

Failure of Trunnion Under Excessive Load

10CFR71.45(b)(3) requires that each tie-down device, which is a structural part of a package, must be designed so that failure of the device under excessive load would not impair the ability of the package to meet other requirements of this part.

Figure 2.5-3 shows the cask supported at the front by a saddle and at the rear by two trunnions. The trunnions serve as the only tie-down devices which are a structural part of the package.

The trunnions were analyzed assuming that the longitudinal (10g) load is taken by the two trunnions. The 2g vertical load is taken 50 percent by the trunnions and 50 percent by the front support. The 5g lateral load is taken 50 percent by one trunnion and 50 percent by the front support.

The maximum load seen by a single trunnion is a 0.5 g vertical load, a 5 g longitudinal load and a 2.5 g lateral load. The vertical and longitudinal loads are combined to form a resultant g load of 5.03 g. The maximum shear stress to the trunnion for the 5.03 g tie-down load is 8,896 psi; this stress occurs at the inner shoulder (Figure 2.5-2, Section A-A).

The stresses transmitted to the outer shell of the package by the trunnions are included in Section 2.10.1.2. These local stresses are calculated in accordance with the methodology of reference WRC-107 which is based on the "Bijlaard" analysis for local stresses in cylindrical shells due to external loadings. The maximum shear stress (not reported in Section 2.10.1.2) due to the same 5.03 g load which occurs at the trunnion/outer shell intersection (welds) is 7,055 psi. This stress is about 20% lower than the shear stress at the trunnion shoulder. Under the "excessive load" condition, the shear stress at the trunnion shoulder will be higher than the shear stress at the trunnion/outer shell intersection. Therefore, the trunnion shoulder would fail before the trunnion welds. Hence an "excessive load" would damage the trunnion, but the cask would not lose its structural integrity. It is concluded that the requirement of 10CFR71.45(b)(3) is satisfied.