
SmartRayVision SRV X1012

ANSI N42.55 Test Summary Results

December 2019

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Introduction

This report documents test results for the SmartRayVision SRV X1012 x-ray imaging panel against the American National Standards Institute (ANSI) N42.55 standard, “American National Standard for the Performance of Portable Transmission X-Ray Systems for Use in Improvised Explosive Device and Hazardous Device Identification.” On behalf of the U.S. Department of Homeland Security, DAGER Technology performed the testing in cooperation with the Office of the Maryland State Fire Marshal. The testing took place November 5–7, 2019, at a Maryland State Fire Marshal property located within the Baltimore/Washington International Airport grounds.

ANSI N42.55 Test Methodology

The testing assessment used the ANSI N42.55 Portable X-ray Standard provided by the National Institute of Standards and Technology (NIST). The standard describes nine distinct tests that can characterize the image quality of an x-ray system. Each test describes different and important capabilities of the x-ray system—for example, its ability to resolve very small objects or its ability to see through shielding material. This allows one to independently measure the capabilities of an x-ray imaging system, rather than solely relying on the claims of manufacturers. This measurement method excludes system components such as vendor software and operator control unit (OCU) display, which also impact the ultimate capabilities of the complete x-ray system.

The x-ray system images the N42.55 test article (shown in the figure) to generate the results. NIST analyzes the images using a set of methods written in the standard that are used to calculate results for each test.

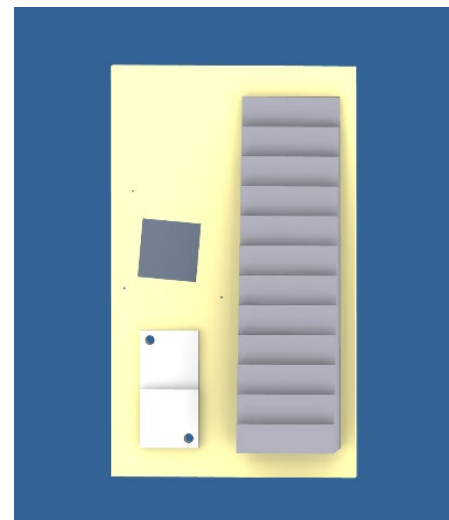


Figure 1. ANSI N42.55 test article

The following section of this report provides a table indicating the measured metric values for each of the nine ANSI N42.55 standard tests completed with the SmartRayVision SRV X1012 x-ray imaging panel. Each of the nine tests received one of the following scores:

- **GREEN** – Pass: Met the desired performance objective
- **RED** – Fail: Failed to meet the desired performance objective

ANSI N42.55 Test Results

As indicated in the below table, the green color shows that the SRV X1012 scored above the minimum performance requirements for Tests 1–9 of the ANSI N42.55 standard.

ANSI N42.55 Test Results

Metric Name		Minimal Performance Requirement	Metric Value Measured	Score
Test 1: Penetration		≥ 6 mm	24 mm*	
Test 2: Organic Material Detection		≥ 2.0	8.1*	
Test 3: Spatial Resolution	MTF20x	≥ 0.5 lp/mm	2.16 lp/mm ± 0.03 lp/mm†	
	MTF20y	≥ 0.5 lp/mm	2.16 lp/mm ± 0.02 lp/mm†	
Test 4: Dynamic Range		≥ 150	1413.2 ± 106.7†	
Test 5: Noise	NEQx at 1 lp/mm	≥ 22,500	1,463,394 ± 43,069†	
	NEQy at 1 lp/mm	≥ 22,500	1,139,395 ± 105,498†	
Test 6: Flatness of Field		≥ 0.5	0.973 ± 0.00†	
Test 7: Image Extent		≤ 10 mm	1 mm*	
Test 8: Image Area		≥ 1000 by 1000 pixels	2552 by 2032 pixels	
Test 9: Aspect Ratio		≤ 0.05	0.001 ± 0.001†	

†These values represent the mean and one-sigma uncertainty in the quantity of interest. In some cases, the metric mean must be two sigma away from the min performance requirement in order to pass. See IEEE/ANSI N42.55 for full details.

*These tests do not have uncertainty values defined in the standard.

Description of ANSI N42.55 Tests

The purpose and definition of the nine tests for the ANSI N42.55 standard are given below.

Test 1: Penetration through Steel

This test describes the ability of a portable x-ray system to produce usable images of objects that are hidden behind shielding or thick metal. The results are measured in millimeters of steel. Larger values of penetration mean that images can be made of objects hidden behind thick shielding. However, large values of useful penetration typically require higher energy x-rays, which may lead to poorer contrast for thinner materials or organics.

Test 2: Organic material detection

Organic material detection describes the ability of the portable x-ray system to image thin pieces of low atomic number material, such as plastic or sheet explosive. A large value for this test

means that thin organic materials will be visible with better contrast compared with the surrounding materials.

Test 3: Spatial Resolution

Spatial resolution describes the ability of a portable x-ray system to detect and resolve small, closely spaced objects. There are many methods for measuring spatial resolution, and each method will give different results and may be measured in different units. In ANSI N42.55, the Modulation Transfer Function (MTF) method is used. The larger the value of spatial resolution, as measured by this standard, the better the spatial resolution.

Test 4: Dynamic Range

The dynamic range of an imaging system describes its ability to represent detail in both dark and light areas of the image simultaneously. Specifically, it is the ratio of the highest pixel value in an image to lowest usable pixel value, which is typically set by the noise level. If a portable x-ray system has high dynamic range, then even in cases of underexposure or overexposure, a useable image may still be produced.

Test 5: Noise (NEQ)

Noise describes the amount of random variation in image (pixel) values. This test is scored using the noise equivalent quanta (NEQ) metric. Higher values for this metric mean less noise and a better image.

Test 6: Flatness of Field

The flatness of field describes the relative uniformity of the image over the active region of the detector. The closer the value of flatness of field is to 1, the more uniform the image. If, for example, a system produces an image that is dark around the edges, it will score more poorly on this test.

Test 7: Image Extent

Image extent describes the ability of the portable x-ray system to provide good image quality near the edge of the detector. More specifically, it measures whether the dynamic range requirement is met close to the edge of the detector. Image extent is measured in millimeters, and a smaller value is better.

Test 8: Image Area

Image area refers to the size of the image, as measured in pixels.

Test 9: Aspect Ratio

Aspect ratio describes how accurately the shapes of objects appear in the image. If the value is significantly different than zero, then distortion of shapes occurs (e.g., stretching and skewing).

SmartRayVision SRV 1417

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Introduction

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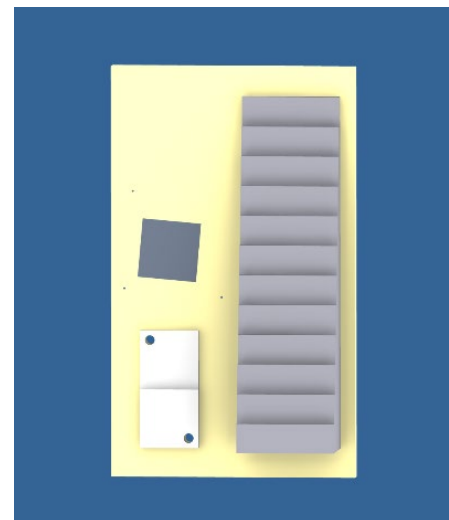


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ANSI N42.55 Test Results

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Test 1: Penetration		≥ 6 mm	18 mm*	
Test 2: Organic Material Detection		≥ 2.0	10.0*	
Test 3: Spatial Resolution	MTF20x	≥ 0.5 lp/mm	1.93 lp/mm ± 0.04 lp/mm†	
	MTF20y	≥ 0.5 lp/mm	1.92 lp/mm ± 0.02 lp/mm†	
Test 4: Dynamic Range		≥ 150	1265.8 ± 221.8†	
Test 5: Noise	NEQx at 1 lp/mm	≥ 22,500	668,500 ± 73,350†	
	NEQy at 1 lp/mm	≥ 22,500	248,856 ± 63,264†	
Test 6: Flatness of Field		≥ 0.5	0.975 ± 0.00†	
Test 7: Image Extent		≤ 10 mm	1 mm*	
Test 8: Image Area		≥ 1000 by 1000 pixels	2800 by 2296 pixels	
Test 9: Aspect Ratio		≤ 0.05	0.001 ± 0.000†	

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