DICOM Correction Proposal

STATUS	Final Text
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Correction Number	CP-1262
Log Summary: Distinguish JPEG Interchange Format from JPEG File Interchange Format	
Name of Standard PS 3.5 2011	
Rationale for Correction: There is no doubt that the Photometric Interpretation in an instance containing JPEG compressed Pixel Data must accurately reflect the color space of the compressed components (e.g., typically be YBR_FULL_422 and not RGB), and this was clarified in 1999 in CP 156. However, there remains some confusion arising from the reference to the JPEG Interchange Format, which does not specify color space, as opposed to the JPEG File Interchange Format (JFIF), which does (but which is not required by DICOM).	
Correction Wording:	

Clarify PS 3.5:

8.2.1   JPEG IMAGE COMPRESSION

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The use of the DICOM Encapsulated Format to support JPEG Compressed Pixel Data requires that the Data Elements that are related to the Pixel Data encoding (e.g. Photometric Interpretation, Samples per Pixel, Planar Configuration, Bits Allocated, Bits Stored, High Bit, Pixel Representation, Rows, Columns, etc.) shall contain values that are consistent with the characteristics of the compressed data stream. The Pixel Data characteristics included in the JPEG Interchange Format shall be used to decode the compressed data stream.

> Notes: 1. These requirements were formerly specified in terms of the "uncompressed pixel data from which the compressed data stream was derived". However, since the form of the "original" uncompressed data stream could vary between different implementations, this requirement is now specified in terms of consistency with what is encapsulated.
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> When decompressing, should the characteristics explicitly specified in the compressed data stream (e.g. spatial subsampling or number of components or planar configuration) be inconsistent with those specified in the DICOM Data Elements, those explicitly specified in the compressed data stream should be used to control the decompression. The DICOM data elements, if inconsistent, can be regarded as suggestions as to the form in which an uncompressed Data Set might be encoded.
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> 2. Those characteristics not explicitly specified in the compressed data stream (e.g. **the** color space **of the compressed components,** which is not specified in the JPEG Interchange Format), or implied by the definition of the compression scheme (e.g. always unsigned in JPEG), can therefore be determined from the DICOM Data Element in the enclosing Data Set. For example a Photometric Interpretation of "YBR_FULL_422" would describe the color space that is commonly used to lossy compress images using JPEG. It is unusual to use an RGB color space for lossy compression, since no advantage is taken of correlation between the red, green and blue components (e.g. of luminance), and poor compression is achieved.

3. The JPEG Interchange Format is distinct from the JPEG File Interchange Format (JFIF). The JPEG Interchange Format is defined in ISO 10918-1 section 4.9.1, and refers to the inclusion of decoding tables, as distinct from the "abbreviated format" in which these tables are not sent (and the decoder is assumed to already have them). The JPEG Interchange Format does NOT specify the color space. The JPEG File Interchange Format, not part of the original JPEG standard, but defined in ECMA TR-098, and under development as ISO 101918-5, is often used to store JPEG bit streams in consumer format files, and does include the ability to specify the color space of the components. THE JFIF APP0 marker segment is NOT required to be present in DICOM encapsulated JPEG bit streams, and should not be relied upon to recognize the color space. Its presence is not forbidden (unlike the JP2 information for JPEG 2000 Transfer Syntaxes), but it is recommended that it be absent.

~~3~~4. Should the compression process be incapable of encoding a particular form of pixel data representation (e.g. JPEG cannot encode signed integers, only unsigned integers), then ideally only the appropriate form should be "fed" into the compression process. However, for certain characteristics described in DICOM Data Elements but not explicitly described in the compressed data stream (such as Pixel Representation), then the DICOM Data Element should be considered to describe what has been compressed (e.g. the pixel data really is to be interpreted as signed if Pixel Representation so specifies).

~~4~~5. DICOM Data Elements should not describe characteristics that are beyond the capability of the compression scheme used. For example, JPEG lossy processes are limited to 12 bits, hence the value of Bits Stored should be 12 or less. Bits Allocated is irrelevant, and is likely to be constrained by the Information Object Definition in PS 3.3 to values of 8 or 16. Also, JPEG compressed data streams are always color-by-pixel and should be specified as such (a decoder can essentially ignore this element however as the value for JPEG compressed data is already known).

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A.4.1 JPEG image compression

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For all images, including all frames of a multi-frame image, the JPEG Interchange Format shall be used (the table specification shall be included).

> **Note:** **This refers to the ISO 10918-1 "interchange format", not the DIS 10918-5 JPEG File Interchange Format (JFIF).**

If images with Photometric Interpretation (0028,0004) YBR_FULL_422 or YBR_PARTIAL_422, are encoded with JPEG coding Process 1 (non hierarchical with Huffman coding), identified by DICOM Transfer Syntax UID "1.2.840.10008.1.2.4.50" the minimum compressible unit is YYC_BC_R, where Y, C_B, and C_R are 8 by 8 blocks of pixel values. The data stream encodes two Y blocks followed by the corresponding C_B and C_R blocks.