

# Primary Diagnostic Monitors Policy and Procedures Manual



Survey Performed Annually

Upstate Medical Physics-  
Diagnostic Radiology, Medical  
Nuclear, Medical Health and Therapeutic  
Radiological Physics, P.C.



*unfors* 

**TOTOKU**



# Key Acronyms & their Definition

- JND – Just Noticeable Difference
  - Ability/limitations of the eye to notice small visual contrast changes
- GSDF – Grayscale Standard Display Function
  - Contrast sensitivity of the eye
- PDM – Primarily Diagnostic Monitor
  - Monitors used by the radiologist to interpret diagnostic images for final diagnoses and report preparation

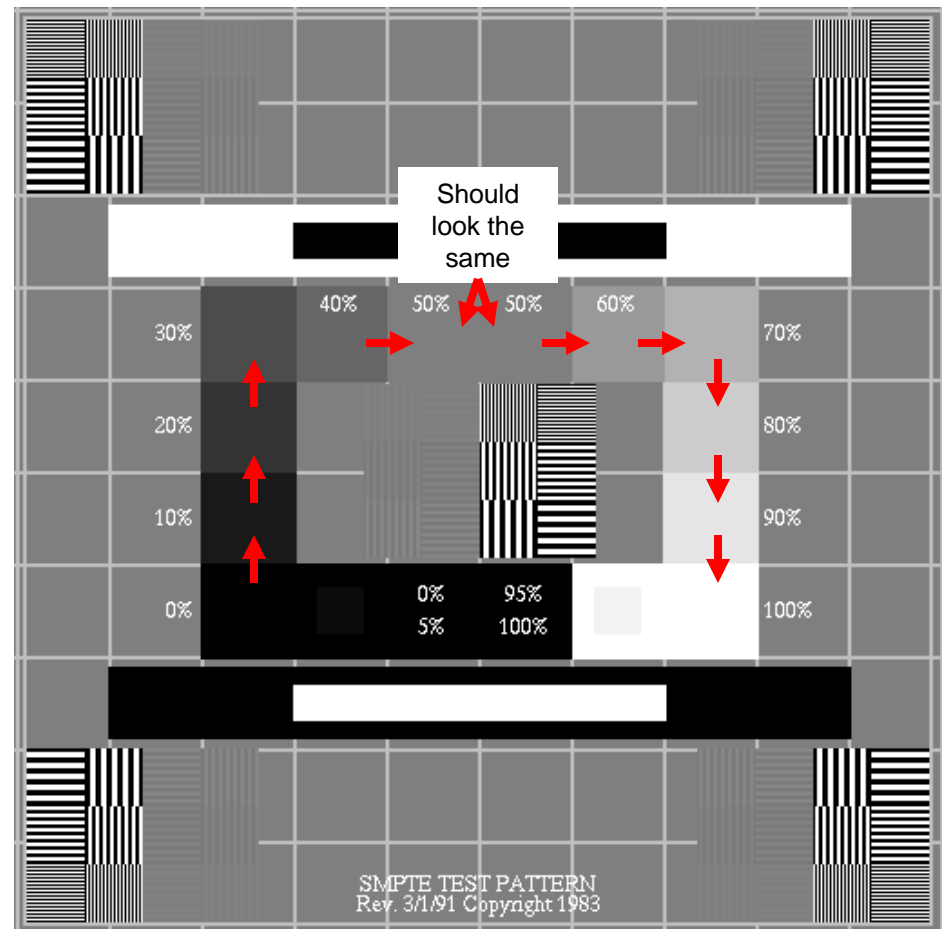
# GSDF intro

- Based on the human Contrast Sensitivity
  - Human eye is less sensitive to dark areas of an image than bright areas (non-linear)
  - This display function provides a perceptual linearization of the image
    - Provides the appearance of a linear image throughout all driving levels of the PDM

# A Qualitative Inspection of the SMPTE Test Pattern Analysis

## Grayscale Visual Check

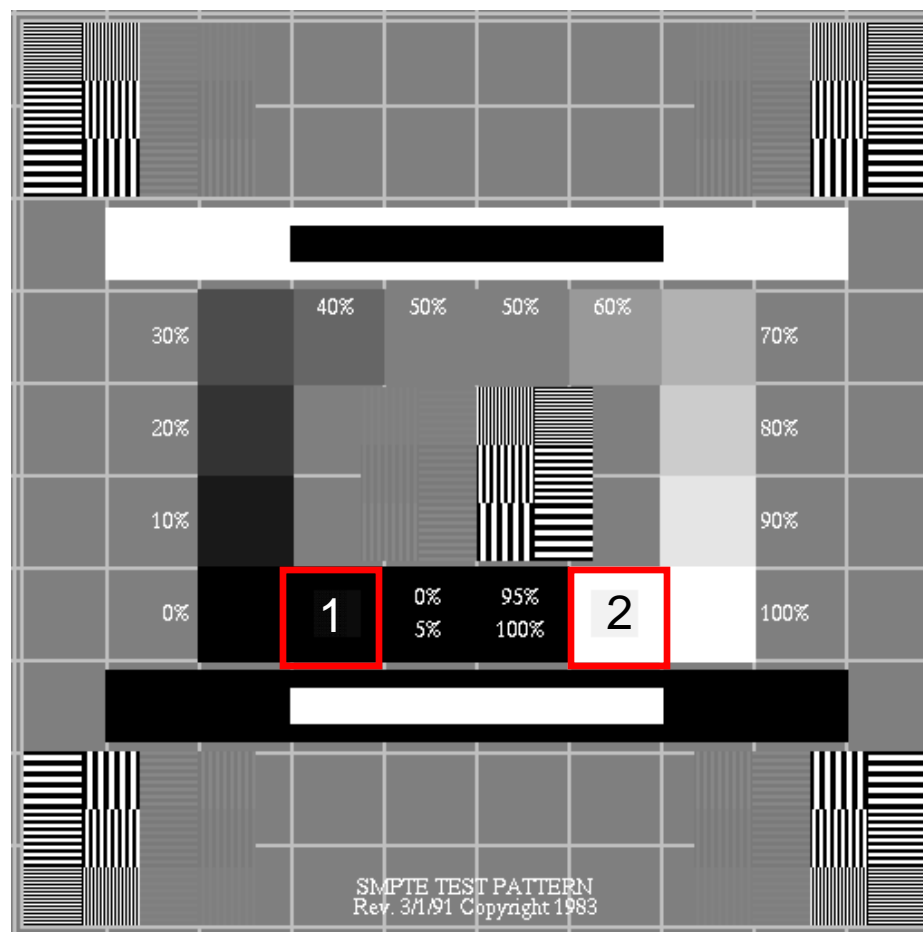
1. Visually inspect the change in gray scale values to ensure each can be differentiated



# A Qualitative Inspection of the SMPTE Test Pattern Analysis

## 0%-5% and 95%-100% Distinction

1. A 5% contrast square should be visible within the 0% contrast square (1)
2. A 95% contrast square should be visible within the 100% contrast square (2)

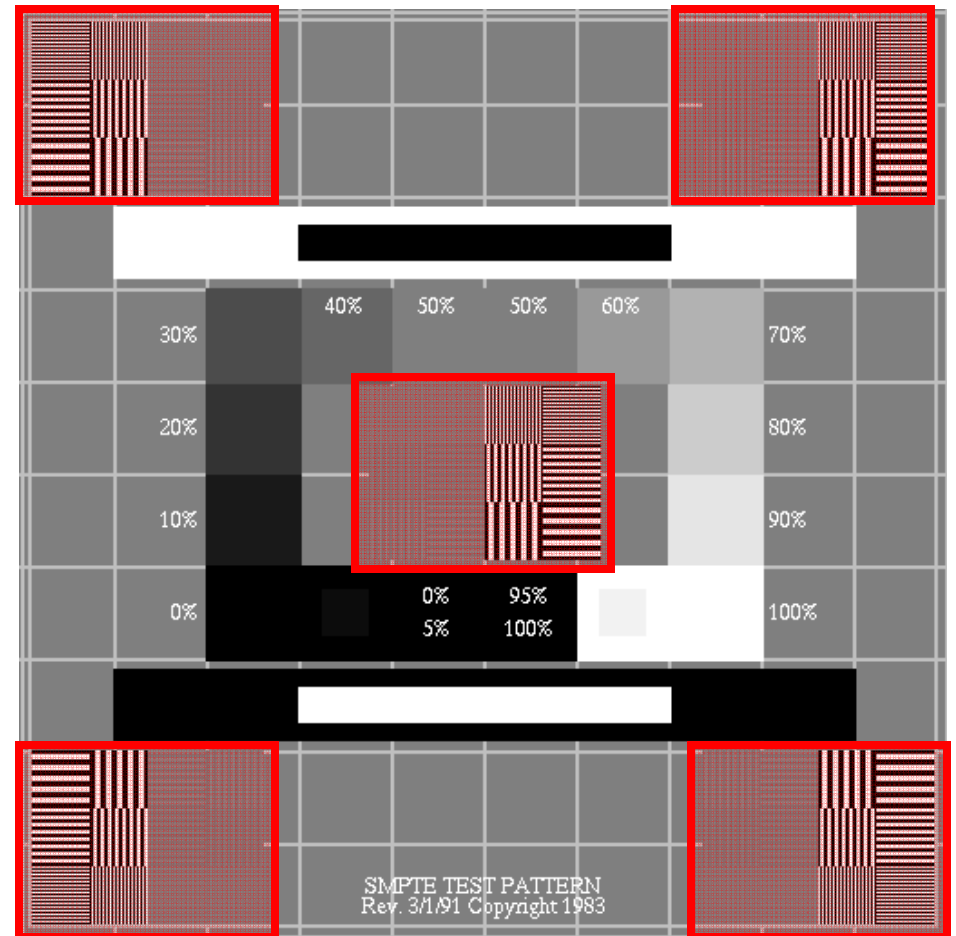


# A Qualitative Inspection of the SMPTE Test Pattern Analysis

## High and Low Contrast Evaluation

- The low and high contrast bars in the center and all 4 corners of the image should be visible.

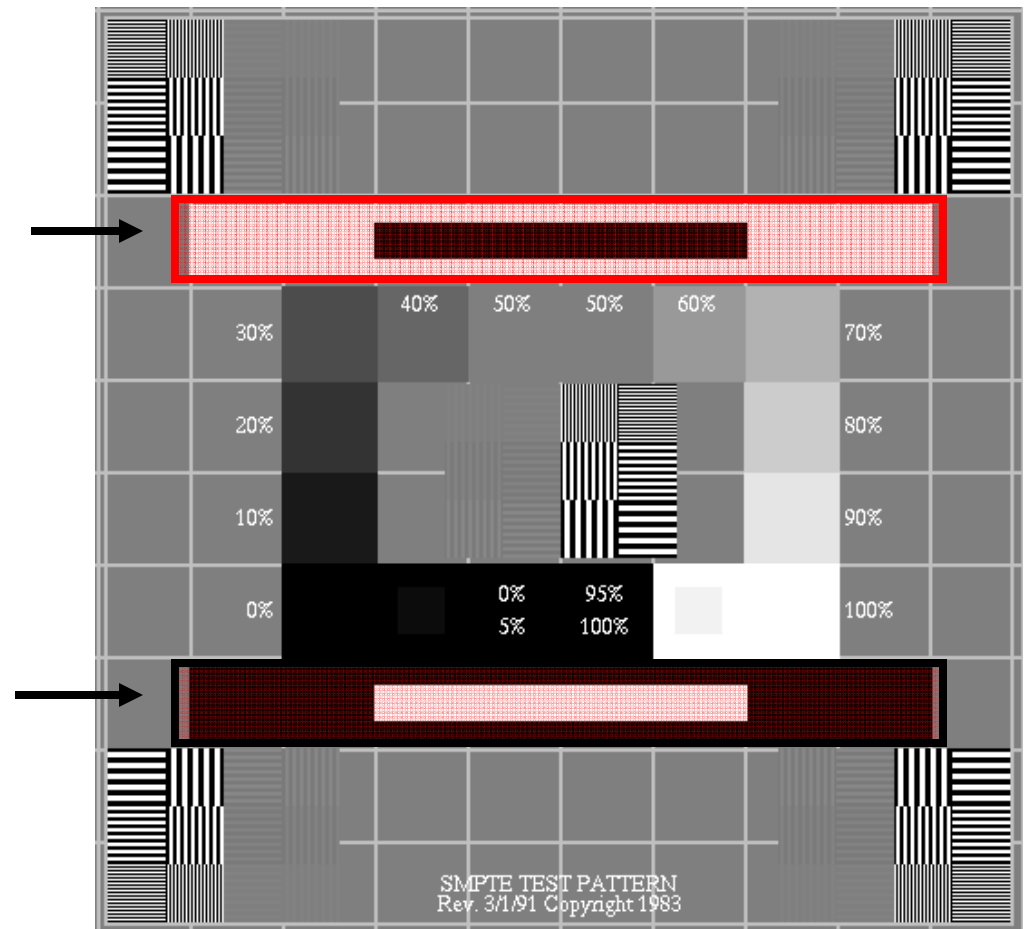
\*Note the presence of aliasing or other display artifacts



# A Qualitative Inspection of the SMPTE Test Pattern Analysis

## Max and Min Brightness Edge

- Sharp edges should be seen between the minimum and maximum gray values
  - Implies that there is optimal spatial resolution between objects of high and low contrast



# A Quantitative Evaluation of the SMPTE Test Pattern Analysis

## Measure Ambient Light

1. Turn off all monitors
2. Set room lighting as clinically used
3. Hold the light meter perpendicular to the monitor from approximately where the Radiologist sits
4. Record readings for both the right and left monitors

\*These values are factored into the final pass/fail criteria



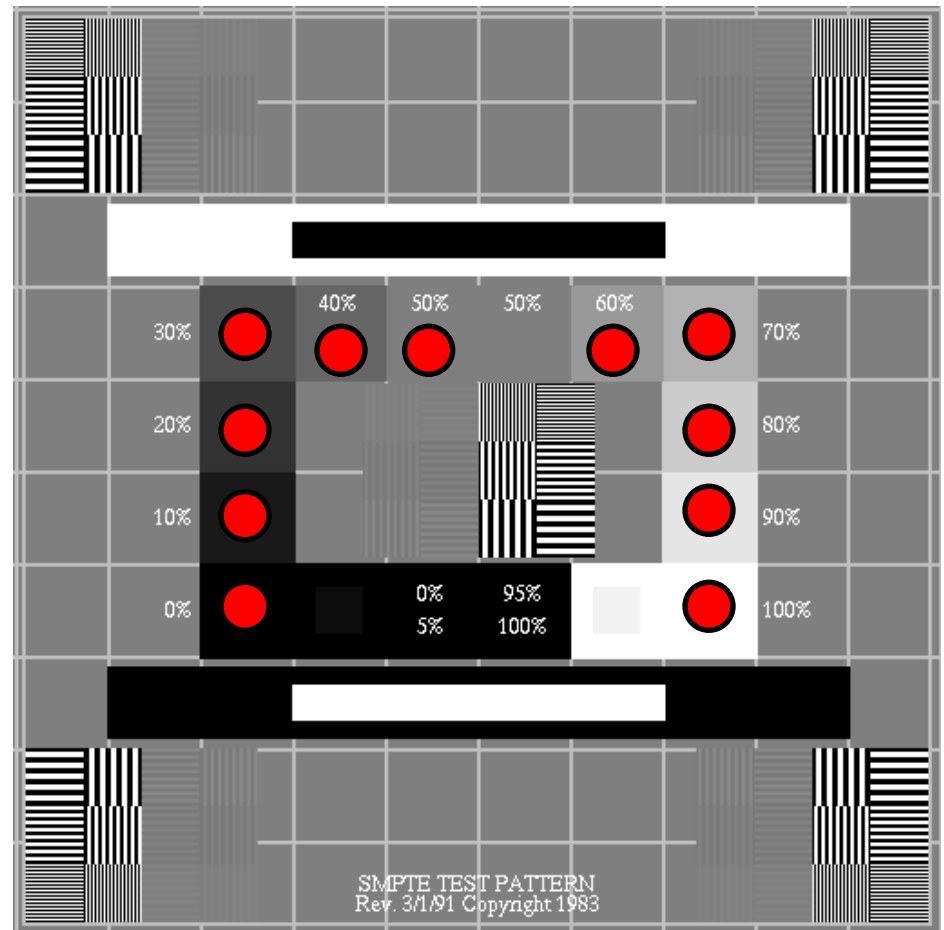


# A Quantitative Evaluation of the SMPTE Test Pattern Analysis

Measure 0% to 100% luminance in candelas per meter squared (cd/m<sup>2</sup>)

1. Use a calibrated Unfors light meter to take luminance readings of all grayscale values
2. Fit the data to a curve of JND vs. the Monitor Contrast Response

Tolerances: The values must be within 10% of the GSDF Contrast Response per JND (graph provided in report)

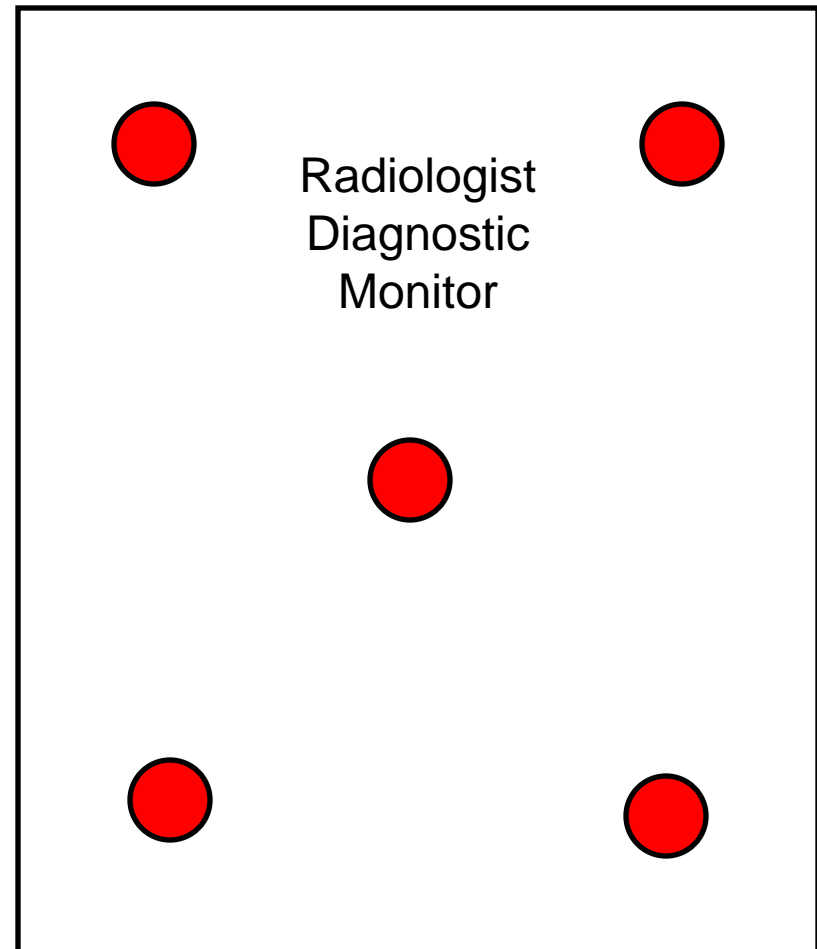


# Maximum Monitor Luminance ( $L_{100}$ )

- The maximum luminance measurements of each PDM are taken using an Unfors light meter in the center and all 4 corners
  - Measurement locations are indicated by the circles

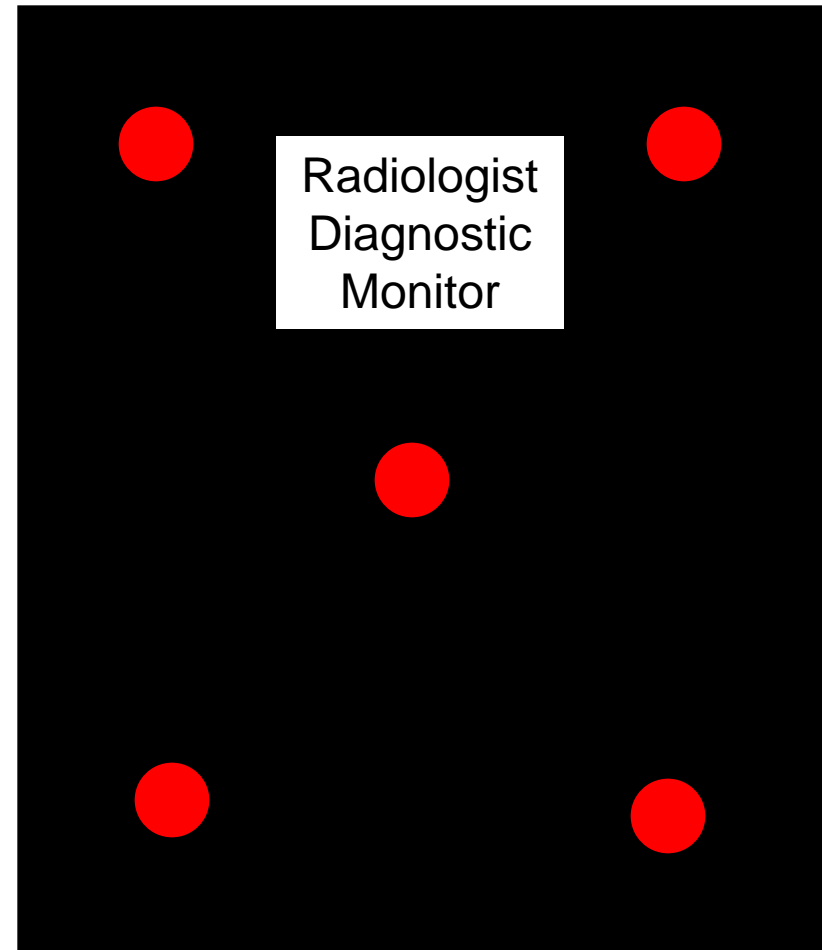
## Tolerances:

1. Maximum luminance should be greater than  $171\text{cd/m}^2$
2. The percent variation of all 5 measurements should be no more than 30%
3. The percent variation between the 2 monitors should be no more than 10%



# Minimum Monitor Luminance ( $L_0$ )

- Minimum luminance measurements are taken using an Unfors light meter in the center and all 4 corners for each monitor
  - Measurement locations are indicated by the circles



# Monitor Luminance Ratio

- The maximum luminance is divided by the minimum luminance

$$\underline{\text{Luminance Ratio}} (L_R) = (L_{100}) / (L_0)$$

## Tolerance:

- Luminance Ratio should be greater than 250

# References

1. **Digital Imaging and Communications in Medicine (DICOM) Part 14: Grayscale Standard Display Function**, *Published by National Electrical Manufacturers Association* 1300 N. 17th Street Rosslyn, Virginia 22209 USA
2. **ACR TECHNICAL STANDARD FOR ELECTRONIC PRACTICE OF MEDICAL IMAGING** 2007 (Res. 13), Effective 10/01/07
3. **ASSESSMENT OF DISPLAY PERFORMANCE FOR MEDICAL IMAGING SYSTEMS**, © 2005 by American Association of Physicists in Medicine One Physics Ellipse College Park, MD 20740-3846