reduced-scale prototype specimens shall be of the same type and material and be manufactured with the same processes and quality as full-scale prototypes and shall be tested at a frequency that represents full-scale prototype loading rates.

The force-deflection properties of an isolator unit shall be considered to be dependent on the rate of loading if the measured property (effective stiffness or effective damping) at the design displacement when tested at any frequency in the range of 0.1 to 2.0 times the inverse of T_D is different from the property when tested at a frequency equal to the inverse of T_D by more than 15 percent.

17.8.2.4 Units Dependent on Bilateral Load

If the force-deflection properties of the isolator units are dependent on bilateral load, the tests specified in Sections 17.8.2.2 and 17.8.2.3 shall be augmented to include bilateral load at the following increments of the total design displacement, D_{TD}: 0.25 and 1.0, 0.5 and 1.0, 0.75 and 1.0, and 1.0 and 1.0

If reduced-scale prototype specimens are used to quantify bilateral-load-dependent properties, the reduced-scale specimens shall be of the same type and material and manufactured with the same processes and quality as full-scale prototypes.

The force-deflection properties of an isolator unit shall be considered to be dependent on bilateral load if the effective stiffness where subjected to bilateral loading is different from the effective stiffness where subjected to unilateral loading, by more than 15 percent.

17.8.2.5 Maximum and Minimum Vertical Load

Isolator units that carry vertical load shall be statically tested for maximum and minimum downward vertical load at the total maximum displacement. In these tests, the combined vertical loads shall be taken as specified in Section 17.2.4.6 on any one isolator of a common type and size. The dead load, D, and live load, L, are specified in Section 12.4. The seismic load E is given by Eqs. 12.4-1 and 12.4-2 where S_{DS} in these equations is replaced by S_{MS} and the vertical loads that result from application of horizontal seismic forces, Q_E, shall be based on the peak response due to the maximum considered earthquake.

17.8.2.6 Sacrificial Wind-Restraint Systems

If a sacrificial wind-restraint system is to be utilized, its ultimate capacity shall be established by test.

17.8.2.7 Testing Similar Units

Prototype tests are not required if an isolator unit is of similar size and of the same type and material as a prototype isolator unit that has been previously tested using the specified sequence of tests.

17.8.3 Determination of Force-Deflection Characteristics

The force-deflection characteristics of the isolation system shall be based on the cyclic load tests of prototype isolator specified in Section 17.8.2.

As required, the effective stiffness of an isolator unit, k_{eff}, shall be calculated for each cycle of loading as prescribed by Eq. 17.8-1:

$$k_{\text{eff}} = \frac{\left|F^+\right| + \left|F^-\right|}{\left|\Delta^+\right| + \left|\Delta^-\right|} \qquad (17.8\text{-}1)$$

where F^+ and F^- are the positive and negative forces, at Δ^+ and Δ^-, respectively.

As required, the effective damping, β_{eff}, of an isolator unit shall be calculated for each cycle of loading by Eq. 17.8-2:

$$\beta_{\text{eff}} = \frac{2}{\pi} \frac{E_{\text{loop}}}{k_{\text{eff}} \left(\left|\Delta^+\right| + \left|\Delta^-\right|\right)^2} \qquad (17.8\text{-}2)$$

where the energy dissipated per cycle of loading, E_{loop}, and the effective stiffness, k_{eff}, shall be based on peak test displacements of Δ^+ and Δ^-.

17.8.4 Test Specimen Adequacy

The performance of the test specimens shall be deemed adequate if the following conditions are satisfied:

1. The force-deflection plots for all tests specified in Section 17.8.2 have a positive incremental force-resisting capacity.
2. For each increment of test displacement specified in item 2 of Section 17.8.2.2 and for each vertical load case specified in Section 17.8.2.2,
   a. For each test specimen, the difference between the effective stiffness at each of the three cycles of test and the average value of effective stiffness is no greater than 15 percent.
   b. For each cycle of test, the difference between effective stiffness of the two test specimens of a common type and size of the isolator unit and the average effective stiffness is no greater than 15 percent.
3. For each specimen there is no greater than a 20 percent change in the initial effective stiffness over the cycles of test specified in item 4 of Section 17.8.2.2.