Exceptional service in the national interest

SAND2012-2510P

Sandia National Laboratories

Explosive Hazard Classification Testing

Christopher Barth

Hazardous Material Packaging Engineer

Org. 10261

U.S. DEPARTMENT OF ENERGY | NNSA

Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

Explosive Hazard Classification Testing

- DEPARTMENT OF DEFENSE AMMUNITION AND EXPLOSIVES HAZARD CLASSIFICATION PROCEDURES – Jan 5, 1998
  - TB-700-2
- Chapter 5 – *Explosives Hazard Classification Test Protocol*
  - Prescribes tests required by 49 CFR (Department of Transportation regulations) for transport and storage
  - Test requirements in TB-700-2 comply to the United Nations (UN) Committee on the Transport of Dangerous Goods
  - UN Series of Tests are divided into seven series
    - UN Series 6 – *Hazard Classification Tests for Hazard Division 1.1, 1.2, 1.3, and 1.4*

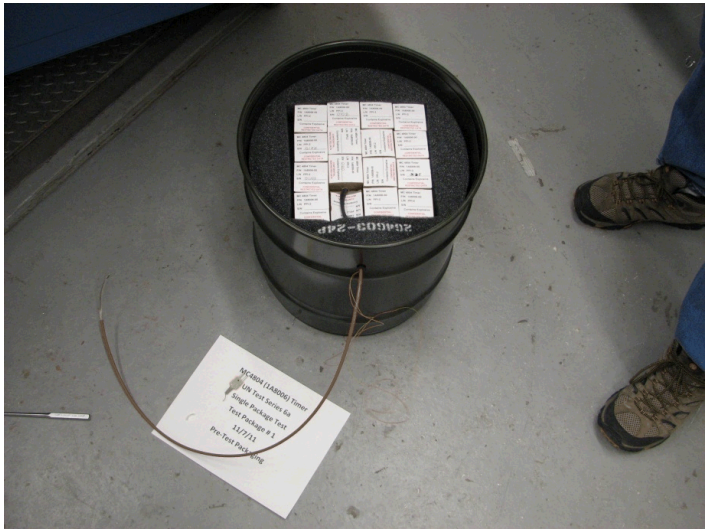
UN Series 6 Hazard Classification

- UN Series 6 consists of three tests
  - 6(a) – Single-Package Test (propagation within package)
  - 6(b) – Stack Test (propagation between packages)
  - 6(c) – External-Fire (Bonfire) Test

UN Series 6(a) – Single-Package Test

- 6(a) test is conducted three times with single packages with explosive articles to determine:
  - (1) whether burning or explosion within the package propagates to other articles within the package
  - (2) how the surroundings can be endangered by these effects.
- DOT Special Permit (SP)-15250 authorizes DOE/SNL to test to the newer revision of TB700-2 still in draft
  - A single-package test shall be conducted twice
    - 1 package confined in place by earth or sand
    - 1 package unconfined

6(a) – Single-Package Test Set-up



6(a) – Single-Package Test - Confined

Sandia National Laboratories

6(a) – Single-Package Test - Unconfined

6(a) – Single-Package Post-Test

6(a) – Single-Package Test Results

- For the explosive article tested, the series 6(a) test demonstrated no effects were propagated to other articles within the package, as well as outside the package, as seen in the post test photos and video.

6(b) – Stack Test

- The stack test is not required if the Series 6(a) single-package test demonstrates that all reaction effects were contained within the packaging.

6(c) – External-Fire (Bonfire) Test

- Test is conducted on four single packages with explosive articles to determine:
  - how the packages behave when involved in an external fire, and
  - whether the surroundings are endangered by blast waves, thermal effects, and/or fragment projections.

  NOTE: Four 9-gallon drums were used to meet a package volume requirement of 5.3 ft^3
- Bonfire is produced by burning a wood lattice constructed of air-dried wood laths doused with jet fuel.
- Bonfire burns with sufficient intensity and duration to bring the explosive material within the articles to reaction (~10 to 30 minutes).

6(c) – Building the Wood Lattice

6(c) – Bonfire Test

6(c) – Bonfire Test

6(c) - Bonfire Post-Test

6(c) – Bonfire Test Results

- For the explosive article tested, the series 6(c) test demonstrated that the packages involved in the fire performed as expected and the surroundings were not endangered by blast waves, thermal effects, and/or fragment projections, as seen in the test video and post test photos.

Bonfire Testing Equipment