

Technical Performance Assessment of Digital Pathology Whole Slide Imaging Devices

Draft Guidance for Industry and Food and Drug Administration Staff

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<https://federalregister.gov/a/2015-03843>

This draft guidance is not final nor is it in effect at this time.

<http://www.fda.gov/ucm/groups/fdagov-public/@fdagov-meddev-gen/documents/document/ucm435355.pdf>

Colour assessment of Whole Slide Imaging Systems

- System-level Assessment
 - A system-level test can be designed for the image acquisition subsystem, the image display subsystem, or a combination of both
 - The goal of system-level tests is to assess the composite performance of a series of consecutive components in the imaging chain
 - System-level tests should be conducted when the component-level tests are either unfeasible or unable to capture the interplay between components
- Designing such a system-level test typically involves the following steps:
 - 1) define the scope of the system and its input and output,
 - 2) define the input, which in most cases is a test target or phantom, [Sierra slide or similar]
 - 3) measure the input to establish the ground truth that would be generated by an ideal system,
 - 4) measure the output of the system under test, and
 - 5) calculate the errors between the truth and the output with a quantitative metric.

Colour Reproducibility

- Color reproducibility is one of the key characteristics of a WSI system and cannot be evaluated at the component level
 - The goal of this system-level test is to measure the color differences between the input color stimuli and the output digital image file
 - This test also evaluates the tone reproduction curve (i.e., gamma curve) of the WSI system

NOTE Colour **can** be evaluated in two steps: *capture to image file* and *image file to display*

Acquisition phase (capture - digital image file)

- Input color patches: use transparent test patterns similar to ColorChecker
- Ground truth:
 - Measure the color coordinates of each color patch in CIEXYZ with a colorimeter or a spectroradiometer [illuminated by standard source yet to be defined]
 - Repeat the same measurement for the reference white [to be defined]
 - Calculate the CIELAB values
- Output digital image file:
 - Each pixel consists of the red, green, and blue (RGB) values in a default color space such as the sRGB or AdobeRGB [or image including an ICC Profile]
 - Convert the RGB values into CIEXYZ based on the default color space
 - Convert the CIEXYZ values into the CIELAB color space
 - Choose a region of interest with at least 100 pixels and calculate the average CIELAB value
- Calculate the color differences with the delta-E 2000 formula

Display phase (digital image file - display)

- Input color patches: set of representative colors such as ColorChecker
- Ground truth:
 - Obtain the CIELAB values of each color patch [from image RGB + ICC Profile or default colour space]
- Output color stimuli:
 - For each color patch, convert the CIELAB values into the device RGB space based on the color profile or the default color space of the workstation, which includes the image review manipulation software, computer environment, and display
 - Create an image file that consists of the color patches
 - Show the image with the workstation
 - Use a colorimeter or a spectroradiometer to measure the color coordinates of each color patch and record the color coordinates in CIEXYZ
 - Repeat the same measurement for the white point (255,255,255)
 - Calculate the CIELAB values
- Calculate the color differences with the delta-E 2000 formula

Other tests / reporting requirements

- Slide Feeder
- Light Source
- Imaging Optics
- Mechanical Scanner Movement
- Digital Imaging Sensor
- Image Processing Software
- Image Composition
- Image Files Formats
- Image Review Manipulation Software
- Computer Environment
- Display
- Spatial Resolution
- Focusing Test
- Stitching Error
- User Interface
- Labeling
- Quality Control

Tests related to colour assessment in red

ICC MIWG comments to be submitted to FDA by May 26 2015

Although you can comment on any guidance at any time (see [21 CFR 10.115\(g\)\(5\)](#)), to ensure that the Agency considers your comment of this draft guidance before it begins work on the final version of the guidance, submit either electronic or written comments on the draft guidance by May 26, 2015.

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Possible errors in references (not confirmed)

- ISO 8039:1997 (page 6)
 - Has been revised twice since 1997 and the updated version is **ISO 8039:2014**
 - The 1997 version is no longer available
- ISO 230-2:2006 (page 8)
 - Has been revised since 2006 and the updated version is **ISO 230-2:2014**
 - The 2006 version is no longer available
- ISO 15739:2003 (page 9)
 - Probably an error in the guidance document as there was no 2003 revision
 - Probably this should be **ISO 15739:2013**
- ISO 15229:2007 (page 16)
 - Probably an error in the guidance document and should be ISO 15529:2007
 - This has been replaced by **ISO 15529:2010** and the 2007 version is not available