

## **PART 1 - GENERAL**

### **1.1 RELATED SECTIONS**

- .1 Section 21 00 00/26 00 00 - Specific Conditions – Mechanical/Electrical.
- .2 Section 26 05 00 - Common Work Results – Electrical.

### **1.2 REFERENCES**

- .1 Unless otherwise indicated, perform all work in accordance with the latest edition of the Quebec Construction Code (QCC).
- .2 Furthermore, work must be carried out in accordance with any other code or standard having jurisdiction, as per the latest edition, including but not limited to:
  - .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE).
    - .1 ASHRAE, Applications Handbook (SI).
  - .2 American Society for Testing and Materials International (ASTM).
    - .1 ASTM E488, Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements
  - .3 NRC-CNRC, Quebec Construction Code – Chapter 1 – Buildings, and the National Building Code – Canada, latest edition.
  - .4 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA).
    - .1 SMACNA, Addendum No. 1, September 2000 to Seismic Restraint Manual, Guidelines for Mechanical Systems.
    - .2 SMACNA, Seismic Restraint Manual, Guidelines for Mechanical Systems.

### **1.3 SUBMITTALS**

- .1 Shop drawings:
  - .1 Submit shop drawings in accordance with Section 21 00 00/26 00 00 - Specific Conditions – Mechanical/Electrical, indicating all installation details, technical calculations and data for the planned seismic controls in order to comply with current standards.

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- .2 Product data:
  - .1 Submit technical data sheets required in accordance with Section 21 00 00/26 00 00 - Specific Conditions – Mechanical/Electrical.
- .3 Samples:
  - .1 N/A.

## **1.4 RESPONSIBILITIES**

- .1 Supply a detailed version of the calculation criteria, execution drawings, list of materials and equipment that will be installed with seismic controls. Should the Contractor fail to use earthquake protection, the engineering firm should be informed in writing. Every contractor is responsible for the seismic controls related to their discipline.
- .2 In the event of an earthquake, it is not necessary for the equipment and electromechanical systems to remain operational following the earthquake. Seismic controls are to prevent the mechanical and electrical systems from moving or toppling over and causing injury to occupants during an earthquake.
- .3 Supply a complete, functional seismic restraint fastening system designed by an engineer who is an OIQ member and who is proficient in the design of seismic fastening systems. Submittals must be signed and sealed by an engineer recognized in the province of Quebec.

## **1.5 DETERMINING PROTECTION LEVEL**

- .1 For electrical ducting and conduits, install seismic control anchoring and stabilization devices in accordance with the instructions in the Seismic Restraint Manual published by SMACNA.
- .2 After calculating the lateral seismic force of the design, determine the protection level required. Protection level SHL-A is designed to resist a lateral seismic force equivalent to 48% of the weight of the equipment. Level SHL-B is designed to resist a lateral seismic force equivalent to 30% of the weight of the equipment and level SHL-C is designed to resist a lateral seismic force equivalent to 15% of the weight of the equipment.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- .1 All electrical equipment mounted on suspended ceilings must be fastened directly to the building structure.
- .2 Seismic control devices must prevent permanent movement and damage from horizontal and vertical shifting and toppling.
- .3 Seismic control devices must be compatible with the electromechanical design. They must not hinder the normal operation of the electromechanical systems.
- .4 Seismic control devices must be flexible and work in every direction. They must not infringe upon soundproofing and vibration isolation devices.
- .5 Fasteners and attachment points to resist same maximum load as seismic restraints.
- .6 Drilled or power driven anchors and fasteners not permitted.
- .7 No equipment, equipment supports or mounts to fail before failure of structure.
- .8 Supports of cast iron or threaded pipe not permitted.
- .9 Seismic control measures must not interfere with integrity of fire-stopping devices.
- .10 Accessories such as speakers and light fixtures installed in suspended ceilings do not have to be stabilized except in exit hallways or where the ceiling is specifically designed to be earthquake resistant.

### **2.2 SEISMIC CONTROL DEVICES**

- .1 Supports to have longitudinal and cross bracing. They may be rigid or wire-type supports.
- .2 Do not stabilize equipment with suspension rods less than 300 mm long.
- .3 Stabilize electrical ducting and conduits 35 mm in rated diameter or more inside mechanical rooms.
- .4 Stabilize electrical ducting and conduits 63 mm in rated diameter or more outside mechanical rooms.

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- .5 Install mechanical restraint devices according to the following frequencies:
  - .1 For cross stabilization:
    - .1 SHL-A: every 6.1 linear metres;
    - .2 SHL-B: every 10 linear metres;
    - .3 SHL-C: every 12.2 linear metres.
  - .2 For longitudinal stabilization:
    - .1 SHL-A: every 12 linear metres;
    - .2 SHL-B: every 20 linear metres;
    - .3 SHL-C: every 24.4 linear metres.
- .6 Cross bracing may be used as longitudinal bracing if it is installed less than 600 mm from the ducting direction change.

## **2.3 STATIC EQUIPMENT**

- .1 The equipment must be fastened to hanging supports, which must be fastened to the structure.
- .2 Use one or more of the methods listed below or follow the instructions on the plans:
  - .1 Fasten suspensions solidly to the frame;
  - .2 Brace the suspensions in all planes;
  - .3 Brace suspensions to the frame;
  - .4 Provide mechanical stabilization by means of cables.
- .3 Devices must prevent horizontal swaying and vertical tipping of devices.
- .4 Suspension rods used must withstand buckling.

## **2.4 EQUIPMENT SUSPENDED USING INSULATORS**

- .1 Equipment must be attached to hanging supports which must be fastened to the structure by means of cables.
- .2 The devices must be flexible and continuous.

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- .3 Seismic control devices must not hinder the efficiency of soundproofing and vibration isolation devices. During normal operation, the clearance between the seismic control devices and equipment must be between 6 mm and 12 mm.

## **2.5 EQUIPMENT SUPPORTED USING ISOLATORS**

- .1 Where aseismic isolators are used, they must be designed and installed to withstand minimum acceleration forces.
- .2 The devices may not be compressed to the point that they lose efficiency.
- .3 Where standard isolators are used, seismic control devices must be incorporated into the vibration isolation devices to prevent them toppling over.
- .4 Seismic control devices must not hinder the efficiency of soundproofing and vibration isolation devices. During normal operation, the clearance between the seismic control devices and equipment must be between 6 mm and 12 mm.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- .1 Seismic control devices must be in compliance with the latest edition of the QCC.
- .2 Ensure that anchoring and attachment points withstand same maximum load as seismic restraints.
- .3 Ensure that connection of ducting and electrical conduits to insulated equipment does not hinder the flexibility of vibration isolation devices and that ducting and conduits passing through walls or floors do not transmit vibrations.
- .4 For equipment not equipped with attachment points, add attachment points or install attachment belts.
- .5 The structural bases of equipment must be stabilized to prevent it from toppling over.
- .6 Clearance of at least 25 mm must be provided between seismic control devices and all other service equipment or component.

### **3.2 ANCHORS**

- .1 Check that anchor bolts, dowel diameters, recess depths in concrete and weld lengths comply with drawings submitted for approval.

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- .2 Bolt all equipment that is not insulated against transmission of vibrations to the frame or structure.
- .3 Oblong drillings for bolt adjustment are not permitted.
- .4 For seismic control purposes, small diameter ducts may be fastened to larger diameter ducts in order to restrain them. The reverse is not permitted.
- .5 Anchor points in concrete slabs must be kept away from the edges as per ASTM E488 and anchor manufacturer's recommendations.

### **3.3 HOLDING CABLES**

- .1 Connect holding cables to hanging equipment so that their axial incidence corresponds to the centre of gravity of the equipment being protected.
- .2 Use wire ways, lugs and other appropriate hardware to ensure alignment of seismic control devices and prevent cables from bending at fastening points.
- .3 For hanging electrical or mechanical equipment, arrange holding cables at a 90° angle and secure them to the building's structural ceiling at an angle not in excess of 90°.
- .4 Adjust holding cables to ensure 19 mm of slack. Under normal operation, holding cables should not support the weight of the equipment being protected.

**END OF SECTION**

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