

1	Status	Final Text
2	Date of Last Update	2023/01/19
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7	Submission Date	2022/06/03

8	Correction Number CP-2237	
9	Log Summary: Propagate VOI and Palette Color support from blending to advanced blending presentation state	
10	Name of Standard	
11	PS3.3, PS3.4 2022e	
12	Rationale for Correction:	
13	The Advanced Blending Presentation State introduced in Sup 189 failed to include key features of the Blending Presentation State, including definition of grayscale transformations and application of palette color LUTs, as defined for the blending pipeline in PS3.4. This greatly limits its utility for sources that are single channel (grayscale structural or parametric).	
14		
15		
16	Add the Softcopy VOI LUT Sequence and the Palette Color Lookup Table Sequence within each Item of the Advanced Blending Sequence, and clarify the PS3.4 text regarding grayscale processing and pseudo-coloring.	
17		
18	The windowing operation is necessary since its effect is that pixels values below the window and above the window are treated as though they were the same as the low and high values of the window, respectively, i.e., the pixels are still displayed. This is distinct from the threshold operation that excludes pixels entirely (renders them transparently) if they are outside the threshold.	
19		
20		
21	The existing thresholding and new windowing operations are not mutually exclusive, since the former may be used for region exclusion (using a pixel padding value) as opposed to contrast adjustment.	
22		
23	The additional information is specified in the Advanced Blending Presentation State Module, rather than the Advanced Blending Presentation State Display Module, because it describes the transformation of the input, which is then referenced in the blending operation for display.	
24		
25		
26	This pattern is also consistent with that used in the Pseudo-Color Softcopy Presentation State IOD.	
27	The new Attributes are added as Type 1C rather than 3, since they have behavioral implications and need to be supported by display SCPs if present; to our knowledge adoption of this recently added SOP class has been limited so this should not break any implementations.	
28		
29		
30	This CP depends on CP 2236 "Need to be able to select optical path in advanced blending presentation state", since different VOI and Palette Color LUTs may be applicable to different optical paths in the same image.	
31		
32	Correction Wording:	

Amend DICOM PS3.3 as follows (changes to existing text are bold and underlined for additions and ~~struckthrough~~ for removals):

A.33.7 Advanced Blending Presentation State IOD

A.33.7.1 Advanced Blending Presentation State IOD Description

The Advanced Blending Presentation State Information Object Definition (IOD) specifies information that may be used to blend two or more sets of grayscale or color images that are referenced from within the IOD for the purpose of presentation (display) as a color image.

It includes capabilities for specifying:

- a. output color space in PCS-Values
- b. optional thresholds to restrict contributing areas of an input
- c. optional windowing (VOI LUT) to be applied to grayscale images before pseudo-colorization
- d. optional pseudo-color palette to be applied to grayscale images
- e. definition of blending control values for the different inputs
- f. selection of the area of the output images to display and whether to rotate or flip it
- g. image and display relative annotations, including graphics, text and overlays

C.11.33 Advanced Blending Presentation State Module

Table C.11.33-1 specifies the Attributes of the Advanced Blending Presentation State Module, which describe one or more inputs optionally one or more sets of registration objects, and the color, grayscale transformations and thresholds to be applied to them, for the purpose of blending.

Table C.11.33-1. Advanced Blending Presentation State Module Attributes

Attribute Name	Tag	Type	Attribute Description
Advanced Blending Sequence	(0070,1B01)	1	A Sequence of Items identifying the inputs and describing transformations of them. One or more Items shall be included in this Sequence. See Section C.11.33.1.1.
>Blending Input Number	(0070,1B02)	1	Identification number of the input. Values shall be ordinal numbers starting from 1 and monotonically increasing by 1 within the Advanced Blending Presentation State Instance.
>Study Instance UID	(0020,000D)	1	Unique identifier for the Study.
>Series Instance UID	(0020,000E)	1	Unique identifier of a Series that is part of the Study defined by the Study Instance UID (0020,000D)
>Referenced Image Sequence	(0008,1140)	1C	The set of images comprising this input. One or more Items shall be included in this Sequence. Required if the input is not the entire set of Instances in the Series.
>>Include Table 10-3 "Image SOP Instance Reference Macro Attributes"			

Attribute Name	Tag	Type	Attribute Description
>>Referenced Optical Path Identifier	(006A,000E)	1C	<p>A single value that identifies the optical path that is the input.</p> <p>Refers to the value in Optical Path Identifier (0048,0106) within the Optical Path Sequence (0048,0105) in the images to which this Presentation State applies.</p> <p>Required if there is more than one Optical Path in the images to which this Presentation State applies.</p>
>Referenced Spatial Registration Sequence	(0070,0404)	1C	<p>A reference to a Spatial Registration Instance that is used to register the referenced inputs.</p> <p>Only one Item shall be included in this Sequence.</p> <p>Required if the Frame of Reference UID (0020,0052) value of the Images referenced by the Referenced Image Sequence (0008,1140) of this Item does not match the Frame of Reference UID (0020,0052) value of this Presentation State Instance. May be present otherwise.</p>
>>Include Table C.17-3 "Hierarchical SOP Instance Reference Macro Attributes"			
>Include Table C.11.33.1-1 "Threshold Sequence Macro Attributes"			
>Softcopy VOI LUT Sequence	(0028,3110)	1C	<p>Defines a Sequence of VOI LUTs or Window Centers and Widths and to which images and frames they apply.</p> <p>No more than one VOI LUT Sequence containing a single Item or one pair of Window Center/Width values shall be specified for each image or frame.</p> <p>One or more Items shall be included in this Sequence.</p> <p>Required if a VOI LUT is to be applied to referenced image(s) and the Threshold Sequence (0070,1B11) is not present. May be present otherwise if the referenced image(s) are grayscale.</p>
>>Referenced Image Sequence	(0008,1140)	1C	<p>Sequence of Items identifying images and optical paths that are defined in the enclosing Item of Advanced Blending Sequence (0070,1B01), to which this VOI LUT or Window Center and Width applies.</p> <p>One or more Items shall be included in this Sequence.</p> <p>Required if the VOI LUT transformation in this Item does not apply to all the images and frames and optical paths listed in the enclosing Item.</p>
>>>Include Table 10-3 "Image SOP Instance Reference Macro Attributes"			
>>>Referenced Optical Path Identifier	(006A,000E)	1C	<p>A single value that identifies the optical path that is the input.</p> <p>Refers to the value in Optical Path Identifier (0048,0106) within the Optical Path Sequence (0048,0105) in the images to which this Presentation State applies.</p> <p>Required if there is more than one Optical Path in the images to which the this reference applies.</p>
>>Include Table C.11-2b "VOI LUT Macro Attributes"			

Attribute Name	Tag	Type	Attribute Description
>Palette Color Lookup Table Sequence	(0048,0120)	1C	<p><u>For grayscale input images, provides a transform of the pixel values into an RGB color representation.</u></p> <p><u>Only a single Item is permitted in this Sequence.</u></p> <p><u>Required if the input is a grayscale image and a palette color transformation is to be applied rather than the default transformation to equal RGB values. See Section N.2.6 “Advanced Blending Transformations” in PS3.4 .</u></p>
<u>>>Include Table C.7-22a “Palette Color Lookup Table Macro Attributes”</u>			
>Time Series Blending	(0070,1B07)	1C	<p>Whether this Series is a time series and every time point in this Series will be blended with the single volumes in the other Series specified in the Advanced Blending Sequence (0070,1B01).</p> <p>Enumerated Values:</p> <p>TRUE FALSE</p> <p>Only a single Item in the Sequence may have the value TRUE</p> <p>Required if the input is a Time Series and all time points need to be blended with the other Series. May be present otherwise</p>
>Geometry for Display	(0070,1B08)	1C	<p>Whether the geometry of this Series is used as the geometry for the blending operation.</p> <p>See Section C.11.33.1.1.</p> <p>Enumerated Values:</p> <p>TRUE FALSE</p> <p>Only a single Item in the Sequence may have the value TRUE</p> <p>Required if the geometry of this input is to be used as the geometry for the blending operation. May be present otherwise.</p>

C.11.33.1 Advanced Blending Presentation State Module Attributes

C.11.33.1.1 Advanced Blending Sequence

The images to be blended are specified in the Advanced Blending Sequence (0070,1B01).

Geometry refers to the following Attributes:

- Number of Frames (0028,0008)
- Rows (0028,0010)
- Columns (0028,0011)
- Pixel Aspect Ratio (0028,0034)
- Imager Pixel Spacing (0018,1164) (if applicable)
- Nominal Scanned Pixel Spacing (0018,2010) (if applicable)

1 • Slice Thickness (0018,0050)

2 • Spacing Between Slices (0018,0088)

3 The geometry of the output images shall match the geometry of the input specified as having the Geometry for Display (0070,1B08)
4 as TRUE. If no input has Geometry for Display (0070,1B08) equal TRUE then the application shall choose which geometry to use.

5 If all inputs do not have the same frames, resolution, etc., the application determines the appropriate pixels to be blended. This implies
6 that the blending result may vary between different applications. If consistent blending results are desired the inputs should be resampled
7 in advance such that they have the same frames, resolution, etc.

8 This Module specifies no explicit relationship (such as pairing or ordering) between the sets of images and frames defined in the Se-
9 quence Attributes. This Module does not define how the images are spatially related, and what re-sampling, if any, needs to be performed
10 before the images are blended for rendering.

11 It is expected that blending takes place between pixels at the same position in space.

12 The images in the image sets may share the same Frame of Reference, in which case the rendering application can spatially relate
13 the image sets based on their Image Position (Patient) (0020,0032) and Image Orientation (Patient) (0020,0037) Attributes.

14 If a spatial registration object is included in the Advanced Blending Sequence (0070,1B01) it shall be applied to the referenced input
15 even if the Frame of Reference is the same, as small corrections might have taken place during post-processing.

16 If they are both missing the application will decide how to blend the inputs.

17 **Note**

18 The underlying image for a superimposed segmentation image need not be the source image for the segmentation.

19 **C.11.33.1.2 Threshold Sequence Macro**

20 The Threshold Sequence is defining the values of the image that are used or ignored.

21 **Table C.11.33.1-1. Threshold Sequence Macro Attributes**

Attribute Name	Tag	Type	Attribute Description
Threshold Sequence	(0070,1B11)	1C	Threshold specification for the image One or more Items shall be included in this Sequence. Required if Threshold needs to be applied <u>and the Softcopy VOI LUT Sequence (0028,3110) is not present. May be present otherwise if Threshold needs to be applied.</u>
>Threshold Type	(0070,1B13)	1	Type of threshold comparison used to determine the presence of a pixel value in the output. See Section C.11.33.1.2.1.
>Threshold Value Sequence	(0070,1B12)	1	Values for thresholding. If the Threshold Type (0070,1B13) is GREATER_OR_EQUAL, LESS_OR_EQUAL, GREATER_THAN or LESS_THAN only a single Item shall be included in this Sequence. If the Threshold Type (0070,1B13) is RANGE_INCL or RANGE_EXCL, exactly two Items shall be included in this Sequence, the first of which is less than or equal to the second.

Attribute Name	Tag	Type	Attribute Description
>>Threshold Value	(0070,1B14)	1	Value for the threshold. See Section C.11.33.1.2.1. Note VR of Threshold Value is FD and if this is different than the VR of the pixels then format conversion is needed.

C.11.33.1.2.1 Threshold

The Threshold Type (0070,1B13) defines the pixel values that will be shown. Values that are not inside any of the specified Threshold Sequence (0070,1B11) Items shall be treated as padding pixels.

To describe a threshold that consists of more than one range, multiple Items are specified in the Threshold Sequence (0070,1B11) Items.

When more than one Item is specified in the Threshold Sequence (0070,1B11) the pixel shall be shown if any Item specifies that the pixel shall be shown.

The number of Items in the Threshold Value Sequence (0070,1B12) and the use of Threshold Value (0070,1B14) depends on the value of the Threshold Type (0070,1B13) as follows:

Enumerated Values for Threshold Type (0070,1B13):

RANGE_INCL	A pixel value shall be shown when the value lies between the specified values or is equal to one of the specified values.
RANGE_EXCL	A pixel value shall be shown when the value lies outside (i.e. not between) the specified values.
GREATER_OR_EQUAL	A pixel value shall be shown when the value is greater than or equal to the specified value.
LESS_OR_EQUAL	A pixel value shall be shown when the value is less than or equal to the specified value.
GREATER_THAN	A pixel value shall be shown when the value is greater than the specified value.
LESS_THAN	A pixel value shall be shown when the value is less than the specified value.

DICOM PS3.3 for reference unchanged:

C.11.34 Advanced Blending Presentation State Display Module

The Advanced Blending Presentation State Display Module specifies the input and the method used for each blending step.

Table C.11.34.1-1. Advanced Blending Presentation State Display Module Attributes

Attribute Name	Tag	Type	Attribute Description
Pixel Presentation	(0008,9205)	1	Grayscale or color space of the Presentation State output. Enumerated Values: TRUE_COLOR Output consists of PCS-Values

Attribute Name	Tag	Type	Attribute Description
Blending Display Sequence	(0070,1B04)	1	The blending operations and the input series to be used. Each Item results in a single RGB output that may be reused in a following step. One or more Items shall be included in this Sequence. Note The order of operations is determined by the specified Blending Input Number (0070,1B02) for each blending step. The displayed output will be the result of the blending step that is not assigned a Blending Input Number (0070,1B02)
>Blending Display Input Sequence	(0070,1B03)	1	Each Item is an input series that will be used in the blending operation. The order of Items is significant Two Items shall be included if the blending mode is FOREGROUND. One or more Items shall be included if the blending mode is EQUAL.
>>Blending Input Number	(0070,1B02)	1	Identification number of the input series to which the Blending information must be applied.
>Relative Opacity	(0070,0403)	1C	Specifies Relative Opacity for the visible pixels of the set referenced by the first Blending Input Number (0070,1B02) Required if Blending Mode (0070,1B06) is equal to FOREGROUND
>Blending Mode	(0070,1B06)	1	Describes the method for weighting the different input images during the blending operation: Enumerated Values: EQUAL BACKGROUND See Section N.2.6 in PS3.4.
>Blending Input Number	(0070,1B02)	1C	Identification of the result as input for a subsequent blending operation. Required if the result is used for further Blending. Note If this Attribute is not present the Item describes the final output of the blending process.

C.7.9 Palette Color Lookup Table Module

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Table C.7-22a. Palette Color Lookup Table Macro Attributes

Attribute Name	Tag	Type	Attribute Description
Red Palette Color Lookup Table Descriptor	(0028,1101)	1	Specifies the format of the Red Palette Color Lookup Table Data (0028,1201). See ??? for further explanation.
Green Palette Color Lookup Table Descriptor	(0028,1102)	1	Specifies the format of the Green Palette Color Lookup Table Data (0028,1202). See ??? for further explanation.
Blue Palette Color Lookup Table Descriptor	(0028,1103)	1	Specifies the format of the Blue Palette Color Lookup table Data (0028,1203). See ??? for further explanation.

Attribute Name	Tag	Type	Attribute Description
Palette Color Lookup Table UID	(0028,1199)	3	Palette Color Lookup Table UID. See ??? for further explanation.
Red Palette Color Lookup Table Data	(0028,1201)	1C	Red Palette Color Lookup Table Data. Required if segmented data is NOT used in an Image IOD or Color Palette IOD, or if the IOD is a Presentation State IOD. See ??? for further explanation.
Green Palette Color Lookup Table Data	(0028,1202)	1C	Green Palette Color Lookup Table Data. Required if segmented data is NOT used in an Image IOD or Color Palette IOD, or if the IOD is a Presentation State IOD. See ??? for further explanation.
Blue Palette Color Lookup Table Data	(0028,1203)	1C	Blue Palette Color Lookup Table Data. Required if segmented data is NOT used in an Image IOD or Color Palette IOD, or if the IOD is a Presentation State IOD. See ??? for further explanation.
Segmented Red Palette Color Lookup Table Data	(0028,1221)	1C	Segmented Red Palette Color Lookup Table Data. Required if segmented data is used in an Image IOD or Color Palette IOD; shall not be present in a Presentation State IOD. See ??? for further explanation.
Segmented Green Palette Color Lookup Table Data	(0028,1222)	1C	Segmented Green Palette Color Lookup Table Data. Required if segmented data is used in an Image IOD or Color Palette IOD; shall not be present in a Presentation State IOD See ??? for further explanation.
Segmented Blue Palette Color Lookup Table Data	(0028,1223)	1C	Segmented Blue Palette Color Lookup Table Data. Required if segmented data is used in an Image IOD or Color Palette IOD; shall not be present in a Presentation State IOD. See ??? for further explanation.

C.11.2 VOI LUT Module

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Table C.11-2b. VOI LUT Macro Attributes

Attribute Name	Tag	Type	Attribute Description
VOI LUT Sequence	(0028,3010)	1C	Defines a Sequence of VOI LUTs. One or more Items shall be included in this Sequence. Required if Window Center (0028,1050) is not present. May be present otherwise.
>LUT Descriptor	(0028,3002)	1	Specifies the format of the LUT Data in this Sequence. See ??? for further explanation.
>LUT Explanation	(0028,3003)	3	Free form text explanation of the meaning of the LUT.
>LUT Data	(0028,3006)	1	LUT Data in this Sequence.
Window Center	(0028,1050)	1C	Window Center for display. See ??? for further explanation. Required if VOI LUT Sequence (0028,3010) is not present. May be present otherwise.
Window Width	(0028,1051)	1C	Window Width for display. See ??? for further explanation. Required if Window Center (0028,1050) is present.
Window Center & Width Explanation	(0028,1055)	3	Free form explanation of the meaning of the Window Center and Width. Multiple values correspond to multiple Window Center and Width values.

Attribute Name	Tag	Type	Attribute Description
VOI LUT Function	(0028,1056)	3	<p>Describes a VOI LUT function to apply to the values of Window Center (0028,1050) and Window Width (0028,1051).</p> <p>See ??? for further explanation.</p> <p>Defined Terms:</p> <p>LINEAR LINEAR_EXACT SIGMOID</p> <p>When this Attribute is not present, the interpretation of the values of Window Center (0028,1050) and Window Width (0028,1051) is linear as in ???.</p>

10.3 Image SOP Instance Reference Macro

Table 10-3. Image SOP Instance Reference Macro Attributes

Attribute Name	Tag	Type	Attribute Description
<i>Include Table 10-11 "SOP Instance Reference Macro Attributes"</i>			
Referenced Frame Number	(0008,1160)	1C	<p>Identifies the frame numbers within the Referenced SOP Instance to which the reference applies. The first frame shall be denoted as frame number 1.</p> <p>Note</p> <p>This Attribute may be multi-valued.</p> <p>Required if the Referenced SOP Instance is a multi-frame image and the reference does not apply to all frames, and Referenced Segment Number (0062,000B) is not present.</p>
Referenced Segment Number	(0062,000B)	1C	<p>Identifies the Segment Number to which the reference applies.</p> <p>Required if the Referenced SOP Instance is a Segmentation or Surface Segmentation and the reference does not apply to all segments and Referenced Frame Number (0008,1160) is not present.</p>

10.8 SOP Instance Reference Macro

Table 10-11. SOP Instance Reference Macro Attributes

Attribute Name	Tag	Type	Attribute Description
Referenced SOP Class UID	(0008,1150)	1	Uniquely identifies the referenced SOP Class.
Referenced SOP Instance UID	(0008,1155)	1	Uniquely identifies the referenced SOP Instance.

C.17.2.1 Hierarchical SOP Instance Reference Macro

Table C.17-3. Hierarchical SOP Instance Reference Macro Attributes

Attribute Name	Tag	Type	Attribute Description
Study Instance UID	(0020,000D)	1	Unique identifier for the Study

Attribute Name	Tag	Type	Attribute Description
Referenced Series Sequence	(0008,1115)	1	Sequence of Items where each Item includes the Attributes of a Series containing referenced Composite Object(s). One or more Items shall be included in this Sequence
>Include Table C.17-3a "Hierarchical Series Reference Macro Attributes"			

Table C.17-3a. Hierarchical Series Reference Macro Attributes

Attribute Name	Tag	Type	Attribute Description
Series Instance UID	(0020,000E)	1	Unique identifier of a Series that is part of this Study and contains the referenced Composite Object(s).
...			
Referenced SOP Sequence	(0008,1199)	1	References to Composite Object SOP Class/SOP Instance pairs that are part of the Study defined by Study Instance UID and the Series defined by Series Instance UID (0020,000E). One or more Items shall be included in this Sequence.
>Include Table 10-11 "SOP Instance Reference Macro Attributes"			
...			

Amend DICOM PS3.4 as follows (changes to existing text are bold and underlined> for additions and ~~struckthrough~~ for removals):

N.2.4 Blending Transformations

The grayscale to color blending transformation model applies only to a pair of grayscale values, one of which is first mapped to color and then superimposed upon the other. The resulting values are device independent color PCS-Values. This process is illustrated in Figure N.2-3.

For the purpose of this section, pixels are referred to as stored pixel values and transformations are defined as point operations on these values. However, it is likely that pixels from either or both the superimposed and underlying image sets will have been spatially resampled and hence interpolated or replicated. Such operations do not affect the conceptual pipeline.

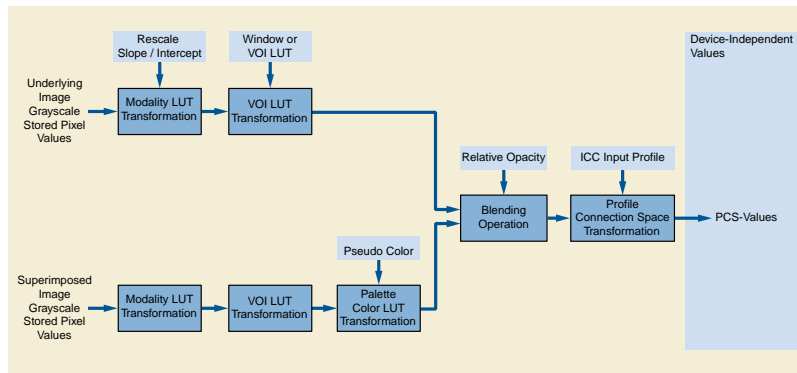


Figure N.2-3. Grayscale to Color Blending Transformation Model

N.2.4.1 Underlying Image Pixels

The Modality LUT and VOI LUT transformations are applied to the stored pixel values of the underlying image.

The output range of the VOI LUT transformation depends either on the width of the linear window or the range of output values of the LUT defined by the LUT Descriptor. Conceptually, for the purpose of describing the succeeding blending operation, the smallest pixel value from the range is mapped to 0.0 and the largest pixel value is mapped to 1.0 and all intermediate values are linearly mapped to the [0.0..1.0] interval.

N.2.4.2 Superimposed Image Pixels

The Modality LUT and VOI LUT transformations are applied to the stored pixel values of the superimposed image.

The full output range of the preceding VOI LUT transformation is implicitly scaled to the entire input range of the Palette Color LUT Transformation.

The output range of the RGB values in the Palette Color LUT Transformation depends on the range of output values of the LUT defined by the LUT Descriptors. Conceptually, for the purpose of describing the succeeding blending operation, a LUT entry of 0 is mapped to 0.0 and the largest LUT entry possible is mapped to 1.0 and all intermediate values are linearly mapped to the [0.0..1.0] interval.

Note

In practice, the Palette Color LUT output for the superimposed images is encoded in 8 or 16 bits and hence will have a range of 0 to 0xFF or 0xFFFF.

The Palette Color LUT used is that encoded in the Blending Presentation State; any Palette Color LUTs or Supplemental Palette Color LUTs in the image instances are ignored.

N.2.4.3 Blending Operation

The inputs to the blending operation are grayscale values from 0.0 to 1.0 from the underlying image (Y_u) and RGB values from 0.0 to 1.0 from the superimposed image (RGB_s), and an opacity value from 0.0 to 1.0 (A).

The output is a single image containing RGB values (RGB_o) blended as:

$$R_o = R_s * A + Y_u * (1-A)$$

$$G_o = G_s * A + Y_u * (1-A)$$

$$B_o = B_s * A + Y_u * (1-A)$$

N.2.4.4 Conversion to Profile Connection Space

The output of the blending operation is implicitly scaled to the gamut of the hypothetical device described by the ICC Input Profile, resulting in PCS-Values.

N.2.6 Advanced Blending Transformations

The advanced blending transformation model applies to multiple **RGB** color inputs, and uses foreground blending or equal blending.

Several transformations in this ~~model~~ affect the input prior to its use in blending as depicted in Figure N.2.6-1.

Grayscale inputs that have grayscale transformations (Modality LUT, VOI LUT) and palette color transformations (Palette Color LUT) specified in the Presentation State shall have those transformations applied, as specified in Section N.2.4.2, to produce RGB values.

Grayscale inputs that have no associated **Palette** Color LUT information **specified in the Presentation State or in the reference Image Instance** shall ~~have the normal grayscale processing and then~~ be converted to a full color image by setting R equals G equals B.

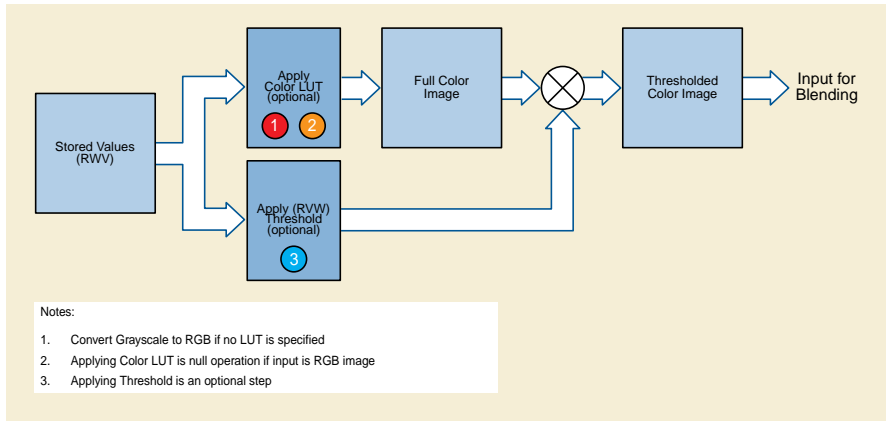


Figure N.2.6-1. Color and Threshold Application

Padding pixels in an input are given an opacity value zero and shall be set to 0 for Red, Green, and Blue.

The foreground method blends two inputs. The first input uses an opacity of Relative Opacity (0070,0403) and the second input uses an opacity of (1 - Relative Opacity (0070,0403)).

If both the inputs are padding values then the result is padding value.

If one of the values is padding value then the result is the non-padding value.

If both pixels have values then result is $Relative\ Opacity * first\ value + (1 - Relative\ Opacity) * second\ value$.

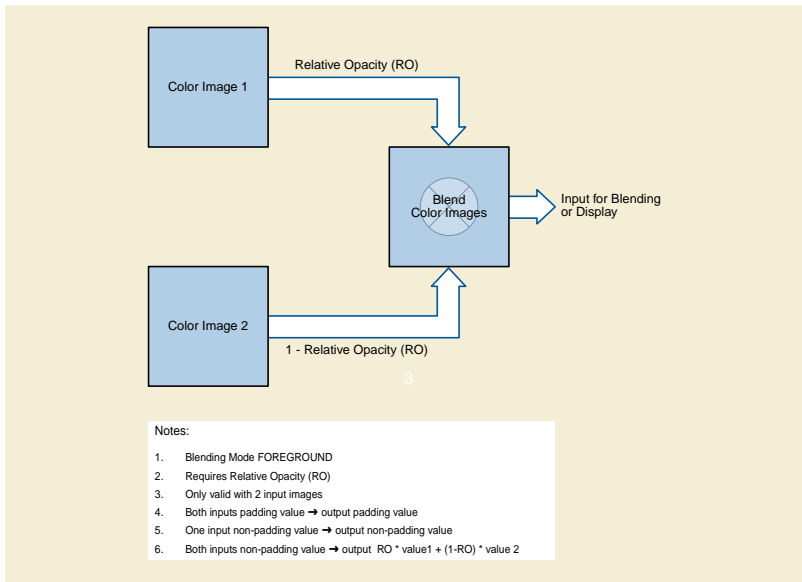


Figure N.2.6-2. Foreground Blending

The Equal blending mode blends two or more inputs where for each pixel location the opacity is calculated as 1.0 divided by the number of non-padding pixels. The result pixel blends all non-padding pixels using the calculated opacity.

If an input pixel value is the padding-value then the Relative Opacity for that input pixel is zero.

If an input pixel value is not the padding value then the Relative Opacity for that pixel is $1 / (\text{number of input pixels that are non-padding pixels})$.

The result value is the sum for all input pixels of the input pixel value * Relative Opacity.

If all the inputs pixels are padding values then the result is padding value.

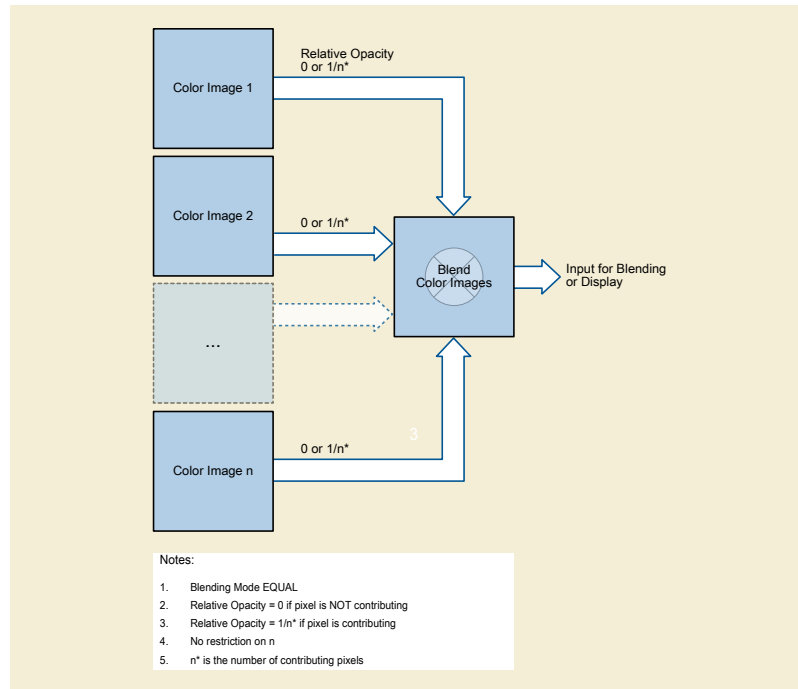


Figure N.2.6-3. Equal Blending