

## VAV BOXES AND SMALL HVAC COMPONENT RESTRAINTS

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Seismic restraint for small HVAC components has historically been inconsistent, not only from region to region, but from project to project within the same area. Codes and guides have been and continue to be misinterpreted and misapplied. This sometimes results in excessive time and materials being used on a project and sometimes results in no or too few restraints. This brief paper will attempt to clearly outline the current state of the art as defined by building codes and code officials and as endorsed by the Vibration Isolation and Seismic Control Manufacturers Association (VISCMA).

To go straight to the conclusion, terminal units (e.g., VAV boxes) and other small HVAC components in most buildings that require seismic restraints do not need to be restrained if they weigh 75 pounds or less and are rigidly connected to ductwork or pipe on both sides. Read on for more details.

Every state within the United States has adopted some version of the International Building Code (IBC), helping to standardize building design and construction across the country. Since 2003, the IBC has pointed to the American Society of Civil Engineers (ASCE) standard 7, *Minimum Design Loads for Buildings and Other Structures*, for all structural design requirements – including non-structural components connected to buildings. These two documents, along with local state and municipal codes, define when and where to use restraints as well as the minimum design loads and acceptance criteria.

If the structural engineer of record has determined that the project has a “Seismic Design Category” (SDC) of “A” or “B”, then all HVAC components are exempt from needing lateral bracing or seismic restraints (ASCE section 11.7 and 13.1.4). If the SDC is defined as “C”, then HVAC components with an importance factor,  $I_p=1.0$  are exempt from restraints (ASCE 13.1.4). Every component attached to a building must be assigned a component importance factor value of either 1.0 or 1.5 (ASCE 13.1.3). For most VAV boxes and small HVAC components, the  $I_p$  will be 1.0. They can however have a value of 1.5 if, as required by ASCE 7 section 13.1.3, “the component is in or attached to a Risk Category IV structure and it is needed for continued operation of the facility or its failure could impair the continued operation of the facility.” Risk Category IV structures include those that are designated as essential facilities, such as fire and police stations, emergency shelters, and hospitals. Whether a particular component is required for the continued operation of such a building can only be determined by the HVAC system design professional and should be indicated in the construction documents.

If the SDC is “C” and the  $I_p = 1.5$ , or the SDC is “D”, “E”, or “F”, then the HVAC components need to be further considered for seismic restraint. There are additional exemptions which may be applied – and this is where some difference in interpretation enters the picture. The requirements and exemptions in ASCE 7 have been tweaked and rewritten a few times – helping to fill in some “gaps” – but there is still room for improvement to remove the ambiguity that remains.

The only clear exemptions that apply to VAV boxes and small HVAC components are those found in ASCE 7 section 13.1.4 where it requires that in order for a component to be exempt from seismic restraints, it must have an  $I_p$  of 1.0, be positively attached to structure, be flexibly connected to associated ductwork, conduit and piping, and weigh 20 pounds (89 N) or less. Some jurisdictions have codes which specifically extend the exemption weight up to 75 pounds (334 N) for  $I_p = 1.0$  equipment. There are no explicit exemptions for any pieces of HVAC equipment that are assigned an  $I_p$  of 1.5, though it has been commonly accepted in most jurisdictions to exempt equipment installed tight to structure or any equipment that weighs 20 pounds (89 N) or less – regardless of the assigned  $I_p$  value.

Another key passage in ASCE 7 is section 13.6.7 on Ductwork which stipulates when and how to apply restraints on ductwork and in-line components. Since a code clarification in 2009 (IBC2009 section 1613.6.8), all ductwork, regardless of its  $I_p$  value, less than 6 square feet in cross-sectional area may be exempt from seismic restraints. The final paragraph in this section states: “Components that are installed in-line with the duct system and have an operating weight greater than 75 lb (334 N), such as fans, heat exchangers, and humidifiers, shall be supported and laterally braced independent of the duct system...” This means that there would be restraints on both the component and the ductwork – separate and independent of one another. It also seems to indicate that if the ductwork is not restrained, but the equipment is over 75 lbs, then there need to be flexible connectors between the component and the ductwork to keep them separate. This section does not say what happens below 75 pounds, but it can at least be inferred that separate restraints are not required for components that weigh 75 pounds or less – they can be restrained by rigid attachments with the ductwork on either side.

VISCMA members have requested and received code interpretation clarifications from ICC staff regarding the restraint of in-line components weighing less than 75 pounds which seem to hinge on the code exemption for ductwork less than 6 square feet in

cross-sectional area. Most VAV boxes, or terminal units, are connected to ductwork that meets this size requirement. Provided that the component is rigidly connected to the ductwork on both sides and flexibly connected to any associated piping or electrical connections, then in-line components weighing less than 75 pounds may be considered exempt as well.

All member companies of VISCMA support this position and encourage specifiers, designers, contractors, and building officials to contact the technical support or engineering division of any of the VISCMA members for further information or assistance in procuring code-compliant seismic and wind restraint designs, products, and installation assistance for non-structural building systems.

Component Weight (lbs)	SDC = A or B	SDC = C		SDC = D, E or F	
	$I_p = 1.0$ & $1.5$	$I_p = 1.0$	$I_p = 1.5$	$I_p = 1.0$	$I_p = 1.5$
$\leq 20$	Exempt	Exempt <sup>(1)</sup>	Exempt <sup>(3)</sup>	Exempt <sup>(2)</sup>	Exempt <sup>(3)</sup>
$> 20$ & $\leq 75$	Exempt	Exempt <sup>(1)</sup>	Reqd/Exmpt <sup>(4)</sup>	Reqd/Exmpt <sup>(4)</sup>	Reqd/Exmpt <sup>(4)</sup>
$> 75$	Exempt	Exempt <sup>(1)</sup>	Required <sup>(5)</sup>	Required <sup>(5)</sup>	Required <sup>(5)</sup>

- Notes: 1. Exempt from seismic restraints per ASCE 7-05/-10 section 13.1.4-3.  
 2. Exempt from seismic restraints per ASCE 7-05/-10 section 13.1.4-5. Flexible connections between components and associated ductwork, piping and conduit must be provided.  
 3. Common industry practice is to follow section 13.1.4-5 as described in note 2. No specific exemption is currently given by the IBC or ASCE.  
 4. **Required** for components flexibly connected on at least one side or unducted or only connected on one side. May be **exempt** if inline and rigidly connected on both sides. Independent restraints are not required.  
 5. Shall be restrained separately and independently of any connected components per ASCE 7-05/-10 section 13.6.7. Flexible connectors may be required if connected systems are not restrained.

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VISCMA is a non-profit association representing the manufacturers of seismic restraint, vibration isolation and noise control equipment. The primary objectives of the organization are to educate the construction industry on the proper use and application of vibration isolation and seismic restraint and to develop standards to continually improve the industry.

In partnership with FEMA and ASCE, VISCMA also publishes three Seismic Installation and Inspection Manuals designed to assist field personnel.

The association office is located at 994 Old Eagle School Road, Suite 1019, Wayne, PA 19087-1866 and can be reached at 610-971-4850 or [info@viscma.com](mailto:info@viscma.com).

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