

**Table 13.6-1 Seismic Coefficients for Mechanical and Electrical Components**

Mechanical and Electrical Components	$a_p^a$	$R_p^b$
Air-side HVAC, fans, air handlers, air conditioning units, cabinet heaters, air distribution boxes, and other mechanical components constructed of sheet metal framing	2.5	6.0
Wet-side HVAC, boilers, furnaces, atmospheric tanks and bins, chillers, water heaters, heat exchangers, evaporators, air separators, manufacturing or process equipment, and other mechanical components constructed of high-deformability materials	1.0	2.5
Engines, turbines, pumps, compressors, and pressure vessels not supported on skirts and not within the scope of Chapter 15	1.0	2.5
Skirt-supported pressure vessels not within the scope of Chapter 15	2.5	2.5
Elevator and escalator components	1.0	2.5
Generators, batteries, inverters, motors, transformers, and other electrical components constructed of high deformability materials	1.0	2.5
Motor control centers, panel boards, switch gear, instrumentation cabinets, and other components constructed of sheet metal framing	2.5	6.0
Communication equipment, computers, instrumentation, and controls	1.0	2.5
Roof-mounted stacks, cooling and electrical towers laterally braced below their center of mass	2.5	3.0
Roof-mounted stacks, cooling and electrical towers laterally braced above their center of mass	1.0	2.5
Lighting fixtures	1.0	1.5
Other mechanical or electrical components	1.0	1.5
Vibration Isolated Components and Systems <sup>b</sup>		
Components and systems isolated using neoprene elements and neoprene isolated floors with built-in or separate elastomeric snubbing devices or resilient perimeter stops	2.5	2.5
Spring isolated components and systems and vibration isolated floors closely restrained using built-in or separate elastomeric snubbing devices or resilient perimeter stops	2.5	2.0
Internally isolated components and systems	2.5	2.0
Suspended vibration isolated equipment including in-line duct devices and suspended internally isolated components	2.5	2.5
Distribution Systems		
Piping in accordance with ASME B31, including in-line components with joints made by welding or brazing	2.5	12.0
Piping in accordance with ASME B31, including in-line components, constructed of high or limited deformability materials, with joints made by threading, bonding, compression couplings, or grooved couplings	2.5	6.0
Piping and tubing not in accordance with ASME B31, including in-line components, constructed of high-deformability materials, with joints made by welding or brazing	2.5	9.0
Piping and tubing not in accordance with ASME B31, including in-line components, constructed of high- or limited-deformability materials, with joints made by threading, bonding, compression couplings, or grooved couplings	2.5	4.5
Piping and tubing constructed of low-deformability materials, such as cast iron, glass, and nonductile plastics	2.5	3.0
Ductwork, including in-line components, constructed of high-deformability materials, with joints made by welding or brazing	2.5	9.0
Ductwork, including in-line components, constructed of high- or limited-deformability materials with joints made by means other than welding or brazing	2.5	6.0
Ductwork, including in-line components, constructed of low-deformability materials, such as cast iron, glass, and nonductile plastics	2.5	3.0

Table 13.6-1 (Continued)

Distribution Systems		
Electrical conduit and cable trays	2.5	6.0
Bus ducts	1.0	2.5
Plumbing	1.0	2.5
Manufacturing or process conveyors (nonpersonnel)	2.5	3.0

<sup>a</sup>A lower value for  $a_p$  is permitted where justified by detailed dynamic analyses. The value for  $a_p$  shall not be less than 1.0. The value of  $a_p$  equal to 1.0 is for rigid components and rigidly attached components. The value of  $a_p$  equal to 2.5 is for flexible components and flexibly attached components.

<sup>b</sup>Components mounted on vibration isolators shall have a bumper restraint or snubber in each horizontal direction. The design force shall be taken as  $2F_p$  if the nominal clearance (air gap) between the equipment support frame and restraint is greater than 0.25 in. (6 mm). If the nominal clearance specified on the construction documents is not greater than 0.25 in. (6 mm), the design force is permitted to be taken as  $F_p$ .

force and relative displacement requirements provided they meet all of the following criteria:

1. The design load for such items shall be equal to 1.4 times the operating weight acting down with a simultaneous horizontal load equal to 1.4 times the operating weight. The horizontal load shall be applied in the direction that results in the most critical loading for the design.
2. Seismic interaction effects shall be considered in accordance with Section 13.2.3.
3. The connection to the structure shall allow a 360° range of motion in the horizontal plane.

Where design of mechanical and electrical components for seismic effects is required, consideration shall be given to the dynamic effects of the components, their contents, and where appropriate, their supports and attachments. In such cases, the interaction between the components and the supporting structures, including other mechanical and electrical components, shall also be considered.

### 13.6.2 Component Period

The fundamental period of the nonstructural component (including its supports and attachment to the structure),  $T_p$ , shall be determined by the following equation provided that the component, supports, and attachment can be reasonably represented analytically by a simple spring and mass single degree-of-freedom system:

$$T_p = 2\pi \sqrt{\frac{W_p}{K_p g}} \quad (13.6-1)$$

where

$T_p$  = component fundamental period

$W_p$  = component operating weight

$g$  = gravitational acceleration

$K_p$  = combined stiffness of the component, supports and attachments, determined in terms of load per unit deflection at the center of gravity of the component

Alternatively, the fundamental period of the component,  $T_p$ , in seconds is permitted to be determined from experimental test data or by a properly substantiated analysis.

### 13.6.3 Mechanical Components

HVAC ductwork shall meet the requirements of Section 13.6.7. Piping systems shall meet the requirements of Section 13.6.8. Boilers and vessels shall meet the requirements of Section 13.6.9. Elevators shall meet the requirements of Section 13.6.10. All other mechanical components shall meet the requirements of Section 13.6.11. Mechanical components with  $I_p$  greater than 1.0 shall be designed for the seismic forces and relative displacements defined in Sections 13.3.1 and 13.3.2 and shall satisfy the following additional requirements:

1. Provision shall be made to eliminate seismic impact for components vulnerable to impact, for components constructed of nonductile materials, and in cases where material ductility will be reduced due to service conditions (e.g., low temperature applications).
2. The possibility of loads imposed on components by attached utility or service lines, due to differential movement of support points on separate structures, shall be evaluated.
3. Where piping or HVAC ductwork components are attached to structures that could displace relative to one another and for isolated structures where such components cross the isolation interface, the