SECTION 26 05 48

~~~ PROJECT NOTE ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
ARCHITECT OF RECORD/ENGINEER OF RECORD IS RESPONSIBLE FOR REVIEWING THIS SPECIFICATION SECTION IN DETAIL FOR COORDINATION WITH THE PROJECT SCOPE OF WORK.

ALL "PROJECT NOTE" TEXT IS TO BE REMOVED FOLLOWING REVIEW OF THE CONTENT OF EACH NOTE BY THE ARCHITECT OF RECORD/ENGINEER OF RECORD.

EDIT THE DOCUMENT FOOTER TO INCLUDE THE PROJECT NAME AND NUMBER.

EDIT THE DOCUMENT HEADER TO INDICATE THE ARCHITECT OF RECORD PROJECT ISSUE" DATE. THE "CPS CONTROL" DATE SHOULD NOT BE EDITED.

ANY MODIFICATIONS TO THE TECHNICAL STANDARDS IN THIS SECTION - INCLUDING THE REMOVAL OR ADDITION OF MANUFACTURERS - MUST BE APPROVED BY CPS.

REQUESTS FOR MODIFICATION ARE TO BE SUBMITTED TO THE DESIGN MANAGER DURING THE DESIGN PHASE FOR REVIEW AND APPROVAL.
~~~ END OF PROJECT NOTE ~~~~~~~~~~~~~~~~~~~~~~~~

NOISE AND VIBRATION CONTROL FOR ELECTRICAL SYSTEMS

~~~ PROJECT NOTE ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
EOR TO REVIEW VIBRATION ISOLATOR REQUIREMENTS. SMALL PROJECTS MAY ALLOW FOR THIS SUBJECT TO BE COVERED IN 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS. REVIEW BOTH SECTIONS.
~~~ END OF PROJECT NOTE ~~~~~~~~~~~~~~~~~~~~~~~~

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Isolation of vibrations induced by Electrical Systems from spaces for which Noise Criteria have been established in Division 1, including vibration isolators, equipment bases, and flexible connections.
   1. Mount transformers and conduits on vibration isolators as noted in the Contract Documents. Select, install and adjust isolators to prevent the transmission of objectionable vibration and noise to the building structure.

1.02 REFERENCE STANDARDS

A. AASHTO HB - Standard Specifications for Highway Bridges; 2002, with Errata (2005).

B. Chicago Electrical Code - Municipal Code of the City of Chicago, Building/Electrical Code Requirements; 2018.

C. NFPA 70 - National Electrical Code; 2017.

1.03 QUALITY ASSURANCE

A. Provide all vibration isolators and equipment bases for Division 26 work from the product line of a single manufacturer, unless otherwise accepted by the Board or Acoustics Consultant.

B. Select isolators to provide uniform deflections within acceptable tolerances when supporting the equipment approved for this project. Coordinate as required with the equipment manufacturers to accomplish this.

C. Provide engineering, isolator selection, site supervision, and inspection by manufacturer's personnel who shall perform these services directly. Alert the Engineer and Acoustics Consultant of isolator selections that may result in resonances with the equipment and structural systems they are intended to isolate. Replace isolators that upon installation are found to resonate with the supported equipment.

D. Provide complete isolation systems that include all elements recommended by the manufacturer for compliance with project requirements and applicable codes, ordinances, and regulations.

E. Include all incidental products and materials required for a complete installation even if not explicitly described in the Construction Documents.

F. Installation & Verification:
   1. Install vibration isolation systems using skilled workers trained and licensed, as applicable, by the manufacturer for installations of the types used on this project.
   2. Upon completion of the work, provide final inspection by the manufacturer's representative and submit to the Architect/Engineer of Record a written report authored by the manufacturer's representative certifying the correctness of installation and compliance with the approved submittal data. Include tabulation of the static deflection expected under design and operating loads in comparison with the actual static deflection measured in the completed installations.
   3. Seismic Restraint Requirements:
      a. Design vibration isolation mounts to meet the current design requirements and codes defined by the Structural Engineer. Use appropriate equipment weights and force factors for the equipment used in this project.
      b. Provide certification by a licensed professional engineer experienced in the design of restraints for resiliently mounted equipment, and in the employ of the manufacturer, stating that the requirements of all applicable codes, ordinances and regulations regarding seismic restraint of resiliently mounted equipment have been met by the design. Provide shop drawings, calculations, and analysis stamped by the manufacturer's engineer and demonstrating this compliance.
   4. Wind Bracing Requirements:
      a. If applicable, design vibration isolation mounts to meet the design wind loads defined by the Structural Engineer and required by applicable codes. Provide calculations and certification stating compliance.

1.04 ENGINEERING

A. The Construction Documents are indicative of isolation requirements. Provide complete engineering services for all components of isolation systems used in this project.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Manufacturer's Data: Submit technical product data confirming that products comply with specified requirements:
   1. Illustrations and descriptions of components including, but not limited to isolators, equipment bases, thrust and seismic restraints, anchors, and accessories.
   2. Operation and maintenance instructions.

C. Shop Drawings
   1. Details of isolation systems, including plan and section drawings indicating isolator and flexible connection locations and types, isolator and connector schedules, details for resilient penetrations, and installation details.
   2. Isolator location drawings will be based on contractor's shop drawings rather than engineer's drawings whenever possible. If shop drawings are not used, the contractor will be required to make field-modifications, including but not limited to replacement and/or relocation of isolators, based on final field conditions at no cost to the Board.
   3. Indicate substrate construction required of other subcontractors.
   4. An initial submittal "For Type Only" is acceptable to confirm the scope of the isolators on the project if the necessary shop drawings by others (i.e. ductwork or equipment) are not yet available to provide final isolator sizing at the time of the initial submission. In this case a follow-up submittal will be required indicating precise isolator sizing and location as noted elsewhere in this section.

D. Samples: provide a sample of each type of isolator assembly used in the project. It is not necessary to submit samples of each spring capacity and pad hardness.

E. Supervision plan for manufacturer's representative in the field during installation of vibration isolation systems.

F. General Requirements for Vibration Isolation Mounts and Hangers: Provide catalog cut sheets, shop drawings, and other documents as necessary to describe the installation and its components. Include the following information:
   1. Calculations:
      a. Submit manufacturer's engineer's calculations of loads, deflections, and natural frequencies for record only.
      b. Color code legend for isolator capacities.
      c. Certifications:
         1) Certify that elastomeric pads meet the requirements of AASHTO HB, Highway Bridge Specification.
      d. Springs Summary, for each spring-based isolator:
         1) Equipment name and number
         2) Operating Weight of Equipment
         3) Isolator type
         4) Weight supported by isolator
         5) Scheduled deflection
         6) Proposed deflection under operating load
         7) Natural Frequency
      e. Elastomeric Pads, for each elastomer-based isolator:
         1) Equipment name and number
         2) Operating Weight of Equipment
         3) Isolator type
         4) Weight supported by isolator
         5) Pad bearing area
         6) Pad free height
         7) Pad operating height
         8) Scheduled deflection
         9) Proposed deflection under operating load
         10) 1Percent deflection
         11) 1Natural Frequency
         12) 1Hardness and compliance with AASHTO HB Bridge Bearing Neoprene quality standard

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Subject to the requirements and the restrictions regarding unacceptable types of isolators, the products of the following manufacturers are acceptable sources for this project:
1. Mason Industries, Inc. (Mason), Hauppage, New York
2. Kinetics Noise Control (Kinetics), Dublin, Ohio
3. Amber-Booth Company, Inc. (Amber Booth), Houston, Texas
4. CDM Novitec (CDM), Evanston, IL
5. Thybar Corporation (Thybar), Addison, IL
6. E.A.R., Indianapolis (EAR), Indiana
7. PSI-Thunderline/Link-Seal (PSI-Thunderline), Houston, Texas
8. Ductmate Industries, Inc. (Ductmate), East Monongahela, PA
9. DynAir Inc. (DynAir), Lachine, QB
10. Carlisle Hardcast (Carlisle), Wylie, TX

2.02 ELASTOMER REQUIREMENTS

A. Provide elastomeric elements with static deflections equal to or greater than those shown on the Construction Documents. Submittals based on rated deflections will be rejected.

B. Provide neoprene elements with a maximum hardness of 40 durometer, Shore A rating, where possible, but in no case exceeding 50 durometer. Where deflections called out in the construction documents exceed those required to achieve the specified natural frequencies, the greater deflection will govern.

C. Meet AASHTO HB Specifications for all neoprene products installed in irretrievable locations and as required elsewhere in the Construction Documents.

2.03 CORROSION RESISTANCE

A. Where applicable, treat isolators and associated hardware for resistance to corrosion per requirements of Division 6.

2.04 ACCEPTABLE PRODUCTS

A. Floor-Supported Mounts
1. Type M-1 Mounts - Neoprene Pads
   a. 3/4”-inch minimum thickness, waffled or ribbed neoprene.
   b. Where multiple layers are required to provide the specified deflections, interleave pads with 16 gauge steel shim plates. Size pads for deflection equal to 10 to 15 percent of unloaded height and provide pads of sufficient thickness to achieve the specified deflection. Provide load-distributing top plates if required for uniform loading.
   c. Acceptable products for individual pads include:
      1) Mason W, SW, and Super W
      2) Kinetics NP
      3) Amber-Booth NR
      4) Acceptable products for neoprene/steel composite pads include:
      5) Mason WSW
      6) Amber-Booth SP-NR Style E
      7) RPG Custom Elastometic/Steel Composite Pads
      8) Type M-2 Mounts - Neoprene-in-Shear Mounts

9) Provide double-deflection in-shear isolators with steel bottom plates with pre- drilled bolt holes for attachment to floor or base, a threaded steel insert at the top of the isolator for attaching the equipment, and friction surfaces at both top and bottom. Coat all metal surfaces with neoprene.
10) 1Acceptable products include:
11) 1Mason ND
12) 1Kinetics RD
13) 1Amber-Booth RVD

B. Ceiling-Supported Hangers
1. Type H-1 Hangers - Not Used
2. Type H-2 Hangers - Neoprene-in-Shear Hangers
a. Provide neoprene-in-shear element mounted in a rigid steel hanger box. Mold neoprene element with a rod isolation bushing that prevents rigid contact between hanger rod and housing from vertical through an angular deflection of not less than 30 degrees in any direction.
b. Acceptable products include:
1) Mason HD and WHD
2) Kinetics RH
3) Amber-Booth BRD
3. Type H-4 Hangers - Pre-Compressed Open Spring with Elastomer
a. Provide built-in adjustable spring restraints for equipment with operating weight greater than weight upon installation to prevent equipment from deflecting (or rising) when the additional weight is applied (or removed in the future). Provide isolators similar to Type H-3, but pre-compressed with restraint mechanisms that can be released to free the spring when subjected to its operational load. Provide an integral scale to indicate amount of deflection.
b. Acceptable products include:
1) Mason PC30N
2) Kinetics SRH, with restraints
3) Amber-Booth PBSRA

C. Wall-Supported Equipment Mounts
1. Type W-1 Mount - Captive Neoprene
a. Maximum 50 durometer solid neoprene or neoprene housed in steel casing. Provide threaded insert to receive equipment mounting bolt.
b. Acceptable products include:
1) Neoprene Wall-Mount Isolators:
2) Mason BR, RBA, and RCA
3) Kinetics RQ
4) RPG Custom Neoprene Wall Mount Isolator

D. Flexible Connections
1. FC-1 Connector - Flexible Conduit Connectors
a. Connectors for conduit over 2-inch diameter.
b. Acceptable products include:
1) Crouse Hinds type XD Expansion/Deflection Coupling
2) OZ/Gedney type DX
3) Anaconda Sealtite
c. Type FC-2 Connector - Flexible Steel Conduit
1) Provide U.L listed flexible zinc-coated steel conduit. Provide liquid tight coating and fittings where required under Division 26.
2) Acceptable Products include:
3) American Flexible Conduit Company Type AC-90
4) International Flexible Hose Company Type RWS
5) Liquid Tight Flexible Steel Conduit:

6) Anaconda Sealtite Type UA
7) Electri-Flex Type LT Liquatight

d. Type FC-3 Connector - Not used

e. Type FC-4 Connector - Below-Grade Penetration Seals
1) Modular EPDM, nitrile, or silicone seal, as appropriate for specific field conditions, with accompanying sleeves, caps, and accessories. Provide fire- and high-temperature rated components where required by project conditions and applicable codes.
2) Acceptable products include:
3) PSI-Thunderline, Link-Seal

E. Isolation Accessories
1. Elastomeric Isolators for Mounting Bolts
a. Provide neoprene grommets, bushings, and washers for all bolts used to secure isolators to floors and housekeeping slabs and for all snubbers. Size bolt holes and washers to accommodate grommets, sleeves, and bushings and to preclude contact between rigid components that would cause bridging between isolated elements and the building structure. Baseplates for neoprene pads may be rigidly bolted to the floor or housekeeping slab if the bolts secure the baseplates only and do not continue through the neoprene to meet any other rigid material. Do not exceed 40 durometer, Shore A hardness.
b. Acceptable products include:
1) Mason HG, HLB and HLW
2) E.A.R. Isodamp and C-1000
3) Amber Booth Elastomeric Grommet Isolators

PART 3 - EXECUTION

3.01 GENERAL

A. Before commencing installation examine the substrate and surrounding conditions to insure that there is nothing to prevent proper and timely execution of the installation. Beginning work specified in this Section indicates acceptance of the substrate and surrounding conditions.

B. Install isolation systems in strict compliance with manufacturer's recommendations and engineering, and submittal data. Make no rigid connections to structure that would compromise the performance of the isolation systems.

C. Resiliently mount or hang mechanical equipment, conduit, and other electrical equipment on structural components indicated on the Drawings and as specified in this section.

D. For all isolated equipment, make connections of conduit using flexible connections specified in this section. Make no connections to isolated equipment in a manner that would compromise the performance of the isolation systems.

E. Install seismic restraints and thrust/sway bracing in conformance with the engineered shop drawings and applicable codes, ordinances, and regulations.

F. Establish isolator locations for ease of installation, adjustment, and inspection as well as specified performance.

G. Replace isolators found to resonate with building structure, at no additional cost to the Board.

3.02 GENERAL REQUIREMENTS FOR MOUNTS AND HANGERS

A. Align mounts and hangers squarely above or below the equipment mounting holes to avoid introducing lateral loads and deflection.

B. Deflection requirements:
   1. Verify installed isolators have deflections equal to or greater than deflections specified on the submittals.
   2. Where multiple deflections apply to a single isolator (where a single isolator supports multiple isolated elements), the largest deflection governs.
   3. Vary the size and/or hardness of isolators as required to yield equal deflection for all isolators supporting a single piece of equipment or length of pipe or ductwork. Consult manufacturer for direction when specified isolators do not yield required deflection and correct non-compliant isolators at no cost to the Board.

C. Support electrical equipment and conduit independently. Do not hang electrical equipment or conduit from other isolated equipment, ductwork, piping, or conduit.

D. Maintain 2 inches of clearance between isolated elements and walls, ceilings, and other non-isolated building components.

E. Adjust leveling bolts and hanger rod lengths so that equipment is level and in alignment with connecting ductwork and piping.

F. Isolate hanger rods passing through barrier ceilings with elastomeric sleeves or grommets or treat as resilient penetrations in accordance with the details and Division 7 - Acoustical Sealants. Unless noted otherwise, locate electrical fixtures, equipment and conduits below barrier ceilings.

3.03 EQUIPMENT MOUNTED ON FLOORS, HOUSEKEEPING PADS, AND STRUCTURAL ELEMENTS

A. For equipment with bases, locate isolators on the sides of the base that are parallel to the equipment shaft.

B. At housekeeping slabs and pedestals, position isolators with entire bearing plate on slab or pedestal. Do not cantilever baseplates beyond edges of slabs and pedestals. Coordinate isolator locations with housekeeping slabs so that outboard height-saving mounts do not contact the housekeeping slabs. Notify contractor of work by others requiring remediation for proper installation of isolators.

C. For floor-mounted equipment, provide a minimum of 2 inches operating clearance from the lowest point of the base to the floor or housekeeping slab. Verify that 2 inches of unobstructed clearance has been provided in the final installation under operating loads. Correct nonconforming conditions at no cost to the Board. Provide height-saving brackets as required to maintain required equipment clearances.

D. For concrete inertia bases, set steel perimeter on bond breaker material, provide steel reinforcing in compliance with Manufacturer's recommendations, and pour normal weight concrete to the full depth of the perimeter steel. If no reinforcing is specified, provide ½-inch reinforcing bar at 6-inch centers each way, and weld reinforcing to the perimeter steel 1½ inches above the bottom of the steel. Provide required anchor bolts held in position by steel templates during the pour.

3.04 ISOLATION SCHEDULE

A. Provide isolation mounts and hangers for Electrical equipment as follows (see also notes after table):

EQUIPMENT TYPE	ON GRADE INST.					ABOVE GRADE INST.
	BASE	ISOLATOR	DEFL.	BASE	ISOLATOR	DEFL.
TRANSFORMERS						
LESS THAN 45KVA	--	M-2 / W-1	1.0"	--	M-3 / H-3 / W-1	0.3"
45KVA TO 750KVA	--	M-2	0.3"	--	M-3 / H-3	1.0"
GREATER THAN 750KVA	--	M-4	1.0"	--	M-3	1.0"
ENCLOSURES CONTAINING RELAYS, TRANSFORMERS, BALLASTS, OR CHOKE COILS	--	M-2 / W-1	0.3"	--	M-2 / W-1	0.3"

B. Table Notes:
1. Quick reference for isolator types:
   a. Mount M-1: Neoprene pad
   b. Mount M-2: Neoprene-in-shear
   c. Hanger H-1: Not used
   d. Hanger H-2: Neoprene-in-shear
   e. Hanger H-3: Open spring
   f. Hanger H-4: Precompressed open spring

C. Provide isolation mounts and hangers for conduit connected to electrical equipment as follows:
1. All conduit connected to isolated electrical equipment must be isolated at the following locations:
   a. A minimum of 30ft. away from the equipment, as measured along the length of the run. Isolation mounts or hangers must be selected with the same minimum static deflection as the mounts or hangers supporting the equipment. This includes vertical runs within chases using type P-1 and P-2 supports as required.
   b. Within the electrical or machine room, even if greater than 30ft. away from the equipment. Isolation mounts or hangers must be selected with the same minimum static deflection as the mounts or hangers supporting the equipment.
   c. At least 8ft. away, as measured along the length of the run, from penetrations through acoustically isolated construction or crossing acoustic isolation joints.
   d. On all hangers supported from the undersides of slabs in rooms with a noise criteria of less than RC-25.
2. Wall-mounted conduit may be isolated as follows, wherever it is to be isolated per the paragraph above:
   a. Conduit groups mounted on unistrut may be isolated using type W-1 wall mounts.
   b. Individual conduit may be wrapped in 1 inch thick Armaflex insulation wrap with the clamp installed over the wrap.
3. Position isolators as high as possible in the hanger rod or strap assembly but not in direct contact with the building structure without manufacturer's written authorization. Provide 1 inch minimum clearance between isolator housing and structure above. Provide side clearance for hangers to allow full 360-degree rotation about the rod axis without contacting any object.
4. Parallel conduit can be hung together on a trapeze that is isolated from the structure. Isolator deflections must be equal to or greater than the greatest deflection required for

the conduit if isolated individually. Do not mix isolated and non-isolated piping on the same trapeze.

D. Provide flexible connections for all conduit connected to electrical equipment as follows:
   1. All conduit serving isolated electrical equipment will be connected to the equipment using flexible conduit connectors as follows:
      a. Use type FC-1 connectors for conduit 2 inches in diameter and larger.
      b. Use type FC-2 connectors for conduit less than 2 inches in diameter. FC-2 flexible conduit will be at least 18 inches long in a slack “U” shaped loop.
   2. Where conduit is embedded in concrete walls or floors and crosses acoustically isolated construction or an acoustic isolation joint, a type FC-1 connector will be used at the crossing point.

E. Provide isolation accessories for all isolated electrical equipment as follows:
   1. All bolted connections between equipment and non-isolated structure, or at other locations recommended by the isolation manufacturer, must be made using Elastomeric Isolators for Mounting Bolts.
   2. Thrust restraints & sway braces
      a. When total rotational thrust exceeds 10 percent of the isolated weight, provide resilient horizontal thrust restraints to prevent excessive horizontal movement.
      b. When suspended equipment is subjected to wind loads and other lateral forces not due to thrust, provide sway braces meeting the same requirements as thrust restraints.

3.05 TESTING, EVALUATION AND ACCEPTANCE PROCEDURES

A. Upon completion of the installation, the vibration isolation manufacturer will send a representative to the site to inspect and approve the installation. The manufacturer’s field report must certify that all of the isolators have been installed in accordance with the manufacturer’s instructions and will include the type and measured static deflection of all spring isolators.

B. If it is found that the construction fails the acoustic test measurements or performance requirements identified in the Contract Documents, make changes necessary to meet the requirements identified in the Contract Documents and be responsible for the costs associated with performing all additional acoustical tests to verify the acoustic performance of the construction. Costs for additional acoustical testing shall include consulting fees at per hour rates in effect at the time of testing along with related expenses including, but not limited to, travel expenses and test equipment use charges.

END OF SECTION 26 05 48