FLOOR-SPAN PROVISIONS*	ON/ABOVE GRADE 30-FOOT FLOOR-SPAN PROVISIONS*	ON/ABOVE GRADE 40-FOOT FLOOR-SPAN PROVISIONS*
7-1/2 hp and over 250 to 500 rpm	B-U-0.35	C-U-1.75	C-U-1.75	C-U-1.75
500 rpm	B-U-0.35	C-U-1.0	C-U-1.5	
*TYPE OF MOUNTING, BASE, AND MINIMUM DEFLECTION IN INCHES				

2.2.10 Medium- and High-Pressure AHU Locations

Vibration-isolation provisions apply to floor-mounted Air Moving and Conditioning Association Classes B and C packaged central-station units.

TYPE EQUIPMENT	BASEMENT BELOW-GRADE PROVISIONS*	ON/ABOVE GRADE 6096 MM FLOOR-SPAN PROVISIONS*	ON/ABOVE GRADE 9144 MM FLOOR-SPAN PROVISIONS*	ON/ABOVE GRADE 12192 MM FLOOR-SPAN PROVISIONS*
Through 3728 watts	B-U-8.9	C-U-25	C-U-25	C-U-25
5592 watt and over to 250 to 500 rpm	B-U-8.9	C-U-44.5	C-U-44.5	C-CIB-44.5
500 rpm	B-U-8.9	C-U-25	C-U-38	
*TYPE OF MOUNTING, BASE, AND MINIMUM DEFLECTION IN MILLIMETER				

TYPE EQUIPMENT	BASEMENT BELOW-GRADE PROVISIONS*	ON/ABOVE GRADE 20-FOOT FLOOR-SPAN PROVISIONS*	ON/ABOVE GRADE 30-FOOT FLOOR-SPAN PROVISIONS*	ON/ABOVE GRADE 40-FOOT FLOOR-SPAN PROVISIONS*
Through 20 hp 250 to 300 rpm	B-U-0.35	C-U-2.5	C-U-2.5	C-U-3.5
300 to 500 rpm	B-U-0.35	C-U-1.75	C-U-1.75	C-U-2.5
500 rpm and over	B-U-0.35	C-U-1.0	C-U-1.0	C-U-1.75
Over 20 hp 250 to 300 rpm	B-U-0.35	C-U-2.5	C-CIB-3.5	C-CIB-3.5
300 to 500 rpm	B-U-0.35	C-U-2.5	C-CIB-2.5	C-CIB-3.5
500 rpm and over	B-U-0.35	C-U-1.0	C-CIB-1.75	C-CIB-2.5
*TYPE OF MOUNTING, BASE, AND MINIMUM DEFLECTION IN INCHES				

2.2.11 Air-Moving Device Locations

Vibration-isolation provisions apply to [housed] [unhoused] free-standing fans of any pressure rating, located in [field-erected [field-] [factory-] fabricated central-station units] [unhoused [return-air] [supply-air] service].

TYPE EQUIPMENT	BASEMENT BELOW-GRADE PROVISIONS*	ON/ABOVE GRADE 6096 MM FLOOR-SPAN PROVISIONS*	ON/ABOVE GRADE 9144 MM FLOOR-SPAN PROVISIONS*	ON/ABOVE GRADE 12192 MM FLOOR-SPAN PROVISIONS*
Through 14.9 kilowatt 250 to 300 rpm	B-U-8.9	C-U-63	C-U-63	C-U-89
300 to 500 rpm	B-U-8.9	C-U-44.5	C-U-44.5	C-U-63
500 rpm and over	B-U-8.9	C-U-25	C-U-25	C-U-44.5
Over 14.9 kilowatt 250 to 300 rpm	B-U-8.9	C-U-63	C-CIB-89	C-CIB-89
300 to 500 rpm	B-U-8.9	C-U-63	C-CIB-63	C-CIB-89
500 rpm and over	B-U-8.9	C-U-25	C-CIB-44.5	C-CIB-63
*TYPE OF MOUNTING, BASE, AND MINIMUM DEFLECTION IN MILLIMETER				

TYPE EQUIPMENT	BASEMENT BELOW-GRADE PROVISIONS*	ON/ABOVE GRADE 20-FOOT FLOOR-SPAN PROVISIONS*	ON/ABOVE GRADE 30-FOOT FLOOR-SPAN PROVISIONS*	ON/ABOVE GRADE 40-FOOT FLOOR-SPAN PROVISIONS*
Through 20 hp 250 to 300 rpm	B-U-0.35	C-S-2.5	C-S-2.5	C-S-3.5
300 to 500 rpm	B-U-0.35	C-S-1.75	C-S-1.75	C-S-2.5
500 rpm and over	B-U-0.35	C-S-1.0	C-S-1.5	C-S-1.75
Over 20 hp 250 to 300 rpm	B-U-0.35	C-S-2.75	C-CIB-3.5	C-CIB-5.0
300 to 500 rpm	B-U-0.35	C-S-1.75	C-CIB-2.5	C-CIB-3.5
500 rpm and over	B-U-0.35	C-S-1.0	C-CIB-1.75	C-CIB-2.5
*TYPE OF MOUNTING, BASE, AND MINIMUM DEFLECTION IN INCHES				

2.2.12 Cross-Flow Cooling Tower Locations

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NOTE: For blank spaces see notes at beginning of paragraph EQUIPMENT. Design vibration isolators capable of supporting towers exposed to wind loading of 1437 pascal 30 pounds per square foot.

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TYPE EQUIPMENT	6096 MM ROOF-SPAN PROVISIONS*	9144 MM ROOF-SPAN PROVISIONS*	12192 MM ROOF-SPAN PROVISIONS*
Package under tower base to 500 rpm	B-U-8.9	D-U-50	D-U-63
500 rpm and over	B-U-8.9	D-U-25	D-U-44.5
Field erected under tower base; all rpm			
Under mechanicl equipment supporting frame to 500 rpm			
500 rpm and over			
*TYPE OF MOUNTING, BASE, AND MINIMUM DEFLECTION IN MILLIMETER			

TYPE EQUIPMENT	20-FOOT ROOF-SPAN PROVISIONS*	30-FOOT ROOF-SPAN PROVISIONS*	40-FOOT ROOF-SPAN PROVISIONS*
Package under tower base to 500 rpm	B-U-0.35	D-U-2.0	D-U-2.5
500 rpm and over	B-U-0.35	D-U-1.0	D-U-1.75
Field erected under tower base; all rpm			
Under mechanical equipment supporting frame to 500 rpm			
500 rpm and over			
*TYPE OF MOUNTING, BASE, AND MINIMUM DEFLECTION IN INCHES			

2.2.13 Blow-Through Cooling Tower Locations

TYPE EQUIPMENT	6096 MM ROOF-SPAN PROVISIONS*	9144 MM ROOF-SPAN PROVISIONS*	12192 MM ROOF-SPAN PROVISIONS*
Under tower base to 500 rpm	B-U-8.9	C-S-63	C-S-89

TYPE EQUIPMENT	6096 MM ROOF-SPAN PROVISIONS*	9144 MM ROOF-SPAN PROVISIONS*	12192 MM ROOF-SPAN PROVISIONS*
500 rpm and over	B-U-8.9	C-S-25	C-S-44.5
*TYPE OF MOUNTING, BASE, AND MINIMUM DEFLECTION IN MILLIMETER			

TYPE EQUIPMENT	20-FOOT ROOF-SPAN PROVISIONS*	30-FOOT ROOF-SPAN PROVISIONS*	40-FOOT ROOF-SPAN PROVISIONS*
Under tower base to 500 rpm	B-U-0.35	C-S-2.5	C-S-3.5
500 rpm and over	B-U-0.35	C-S-1.0	C-S-1.75
*TYPE OF MOUNTING, BASE, AND MINIMUM DEFLECTION IN INCHES			

2.2.14 Pipe And Duct Vibration Isolation

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NOTE: Drawings should show pipe and duct isolation required by project conditions.

Hanger-rod length should be long enough to dissipate conducted heat which might be detrimental to elastomers.

Drawings should show type and spacing of pipe isolators in accordance with the following guide:

Pipe Size Millimeter	Distance to be Isolated	Maximum Spacing Between Isolators
25	3048	3048
50	4572	3048
75	6096	3048
100	7620	3048
150	9144	3048
200	12192	3048
250	13716	3048
300	15240	3048
406	18288	3048

Pipe Size Inches Inclusive	Distance to be Isolated Feet	Maximum Spacing Between Isolators Feet
1	10	10
2	15	10
3	20	10
4	25	10
6	30	10
8	40	10
10	45	10
12	50	10
16	60	10

Coordinate duct and piping drawings and specifications with respect to connected vibration-isolated equipment deflections, expansion joints, and other flexible equipment connections.

In addition to springs and rubber, high-density fibrous-glass segment pipe saddles may be used for vibration isolation.
****

[Type G: Provide isolators with in-series contained steel springs and preformed fibrous-glass or chloroprene-elastomer elements for connecting to building-structure attachments. Load devices by supported system during operating conditions to produce a minimum spring and elastomer static deflection of 25 millimeter and 10 millimeter 1-inch and 3/8-inch, respectively.
]
****
NOTE: Use Type H and Type J isolators where necessary to support pipe beyond tabulated distance.
****

[Type H: Provide isolators with contained chloroprene-elastomer elements for connecting to building-structure attachments. Load devices by supported system during operating conditions to produce a minimum elastomer static deflection of 10 millimeter 3/8-inch.

][Type J: Provide isolators with elastomers mounted on floor-supported columns or directly on the floor. Load devices by supported system during operating conditions to produce a minimum elastomer static deflection of 10 millimeter 3/8-inch.

][2.2.14.1 Floor-Mounted Piping

Type K: Provide isolators with springs mounted on floor-supported

columns or directly on the floor. Load devices by supported system during operating conditions to produce a minimum spring static deflection of 25 millimeter 1-inch.

]2.2.14.2 Vertical Piping

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NOTE: For pipe approximately DN100 4 inches and larger.

Do not use Type l typical vertical pipe attachments on vibration-isolated pipe.

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[Type L: Provide isolators which are pipe base-support devices with one or more contained steel springs. Load devices by supported system during operating conditions to produce a minimum static deflection of 25 millimeter 1-inch. Equip devices with precompression and vertical-limit features, as well as a minimum 6.4 millimeter 1/4-inch thick elastomer sound pad and isolation washers, for mounting to floor.

][Type M: Provide isolators which are elastomer mounted baseplate and riser pipe-guide devices, with contained double acting elastomer elements which under rated load have a minimum static deflection of 10 millimeter 3/8-inch. Size isolator to accommodate thermal insulation within the stationary guide ring.
]

2.3 MATERIALS

Ensure rubber is natural rubber and elastomer is chloroprene. Shore A durometer measurement of both materials and range between 40 and 60.

Inorganic materials such as precompressed, high-density, fibrous glass encased in a resilient moisture-impervious membrane may be used in lieu of specified natural rubber and elastomers. Where this substitution is made, ensure specified deflections are modified by the manufacturing source to accommodate physical characteristics of inorganic materials and to provide equal or better vibration isolation.

Ensure weather-exposed metal vibration-isolator parts are corrosion protected. Chloroprene coat springs.

2.4 TESTS, INSPECTIONS, AND VERIFICATIONS

Submit test reports for testing vibration isolation for each type of isolator and each type of base. Meet referenced standards contained within this section. Include in test reports allowable deflection and measured deflection also meeting referenced standards within this section.

PART 3 EXECUTION

3.1 INSTALLATION

Install equipment in accordance with manufacturer's recommendations.

[Ensure rails, structural steel bases, and concrete inertia blocks are raised not less than 25 millimeter 1-inch above the floor and are level when equipment supported is under operating load.

][Ensure vibration-isolation installation and deflection testing after equipment start-up is directed by a competent representative of the manufacturer.

][3.2 FIELD QUALITY CONTROL

3.2.1 Tests and Reports

Ensure vibration-isolation devices are deflection tested. Submit test reports substantiating that all equipment has been isolated as specified and that minimum specified deflections have been met. Make all measurements in the presence of the Contracting Officer.

] -- End of Section --