Digital Imaging and Communications in Medicine (DICOM)

Supplement 120: Extended Presentation States

Prepared by:

DICOM Standards Committee, Working Group 11 – Display Function Standard

1300 N. 17th Street, Suite 1752

Rosslyn, Virginia 22209 USA

VERSION: Final Text – 25 March 2010

Developed pursuant to DICOM Work Item Number 2005-09-A

Table of Contents

66 # Scope and Field of Application

This Supplement extends DICOM presentation states (i.e. grayscale softcopy presentation state, color
68 softcopy presentation state, pseudo-color softcopy presentation state and blending softcopy presentation state) to support Compound Graphics.

70 Existing SOP classes are extended rather than new SOP classes being defined. All the new compound graphic types can be built with existing mandatory graphic types.

72 This supplement adds a number of graphic objects to enhance the DICOM presentation states. Compound Graphic Types such as CROSSHAIR, ARROW, AXIS, RULER, etc. are standardized to improve
74 interoperability, since they are already widely used.

This supplement also adds the ability to group graphic objects.

76

78

80

82

84

Changes to NEMA Standards Publication PS 3.3-2009

Digital Imaging and Communications in Medicine (DICOM)

86

Part 3: Information Object Definitions

Item #1: Add new reference to Section 2

2 Normative References

Cascading Style Sheet (CSS)	CSS2 generic font families, http://www.w3.org/TR/REC-CSS2/fonts.html#generic-font-families
ISO_32000	Portable document format, http://www.iso.org/iso/catalogue_detail.htm?csnumber=51502
ISO/IEC 14496-22	Open font format, http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=52136

Item #2: Add new module in Section A.1.4, Table A.1-2

A.1.4 Overview of the Composite IOD Module Content

Table A.1-2
COMPOSITE INFORMATION OBJECT MODULES OVERVIEW - NON-IMAGES

IODs Modules	Gray Pres St	Col Pres St	PS-ColPres St	Blend Pres St
Patient	M	M	M	M
Clinical Trial Subject	U	U	U	U
General Study	M	M	M	M
Patient Study	U	U	U	U
Clinical Trial Study	U	U	U	U
General Series	M	M	M	M
Clinical Trial Series	U	U	U	U
Presentation Series	M	M	M	M
General Equipment	M	M	M	M
Mask	C		C	
Display Shutter	C	C	C	
Bitmap Display Shutter	C	C	C	
Palette Color LUT			M	M
Overlay Plane	C	C	C	

Displayed Area	C	M	M	M
Overlay Activation	M	C	C	
Graphic Annotation	C	C	C	C
Spatial Transformation	C	C	C	C
Graphic Layer	C	C	C	C
Graphic Group	**U**	**U**	**U**	**U**
Modality LUT	C		C	
Softcopy VOI LUT	C		C	
Softcopy Presentation LUT	M		C	
Presentation State Identification	M	M	M	M
Presentation State Relationship	M	M	M	
Presentation State Shutter	M	M	M	
Presentation State Mask	M		M	
Presentation State Blending				M
ICC Profile		M	M	M
SOP Common	M	M	M	M

102 ***Item #3: Add new module to Section A.33.1.2, Table A.33.1-1***

A.33 SOFTCOPY PRESENTATION STATE INFORMATION OBJECT DEFINITIONS

104 …

A.33.1.2 Grayscale Softcopy Presentation State IOD Module Table

106 **Table A.33.1-1**
Grayscale Softcopy Presentation State IOD MODULES

IE	Module	Reference	Usage
	…		
	Spatial Transformation	C.10.6	C – Required if Rotation or Flipping are to be applied to referenced image(s)
	Graphic Layer	C.10.7	C – Required if Graphic Annotations or Overlays or Curves are to be applied to

			referenced image(s)
	Graphic Group	**C.10.X**	**U**
	Modality LUT	C.11.1	C – Required if a Modality LUT is to be applied to referenced image(s)
	…		

108

A.33.2.2 Color Softcopy Presentation State IOD Module Table

110 **Table A.33.2-1**
Color Softcopy Presentation State IOD MODULES

IE	Module	Reference	Usage
	…		
	Spatial Transformation	C.10.6	C – Required if Rotation or Flipping are to be applied to referenced image(s)
	Graphic Layer	C.10.7	C – Required if Graphic Annotations or Overlays or Curves are to be applied to referenced image(s)
	Graphic Group	**C.10.X**	**U**
	ICC Profile	C.11.15	M
	…		

112

A.33.3.2 Pseudo-Color Softcopy Presentation State IOD Module Table

114 **Table A.33.3-1**
Pseudo-Color Softcopy Presentation State IOD MODULES

IE	Module	Reference	Usage
	…		
	Spatial Transformation	C.10.6	C – Required if Rotation or Flipping are to be applied to referenced image(s)
	Graphic Layer	C.10.7	C – Required if Graphic Annotations or Overlays or Curves are to be applied to referenced image(s)
	Graphic Group	**C.10.X**	**U**
	Modality LUT	C.11.1	C – Required if a Modality LUT is to be applied to referenced image(s)
	…		

116

A.33.4.2 Blending Softcopy Presentation State IOD Module Table

118 **Table A.33.4-1**
Blending Softcopy Presentation State IOD MODULES

IE	Module	Reference	Usage
	…		
	Spatial Transformation	C.10.6	C – Required if Rotation or Flipping are to be applied to referenced image(s)
	Graphic Layer	C.10.7	C – Required if Graphic Annotations or Overlays or Curves are to be applied to referenced image(s)
	Graphic Group	**C.10.X**	**U**
	Palette Color LUT	C.7.9	M
	…		

120

Item #5: Change Table C.10-5

122 **C.10.5 Graphic Annotation Module**

…

124 **Table C.10-5**
GRAPHIC ANNOTATION MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Graphic Annotation Sequence	(0070,0001)	1	A sequence of Items each of which represents a group of annotations composed of graphics or text or both. One or more Items shall be present.
…			
>Graphic Layer	(0070,0002)	1	The layer defined in the Graphic Layer Module C.10.7 in which the graphics or text is to be rendered.
>Text Object Sequence	(0070,0008)	1C	Sequence that describes a text annotation. One or more Items may be present. Either one or both of Text Object Sequence (0070,0008) or Graphic Object Sequence (0070,0009) are required if the Sequence Item is present.
…			
>>Unformatted Text Value	(0070,0006)	1	Text data which is unformatted and whose manner of display within the defined bounding box or relative to the specified anchor point is implementation dependent. See C.10.5.1.1. The text value may contain spaces, as well as multiple lines separated by either LF, CR, CR LF or LF CR, but otherwise no format control characters (such as horizontal or vertical tab and form feed) shall be present, even if permitted by the Value Representation of ST. The text shall be interpreted as specified by Specific Character Set (0008,0005) if present in the SOP Common Module. Note: The text may contain single or multi-byte characters and use code extension techniques as described in PS 3.5 if permitted by the values of Specific Character Set (0008,0005).
>>Include 'Text Style Sequence Macro' Table C.10-X2			**See C.10.5.1.X.12**
…			

>>Anchor Point Visibility	(0070,0015)	1C	Flag to indicate whether or not a visible indication (such as a line or arrow) of the relationship between the text and the anchor point is to be displayed. Enumerated Values: Y = yes N = no Required if Anchor Point (0070,0014) is present.
>>Compound Graphic Instance ID	**(0070,0226)**	**3**	**The identifier of the Compound Graphic represented, in part, by this Item.** **The value of this attribute shall be equal to the value of the Compound Graphic Instance ID (0070,0226) of the corresponding Item in the Compound Graphic Sequence (0070,0209).** **See C.10.5.1.X.1.**
>>Graphic Group ID	**(0070,0295)**	**3**	**A number identifying the group from the Graphic Group Sequence (0070,0234) to which this Item belongs. If this attribute is not present, this Item does not belong to a group.** **If Compound Graphic Instance ID (0070,0226) is present in this Item, the value of Graphic Group ID (0070,0295) shall be the same as the value of Graphic Group ID (0070,0295) of the corresponding Item in the Compound Graphic Sequence (0070,0209) with the same Compound Graphic Instance ID (0070,0226).**
>Graphic Object Sequence	(0070,0009)	1C	Sequence that describes a graphic annotation. One or more Items may be present. Either one or both of Text Object Sequence (0070,0008) or Graphic Object Sequence (0070,0009) are required if the Sequence Item is present.
…			
>>Graphic Type	(0070,0023)	1	The shape of graphic that is to be drawn. See C.10.5.1.2. Enumerated Values: POINT POLYLINE INTERPOLATED CIRCLE ELLIPSE
>>Include 'Line Style Sequence Macro' Table C.10-X3			**See C.10.5.1.X.13**

>>Graphic Filled	(0070,0024)	1C	Whether or not the closed graphics element is displayed as filled (in some unspecified manner that shall be distinguishable from an outline) or as an outline. See C.10.5.1.2. Enumerated Values: Y = yes N = no Required if Graphic Data (0070,0022) is "closed", that is Graphic Type (0070,0023) is CIRCLE or ELLIPSE, or Graphic Type (0070,0023) is POLYLINE or INTERPOLATED and the first data point is the same as the last data point.
>>Include 'Fill Style Sequence Macro' Table C.10-X4			**See C.10.5.1.X.14**
>>Compound Graphic Instance ID	**(0070,0226)**	**3**	**The identifier of the Compound Graphic represented, in part, by this Item.** **The value of this attribute shall be equal to the value of the Compound Graphic Instance ID (0070,0226) of the corresponding Item in the Compound Graphic Sequence (0070,0209).** **See C.10.5.1.X.1.**
>>Graphic Group ID	**(0070,0295)**	**3**	**A number identifying the group from the Graphic Group Sequence (0070,0234) to which this Item belongs. If this attribute is not present, this Item does not belong to a group.** **If Compound Graphic Instance ID (0070,0226) is present in this Item, the value of Graphic Group ID (0070,0295) shall be the same as the value of Graphic Group ID (0070,0295) of the corresponding Item in the Compound Graphic Sequence (0070,0209) with the same Compound Graphic Instance ID (0070,0226).**

126

Item #6: Add to the end of Table C.10-5 (continuation of table in item #5, the update is split to increase readability)

128

Table C.10-5
130 **GRAPHIC ANNOTATION MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
…			

>Compound Graphic Sequence	(0070,0209)	3	A sequence of Items that describe Compound Graphics. One or more Items may be present in the sequence. For each Compound Graphic there shall be an alternate rendering encoded as Items in the Text Object Sequence (0070,0008) and Graphic Object Sequence (0070,0009) linked by the Compound Graphic Instance ID (0070,0226). See C.10.5.1.X.1.
>>Compound Graphic Instance ID	(0070,0226)	1	A number that identifies the Compound Graphic described in this Item. The value shall be unique within this SOP instance. See C.10.5.1.X.1.
>>Compound Graphic Units	(0070,0282)	1	Type of dimension used in attributes for the Compound Graphic when specifying distances and locations. Enumerated Values: PIXEL = When an attribute value specifies a location, it shall be an image relative position specified with sub-pixel resolution such that the origin at the Top Left Hand Corner (TLHC) of the TLHC pixel is 0.0\0.0, the Bottom Right Hand Corner (BRHC) of the TLHC pixel is 1.0\1.0, and the BRHC of the BRHC pixel is Columns\Rows (see figure C.10.5-1). The values must be within the range 0\0 to Columns\Rows. When an attribute value specifies a distance the distance shall be in pixels. DISPLAY = When an attribute value specifies a location, it shall be a fraction of Specified Displayed Area where 0.0\0.0 is the TLHC and 1.0\1.0 is the BRHC. The values must be within the range 0.0 to 1.0. When an attribute value specifies a distance the distance shall be in fraction of Specified Displayed Area.
>>Graphic Dimensions	(0070,0020)	1	Enumerated Value: 2
>>Number of Graphic Points	(0070,0021)	1	Number of data Items, e.g. points, in this Compound Graphic.
>>Graphic Data	(0070,0022)	1	Numerical data Items that specify this Compound Graphic (points, vectors and scalars). See C.10.5.1.X for further explanation.

>>Compound Graphic Type	(0070,0294)	1	The shape of this Compound Graphic. See C.10.5.1.X. Defined terms: MULTILINE INFINITELINE CUTLINE RANGELINE RULER AXIS CROSSHAIR ARROW RECTANGLE ELLIPSE Note: Implementors may add private graphic types.
>>Include 'Text Style Sequence Macro' Table C.10-X2			See C.10.5.1.X.12
>>Include 'Line Style Sequence Macro' Table C.10-X3			See C.10.5.1.X.13
>>Rotation Angle	(0070,0230)	3	The rotation of this Compound Graphic in degrees. Value shall be in degrees, between 0 and 360. See C.10.5.1.X.
>>Rotation Point	(0070,0273)	1C	The rotation point of this Compound Graphic. See C.10.5.1.X. Required if Rotation Angle (0070,0230) is present or if Compound Graphic Type (0070,0294) is CUTLINE or INFINITELINE.
>>Gap Length	(0070,0261)	1C	Diameter of the circle around the Rotation Point (0070,0273) where the CUTLINE or INFINITELINE is not rendered. Diameter of the circle around the origin, specified by Graphic Data (0070,0022) where the CROSSHAIR is not rendered. The Compound Graphic Units (0070,0282) of the Gap Length (0070,0261) shall be DISPLAY. See C.10.5.1.X. Required if Compound Graphic Type (0070, 0294) equals CUTLINE, INFINITELINE or CROSSHAIR.
>>Diameter of Visibility	(0070,0262)	1C	Diameter of the circle around the CROSSHAIR origin where the CROSSHAIR is visible. The Compound Graphic Units (0070,0282) of the Diameter of Visibility (0070,0262) shall be DISPLAY. See C.10.5.1.X. 10 Required if Compound Graphic Type (0070, 0294) equals CROSSHAIR.

>>Major Ticks Sequence	(0070,0287)	1C	The sequence of major ticks on the AXIS object. Two or more Items shall be present. Required if Compound Graphic Type (0070, 0294) equals AXIS.
>>>Tick Position	(0070,0288)	1	The position of the tick in the range 0.0 (start point) to 1.0 (end point).
>>>Tick Label	(0070,0289)	1	The label of the tick.
>>Tick Alignment	(0070,0274)	1C	The alignment of the ticks with respect to the line. Enumerated Values: BOTTOM CENTER TOP See C.10.5.1.X. Required if Compound Graphic Type (0070,0294) equals RULER, AXIS or CROSSHAIR.
>>Tick Label Alignment	(0070,0279)	1C	The alignment of the label with respect to the tick. Enumerated Values: BOTTOM TOP See C.10.5.1.X. Required if Compound Graphic Type (0070,0294) equals RULER, AXIS. or CROSSHAIR.
>>Show Tick Label	(0070,0278)	1C	Indicates whether the tick label should be initially visible. Enumerated Values: Y = yes N = no Required if Compound Graphic Type (0070,0294) equals RULER, AXIS or CROSSHAIR.
>>Graphic Filled	(0070,0024)	1C	Indicates whether or not the Compound Graphics is displayed as filled. Enumerated Values: Y = yes N = no Required if Compound Graphic Type (0070, 0294) equals RECTANGLE or ELLIPSE.
>>Include 'Fill Style Sequence Macro' Table C.10-X4			In this Module, attribute Fill Style Sequence (0070,0233) is Type 1C. Required if Graphic Filled (0070,0024) equals Y. See C.10.5.1.X.14

>>Graphic Group ID	(0070,0295)	3	A number that defines the corresponding group object in the Graphic Group Sequence (0070,0234). If the attribute is not present the object does not belong to a group.

Add to Section C.10.5.1

C.10.5.1 Graphic Annotation Attribute Descriptions

…

C.10.5.1.X Compound Graphic Sequence

The attributes of the Compound Graphic Sequence (0070,0209) are described within this section.

For point encoding rules of Graphic Data (0070,0022) see C.10.5.1.2.

All graphics are applied after the application of the image rendering pipeline.

C.10.5.1.X.1 Compound Graphic Instance ID

Every Item in the Compound Graphic Sequence shall have a Compound Graphic Instance ID (0070,0226) with a value that is unique within this sequence.

There shall be one or more Items in the Graphic Object Sequence or Text Object Sequence that represents an alternate rendering of the Compound Object Sequence Item. As a linkage for backward compatibility these Items share the same Compound Graphic Instance ID (0070,0226).

Note: Every Compound Graphic has an equivalent rendering encoded as a set of simple graphic objects linked by the Compound Graphic Instance ID (0070,0226). Simple graphic objects are elements such as points, polylines, interpolated lines, circles and ellipses.
The equivalent rendering is a set of simple graphic objects to support an SCP that only understands the simple graphical objects.

C.10.5.1.X.2 Rotation

All Compound Graphics can be rotated by specifying a Rotation Angle (0070,0230) value and a Rotation Point (0070,0273). The convention for rotation is that positive angle values are defined as counterclockwise around the Rotation Point (0070,0273).

C.10.5.1.X.3 Ellipses

For the Compound Graphic Type (0070,0294) ELLIPSE, exactly 2 points shall be present inside the Graphic Data (0070,0022). The first point is the top/left hand corner (TLHC) and the second point is the bottom/right hand corner (BRHC) of the bounding rectangle (see Figure C.10.5-X1).

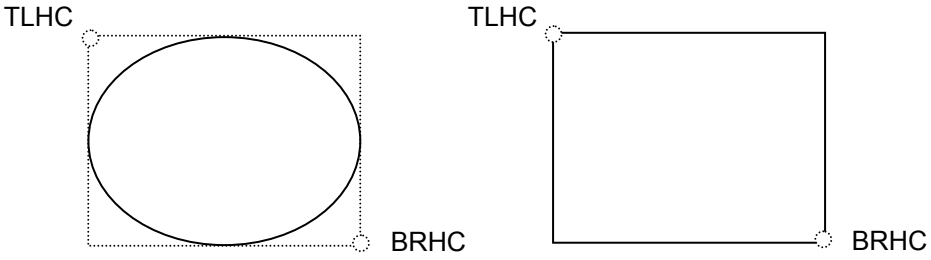


Figure C.10.5-X1
ELLIPSE on the left and RECTANGLE object on the right

C.10.5.1.X.4 Rectangles

For the Compound Graphic Type (0070,0294) RECTANGLE, exactly 2 points shall be present inside the Graphic Data (0070,0022). The first point is the top/left hand corner of the rectangle (TLHC) and the second point is the bottom/right hand corner (BRHC) of the rectangle (see Figure C.10.5-X1).

C.10.5.1.X.5 Multi-lines

For the Compound Graphic Type (0070,0294) MULTILINE, the list of points inside the Graphic Data (0070,0022) is an n-tuple list of start and end points of straight lines to be drawn (see Figure C.10.5-X2).

If Rotation Angle (0070,0230) is present, all points in the MULTILINE are rotated around the same Rotation Point (0070,0273).

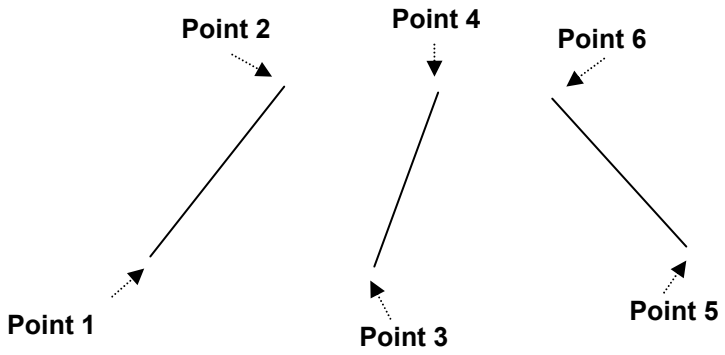


Figure C.10.5-X2
Example for MULTILINE object

C.10.5.1.X.6 Cut and Infinite-lines

For the Compound Graphic Type (0070,0294) CUTLINE or INFINITELINE, exactly two points shall be present inside the Graphic Data (0070,0022). The rendering of these lines always extends to the borders of the render area of a view (see Figure C.10.5-X3).

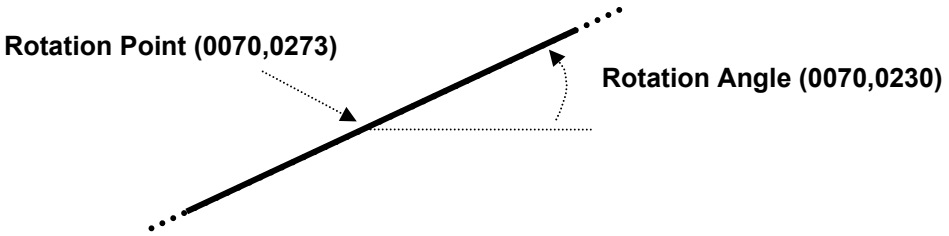


Figure C.10.5-X3
INFINITELINE

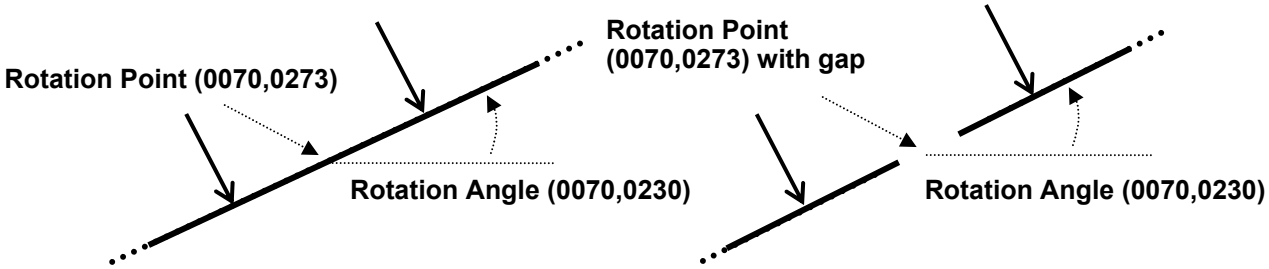


Figure C.10.5-X4
CUTLINE on the left and CUTLINE with gap on the right

In case of a CUTLINE, two arrows shall be drawn perpendicular to the cutline. The arrows ends shall be positioned at the midpoints of each half of the cutline. The arrow heads shall point toward the cutline and shall be drawn in the positive right half-plane of the cutline before rotation. Typically, the arrows indicate the viewing direction for MPR renderings that are referenced by these lines.

Gap Length (0070,0261) defines the diameter of the circular area where the CUTLINE or INFINITELINE is not rendered. Center of the circular area is the Rotation Point (0070,0273). Since the dimension units of the Gap Length is DISPLAY, independent of the value of Compound Graphic Units (0070,0282), the length of the gap is not changed by zoom operations on the image performed by the application.

C.10.5.1.X.7 Range lines

For the Compound Graphic Type (0070,0294) RANGELINE exactly two points shall be present inside the Graphic Data (0070,0022).

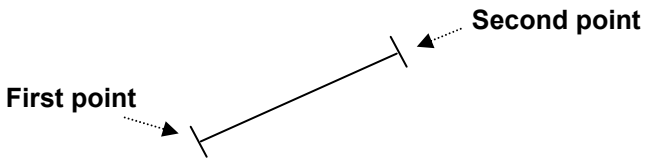


Figure C.10.5-X5
RANGELINE example

C.10.5.1.X.8 Ruler

For the Compound Graphic Type (0070,0294) RULER, exactly two points shall be present inside the Graphic Data (0070,0022) defining the ruler line.

Tick Alignment (0070,0274) defines the alignment of the ticks.

BOTTOM - ticks are aligned to the lower part of the line, where the first point of the line is on the left and the line extends horizontally to the right.

CENTER - ticks are centered on the line.

TOP - ticks are aligned to the upper part of the line, where the first point of the line is on the left and the line extends horizontally to the right.

Tick Label Alignment (0070,0279) defines the alignment of the tick labels.

BOTTOM - labels are aligned to the lower part of the line, where the first point of the line is on the left and the line extends horizontally to the right.

TOP - labels are aligned to the upper part of the line, where the first point of the line is on the left and the line extends horizontally to the right.

The presence, labeling and units of the ticks on the line is application dependent (see Figure C.10.5-X6). If present as numerical values, the labels of the ticks shall increase toward the second point.

C.10.5.1.X.9 Axis

For the Compound Graphic Type (0070,0294) AXIS, exactly two points shall be present inside the Graphic Data (0070,0022) defining the axis' line.

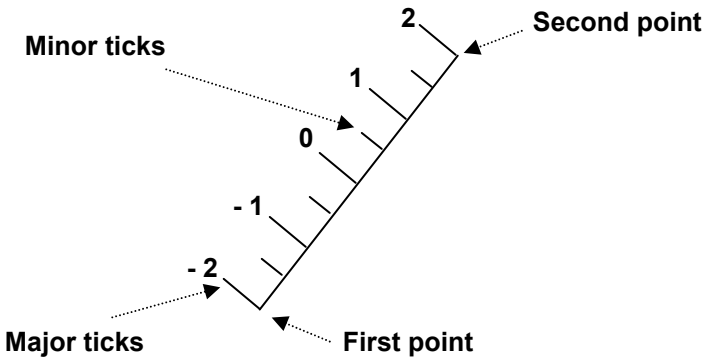


Figure C.10.5-X6
RULER / AXIS example showing TOP Tick Alignment and TOP Tick Label Alignment

The Major Ticks Sequence (0070,0287) specifies the placement and label of the ticks. The rendering of the minor ticks is left to the application.

Tick Alignment (0070,0274) defines the alignment of the ticks.

BOTTOM - ticks are aligned to the lower part of the line, where the first point of the line is on the left and the line extends horizontally to the right.

CENTER - ticks are centered on the line.

TOP - ticks are aligned to the upper part of the line, where the first point of the line is on the left and the line extends horizontally to the right.

Tick Label Alignment (0070,0279) defines the alignment of the tick labels.

BOTTOM - labels are aligned to the lower part of the line, where the first point of the line is on the left and the line extends horizontally to the right.

TOP - labels are aligned to the upper part of the line, where the first point of the line is on the left and the line extends horizontally to the right.

C.10.5.1.X.10 Crosshairs

For the Compound Graphic Type (0070,0294) CROSSHAIR exactly one point shall be present inside the Graphic Data (0070,0022). This point is the origin of the CROSSHAIR (see Figure C.10.5-X7).

Tick Alignment (0070,0274) and Tick Label Alignment (0070,0279) are also valid for the CROSSHAIR. Tick rendering is application dependent.

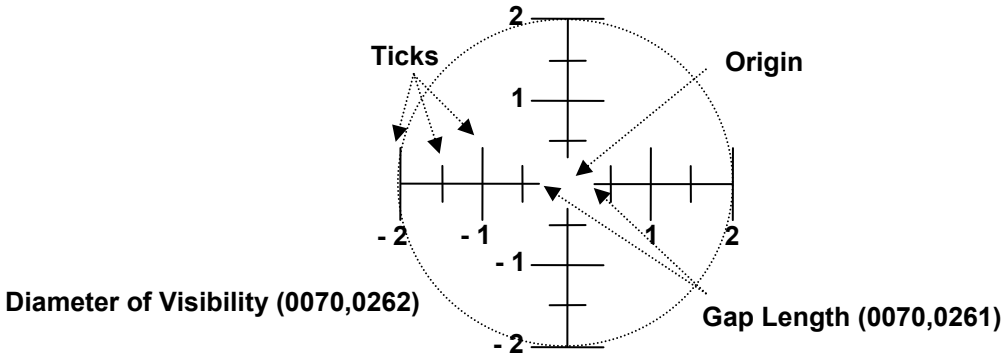


Figure C.10.5-X7
CROSSHAIR example showing BOTTOM tick labels alignment

Gap Length (0070,0261) defines the diameter of the circular area around the origin where the CROSSHAIR is not rendered. Since the dimension units of the Gap Length is DISPLAY, independent of the value of Compound Graphics Units (0070,0282), the length of the gap is not changed by zoom operations on the image performed by the application.

Diameter of Visibility (0070,0262) defines the diameter of the circular area around the origin where the CROSSHAIR is rendered. Since the dimension units of the Diameter of Visibility is DISPLAY, independent of the value of Compound Graphic Units (0070,0282), the size of the crosshair is not changed by zoom operations on the image performed by the application.

The value of the Tick Alignment (0070,0274) shall be CENTER.

C.10.5.1.X.11 Arrows

For the Compound Graphic Type (0070,0294) ARROW, two points shall be present inside the Graphic Data (0070,0022). The first point is the anchor point, the second point is the foot point of the arrow (see Figure C.10.5-X8). The arrow head style at the anchor point is not specified.

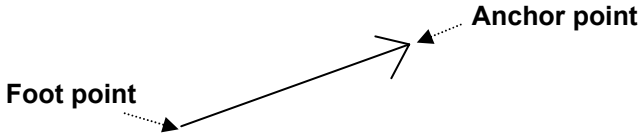


Figure C.10.5-X8
ARROW example

C.10.5.1.X.12 Text Style Sequence

Text Style Sequence (0070,0231) contains the text style for each text object. This attribute gives recommendations on how the annotation text should be rendered at the display.

Table C.10-X2 specifies the attributes that describe Text Style Sequence Macro.

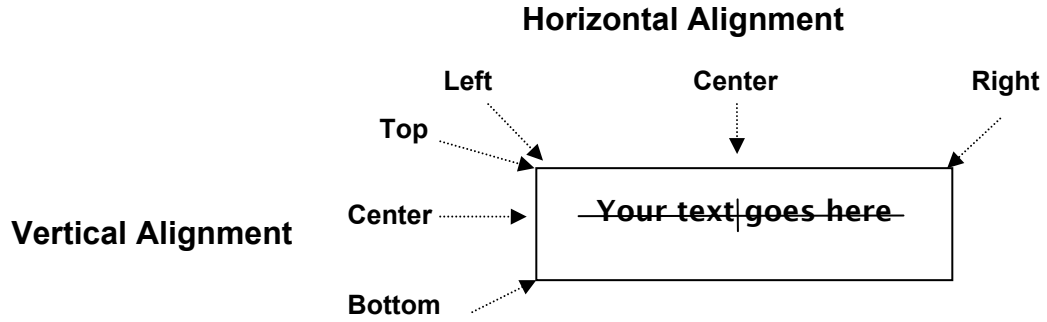
266 **Table C.10-X2**
TEXT STYLE SEQUENCE MACRO ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Text Style Sequence	(0070,0231)	3	Sequence that describes the text style. Only one Item may be present.
>Font Name	(0070,0227)	3	Font name in a standard type.
>Font Name Type	(0070,0228)	1C	Defined term: ISO_32000 Required if Font Name (0070,0227) is present. Note: This is the font naming system used by Adobe PDF and defined in ISO/IEC 14496-22.
>CSS Font Name	(0070,0229)	1	Generic font name as defined within CSS (Cascading Style Sheets). Default fontname, if the font specified in Font Name (0070,0227) is not present or can not be rendered.
>Text Color CIELab Value	(0070,0241)	1	A default color triplet value used to specify the text color in which it is recommended that the text be rendered on a color display. The units are specified in PCS-Values, and the value is encoded as CIELab. See C.10.7.1.1. This value shall override the Graphic Layer Recommended Display CIELab Value (0070,0401).
>Horizontal Alignment	(0070,0242)	3	Specifies the horizontal position of the text relative to the vertical edges of the bounding box. Horizontal Alignment shall override the Bounding Box Text Horizontal Justification (0070,0012) of the Text Object Sequence Item. See C.10.5.1.X.12.1 Enumerated Values: LEFT CENTER RIGHT Required if Bounding Box Top Left Hand Corner (0070,0010) is present.
>Vertical Alignment	(0070,0243)	3	Specifies the vertical position of the text relative to the horizontal edges of the bounding box. See C.10.5.1.X.12.1 Enumerated Values: TOP CENTER BOTTOM Required if Bounding Box Top Left Hand Corner (0070,0010) is present.

>Shadow Style	(0070,0244)	1	The shadow style of the text to be displayed. Enumerated Values: NORMAL — the shadow is drawn on 1 side of the contour of the text object OUTLINED — the shadow is drawn around the contour of the text object OFF — no shadow See C.10.5.1.X.13.1
>Shadow Offset X	(0070,0245)	1	Floating point value that defines the shadow offset in X direction in Anchor Point Annotation Units (0070,0004) if used in Text Object Sequence Item or in Graphic Annotation Units (0070,0005) if used in Graphic Object Sequence Item. See C.10.5.1.X.13.1
>Shadow Offset Y	(0070,0246)	1	Floating point value that defines the shadow offset in Y direction in Anchor Point Annotation Units (0070,0004) if used in Text Object Sequence Item or in Graphic Annotation Units (0070,0005) if used in Graphic Object Sequence Item. See C.10.5.1.X.13.1
>Shadow Color CIELab Value	(0070,0247)	1	A color triplet value used to encode the Shadow Color. The units are specified in PCS-Values, and the value is encoded as CIELab. See C.10.7.1.1.
>Shadow Opacity	(0070,0258)	1	Encodes the shadow opacity. The value is encoded as floating point alpha value (0.0-1.0).
>Underlined	(0070,0248)	1	Specifies whether or not the text shall be rendered underlined. Enumerated Values: Y = yes N = no
>Bold	(0070,0249)	1	Specifies whether or not the text shall be rendered in bold. Enumerated Values: Y = yes N = no
>Italic	(0070,0250)	1	Specifies whether or not the text shall be rendered italicized. Enumerated Values: Y = yes N = no

C.10.5.1.X.12.1 Text Alignment

270 The Horizontal Alignment (0070,0242) and the Vertical Alignment (0070,0243) define the position of the text relative to the bounding box of the text object (see Figure C.10.5-X9).



272

Figure C.10.5-X9
274 **Example of horizontal and vertical CENTER alignment**

C.10.5.1.X.13 Line Style Sequence

276 Table C.10-X3 specifies the attributes that describe Line Style Sequence Macro.

Table C.10-X3
278 **LINE STYLE SEQUENCE MACRO ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Line Style Sequence	(0070,0232)	3	Sequence that describes the line style. Only one Item may be present.
>Pattern On Color CIELab Value	(0070,0251)	1	A color triplet value used to encode the foreground. The units are specified in PCS-Values, and the value is encoded as CIELab. See C.10.7.1.1. This value shall override the Graphic Layer Recommended Display CIELab Value (0070,0401).
>Pattern Off Color CIELab Value	(0070,0252)	3	A color triplet value used to encode the color of parts of the line that are off, i.e. the background. The units are specified in PCS-Values, and the value is encoded as CIELab. See C.10.7.1.1.
>Pattern On Opacity	(0070,0284)	1	Encodes the foreground opacity. The value is encoded as floating point alpha value (0.0-1.0).
>Pattern Off Opacity	(0070,0285)	3	Encodes the background opacity. The value is encoded as floating point alpha value (0.0-1.0).
>Line Thickness	(0070,0253)	1	Specifies the line thickness. The dimension for this attribute is defined by Graphic Annotation Units (0070,0005) or Compound Graphic Units (0070,0282).

>Line Dashing Style	(0070,0254)	1	The dashing style of the line to be displayed. Enumerated Values: SOLID DASHED DASHED draws one part of the line with the Pattern On Color CIELab Value (0070,0251) and the other part with the Pattern Off Color CIELab Value (0070,0252). See C.10.5.1.X.13.1.
>Line Pattern	(0070,0255)	1C	Pattern that defines the line dashing style. The Line Pattern is a 32 bit value. If the bit inside the pattern is set to 1 the foreground color is drawn, else the background color is drawn. Note: For example, 00FFH defines the dashes with an equal size. Required if Line Dashing Style (0070,0254) has a value of DASHED.
>Shadow Style	(0070,0244)	1	The shadow style of the line to be displayed. Enumerated Values: NORMAL the shadow is drawn on 1 side of the contour of the text object OUTLINED the shadow is drawn around the contour of the text object OFF no shadow See C.10.5.1.X.13.2
>Shadow Offset X	(0070,0245)	1	Floating point value that defines the shadow offset in X direction in Graphic Annotation Units (0070,0005). See C.10.5.1.X.13.2.
>Shadow Offset Y	(0070,0246)	1	Floating point value that defines the shadow offset in Y direction in Graphic Annotation Units (0070,0005). See C.10.5.1.X.13.2.
>Shadow Color CIELab Value	(0070,0247)	1	A color triplet value used to encode the Shadow Color. The units are specified in PCS-Values, and the value is encoded as CIELab. See C.10.7.1.1.
>Shadow Opacity	(0070,0258)	1	Encodes the shadow opacity. The value is encoded as floating point alpha value (0.0-1.0).

C.10.5.1.X.13.1 Line Dashing Style

The Line Dashing Style (0070,0254) value SOLID indicates the line to be drawn with the foreground color which is specified by Pattern On Color CIELab Value (0070,0251).

The Line Dashing Style (0070,0254) attribute does not apply to shadows which shall always be rendered in SOLID background color.

C.10.5.1.X.13.2 Shadows

Shadow Style (0070,0244) contains one of the values OFF, NORMAL or OUTLINED (see Figure C.10.5.-X10 and Figure C.10.5-X11). Shadow shall be applied after rotation. The coordinate system of the shadow is relative to the line. Shadow Offset X (0070,0245) extends to the right and Shadow Offset Y (0070,0246) extends downward.

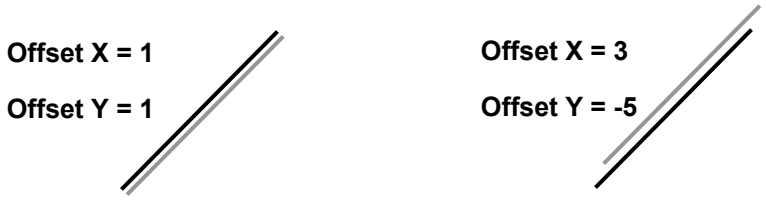


Figure C.10.5-X10
Example for the Shadow Style (0070,0244) NORMAL

The OUTLINED shadow defines a filled outline shadow. The length of the vector given by Shadow Offset X (0070,0245) and Shadow Offset Y (0070,0246) defines the radius of the shadow.

Figure C.10.5-X11
Example for Shadow Style (0070,0244) OUTLINED

C.10.5.1.X.14 Fill Style Sequence

Table C.10-X4 specifies the attributes that describe Fill Style Sequence Macro.

Table C.10-X4
FILL STYLE SEQUENCE MACRO ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
Fill Style Sequence	(0070,0233)	3	Sequence that describes the fill style. Only one Item may be present.
>Pattern On Color CIELab Value	(0070,0251)	1	A color triplet value used to encode the foreground color. The units are specified in PCS-Values, and the value is encoded as CIELab. See C.10.7.1.1. This value shall override the Graphic Layer Recommended Display CIELab Value (0070,0401).
>Pattern Off Color CIELab Value	(0070,0252)	3	A color triplet value used to encode the background color. The units are specified in PCS-Values, and the value is encoded as CIELab. See C.10.7.1.1.

>Pattern On Opacity	(0070,0284)	1	Encodes the foreground opacity. The value is encoded as floating point alpha value (0.0-1.0).
>Pattern Off Opacity	(0070,0285)	1	Encodes the background opacity. The value is encoded as floating point alpha value (0.0-1.0).
>Fill Mode	(0070,0257)	1	The texture of the closed object to be displayed. Enumerated Values: SOLID STIPPELED See C.10.5.1.X.14.1.
>Fill Pattern	(0070,0256)	1C	A binary fill pattern. A set bit corresponds to foreground. An unset bit corresponds to background. A 128 byte value defining a 32x32 1 bit matrix. This fill pattern is replicated in tiles inside the boundaries of the graphic type. The most significant bit corresponds to the leftmost pixel in the row. The fill pattern relates to display pixels where one bit value corresponds to one display pixel. Required if Fill Mode (0070,0257) equals STIPPELED.

C.10.5.1.X.14.1 Fill Mode

The Fill Mode (0070,0257) value SOLID indicates that the graphic object is filled with the foreground.

The Fill Mode (0070,0257) attribute does not interfere with (line) shadows which shall always be rendered in SOLID background color.

Item #7: Add new section to C.10

C.10.X Graphic Group Module

Graphic Group Module provides the label and description for the logical associations made by the Graphic Group ID (0070,0295) of graphic objects.

The grouping concept used in the Graphic Group Module differs from the grouping concept used in the Graphic Layer Module. Graphic Layer Module addresses the rendering order by using the Graphic Layer Order (0070,0062) which specifies which annotations are rendered first. The Graphic Group Module is used to specifiy which annotations belong together and shall be handled together (e.g., rotate, move) independent of the Graphic Layer to which they are assigned.

Table C.10-X1
GRAPHIC GROUP MODULE

Attribute Name	Tag	Type	Attribute Description

Graphic Group Sequence	(0070,0234)	1	Sequence that describes the combined graphic object. One or more Items shall be present.
>Graphic Group ID	(0070,0295)	1	A unique number identifying the Graphic Group, i.e. the combined graphic object.
>Graphic Group Label	(0070,0207)	1	Name used to identify the Graphic Group, i.e. the combined graphic object.
>Graphic Group Description	(0070,0208)	3	Description of the group.

318

320

322

324

326 # Changes to NEMA Standards Publication PS 3.4-2009

Digital Imaging and Communications in Medicine (DICOM)

328 # Part 4: Service Class Specifications

Item #8: Add to Section N.3 and N.4

N.3 BEHAVIOR OF AN SCP

In addition to the behavior for the Storage Service Class specified in B.2.2 Behavior of an SCP, the following additional requirements are specified for the Softcopy Presentation State Storage SOP Classes:

- a display device acting as an SCP of these SOP Classes shall make all mandatory presentation attributes available for application to the referenced images at the discretion of the display device user, for all Image Storage SOP Classes defined in the Conformance Statement for which the Softcopy Presentation State Storage SOP Class is supported.
- **a display device that is acting as an SCP of these SOP Classes and that supports compound graphics types shall display the graphics described in the Compound Graphic Sequence (0070,0209) and shall not display the Items in the Text Object Sequence (0070,0008) and Graphic Object Sequence (0070,0009) that have the same Compound Graphic Instance ID (0070,0226) value.**

Note: Though it is not required, a display device acting as an SCP of the Blending Softcopy Presentation State Storage SOP Class may support the Spatial Registration Storage SOP Class in order to transform one Frame of Reference into another or to explicitly identify the relationship between members of two sets of images, and may be able to resample underlying and superimposed sets of images that differ from each other in orientation and in-plane and between-plane spatial resolution.

N.4 CONFORMANCE

In addition to the Conformance Statement requirements for the Storage Service Class specified in B.4.3, the following additional requirements are specified for the Softcopy Presentation State Storage SOP Classes:

N.4.1 Conformance Statement for An SCU

The following issues shall be documented in the Conformance Statement of any implementation claiming conformance to a Softcopy Presentation State Storage SOP Class as an SCU:

- For an SCU of a Softcopy Presentation State Storage SOP Class that is creating a SOP Instance of the Class, the manner in which presentation related attributes are derived from a displayed image, operator intervention or defaults, and how they are included in the IOD.
- For an SCU of a Softcopy Presentation State Storage SOP Class, the Image Storage SOP Classes that are also supported by the SCU and which may be referenced by instances of the Softcopy Presentation State Storage SOP Class.
- **For an SCU of a Softcopy Presentation State Storage SOP Class whether it supports the Compound Graphic Sequence (0070,0209) and specifies which compound graphic types can be generated, including additional private defined compound graphic types.**

N.4.2 Conformance Statement for An SCP

The following issues shall be documented in the Conformance Statement of any implementation claiming conformance to a Softcopy Presentation State Storage SOP Class as an SCP:

- For an SCP of a Softcopy Presentation State Storage SOP Class that is displaying an image referred to by a SOP Instance of the Class, the manner in which presentation related attributes are used to influence the display of an image.

374 — For an SCP of a Softcopy Presentation State Storage SOP Class, the Image Storage SOP Classes that are also supported by the SCP and which may be referenced by instances of the
376 Softcopy Presentation State Storage SOP Class.

— **For an SCP of a Softcopy Presentation State Storage SOP Class whether it supports the**
378 **Compound Graphic Sequence (0070,0209) and which compound graphic types can be rendered, including additional private defined compound graphic types.**

380

382

384

386

388

390

Changes to NEMA Standards Publication PS 3.6-2009

Digital Imaging and Communications in Medicine (DICOM)

392

Part 6: Data Dictionary

Item #9: Add the following rows to Section 6

394

Tag	Name	Keyword	VR	VM
(0070,0207)	Graphic Group Label	GraphicGroupLabel	LO	1
(0070,0208)	Graphic Group Description	GraphicGroupDescription	ST	1
(0070,0209)	Compound Graphic Sequence	CompoundGraphicSequence	SQ	1
(0070,0226)	Compound Graphic Instance ID	CompoundGraphicInstanceID	UL	1
(0070,0227)	Font Name	FontName	LO	1
(0070,0228)	Font Name Type	FontNameType	CS	1
(0070,0229)	CSS Font Name	CSSFontName	LO	1
(0070,0230)	Rotation Angle	RotationAngle	FD	1
(0070,0231)	Text Style Sequence	TextStyleSequence	SQ	1
(0070,0232)	Line Style Sequence	LineStyleSequence	SQ	1
(0070,0233)	Fill Style Sequence	FillStyleSequence	SQ	1
(0070,0234)	Graphic Group Sequence	GraphicGroupSequence	SQ	1
(0070,0241)	Text Color CIELab Value	TextColorCIELabValue	US	3
(0070,0242)	Horizontal Alignment	HorizontalAlignment	CS	1
(0070,0243)	Vertical Alignment	VerticalAlignment	CS	1
(0070,0244)	Shadow Style	ShadowStyle	CS	1
(0070,0245)	Shadow Offset X	ShadowOffsetX	FL	1
(0070,0246)	Shadow Offset Y	ShadowOffsetY	FL	1
(0070,0247)	Shadow Color CIELab Value	ShadowColorCIELabValue	US	3
(0070,0248)	Underlined	Underlined	CS	1
(0070,0249)	Bold	Bold	CS	1
(0070,0250)	Italic	Italic	CS	1
(0070,0251)	Pattern On Color CIELab Value	PatternOnColorCIELabValue	US	3
(0070,0252)	Pattern Off Color CIELab Value	PatternOffColorCIELabValue	US	3
(0070,0253)	Line Thickness	LineThickness	FL	1
(0070,0254)	Line Dashing Style	LineDashingStyle	CS	1
(0070,0255)	Line Pattern	LinePattern	UL	1
(0070,0256)	Fill Pattern	FillPattern	OB	1
(0070,0257)	Fill Mode	FillMode	CS	1

(0070,0258)	Shadow Opacity	ShadowOpacity	FL	1
(0070,0261)	Gap Length	GapLength	FL	1
(0070,0262)	Diameter of Visibility	DiameterOfVisibility	FL	1
(0070,0273)	Rotation Point	RotationPoint	FL	2
(0070,0274)	Tick Alignment	TickAlignment	CS	1
(0070,0278)	Show Tick Label	ShowTickLabel	CS	1
(0070,0279)	Tick Label Alignment	TickLabelAlignment	CS	1
(0070,0282)	Compound Graphic Units	CompoundGraphicUnits	CS	1
(0070,0284)	Pattern On Opacity	PatternOnOpacity	FL	1
(0070,0285)	Pattern Off Opacity	PatternOffOpacity	FL	1
(0070,0287)	Major Ticks Sequence	MajorTicksSequence	SQ	1
(0070,0288)	Tick Position	TickPosition	FL	1
(0070,0289)	Tick Label	TickLabel	SH	1
(0070,0294)	Compound Graphic Type	CompoundGraphicType	CS	1
(0070,0295)	Graphic Group ID	GraphicGroupID	UL	1

396

398

400

402

404 **Changes to NEMA Standards Publication PS 3.17-2009**

Digital Imaging and Communications in Medicine (DICOM)

406 **Part 17: Explanatory Information**

Item #10: Add new Annex:

Annex X Compound and Combined Graphic Objects in Presentation States (Informative)

Presentation States may contain Compound Graphics and combined graphic objects. Two illustrative examples are given in this informative annex to explain these two concepts.

First, an example of a Compound Graphic is given, an AXIS object, and secondly an example of a combined graphic object is given, a distance line.

The rendered appearance of the Compound Graphics (such as illustrated in Figure 1-10) are recommendations and are not mandatory. For example, the Compound Graphic 'AXIS' can look slightly different on different viewing workstations.

X.1 AN EXAMPLE OF THE COMPOUND GRAPHIC 'AXIS'

The AXIS from Figure X-1 is defined in the following Compound Graphic Sequence (0070,0209) (see the following Table X-1). An AXIS object is typically used for measurement purposes.

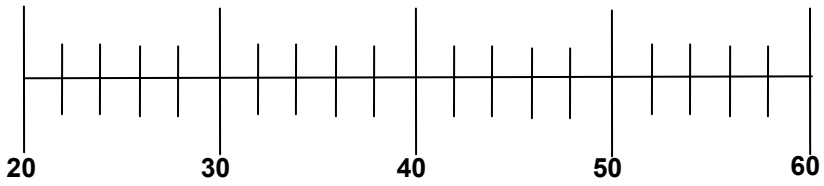


Figure X-1
Compound Graphic 'AXIS'

Table X-1
GRAPHIC ANNOTATION MODULE ATTRIBUTES

Attribute Name	Tag	Attribute Value
Graphic Annotation Sequence	(0070,0001)	…
…		
>Compound Graphic Sequence	(0070,0209)	
>>Compound Graphic Instance ID	(0070,0226)	1
>>Compound Graphic Units	(0070,0282)	PIXEL
>>Graphic Dimensions	(0070,0020)	2
>>Number of Graphic Points	(0070,0021)	2
>>Graphic Data	(0070,0022)	10\10\150\10
>>Compound Graphic Type	(0070,0294)	AXIS
>>Major Ticks Sequence	(0070,0287)	

%item		
>>>Tick Position	(0070,0288)	0
>>>Tick Label	(0070,0289)	20
%enditem		
%item		
>>>Tick Position	(0070,0288)	0.25
>>>Tick Label	(0070,0289)	30
%enditem		
%item		
>>>Tick Position	(0070,0288)	0.5
>>>Tick Label	(0070,0289)	40
%enditem		
%item		
>>>Tick Position	(0070,0288)	0.75
>>>Tick Label	(0070,0289)	50
%enditem		
%item		
>>>Tick Position	(0070,0288)	1.0
>>>Tick Label	(0070,0289)	60
%enditem		
%endseq		
>>Tick Alignment	(0070,0274)	CENTER
>>Tick Label Alignment	(0070,0279)	BOTTOM
>>Show Tick Label	(0070,0278)	Y

The following table shows the simple graphic objects for an axis. The breakdown of the axis into simple graphics is up to the implementation. The Compound Graphic Instance ID (0070,0226) is used to relate the compound and the simple representation. To keep the example short only the first major tick is shown.

Table X-2
GRAPHIC ANNOTATION MODULE ATTRIBUTES

Attribute Name	Tag	Attribute Value	Comment
Graphic Annotation Sequence	(0070,0001)	…	
…			
>Text Object Sequence	(0070,0008)		Tick Labels
>>Anchor Point Annotation Units	(0070,0004)	PIXEL	First Tick Label
>>Anchor Point	(0070,0014)	8/22	
>>Anchor Point Visibility	(0070,0015)	N	
>>Unformatted Text Value	(0070,0006)	20	
>>Compound Graphic Instance ID	(0070,0226)	1	
…			

>Graphic Object Sequence	(0070,0009)		Primary Axis Line
>>Graphic Annotation Units	(0070,0005)	PIXEL	
>>Graphic Dimensions	(0070,0020)	2	
>>Number of Graphic Points	(0070,0021)	2	
>>Graphic Data	(0070,0022)	10\10\150\10	
>>Graphic Type	(0070,0023)	POLYLINE	
>>Compound Graphic Instance ID	(0070,0226)	1	
…			
>>Graphic Annotation Units	(0070,0005)	PIXEL	First Major Tick
>>Graphic Dimensions	(0070,0020)	2	
>>Number of Graphic Points	(0070,0021)	2	
>>Graphic Data	(0070,0022)	10\5\10\15	
>>Graphic Type	(0070,0023)	POLYLINE	
>>Compound Graphic Instance ID	(0070,0226)	1	
…			

X.2 AN EXAMPLE OF DISTANCELINE DEFINED AS A COMBINED GRAPHIC OBJECT

Now, a distance line is defined as a combined graphic object, i.e. grouping a text object with a polyline graphic object (see Figure X-2). Distance lines are typically used for measurements and for computing the grayscale values along this line to build up a profile curve.

This simple example is intended to show how the Graphic Group ID (0070,0295) is used for grouping of graphic annotations.

52.20 mm

Figure X-2
Combined Graphic Object 'DistanceLine'

Table X-3
GRAPHIC GROUP MODULE

Attribute Name	Tag	Attribute Value
Graphic Group Sequence	(0070,0234)	
>Graphic Group ID	(0070,0295)	1
>Graphic Group Label	(0070,0207)	DistanceLine
>Graphic Group Description	(0070,0208)	Measurement Tool

448

Table X-4
GRAPHIC ANNOTATION MODULE ATTRIBUTES

Attribute Name	Tag	Attribute Value
Graphic Annotation Sequence	(0070,0001)	…
…		
>Text Object Sequence	(0070,0008)	
>>Anchor Point Annotation Units	(0070,0004)	PIXEL
>>Anchor Point	(0070,0014)	70/20
>>Anchor Point Visibility	(0070,0015)	N
>>Unformatted Text Value	(0070,0006)	52.20 mm
>> Graphic Group ID	(0070,0295)	1
…		
>Compound Object Sequence	(0070,0009)	
>>Graphic Annotation Units	(0070,0005)	PIXEL
>>Graphic Dimensions	(0070,0020)	2
>>Number of Graphic Points	(0070,0021)	2
>>Graphic Data	(0070,0022)	10\10\150\10
>>Graphic Type	(0070,0023)	POLYLINE
>>Graphic Group ID	(0070,0295)	1

450