## RELEASE NUT PYROTECHNIC SHOCK ENERGY SCALING Revision A

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MIL-STD-810F, Paragraph 2.3.2.1 gives the following scaling law for a new SRS level.

$$SRS_n(fn) = SRS_r(fn) \quad \sqrt{\frac{E_n}{E_r}}$$
 (1)

where

- SRS  $_{n}$  is the new SRS
- SRS r is the reference SRS
- $E_n$  is the new energy level
- E<sub>r</sub> is the reference energy level

The energy values may come from physical considerations related to the pyrotechnic device, according to MIL-STD-810F.

Assume that E represents strain energy. The total strain energy U for a bolt in tension is

$$U = \frac{1}{2} \frac{\sigma^2}{E_{ym}} LA$$
 (2)

where

 $\sigma$  is axial stress

Eym is Young's modulus of elasticity

- L is length
- A is cross-sectional area

Equation (2) is taken from Roark's Formulas for Stress and Strain. Assume that the axial stress, modulus, and length are constant for each bolt diameter case. Note that the axial stress is proportional to the torque. Bolt torque values are typically chosen on the basis of the yield stress limit of the bolt material.

Thus,

$$U \propto A$$
 (3)

Let d be the diameter.

$$U \propto d^2$$
 (4)

Substitute (4) into (1).

$$\frac{\text{SRS}_{n}(\text{fn})}{\text{SRS}_{r}(\text{fn})} \propto \sqrt{\frac{d_{n}^{2}}{d_{r}^{2}}}$$
(5)

$$\frac{SRS_{n}(fn)}{SRS_{r}(fn)} \propto \frac{d_{n}}{d_{r}}$$
(6)

## APPENDIX A

## Release Nut Reference SRS Data

The source shock for three 3/4-inch diameter release nuts is given in Table A-1, as taken from

- BTTV 6 Flight Accelerometer Data, Preliminary Viper 1 Data Analysis Report, Sandia National Laboratories, 1994.
- SRALT 048-004 Rev C, SRALT Shock and Vibration Analysis, 2002.

Table A-1. SRS Q=10, Source Shock MPE, for 3 x 3/4 inch Sep Nuts (For Reference Only)	
Natural	Peak
Frequency	Accel
(Hz)	(G)
100	168
1000	538
3250	6411
6900	14304
10000	14304