

# X-ray and $\gamma$ -ray standards for aviation security

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**IEEE Standards**

## N42.4x

American National Standards for  
Evaluation and Performance of X-ray  
Security Screening Systems

Accredited by the American National Standards Institute

Sponsored by the  
National Committee on Radiation Instrumentation, N42



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**Homeland  
Security**

American National Standards Institute  
**HOMELAND SECURITY  
STANDARDS PANEL**



**NIST**

# Motivations:

X-RAY



At the creation of DHS, the need for national technical performance and radiation safety standards was quickly identified for x-ray and gamma-ray security screening systems that continue to be deployed on a large scale at transportation and commercial venues.

As of 2010, first versions or revisions of a complete suite of x-ray standards have been published that cover the screening of explosives and VBIED's, PBIED's, and LBIED's.

Screening!

*“changing national policy and practice in the area of bulk explosives detection across key DHS agencies through national x-ray standards development & international standards harmonization”*



# Programmatic Goals

To enhance the effective use of bulk-explosives x-ray detection technologies by:

- [1] providing standard evaluation metrics, test objects, and protocols for image quality and radiation safety for x-ray &  $\gamma$ -ray security-screening systems
- [2] enabling field testing of prototype systems, procurement guidance, & support for certification activities uniformly across DHS agencies
- [3] filling well-documented gaps in transportation security, to meet the requirements for 100 % screening of baggage, cargo, and airline passengers



# Partnerships/Customers

## Government Partners / Customers:

TSIF, TMEC/DOD, USSS, SRNL/DOE, S&T/DHS, TSA/FAA, TSL/DHS, Canadian Nuclear Safety Commission, CDRH/FDA, CBP/DHS, DNDO/DHS, Fed. Bur. Prisons/DOJ, NIJ/DOJ, Transport Canada, NIST/OLES/DOC, States (FL, NY) Hazardous Devices School / NBSCAB

## Industrial Partners:

Analogic, Astrophysics Corporation, ENSCO GE Security (formerly Invision) , Reveal Imaging, SureScan Corporation, Control Screening, AS&E, L-3 Communications, Rapiscan Systems, SAIC, Smiths Detection, Tek84 LLC, SecurePath, HighCom, Annistech, CSC, SRA Intl., SCA, Batelle, Varian, Underwriter's Labs, Valley Forge Imaging





# Primary Outputs

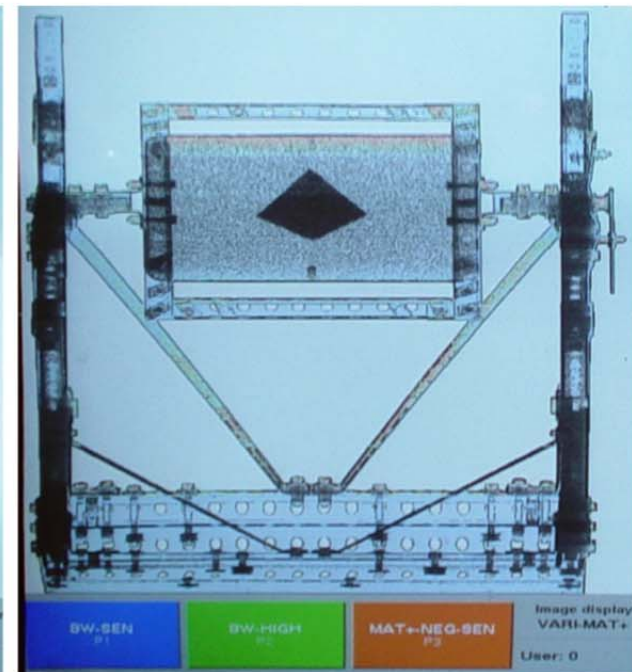
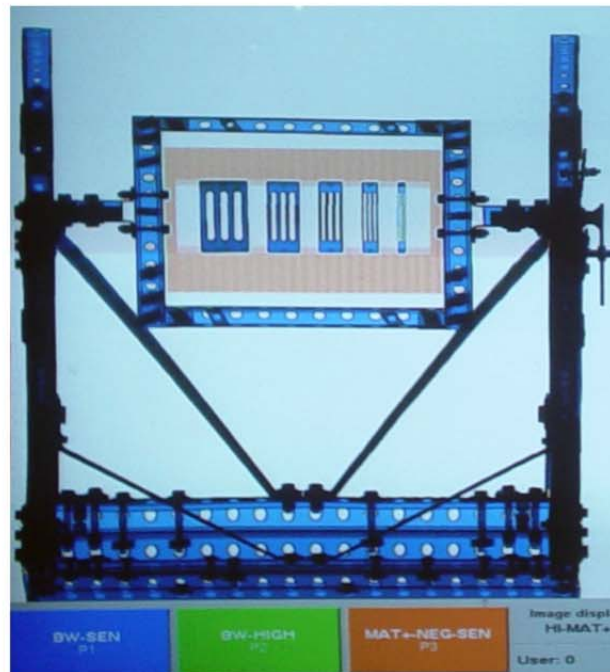
- documentary standards
- standard test objects, test methods, T&E protocols, and minimum performance requirements
- field testing (of standards & protocols)
- dosimetric protocols informed by radiation-transport calculations
- technical & guidance documents

ANSI N42.45 CT PHANTOMS



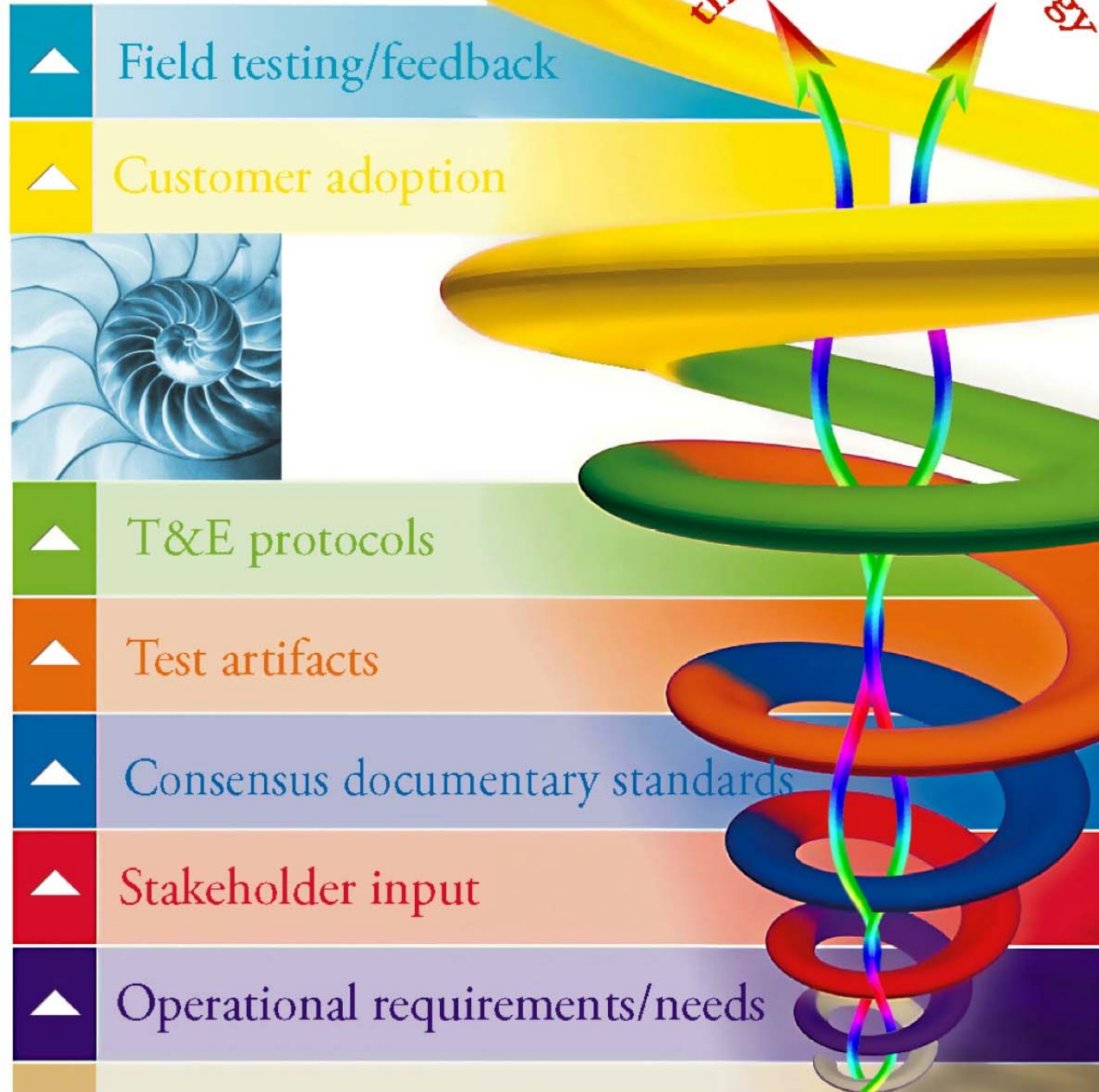
Z-EFFECTIVE

STREAK ARTIFACTS



# Spiral Development of X-Ray Standards

## Technical Approach





# BRIDGING THE GAP

THREAT-BASED /  
OPERATIONAL  
TESTING

TECHNICAL /  
IMAGING  
PERFORMANCE



Technical Performance

Radiation Safety

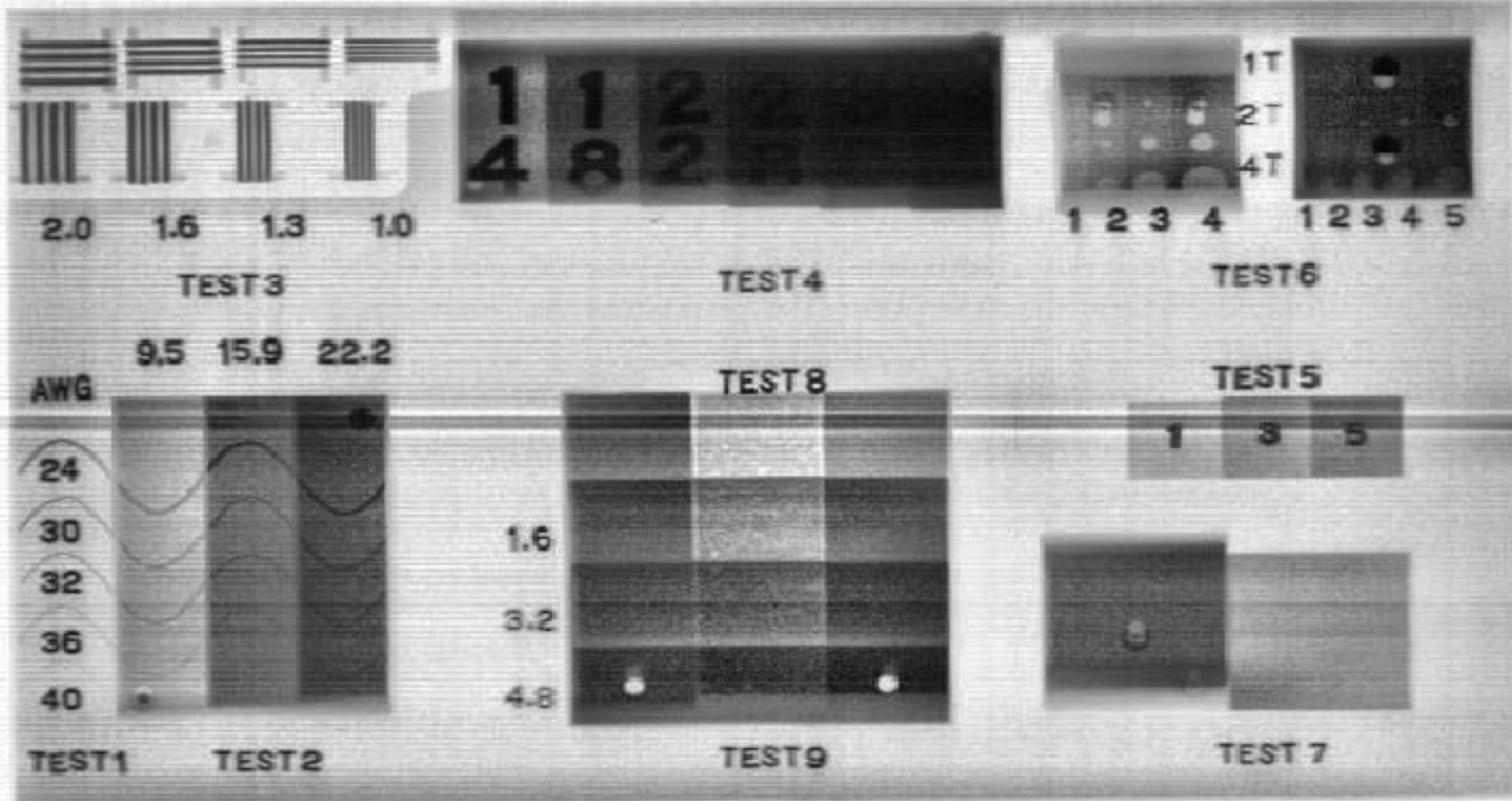
## National & International X-Ray Standards for Bulk Explosives

Venue	Technical Performance	Radiation Safety
Checkpoint	ANSI N42.44 – 2008 ASTM F 792 – 2008	ASTM F 1039 (21 CFR 1020.40)
CT / EDS (checked luggage)	ANSI N42.45-2010	(21 CFR 1020.40)
Cargo / Vehicle	ANSI N42.46 – 2008 IEC 62523 – 2010 ANSI N42.41 – 2007	ANSI N43.16 – draft IEC 62523 – 2010 ANSI N43.14 – draft
Whole Body Imaging (AIT)	ANSI N42.47 – 2010  IEC – Critical Draft	ANSI/HPS N43.17 – 2009 ANSI/ANS 6.1.1 IEC 62463 – 2010
Bomb Squads (portable sources)	NIJ 0603.01	ANSI/HPS N43.3





# ASTM F-792 test piece x-ray image



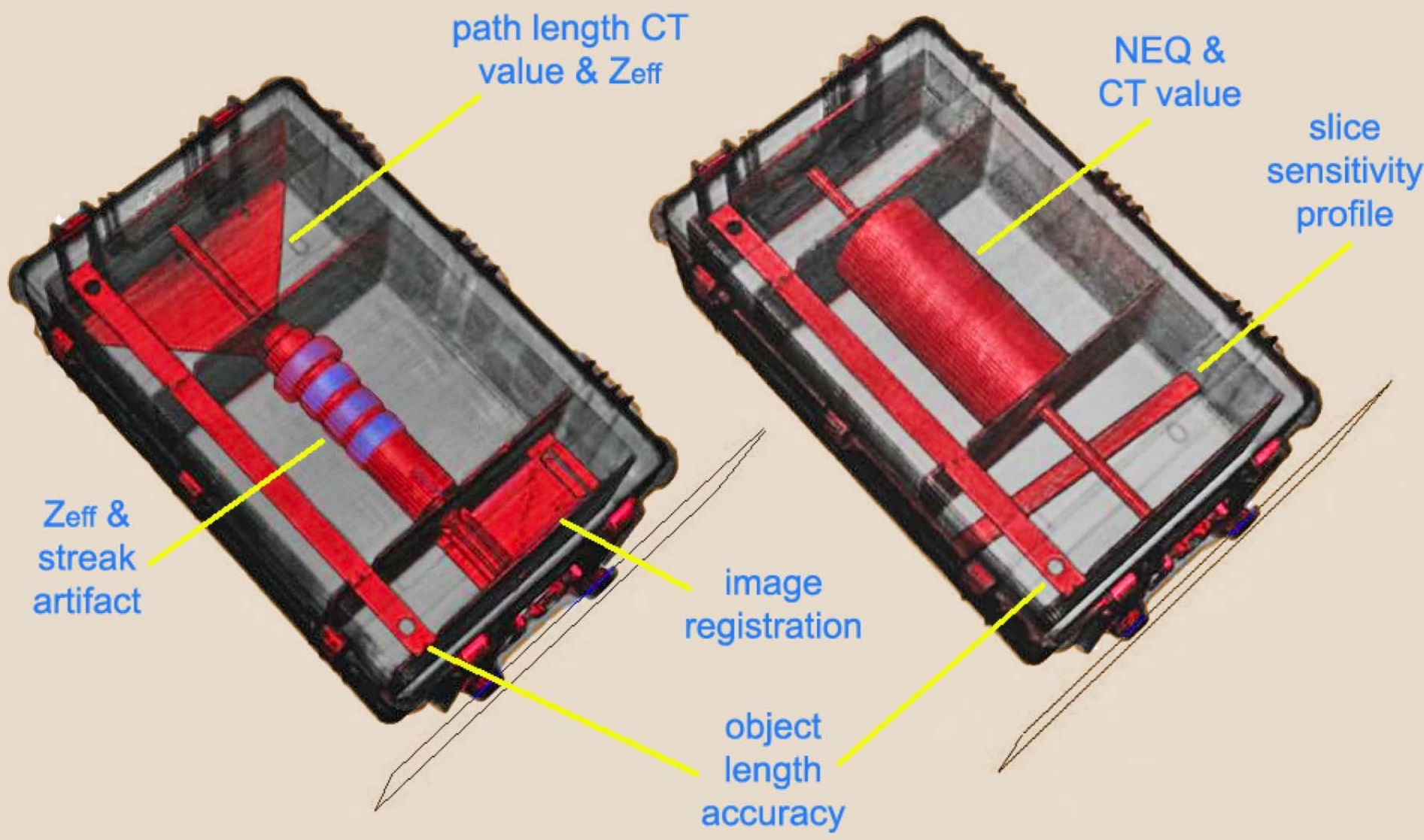


# ANSI N42.45 test articles for CT systems





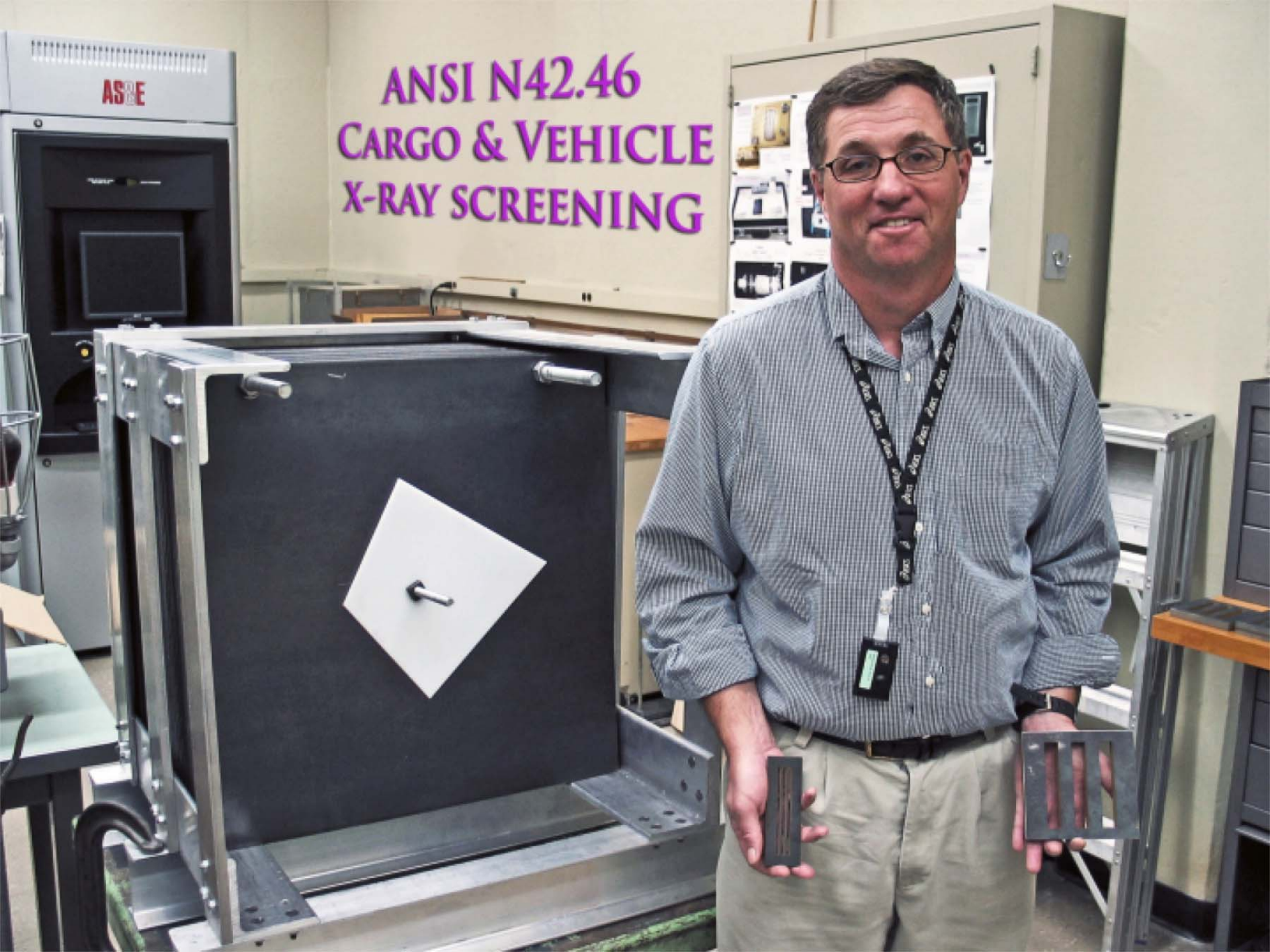
# ANSI N42.45 Test Article for CT Security Screening Systems

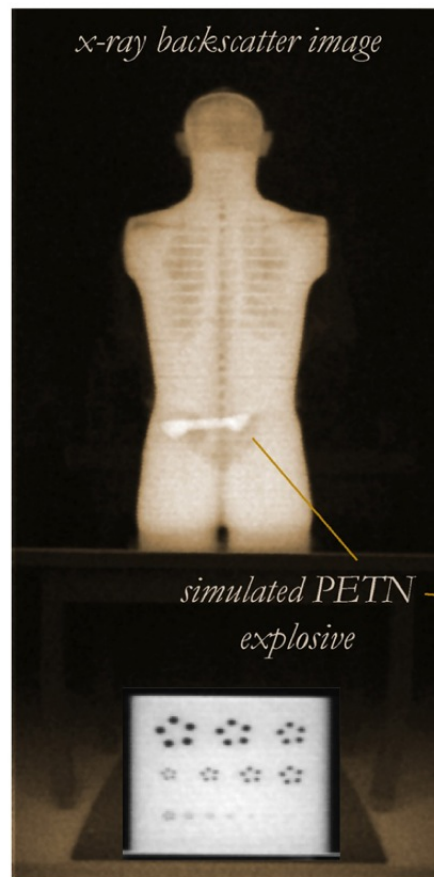


x-ray images acquired and reconstructed with GE Security CTX-9800 DSi™



# ANSI N42.46 CARGO & VEHICLE X-RAY SCREENING





*simulated PETN explosive*

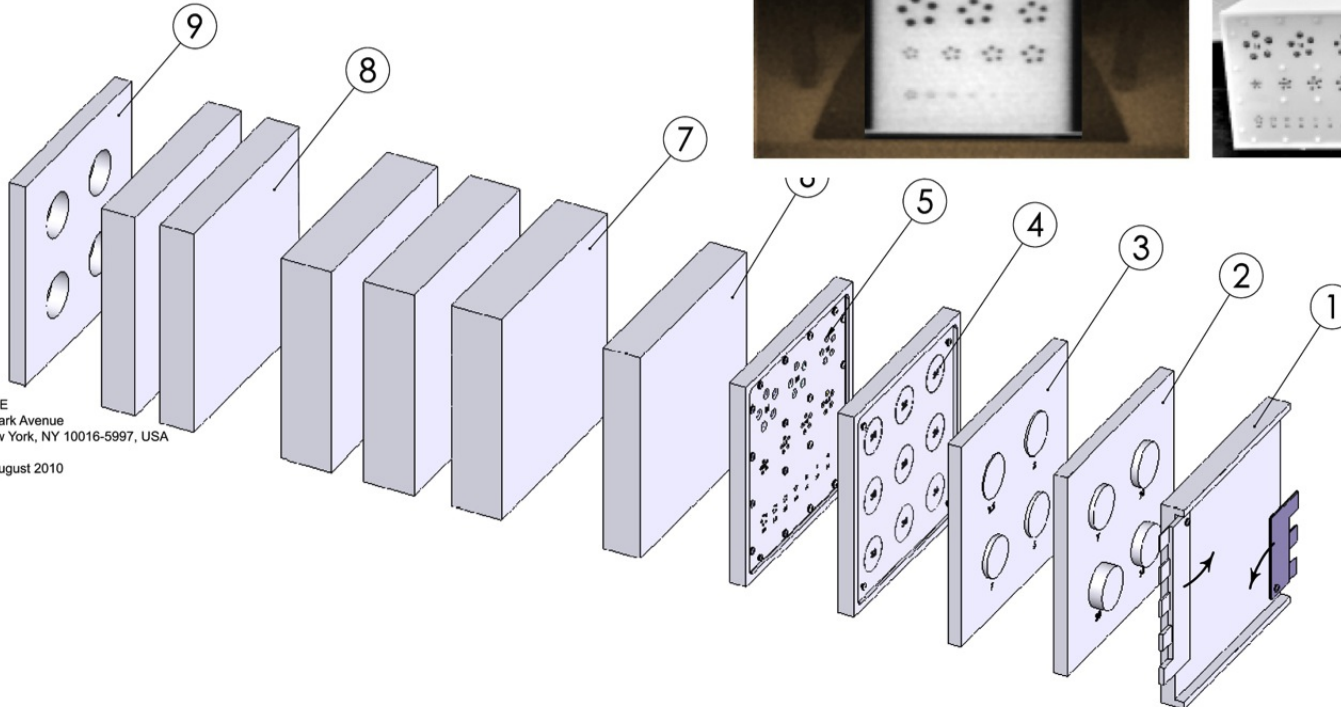
← image quality test objects



# American National Standard for Measuring the Imaging Performance of X-ray and Gamma-ray Systems for Security Screening of Humans

Accredited by the American National Standards Institute

Sponsored by the National Committee on Radiation Instrumentation, N42

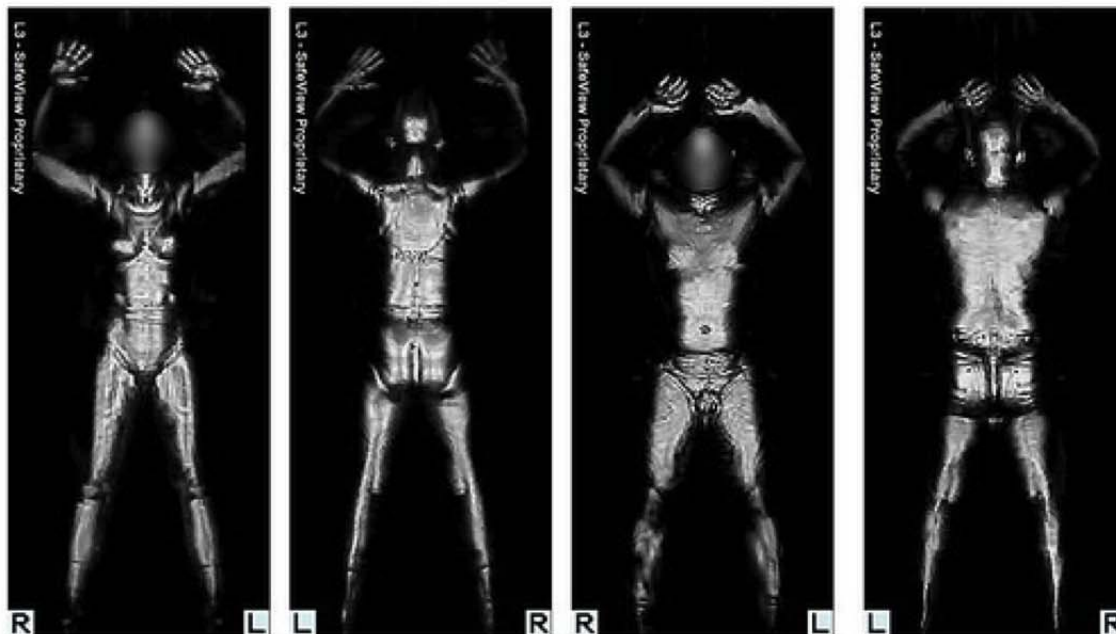


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3 August 2010

N42.47



The United States is set to deploy 950 full body screeners by the end of 2011, and about 1,800 by the end of 2014



mm-wave whole-body imaging





Standards for  
portable x-ray  
sources used  
by bomb  
squads



# identifying needs:



**ANSI-HSSP Workshop on  
Standards for Noninvasive  
Inspection Systems**

- April 2010
- 160 participants
- 75 organizations

revised ANSI N42.46 (technical performance, cargo/vehicle)	<ul style="list-style-type: none"><li>• <i>add materials discrimination test</i></li><li>• re-size for air-cargo inspection</li><li>• apply statistical scoring</li><li>• safety considerations</li><li>• compare results to IEC cargo standard</li></ul>
revised ASTM F-792 (classic aviation checkpoint IQ test piece)	technically outdated
ANSI N43.16 (cargo/vehicle radiation safety)	needed by CBP, NBSCAB, & TSIF
revised NIJ 0603.01 (bomb squads; image quality)	NBSCAB 2010 requirements document
IEC standard for x-ray AIT image quality	NWP accepted OCT 2010
imaging performance standard for mm-wave or technology-neutral standard	currently no extant standards
dosimetric protocol to measure high-E beams used in cargo screening	under development at NIST, traceable to primary standards
standard screener training, CONOPS, data formats, and Automated Target Recognition	NEMA's DICOS standard, <i>etc.</i>



# Homeland Security

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