Hardened Unit Load Device (HULD) Research and Development History

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Presentation Outline

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  - Program Objectives
- **Commercial Aircraft Blast Mitigation/Vulnerability Reduction**
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- **Hardened Unit Load Device (HULD) Development**
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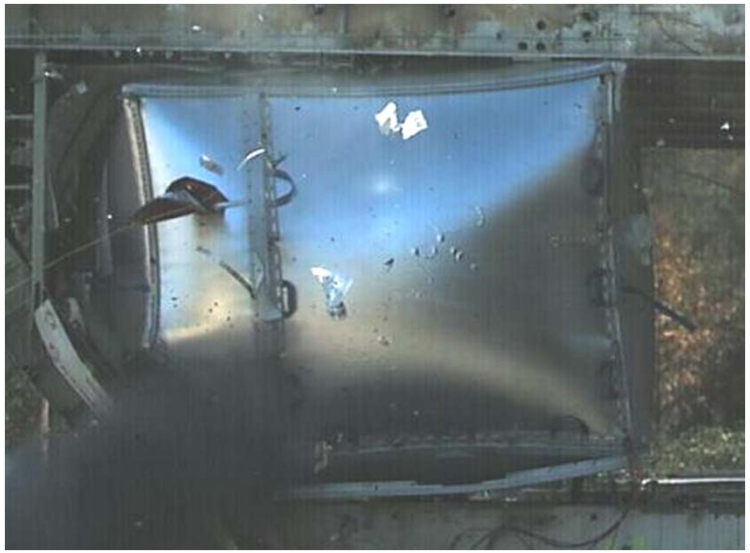
Commercial Aircraft Vulnerability/Mitigation Program Requirements

- Milestones in aviation security that have resulted in the formation and driven the direction of DHS commercial aircraft vulnerability initiatives include:
  - (1988) Destruction of Pan Am Flight 103 over Lockerbie Scotland
  - (1990) Presidential Commission Report on Aviation Security and Terrorism
  - (1990) Public Law 101-604, Aviation Security Improvement Act (Called for EDS standards and inception of Commercial Aircraft Vulnerability Program)
  - (1996) Aviation Security Advisory Committee Domestic Security Baseline Report
  - (1997) U.S. Vice Presidential Commission Aviation Safety & Security Report
  - (2001) Public Law 107-71, Aviation and Transportation Security Act
    - PL 107-71 (Sec. 137(a)7) states: "[The TSA shall accelerate] research, development, testing, and evaluation of aircraft hardening materials, and techniques to reduce the vulnerability of aircraft to terrorist attack."

Program Objectives

- Validate Detection Standards in Terms of Commercial Aircraft Vulnerability. What is the Minimum Size Explosive that Must Be Detected? (Aircraft Vulnerability)
- Develop & Evaluate Techniques that Minimize the Effects of Internal Explosive Events. (Explosive Mitigation)
- Assess Other Threats to the Aircraft



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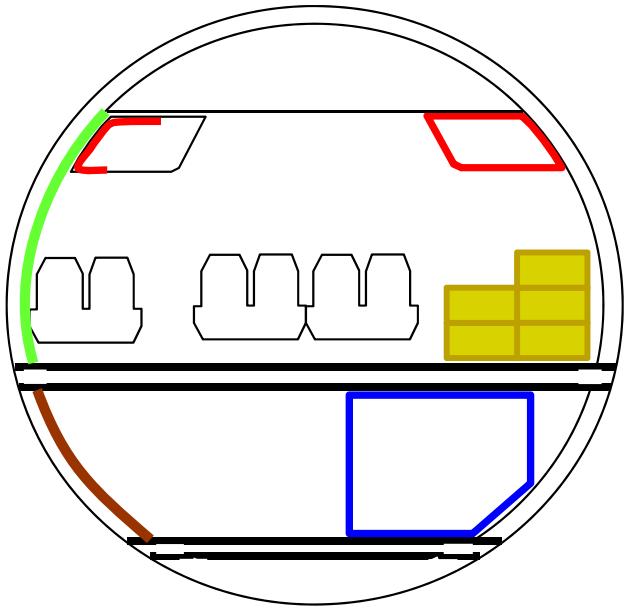
L1011 Pressurized Test, Cargo Hold (1998)

Commercial Aircraft Blast Mitigation Overview

- Aircraft Internal Blast Mitigation:
  - **Hardened passenger cabin liners**
  - **Hardened overhead bin/bin liners**
  - **Hardened cargo hold liners (Narrow-Body AC)**
  - **Hardened luggage containers (Wide-Body AC)**
  - **Least Risk Bomb Location (LRBL)**
- Coordinate with FAA certification to ensure that mitigation technology conforms to existing FAA airworthiness requirements.
- Perform cost-benefit analysis of selected explosive mitigation technologies.
- Since 1990, have conducted over 150 full-scale aircraft blast mitigation tests on a variety of concepts/materials/technologies.



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HULD Development

- HULD project initiated (1990) in response to PL 101-64 as a result of the destruction of Pam Am 103 (1988).
- HULD Objective – Protect wide-body commercial aircraft from catastrophic structural or critical system failure due to a terrorist-initiated, in-flight explosion within checked passenger luggage and/or air cargo contents.
- HULD design (internal dimensions, contour) is based upon the LD3 model of commercial aircraft lower deck baggage/cargo container.
- HULDs must meet the following requirements:
  - DHS Security – Resist/mitigate internal blast effects (shock/impulse, fragmentation, overpressure, post-blast fire).
  - FAA Airworthiness – FAA certification process ensures quality control of production units and confirms HULD is safe to install within aircraft for normal flight operations.
  - Airline – Design must meet airline user demands (operability, maintenance/repair, compatibility, etc.)

Initial HULD Design Development (1990-1994)

- Jaycor developed and tested 5 HULD prototypes (1990-1994)
- Jaycor prototype HULD construction – continuous joint HULD body design, Spectra fiber composite construction
- Use existing LD3 design geometry as basis
- Door design – side-sliding, externally stowed.
- Prototype tare weight ranges – 680-300 pounds

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Jaycor HULD Prototype #5 Test (1994)

SAE Participation in HULD Development (1994-1998)

Background:

- Society of Automotive Engineers (SAE) created existing LD3 industry requirements upon which the initial HULD requirements are based
- SAE HULD working group was formed consisting of FAA (Security and Certification), Air Transport Association (ATA), Airlines, Aircraft Manufacturers, and existing HULD designers

Recommendations:

- HULD requirement should address: airworthiness, ground handling (operational), and explosive resistance
- Requirement would be performance-based and use ISO 6517 (ULD design, performance and test requirements) as a baseline
- Initially pertain to use of HULD with checked passenger baggage contents only
- FAA (Security) would provide panel with research results and test data on which requirement would be based
- FAA (Certification) would confirm airworthiness compliance of HULD designs that meet explosive test criteria

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HULD Operational Evaluation Efforts (1995-1999)

- 1995 – FAA issues Phase I solicitation for limited HULD deployment/evaluation. Of 12 respondents, 4 vendors are selected for HULD prototype fabrication/testing. None of the tested designs are successful in meeting blast test requirements.
- 1997 – FAA issues Phase II solicitation. Of 8 respondents, 2 vendors are selected for HULD prototype fabrication/testing. One vendor (Galaxy Scientific) meets explosive resistance and airworthiness requirements.
- 1998-1999 – Galaxy HULD design undergoes limited operational testing.
- 1999 – Telair International HULD Generation I (GEN-I) HULD design meets blast and airworthiness requirements.

Galaxy Scientific HULD Design (1997)

- Composition: Aluminum Frame with Glare (Glass Reinforced Fiber Metal Laminate) body panels
- Tare weight: 400 lbs.
- FAA Airworthiness Certified (TSO-C90c)
- User Acceptance Issues:
  - Impact of continued operational use on blast resistance
  - Complicated door engagement design
  - Solid/single door panel design
  - Weight/cost

Telair International HULD Design (GEN-I) (1999)

- Composition: Aluminum Frame with Kevlar body panels
- Tare weight: 322 lbs.
- FAA Airworthiness Certified (TSO-C90c)
- User Acceptance Issues:
  - Complicated door engagement design
  - Weight/cost
- Note: Telair GEN-I design was used in subsequent HULD Pilot Program

Telair GEN-I HULD (Pre-test)

Telair GEN-I HULD (Post-test)

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HULD R&D Efforts (2000-2004)

- 2000-2002 – Limited operational testing and subsequent explosive testing on Telair GEN-I HULD prototype in cooperation with foreign government partner
- 2003 – HULD concept successfully subjected to blast test within pressurized aircraft with active aircraft cargo hold fire-suppression system
- 2003-2004 – Conducted investigation of HULD blast mitigation capability for explosive threat within air cargo contents
- 2004 – Initial cost-benefit analysis of HULD technology completed

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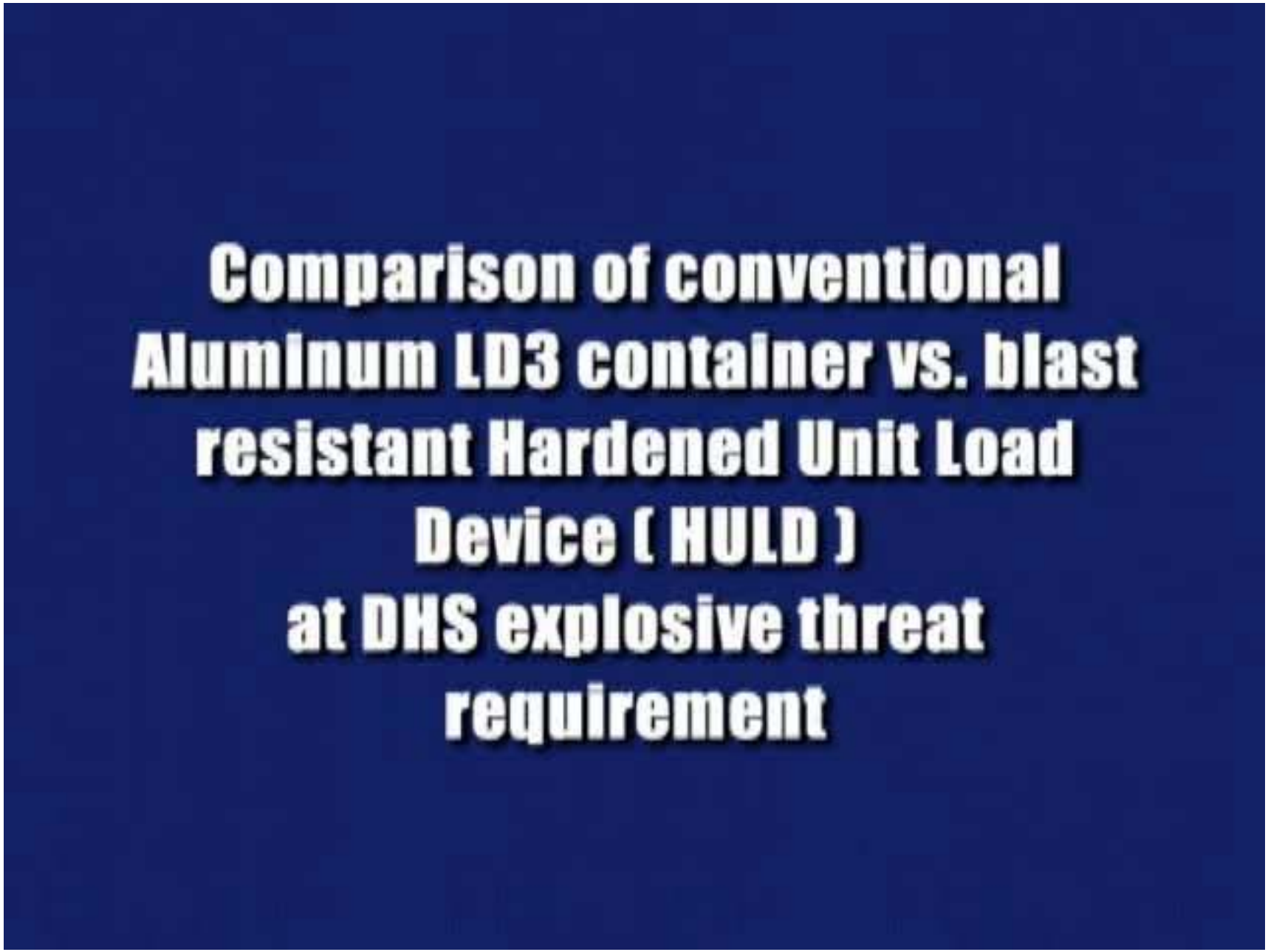
Comparison Test: Conventional LD3 vs. GEN-II HULD Checked Passenger Baggage Contents (2006)



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HULD R&D Efforts (2005-Present)

- 2005-2009 – TSA conducted HULD operational Pilot Program (operational deployment with participating US air carriers followed by explosive testing of deployed units at pre-determined operational intervals)
- 2006 – Telair GEN-II HULD prototype design (265 pound tare weight) successfully blast tested by DHS and subsequently met FAA airworthiness requirements
- 2010-2014 – Reduced cost/weight HULD (HULD-R) development effort
- 2013-2014 – Updated HULD cost-benefit assessment

Reduced Weight HULD (HULD-R)

Background:

- In response to air carrier concerns pertaining to existing (GEN-I/II) HULD acquisition cost and weight penalties, develop and test a reduced cost/weight HULD prototype (HULD-R).

HULD-R Design Requirement Goals:

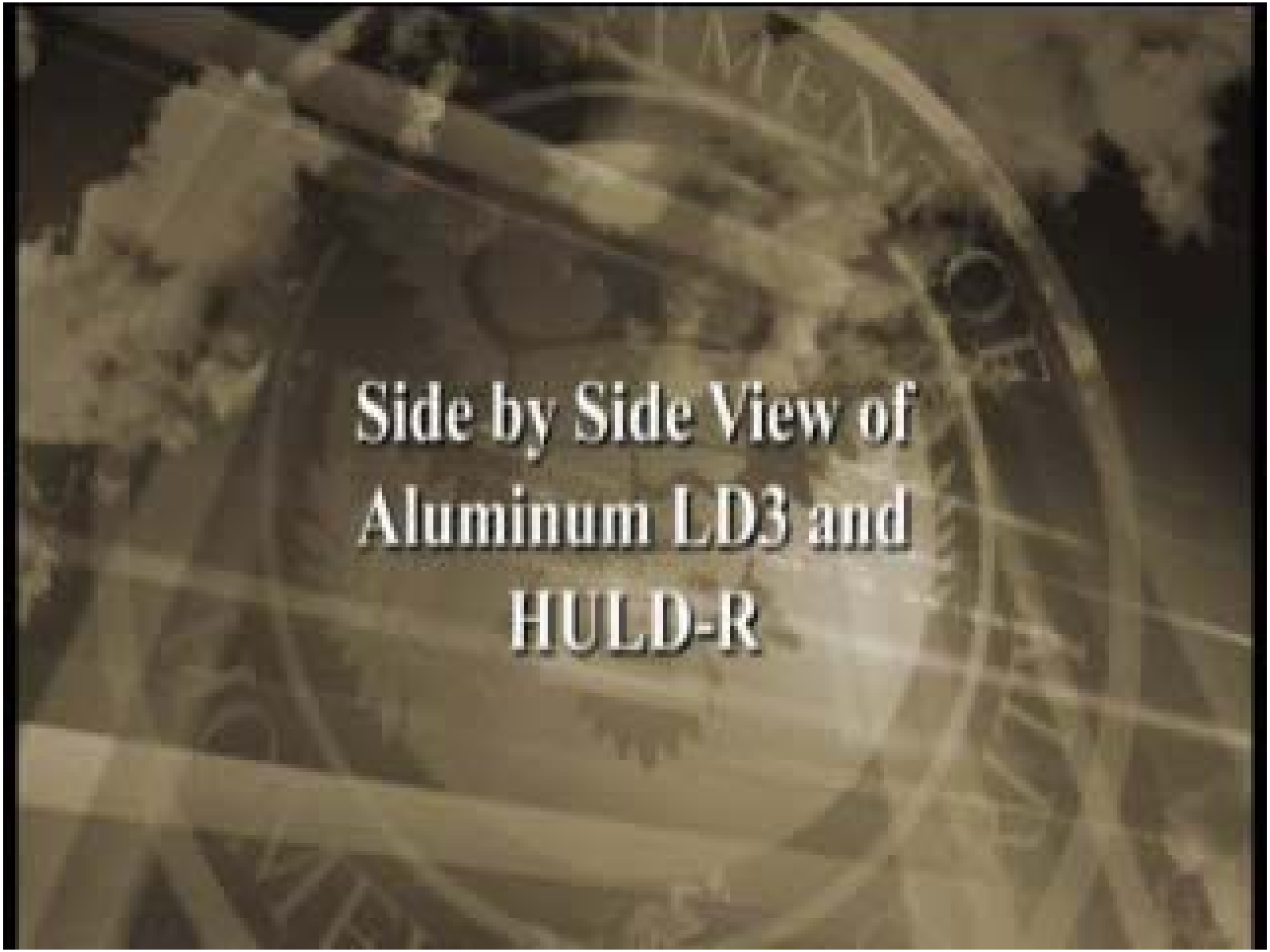
- FAA TSO approved (TSO-C90c).
- Capable of mitigating detonations from explosive devices in checked baggage and air cargo contents
- Target HULD-R acquisition cost <$10K
- Target HULD-R tare weight <220 pounds.

Reduced Weight HULD (HULD-R)

HULD-R Project Status Summary:

- DHS S&T contract awarded to International Composites Technologies (Compton, CA) via competitive solicitation
- Successfully developed and blast tested an FAA airworthiness certified HULD-R design with tare weight (199 lbs.) in range of existing unhardened industry Unit Load Devices (180-220 lbs.) (August 2012)
- Acquire and test additional HULD-Rs to determine mitigation capability for threats in checked baggage and cargo mitigation threshold (to be completed Q4, FY14)

Comparison Test: Conventional LD3 vs. HULD-R, Air Cargo Contents (2011)



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Concluding Remarks

- HULD design material selection is a very small component of developing a successful HULD concept. Structural configuration and operational design aspects of the HULD (operational utility, damage/repair considerations, etc.) are paramount in successful HULD design development.
- HULD cost-benefit effort provides government with data to support policy formation, assess alternative methods of security (such as detection versus protection), and assess alternative security products in the context of a unified and layered security system.
- The HULD is but one part of a layered systems solution to aircraft/passenger protection. HULD effectiveness relative to protection of the aircraft is tied to pre-load detection technologies (HULD is not a singular solution).

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