

Exceptional service in the national interest



SANDIA PACKAGE TESTING PROGRAM

US/MEP Technical Exchange

July 28, 2015

Dr. Douglas J. Ammerman

Testing Purpose

- Type B Package Certification
 - NCT
 - HAC
- Package Development
- Component Tests
- Tie-Down Tests
- Benchmarking of Finite Element Codes
- Accident Scenario Tests
- Air Transport Package Tests
- Extra-Regulatory Tests

Type B Package Certification (NCT)

- Requirements
 - No damage to package that effects operability
 - Package remains leak-tight (10^{-6} A₂/hour)
 - No loss of shielding
 - Contents in the same position
 - Product quality
- Environments
 - Heat and cold
 - Decreased and increased external pressure
 - Vibration (generally also includes normal transport shock environment)
 - Water spray
 - 1.2 meter free drop (lower for packages > 5000 kg)
 - Corner drop (generally not required for our packages)
 - Compression
 - Penetration

NCT Tests

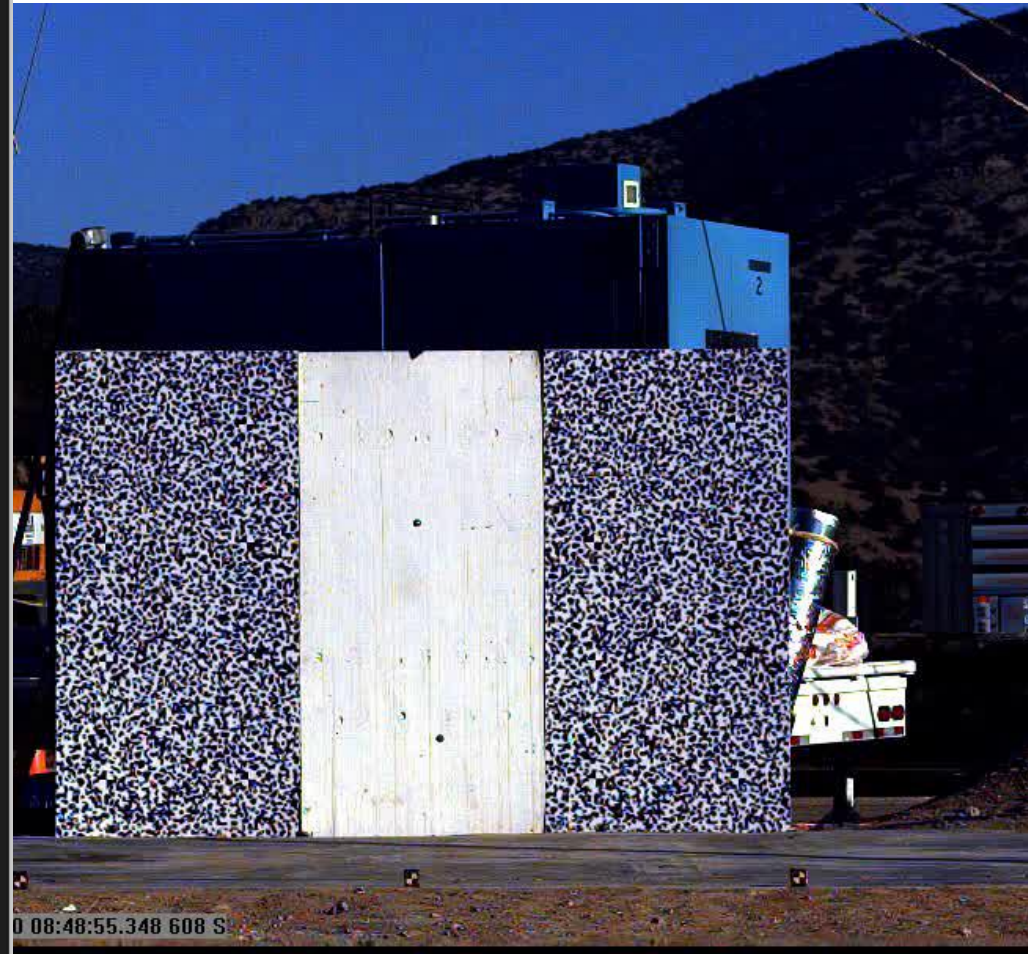


- Various climatic chambers
 - Sizes up to 3x3x8 meters
 - Temp Range: -73° C to 200° C
 - Some with vacuum below 0.2 kPa

- Various shaker tables
 - Object mass: to 1800 kg
 - Freq. range: 1-3000 Hz
 - Displacement: 20 cm peak-to-peak

Certification Testing – 9-meter drop

ENSA Slapdown Drop
Test 4 - 9 m Cold
South East
11.12.2010

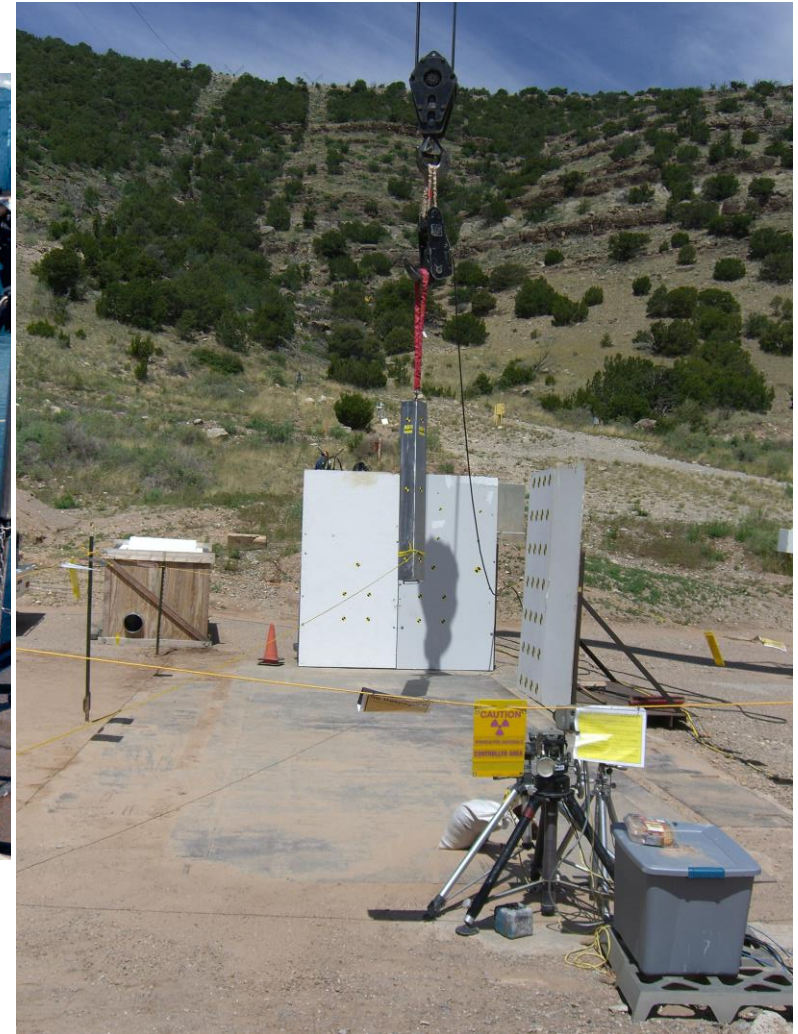


NCT Tests (cont.)

Water spray test



1.2m free drop



NCT Tests (concl.)

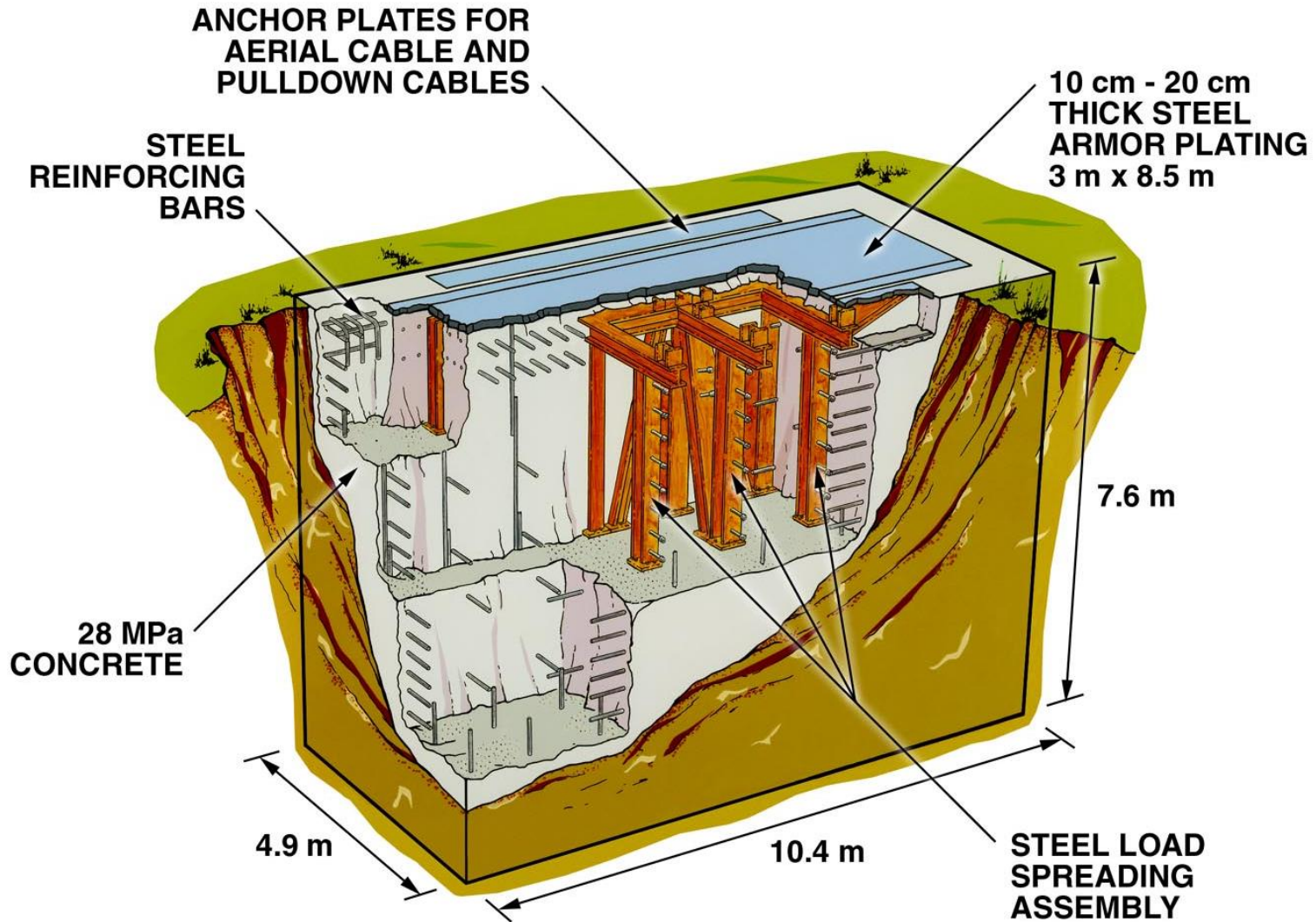
- Crush tests
 - Capacity up to 1,000,000 lbs
 - Cross section up to 1m x 1m
 - Package height to 2m



Type B Package Certification (HAC)

- Requirements
 - Package remains leak-tight (A_2 /week)
 - Limited loss of shielding
 - Maintain subcriticality
- Environments
 - 9 meter free drop
 - Dynamic crush (for packages < 500 kg, < 1000 kg/m³, if non-fissile $> 1000A_2$)
 - Punch
 - Thermal
 - For fissile material, 0.3m immersion
 - Non-sequential 15m immersion (unless $> 10^5 A_2$, then 2 MPa [~ 200 m])

HAC Tests



910 Tonne Armored Target at Sandia National Laboratories

Certification Testing – Punch Test

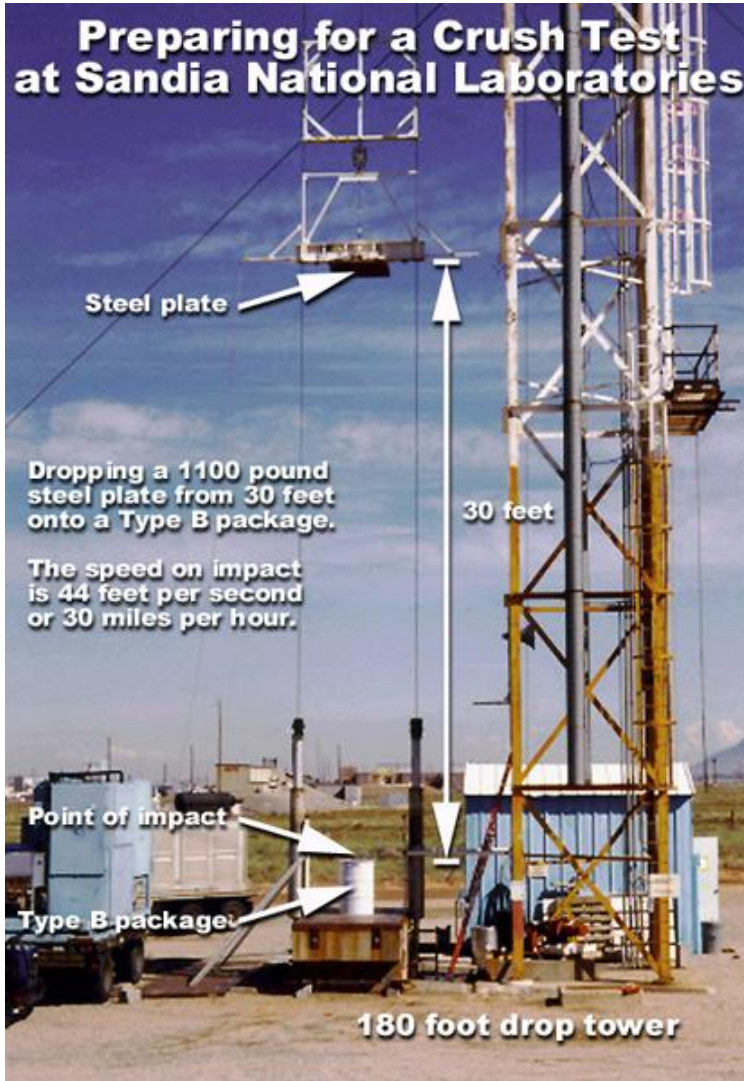
ENSA Side Puncture Drop
Test 7 - 1m
South East
11.19.2010



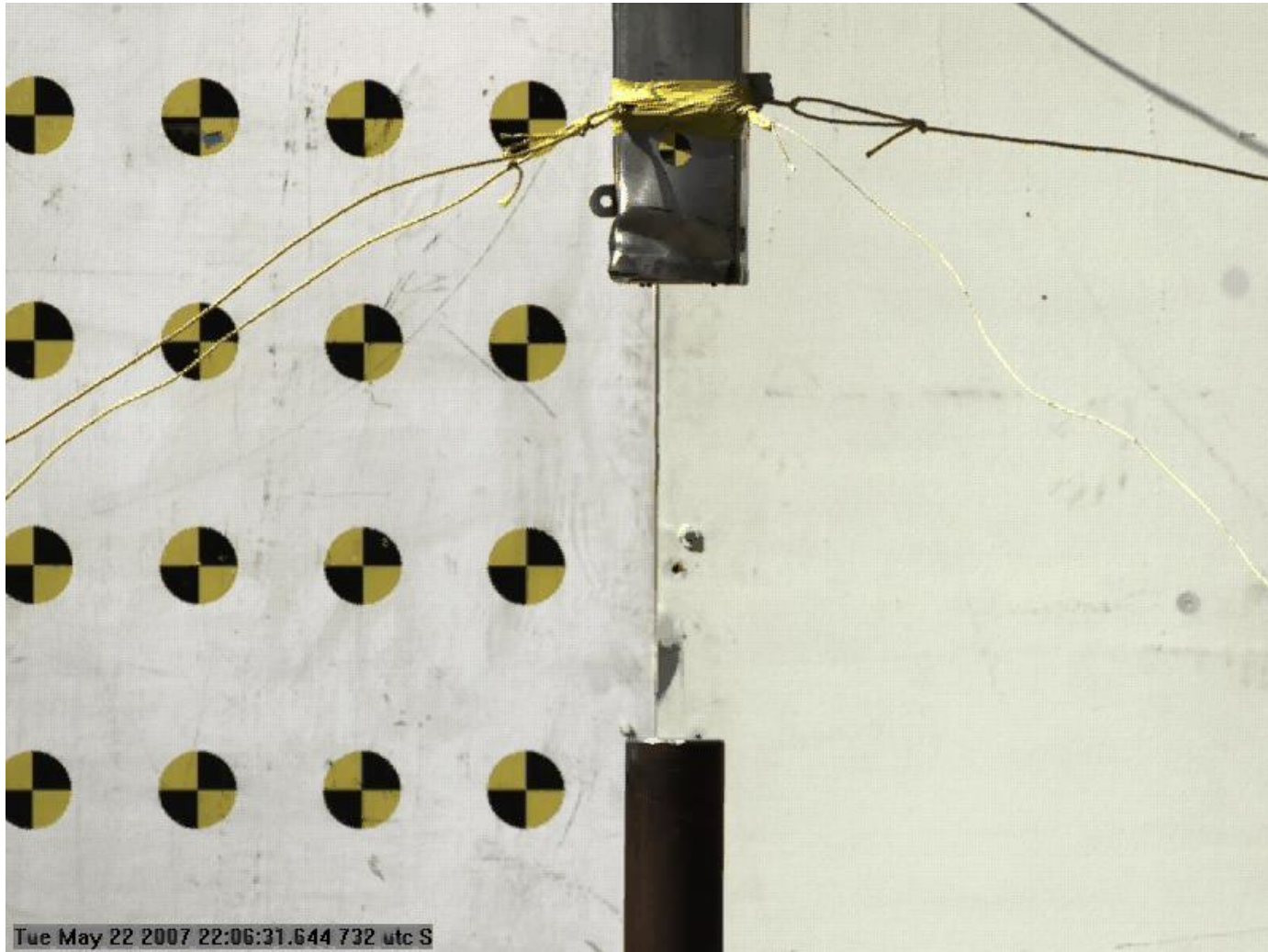
HAC Tests (9-meter drop)



HAC Tests (dynamic crush)



HAC Tests (puncture)



HAC Tests (thermal)

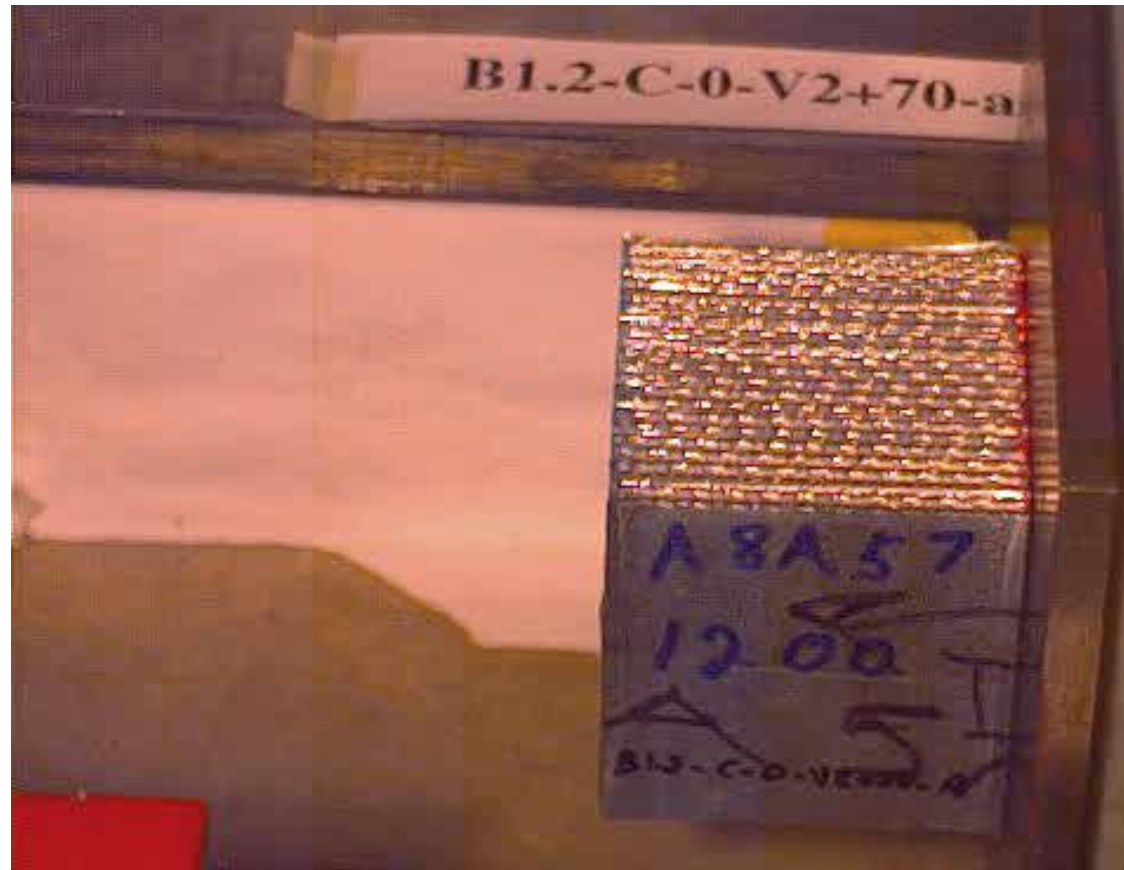


HAC Tests (immersion)

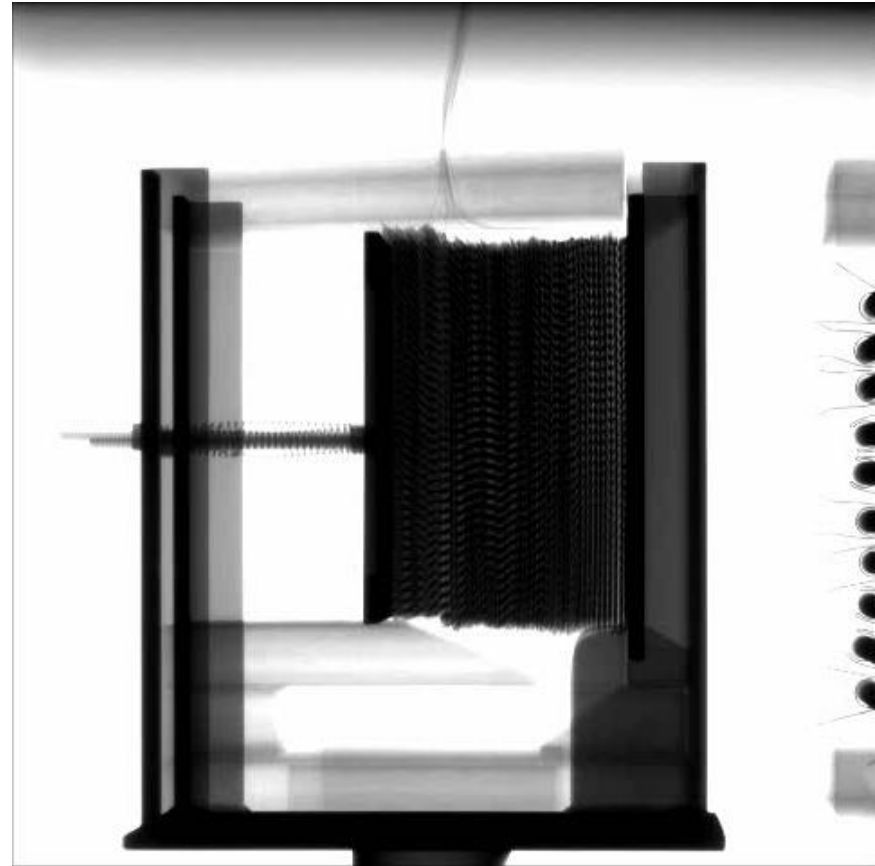
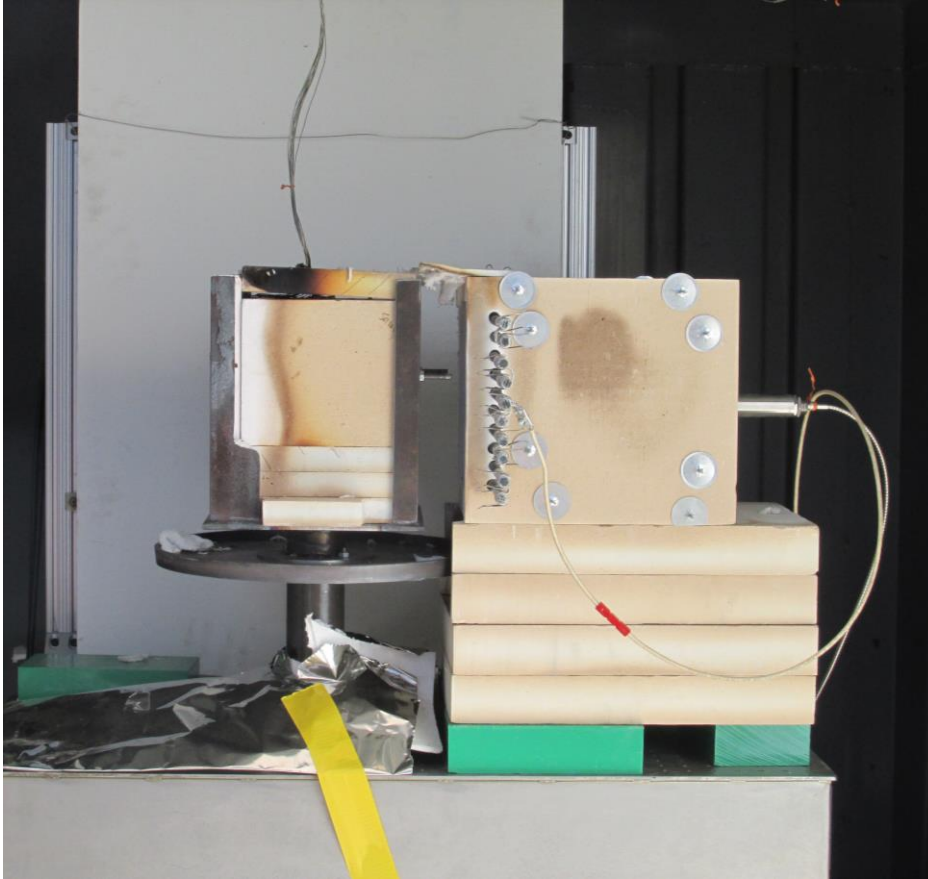


Package Development

- During package development it is sometimes advantageous to perform tests to check resistance of particular components to various assaults.
 - Puncture resistance of wall sections
 - 1-D thermal tests
 - Shock and vibration for product quality
- Material tests

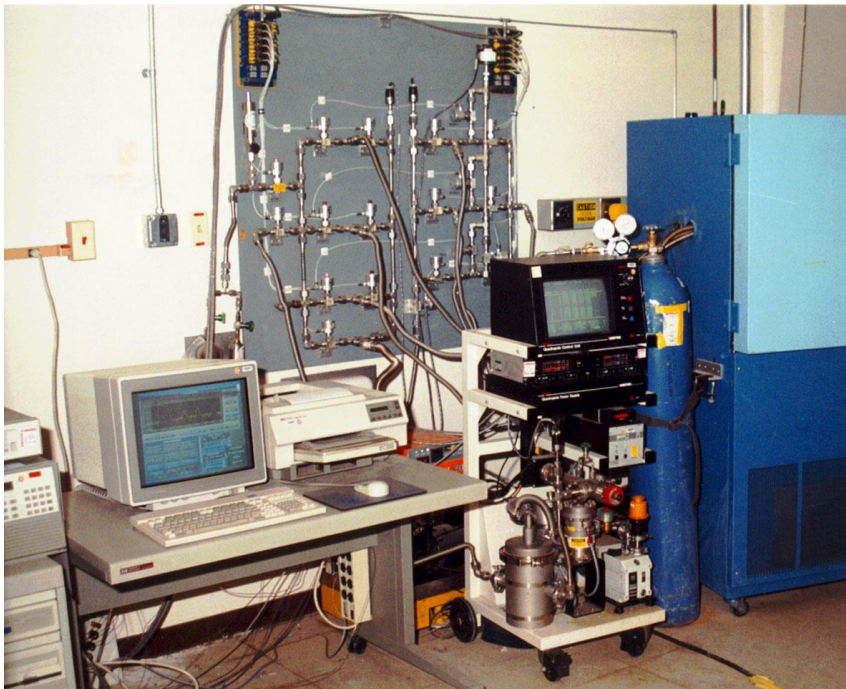


Package Development (1-D thermal test)



Component Tests

- Shock testing
 - Apply known repeatable shock pulse to components
- Seal testing



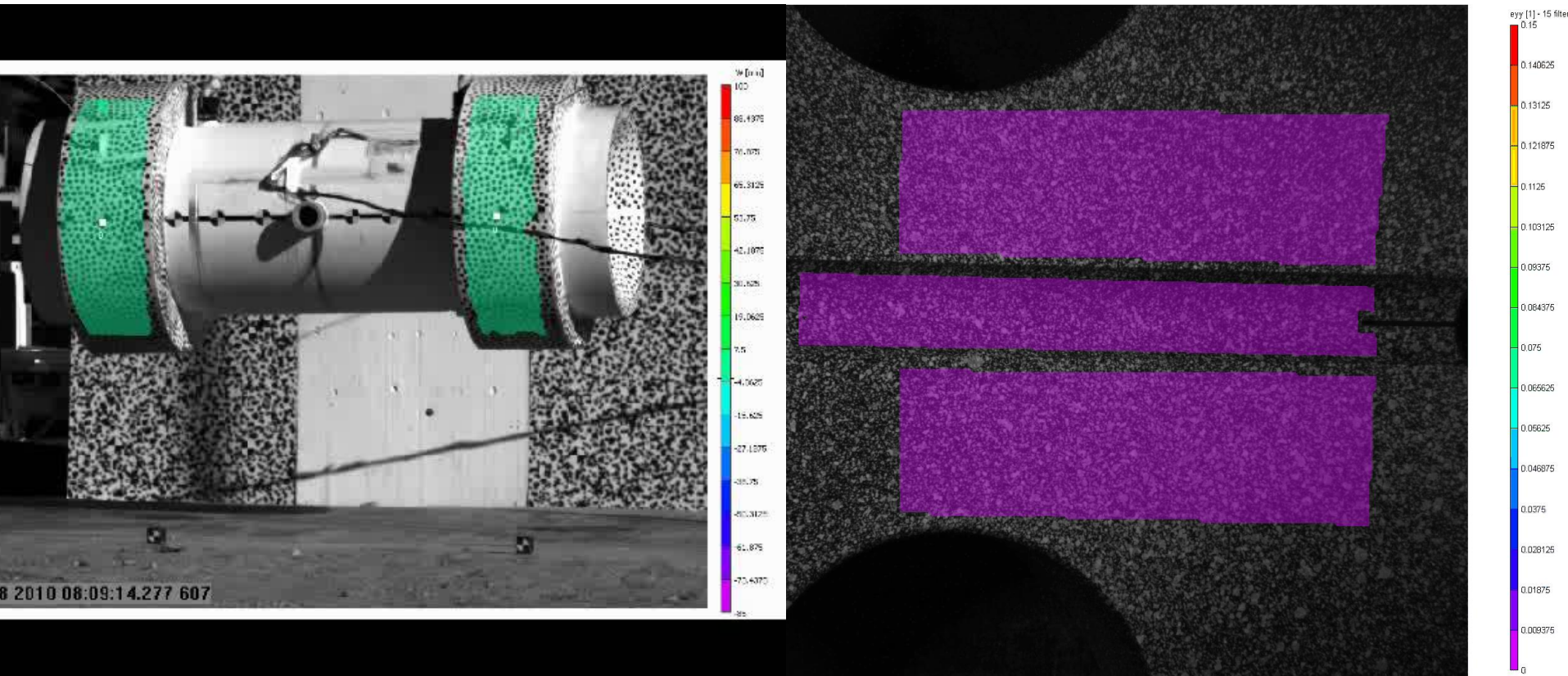
Tie-Down Tests

- Dynamic – impact test of mock floors with packages tied to them
- Centrifuge – apply 10G field to the package/tie-down
- Static – pull tests on tie-down systems



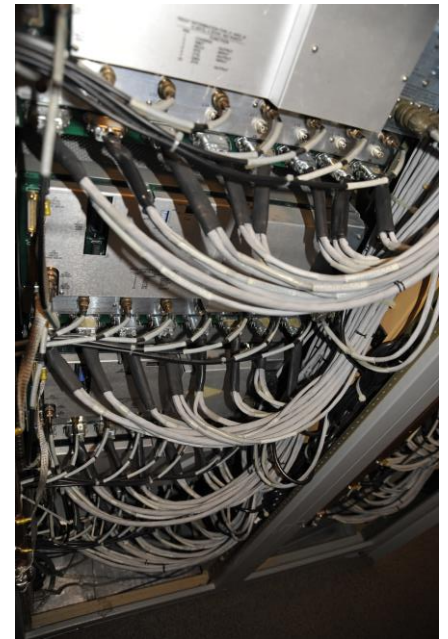
Photometrics

- High-speed digital video cameras capture test events
- Video is used as data, not just for images



Data Acquisition

- The Mobile Instrumentation and Data Acquisition System (MIDAS) is contained within a 40-foot trailer.
- Capable of collecting up to 168 channels of structural response data at speeds up to 10,000,000 samples/second
- Capable of acquiring up to 100 channels of thermal data
- Extremely rigorous quality assurance program



Accident Scenario Tests

- Help to answer the question “Do the HAC tests bound real accidents?”
- Define the environments that packages experience in real accidents
- The degree of mitigation provided by the transport vehicles



Air Transport Package Tests

- 129 m/s impact tests
 - Pull-down
 - Sled track



Conclusion

- Sandia has been conducting package testing for over 40 years
- A broad range of facilities is available for conducting these tests
- A great deal of testing expertise has been gained from this experience
- Package testing requires more than just picking it up and dropping it