DICOM Correction Item

Correction Number	CP 705
Log Summary: ICC profiles for Basic Color Print	
Type of Modification Addition	Name of Standard PS 3.3, 3.4 2007
Rationale for Correction When ICC input profiles were added to images and presentation states to describe the actual or hypothetical color space in which image pixel or color LUT data is encoded, there was no corresponding capability added for Basic Color Print. This correction adds an ICC Profile attribute at the film box level, intended to describe the input color space of the N-SET pixel data in all image boxes in that film box; this allows the print SCP to perform any color space management at its discretion. No mechanism to communicate an output ICC profile is provided … it is not the intent to manage printer calibration.	
Sections of documents affected PS 3.3 C.13.3 PS 3.4 H.4.2.2.1, H.4.2.2.2, H.4.3.2	
Correction Wording:	

C.11.15 ICC Profile Module

Table C.11.15-1 contains Attributes that identify and describe an ICC Profile.

Table C.11.15-1
ICC PROFILE MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
ICC Profile	(0028,2000)	1	An ICC Profile encoding the transformation of device-dependent color stored pixel values into PCS-Values.

C.11.15.1 Attribute descriptions

C.11.15.1.1 ICC Profile

The ICC Profile (0028,2000) Attribute encodes an ICC Input Device Profile that encodes the transformation of device-dependent color stored pixel values into PCS-Values.

Notes: 1. Only Input Device profiles are encoded, since display and output device profiles are not interchanged in DICOM, though they may be used internally within display and output devices, for example when they are calibrated.

2. Since the version of the ICC Profile is encoded within the profile itself, no additional version information is encoded in the ICC Profile Module.

The following constraints on the encoding of the ICC Profile shall be observed:

- The profile shall be of the Input Device class, i.e., header bytes 12 through15, Profile Device/Class Signature, shall be “scnr”

- The color space of the input shall be RGB, i.e., header bytes 16 through 19, Color Space Signature, shall be “RGB”, regardless of the Photometric Interpretation of the image pixel data prior to decompression

- PCS shall be CIELab or CIEXYZ, i.e., header bytes 20 through 23, Profile Connection Space, shall be either “Lab” or “XYZ”.

Notes: 1. In the case of a PCS of CIELab, the profile will contain an N-component LUT-based AtoB0Tag, since three-component matrix based transformations are only possible with a PCS of CIEXYZ. A three-component matrix based transformation might be used to define a well-known rather than device-specific profile for such spaces as sRGB.

2. Selection of a PCS of CIELab or CIEXYZ within the ICC profile does not impact the DICOM encoding, since all color management systems support both.

The following constraints on the encoding of the ICC Profile are recommended:

- The Rendering Intent should be Perceptual.

Notes: 1. The rendering intent specifies how rendering will take place when the ICC Input Profile is linked with another Profile for the purpose of display.

2. A perceptual rendering intent implies that AtoB0Tag and BtoA0Tag tags will be present in the profile. The AtoB0Tag allows mapping from the input values to the PCS. The BtoA0Tag allows mapping from the PCS to the input values, though this is not required for the color rendering pipeline defined in PS 3.4.

- All LUTs should be represented as 16 bit values, using tag type lut16Type, for greater precision.
- The chromaticAdaptationTag should be set if the actual illumination source is not D50.

Note: See the discussion of white point in PS 3.4.

C.13.3 Basic Film Box Presentation Module

Table C.13-3
BASIC FILM BOX PRESENTATION MODULE ATTRIBUTES

Attribute Name	Tag	Attribute Description
…	…	…
Reflected Ambient Light	(2010,0160)	For transmissive film, luminance contribution due to reflected ambient light. Expressed as L_a, in candelas per square meter (cd/m^2).
Requested Resolution ID	(2020,0050)	Specifies the resolution at which images in this Film Box are to be printed. Defined Terms: STANDARD = approximately 4k x 5k printable pixels on a 14 x 17 inch film HIGH = Approximately twice the resolution of STANDARD.

ICC Profile	**(0028,2000)**	**An ICC Profile encoding the transformation of device-dependent color stored pixel values into PCS-Values. See C.11.5.** **Note. This is an Input Device Profile that describes the characteristics of the pixel data in the film box, not an Output Device Profile that might describe the characteristics of the Print SCP.**

H.4.2 Basic Film Box SOP Class

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H.4.2.2.1 N-CREATE

The N-CREATE is used to create an instance of the Basic Film Box SOP Class.

H.4.2.2.1.1 Attributes

The Attribute list of the N-CREATE is shown in Table H.4-6.

Table H.4-6
N-CREATE ATTRIBUTE LIST

Attribute Name	Tag	Usage SCU/SCP
…	…	…
Reflected Ambient Light	(2010,0160)	U/MC (Required if Presentation LUT is supported)
Requested Resolution ID	(2020,0050)	U/U
ICC Profile	**(0028,2000)**	**U/U**

The meaning of the Usage SCU/SCP is described in Section H.2.4.

If the Illumination (2010,015E) and Reflected Ambient Light (2010,0160) values, respectively termed L_0 and L_a, are not created, the following default values are recommended **for grayscale printing**:

For transmissive film: $L_0 = 2000$ cd/m^2.
$L_a = 10$ cd/m^2.
For reflective media: $L_0 = 150$ cd/m^2.

The ICC Profile (0028,2000) attribute shall only be used to describe the color space of images for color printing, i.e., in conjunction with the Basic Color Image Box SOP Class. It shall not be used with the Basic Grayscale Image Box SOP Class.

H.4.2.2.1.2 Status

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H.4.2.2.1.3 Behavior

The SCU uses the N-CREATE to request the SCP to create a Basic Film Box SOP Instance. The SCU shall initialize Attributes of the SOP Class as specified in Section H.2.4.

The SCP shall create the SOP Instance and shall initialize Attributes of the SOP Class as specified in Section H.2.4.

Note: If there exists a Film Box SOP Instance that has not been printed and the SCP does not support N-ACTION on the Film Session, then the SCP should fail the N-CREATE of the new SOP Instance.

Upon the creation of the Basic Film Box SOP Instance, the SCP shall append the SOP Class/Instance UID pair of the created Basic Film Box SOP Instance to the Attribute Referenced Film Box Sequence (2000,0500) of the parent Basic Film Session SOP Instance to link the Basic Film Box SOP Instance to the Basic Film Session SOP Instance.

The SCP shall create Image Box SOP Instances of the appropriate Image Box SOP Class for each image box as defined by the Attribute Image Display Format (2010,0010). The SOP Class of the created Image Box SOP Instance depends on the Meta SOP Class context. For example the Grayscale Image Box SOP Class is related to the Basic Grayscale Print Management Meta SOP Class. The Meta SOP Class context is conveyed by the Presentation Context ID that corresponds with the Meta SOP Class and is defined at Association setup.

The SCP shall append the SOP Class/Instance UID pair of the created Image Box SOP Instance to the Referenced Image Box Sequence Attribute of the parent Basic Film Box SOP Instance to link each Image Box SOP Instance to the Basic Film Box SOP Instance. The SCP returns the list of Image Box SOP Class/Instance UID pairs in the Attribute Referenced Image Box Sequence (2010,0510) of the N-CREATE response message.

If supported, the SCP shall create Basic Annotation Box SOP Instances for each Annotation Box defined by the Attribute Annotation Display Format ID and shall append the SOP Class/Instance UID pair of the created Basic Annotation Box SOP Instance to the Referenced Annotation Box Sequence Attribute of the parent Basic Film Box SOP Instance to link each Basic Annotation Box SOP Instance to the Basic Film Box SOP Instance. The SCP returns the list of Basic Annotation Box SOP Class/Instance UID pairs in the Attribute Referenced Annotation Box Sequence of the N-CREATE response message. The Annotation Boxes shall support the same character sets as the Basic Film Box.

The character set supported by the Film Box shall be the same as the character set of the Basic Film Session.

The SCP shall return the status code of the requested SOP Instance creation. The meaning of success, warning, and failure status codes is defined in Section H.2.5.

H.4.2.2.2 N-SET

The N-SET may be used to update the last created instance of the Basic Film Box SOP Class.

H.4.2.2.2.1 Attributes

The Attributes which may be updated are shown in Table H.4-7.

Table H.4-7
N-SET ATTRIBUTES

Attribute Name	Tag	Usage SCU/SCP

…	…	…
Reflected Ambient Light	(2010,0160)	U/MC (Required if Presentation LUT is supported)
ICC Profile		**U/U**

The meaning of the Usage SCU/SCP is described in Section H.2.4.

H.4.2.2.2.2 Status

The status values which are specific for this SOP Class are defined in H.4.2.2.1.2.

H.4.2.2.2.3 Behavior

The SCU uses the N-SET to request the SCP to update a Basic Film Box SOP Instance. The SCU shall only specify the SOP Instance UID of the last created Basic Film Box SOP Instance in the N-SET request primitive, and shall specify the list of Attributes for which the Attribute Values are to be set.

The SCP shall set new values for the specified Attributes of the specified SOP Instance.

The SCP shall return the status code of the requested SOP Instance update. The meaning of success, warning, and failure status codes is defined in Section H.2.5.

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H.4.3.2 Basic Color Image Box SOP Class

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H.4.3.2.2.1 N-SET

The N-SET may be used to update an instance of the Basic Color Image Box SOP Class.

H.4.3.2.2.1.1 Attributes

The Attributes which may be updated are shown in Table H.4-11.

The meaning of the Usage SCU/SCP is described in Section H.2.4.

The values of Magnification Type (2010,0060) and Smoothing Type (2010,0080) of a particular image box override the values of Magnification Type and Smoothing Type of the film box.

Table H.4-11
N-SET ATTRIBUTES

Attribute Name	Tag	Usage SCU/SCP
Image Position	(2020,0010)	M/M
Basic Color Image Sequence	(2020,0111)	M/M
>Samples Per Pixel	(0028,0002)	M/M
>Photometric Interpretation	(0028,0004)	M/M
>Planar Configuration	(0028,0006)	M/M
>Rows	(0028,0010)	M/M
>Columns	(0028,0011)	M/M
>Pixel Aspect Ratio	(0028,0034)	MC/M

		(Required if the aspect ration is not 1\1))
>Bits Allocated	(0028,0100)	M/M
>Bits Stored	(0028,0101)	M/M
>High Bit	(0028,0102)	M/M
>Pixel Representation	(0028,0103)	M/M
>Pixel Data	(7FE0,0010)	M/M
Polarity	(2020,0020)	U/M
Magnification Type	(2010,0060)	U/U
Smoothing Type	(2010,0080)	U/U
Requested Image Size	(2020,0030)	U/U
Requested Decimate/Crop Behavior	(2020,0040)	U/U

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H.4.3.2.2.1.3 Behavior

The SCU uses the N-SET to request the SCP to update a Basic Color Image Box SOP Instance. The SCU shall only specify the SOP Instance UID of a Basic Color Image Box belonging to the last created Film Box SOP Instance and shall specify the list of Attributes for which the Attribute Values are to be set.

To instruct the SCP to erase the image in the image position, the SCU shall set a zero length and no value in the Attribute Basic Color Image Sequence (2020,0111).

The SCP shall set new values for the specified Attributes of the specified SOP Instance.

Note: The image in this N-SET supersedes any image previously set in the Image Box.

The SCP shall return the status code of the requested SOP Instance update. The meaning of success, warning, and failure status codes is defined in Section H.2.5.

If Requested Decimate/Crop Behavior (2020,0040) specifies DECIMATE, Magnification Type (2010,0060) specifies NONE, and the image is too large to fit the Image Box, the SCP shall fail the N-SET.

The color characteristics of the Pixel Data (7FE0,0010) in the Basic Color Image Box may be described by an ICC Input Device Profile specified in the Film Box, in which case the same profile shall apply to all the Image Boxes in the same Film Box. See H.4.2.2.1 and H.4.2.2.2.