Kodak DIRECTVIEW Total Quality Tool

Overview

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HEALTH IMAGING
A BETTER VIEW OF LIFE.

KODAK Digital Capture Solutions

Milestones

- KODAK DIRECTVIEW PTS Software (1997)

Early Innovator—Kodak patents storage phosphor technology—a foundation for the first CR systems in the industry

- First KODAK CR System (1993)
- Next-generation CR—multi-cassette system with unique "drop-and-go" workflow (1995)
- KODAK Black Surround / Masking Software (1997)
- KODAK DIRECTVIEW EVP Software (1999)
- KODAK DIRECTVIEW Total Quality Tool (2001)

- KODAK DIRECTVIEW CR 950 System (2003)
- KODAK DIRECTVIEW Remote Operations Panel (2000)

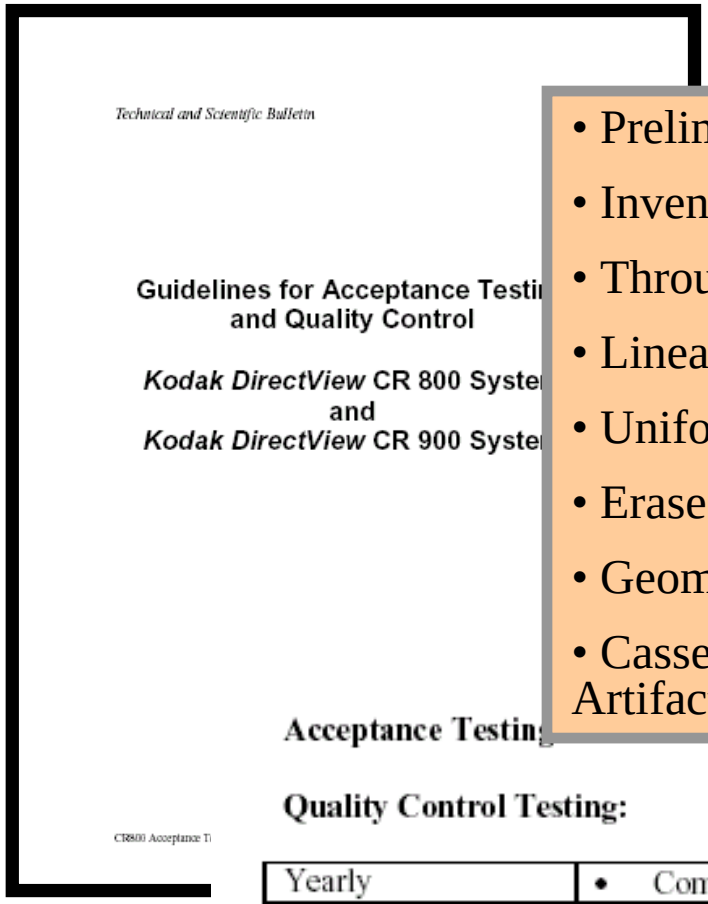
- KODAK DIRECTVIEW V3 Software (2002)

- KODAK DIRECTVIEW CR 500 System (2003)

2004

- KODAK DIRECTVIEW CR 850 System (2003)
- KODAK DIRECTVIEW DR System s (2000)

Manual Acceptance Testing and Quality Control


Technical and Scientific Bulletin

Guidelines for Acceptance Testi
and Quality Control

Kodak DirectView **CR 800 Syste**
and
Kodak DirectView **CR 900 Syste**

CR800 Acceptance Ti

- Preliminary testing (x-ray machine, displays, printers)
- Inventory & Inspection
- Throughput
- Linearity
- Uniformity & Artifacts
- Erase Function
- Geometry
- Cassette testing (Exposure Response, Uniformity and Artifacts)

Acceptance Testin

Quality Control Testing:

Yearly	• Complete acceptance test
Twice yearly	• **Cassette Exposure Response, Uniformity and Artifacts** - Test the 10 mR system response and visually check the resulting image from each cassette for uniformity and artifacts.
Monthly	• Visually inspect all screens for dust and scratches
Weekly	• Erase all unused cassettes • Verify luminance calibration of workstation displays
Daily	• Verify printer-processor density calibration

Kodak TQT – CR Testing Matrix

Manufacturing ⇔ Service ⇔ User

TQT

Exposure Response
- *Linearity & Noise*

Spatial Resolution - MTF
- *Slow scan & fast scan*
- 50% *and* 95% $f_{Nyquist}$

Geometric Accuracy
- *Pixel Spacing, Aspect Ratio, Scan Linearity*

Field Uniformity

Erase

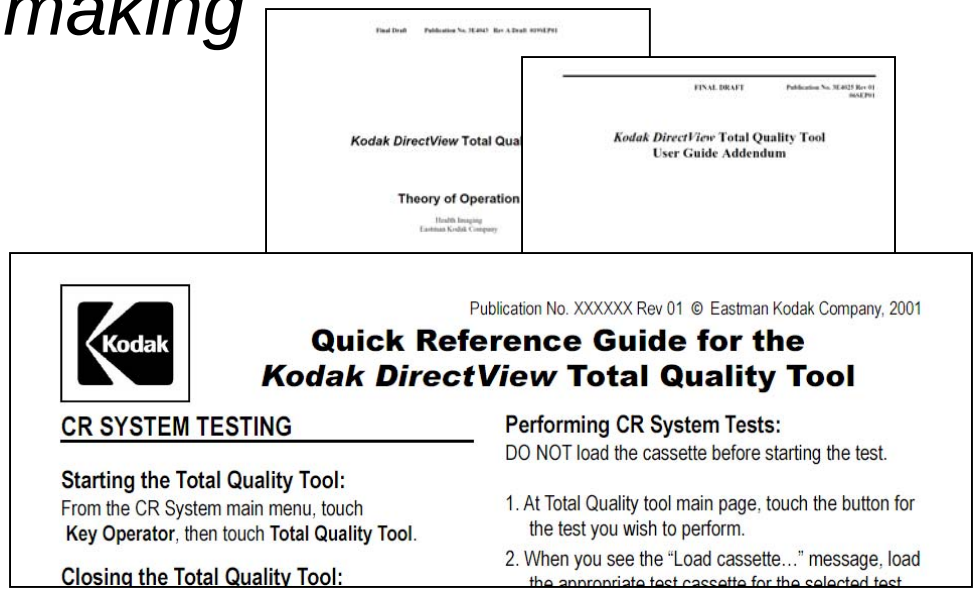
Artifacts:
- *Streaks, Pixel-Position Error, Line-Position Error*

System Electronic Noise

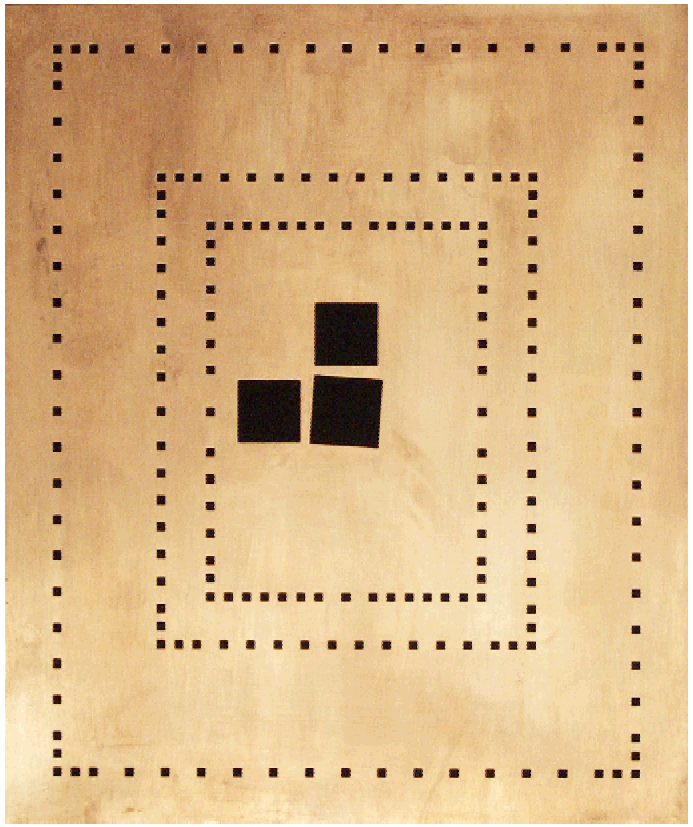
Acceptance Testing and Quality Control

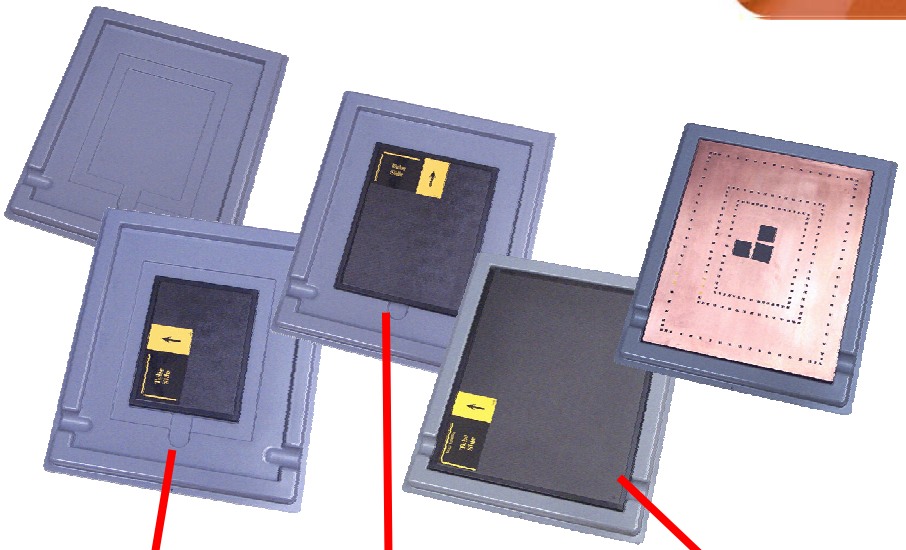
Kodak Total Quality Tool

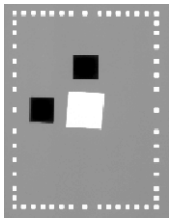
- **Phantom** - *targets for quantitative analyses*
- **Procedure** - *acquire phantom and flat-field images using controlled exposures*
- **Analysis Software** - *automatic image analyses and decision making*
- **Documentation**
  - **Theory of Operation**
  - **User Guide Addendum**
  - **Quick Users**



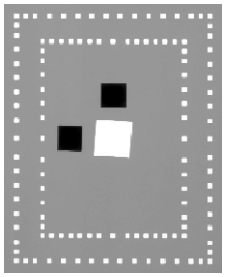
Kodak TQT Phantom



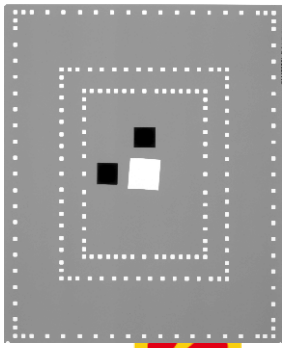




18 x 24 cm

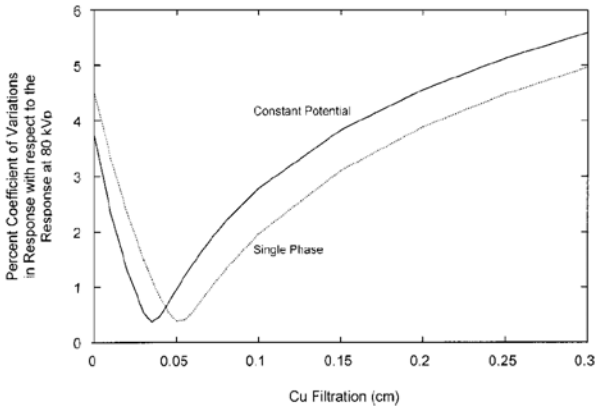


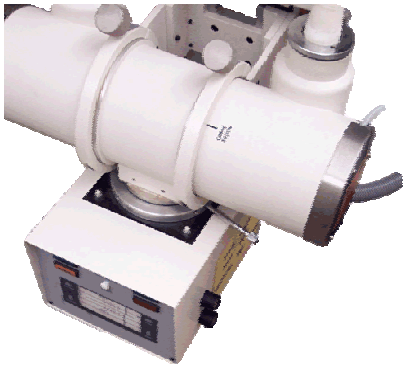
24 x 30 cm



35 x 43 cm

Kodak TQT Procedure

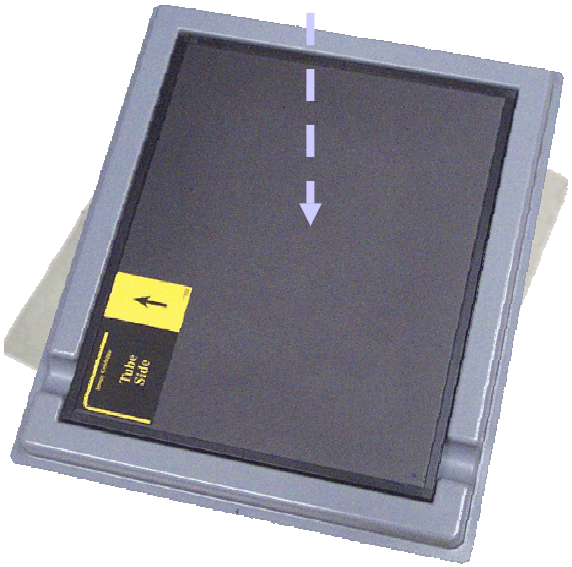


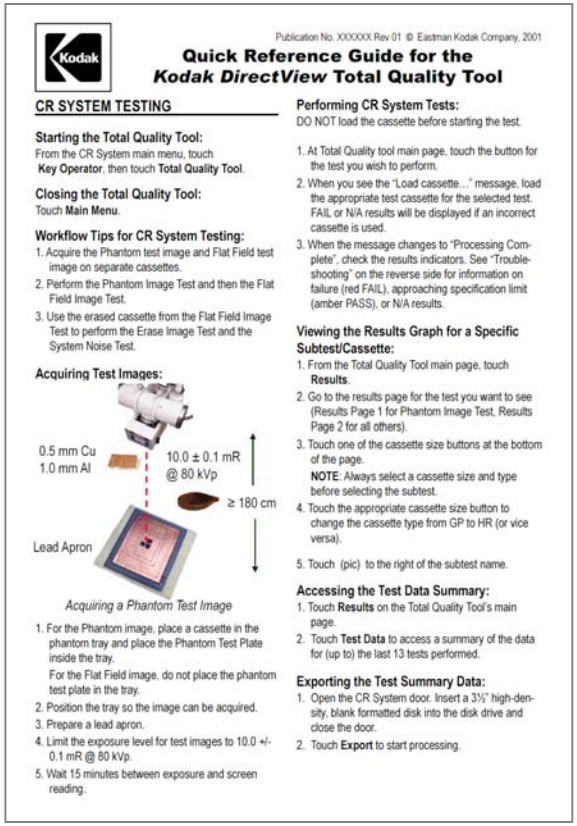


0.5 mm Cu
1.0 mm Al

≥ 180 cm

10.0 ± 0.2 mR
@ 80 kVp





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Quick Reference Guide for the *Kodak DirectView* Total Quality Tool

CR SYSTEM TESTING

Starting the Total Quality Tool:
From the CR System main menu, touch **Key Operator**, then touch **Total Quality Tool**.

Closing the Total Quality Tool:
Touch **Main Menu**.

Workflow Tips for CR System Testing:
1. Acquire the Phantom test image and Flat Field test image on separate cassettes.
2. Perform the Phantom Image Test and then the Flat Field Image Test.
3. Use the erased cassette from the Flat Field Image Test to perform the Erase Image Test and the System Noise Test.

Acquiring Test Images:

Acquiring a Phantom Test Image

1. For the Phantom image, place a cassette in the phantom tray and place the Phantom Test Plate inside the tray.
   For the Flat Field image, do not place the phantom test plate in the tray.
2. Position the tray so the image can be acquired.
3. Prepare a lead apron.
4. Limit the exposure level for test images to 10.0 +/- 0.1 mR @ 80 kVp.
5. Wait 15 minutes between exposure and screen reading.

Performing CR System Tests:
DO NOT load the cassette before starting the test.

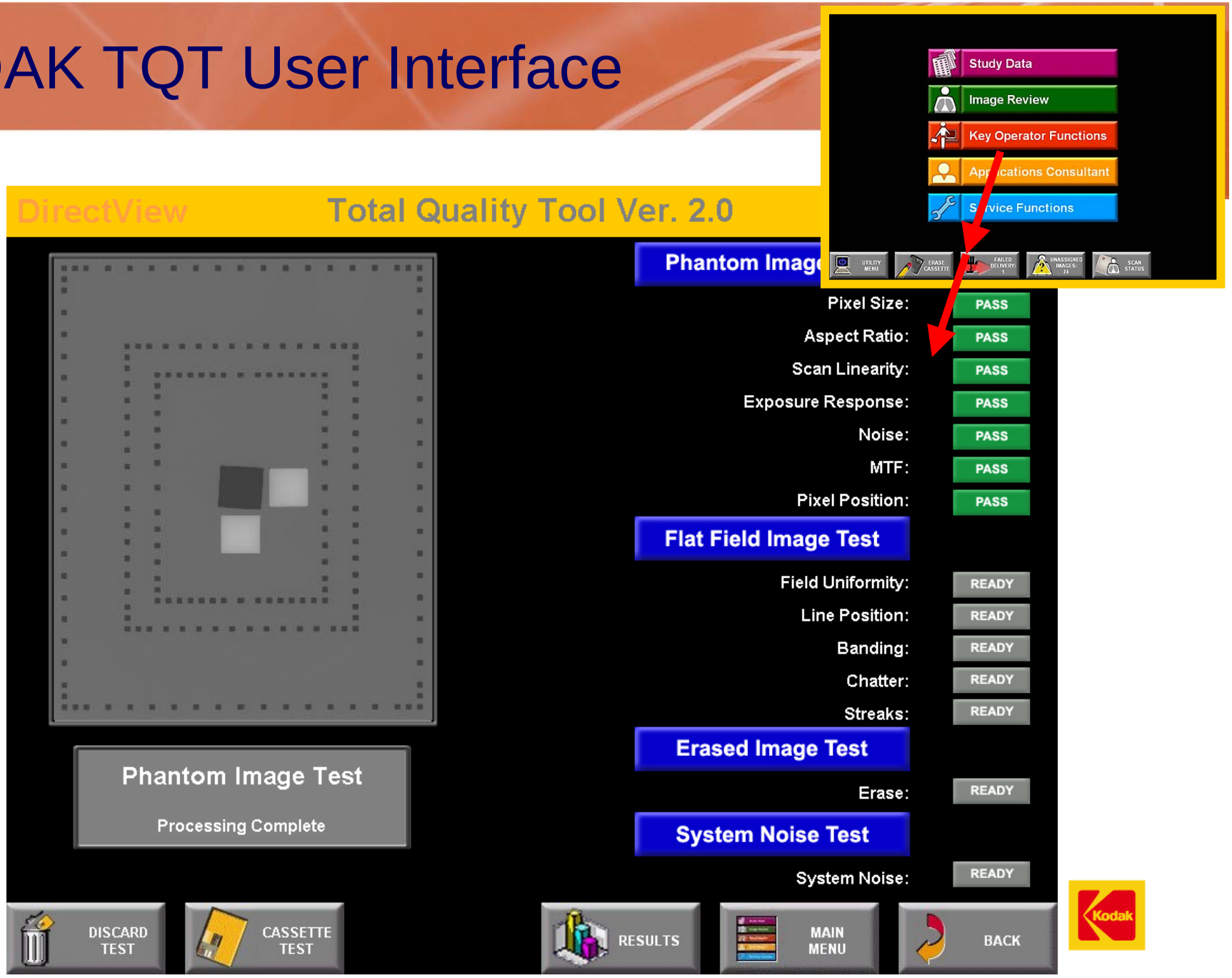
1. At Total Quality tool main page, touch the button for the test you wish to perform.
2. When you see the "Load cassette..." message, load the appropriate test cassette for the selected test. FAIL or N/A results will be displayed if an incorrect cassette is used.
3. When the message changes to "Processing Complete", check the results indicators. See "Troubleshooting" on the reverse side for information on failure (red FAIL), approaching specification limit (amber PASS), or N/A results.

Viewing the Results Graph for a Specific Subtest/Cassette:
1. From the Total Quality Tool main page, touch **Results**.
2. Go to the results page for the test you want to see (Results Page 1 for Phantom Image Test, Results Page 2 for all others).
3. Touch one of the cassette size buttons at the bottom of the page.
   NOTE: Always select a cassette size and type before selecting the subtest.
4. Touch the appropriate cassette size button to change the cassette type from GP to HR (or vice versa).
5. Touch (pic) to the right of the subtest name.

Accessing the Test Data Summary:
1. Touch **Results** on the Total Quality Tool's main page.
2. Touch **Test Data** to access a summary of the data for (up to) the last 13 tests performed.

Exporting the Test Summary Data:
1. Open the CR System door. Insert a 3½" high-density, blank formatted disk into the disk drive and close the door.
2. Touch **Export** to start processing.

KODAK TQT User Interface



Test Result Details

Phantom Image Test Results

Pixel Size 2.0% max:	1.4%
Aspect Ration 3.0% max:	2.7%
Scan Non-Linearity 2.0% max:	0.95%
Exposure Latitude 100.0 max:	76.4
Noise Level (@0.19mR) 13.3 max:	11.9
Noise Level (@2.11mR) 11.3 max:	10.7
Noise Level (@10.0mR) 10.3 max:	9.12
Pixel Placement Error 0.25 max:	0.114
MTF (short direction @ 50% Nyquist) 34.5% min:	59.5%
MTF (short direction @ 95% Nyquist) 10.3% min:	21.7%
MTF (long direction @ 50% Nyquist) 34.5% min:	29.5%
MTF (long direction @ 50% Nyquist) 10.3% min:	10.9%

Flat Field Image Test Results

Field Non-Uniformity 100max:	74.0
Galvo Function 5.0E+06 max:	3.7E+06
Transport Banding 810.0 max:	715.7
Random Streak 5 max:	2

Erased Image Test Results

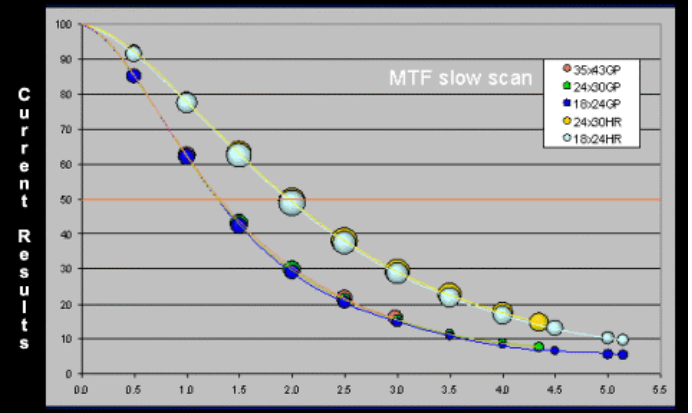
Residual Signal 100.0 max:	Not Available

System Noise Test Results

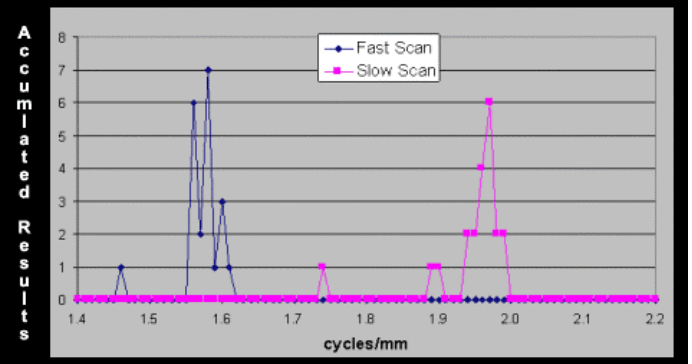
BaseLine System Noise 6.0E-06 max:	Not Available

Select test result to display graph

MTF (long direction @ 50%)

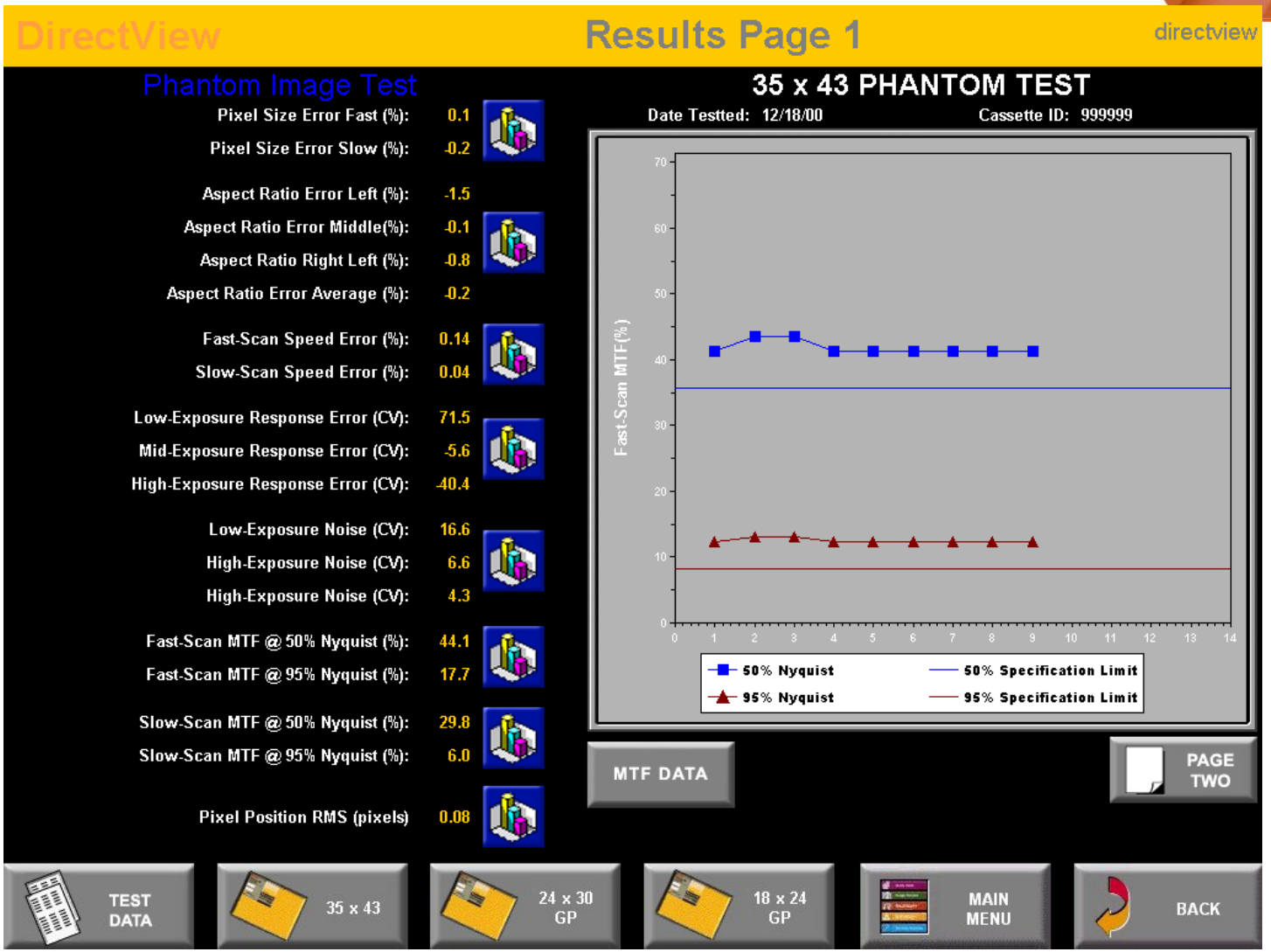


Previous 8 results of MTF



Print Results | Main Menu | Back

Test Result Details



Detailed Tracking and Reporting

DirectView

35 x 43 Test Results

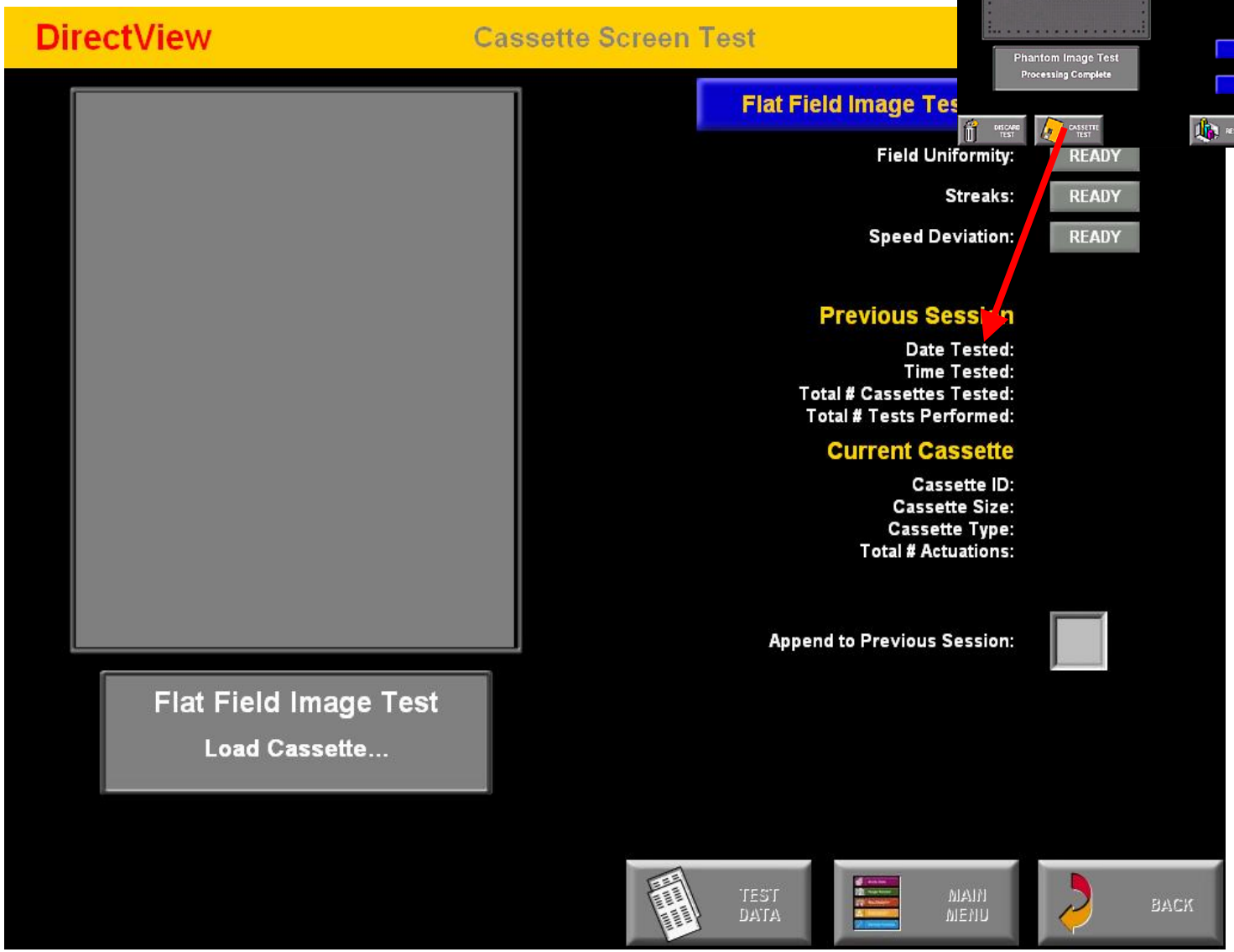
directview

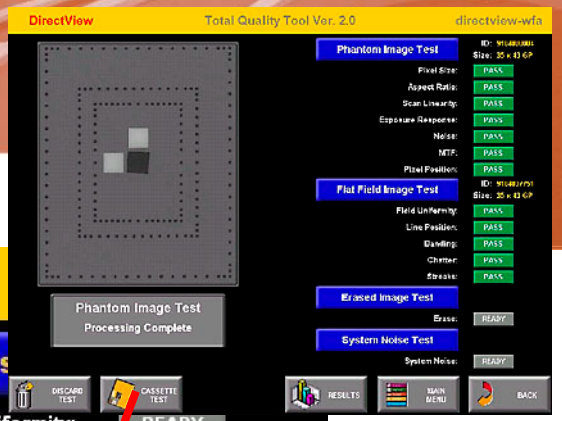
Phantom Test		Flat Field Test		Erased Test		System Noise Test		
Date	2000/07/17	2000/07/17	2001/01/05	2001/01/05	2000/07/17	2000/07/17	2000/07/17	2000/07/17	2000/07/17
Cassette ID	9104000004	9104000004	9104037750	9104037750	9104000004	9104000004	9104000004	9104000004	9104000004
Pass/Fail	FAIL	FAIL	PASS	PASS	FAIL	FAIL	FAIL	FAIL	FAIL
Pixel Size Error Fast(%)	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6
Pixel Size Error Slow(%)	0	0	0	0	0	0	0	0	0
Aspect Ratio Error Left(%)	1.2	1.2	1.8	1.8	1.2	1.2	1.2	1.2	1.2
Aspect Ratio Error Middle(%)	0.7	0.7	0.9	0.9	0.7	0.7	0.7	0.7	0.7
Aspect Ratio Error Right(%)	0.4	0.4	0.1	0.1	0.4	0.4	0.4	0.4	0.4
Aspect Ratio Error Average(%)	0.5	0.5	0.6	0.6	0.5	0.5	0.5	0.5	0.5
Fast-Scan Speed Error(%)	0.12	0.12	0.33	0.33	0.12	0.12	0.12	0.12	0.12
Slow-Scan Speed Error(%)	0.05	0.05	0.02	0.02	0.05	0.05	0.05	0.05	0.05
Low-Exposure Response Error(CV)	-33.6	-33.6	20.7	20.7	-33.6	-33.6	-33.6	-33.6	-33.6
Mid-Exposure Response Error(CV)	-4.1	-4.1	5.2	5.2	-4.1	-4.1	-4.1	-4.1	-4.1
High-Exposure Response Error(CV)	189	189	46.9	46.9	189	189	189	189	189
Low-Exposure Noise(CV)	12	12	13.4	13.4	12	12	12	12	12
Mid-Exposure Noise(CV)	4.3	4.3	4.8	4.8	4.3	4.3	4.3	4.3	4.3
High-Exposure Noise(CV)	3.2	3.2	3.6	3.6	3.2	3.2	3.2	3.2	3.2
Fast-Scan MTF @50% Nyquist(%)	41.4	41.4	43.6	43.6	41.4	41.4	41.4	41.4	41.4
Fast-Scan MTF @95% Nyquist(%)	12.4	12.4	13.1	13.1	12.4	12.4	12.4	12.4	12.4
Slow-Scan MTF @50% Nyquist(%)	43.2	43.2	45.8	45.8	43.2	43.2	43.2	43.2	43.2
Slow-Scan MTF @95% Nyquist(%)	16.6	16.6	19.7	19.7	16.6	16.6	16.6	16.6	16.6
Pixel Position RMS(pixels)	0.03	0.03	0.04	0.04	0.03	0.03	0.03	0.03	0.03

EXPORT | 35 x 43 | 24 x 30 GP | 18 x 24 GP | MAIN MENU | BACK

Kodak

Cassette Quality Assurance





Kodak TQT Summary

Kodak DirectView CR Image Quality Tool is used in production, by service and by users.

- Precise and accurate quality control testing
- Highly reproducible quantitative results
- Detects sub-visible changes in CR image quality performance to initiate timely preventive maintenance
- Avoids hours of tedious and labor-intensive effort with a highly automated procedure
- Full data reporting in Excel format