

## DICOM Correction Item

Correction Number	CP-593
Log Summary: Rename and Extension of Cardiac Trigger Macro	
Type of Modification	Name of Standard
Clarification / Addition / Correction	PS 3.3 - 2004 + Supplement 83
Rationale for Correction:  This change proposal proposes registration of respiratory triggers for respiratory and cardiac/respiratory examination for the Enhanced MR, Spectroscopy, CT multi-frame IOD and Enhanced XA/XRF.  To fulfill the requirements the next extensions and changes are proposed:  1. Extension of the Cardiac Trigger Functional Group. 2. Introduction of a new Functional group for Respiratory Triggers.	
Sections of documents affected:  PS 3.3 Sections A.36.2.4, A.36.3.4, A.38.1.4, C.7.6.16.2, C.7.6.18.2, C.8.15.2.1.1.3 and C.8.16.1.3  PS 3.3, Part 6.  Supplement 83 Sections A.X.4 and A.Y.4	
Correction Wording:	

**Item 1: Add new functional group to PS 3.3, Section A.36.2.4**

**A.36.2.4 Enhanced MR Image Functional Group Macros**

Table A.36-2 specifies the use of the Functional Group macros used in the Multi-frame Functional Groups Module for the Enhanced MR Image IOD.

**Table A.36-2  
 ENHANCED MR IMAGE FUNCTIONAL GROUP MACROS**

Functional Group Macro	Section	Usage
...		
Cardiac Trigger	C.7.6.16.2.7	C - Required if Cardiac Synchronization Technique (0018,9037) equals other than NONE and if Image Type (0008,0008) Value 1 is ORIGINAL or MIXED. May be present otherwise.
...		
Contrast/Bolus Usage	C.7.6.16.2.12	C – Required if Contrast/Bolus Agent Sequence (0018,0012) is used. May not be used as a Shared Functional Group
<b><u>Respiratory Trigger</u></b>	<b><u>C.7.6.16.2.X</u></b>	<b><u>C – Required if Respiratory Motion Compensation Technique (0018,9170) equals other than NONE, REALTIME or BREATH_HOLD and if Image Type (0008,0008) Value 1 is ORIGINAL or MIXED. May be present otherwise.</u></b>
...		

**Item 2: Add new functional group to PS 3.3, Section A.36.3.4**

**A.36.3.4 MR Spectroscopy Functional Group Macros**

Table A.36-4 specifies the use of the Functional Group macros used in the Multi-frame Functional Groups Module for the MR Spectroscopy IOD.

**Table A.36-4  
 MR SPECTROSCOPY FUNCTIONAL GROUP MACROS**

Functional Group Macro	Section	Usage
...		
Cardiac Trigger	C.7.6.16.2.7	C - Required if Cardiac Synchronization Technique (0018,9037) equals other than NONE and if Image Type (0008,0008) Value 1 is ORIGINAL or MIXED. May be present otherwise.
...		
Contrast/Bolus Usage	C.7.6.16.2.12	C – Required if Contrast/Bolus Agent Sequence (0018,0012) is used. May not be used as a Shared Functional Group
<b><u>Respiratory Trigger</u></b>	<b><u>C.7.6.16.2.X</u></b>	<b><u>C – Required if Respiratory Motion Compensation Technique (0018,9170) equals other than NONE, REALTIME or BREATH_HOLD and if Image Type (0008,0008) Value 1 is ORIGINAL or MIXED. May be present otherwise.</u></b>
...		

**Item 3: Add new functional group to PS 3.3, Section A.38.1.4**

**A.38.1.4 Enhanced CT Image Functional Group Macros**

Table A.38-2 specifies the use of the Functional Group macros used in the Multi-frame Functional Group Module for the Enhanced CT Image IOD.

**Table A.38-2  
ENHANCED CT IMAGE FUNCTIONAL GROUP MACROS**

Functional Group Macro	Section	Usage
...	...	...
Cardiac Trigger	C.7.6.16.2.7	C - Required if Cardiac Synchronization Technique (0018,9037) equals other than NONE and if Image Type (0008,0008) Value 1 is ORIGINAL or MIXED. May be present otherwise.
...	...	...
Contrast/Bolus Usage	C.7.6.16.2.12	C – Required if Contrast/Bolus Agent Sequence (0018,0012) is used. May not be used as a Shared Functional Group
<b><u>Respiratory Trigger</u></b>	<b><u>C.7.6.16.2.X</u></b>	<b><u>C – Required if Respiratory Motion Compensation Technique (0018,9170) equals other than NONE, REALTIME or BREATH_HOLD and if Image Type (0008,0008) Value 1 is ORIGINAL or MIXED. May be present otherwise.</u></b>
...	...	...

**Item 4: Add new functional group to Supplement 83, Section A.X.4**

**A.X.4 Enhanced XA Image Functional Group Macros**

Table A.X-2 specifies the use of the Functional Group macros used in the Multi-frame Functional Groups Module for the Enhanced XA Image IOD.

**Table A.X-2  
ENHANCED XA IMAGE FUNCTIONAL GROUP MACROS**

Functional Group Macro	Section	Usage
...		
Cardiac Trigger	C.7.6.16.2.7	U
...		
Frame Display Shutter	C.7.6.16.2.X5	U
<b><u>Respiratory Trigger</u></b>	<b><u>C.7.6.16.2.X</u></b>	<b><u>U</u></b>
...		

**Item 5: Add new functional group to Supplement 83, Section A.Y.4**

**A.Y.4 Enhanced XRF Image Functional Group Macros**

Table A.Y-2 specifies the use of the Functional Group macros used in the Multi-frame Functional Groups Module for the Enhanced XRF Image IOD.

**Table A.Y-2  
 ENHANCED XRF IMAGE FUNCTIONAL GROUP MACROS**

Functional Group Macro	Section	Usage
...		
Cardiac Trigger	C.7.6.16.2.7	U
...		
Frame Display Shutter	C.7.6.16.2.X5	U
<b><u>Respiratory Trigger</u></b>	<b><u>C.7.6.16.2.X</u></b>	<b><u>U</u></b>
...		

**Item 6: Add new attributes to PS 3., Section C.7.6.16.2.7 and correct Figure C.7.6.16-5**

**C.7.6.16.2.7 Cardiac Trigger Macro**

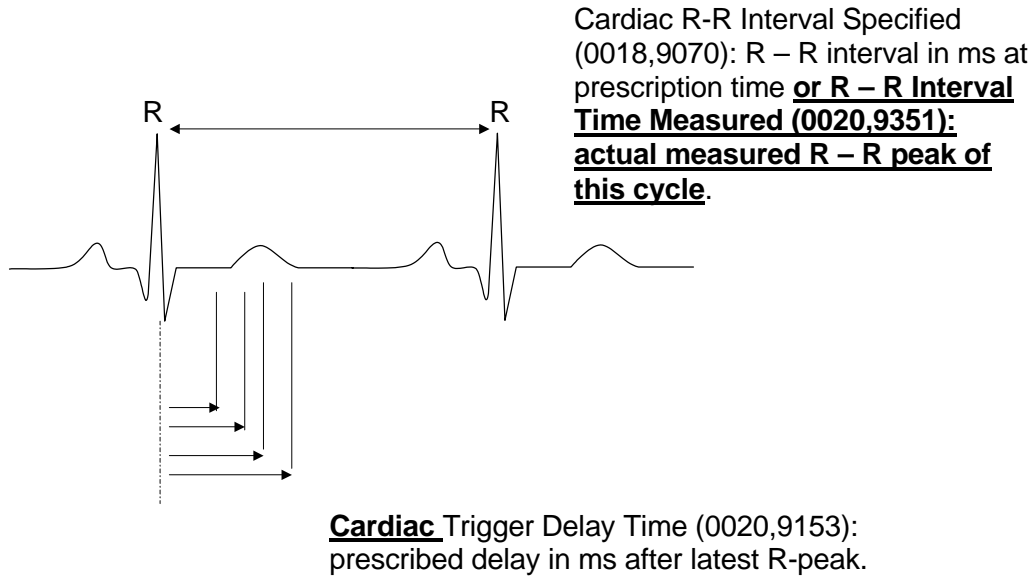
Table C.7.6.16-8 specifies the attributes of the Cardiac Trigger Functional Group macro.

**Table C.7.6.16-8  
 CARDIAC TRIGGER MACRO ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Cardiac Trigger Sequence	(0018,9118)	1	Identifies cardiac trigger delay for this frame. Only a single Item shall be permitted in this sequence.
> <b><u>Cardiac</u></b> Trigger Delay Time	(0020,9153)	1	Trigger delay time in ms from the previous R-peak to the value of the Frame Reference Datetime (0018,9151). See C.7.6.16.2.7.1 for further explanation.
> <b><u>R – R Interval Time Measured</u></b>	<b><u>(0020,9251)</u></b>	<b><u>1C</u></b>	<b><u>Measured R-peak – R-peak interval time in ms for the cardiac cycle in which this frame occurs. See C.7.6.16.2.7.1 for further explanation. Required if Cardiac Synchronization Technique (0018,9037) equals other than NONE or REALTIME. May be present otherwise.</u></b>

**C.7.6.16.2.7.1 Relationship of Cardiac Timing Attributes**

Figure C.7.6.16-5 depicts the usage.



**Figure C.7.6.16-5  
 Cardiac Timing Tags**

**Item 7: Add new section to PS 3.3, Section C.7.6.16.2**

**C.7.6.16.2.X Respiratory Trigger Macro**

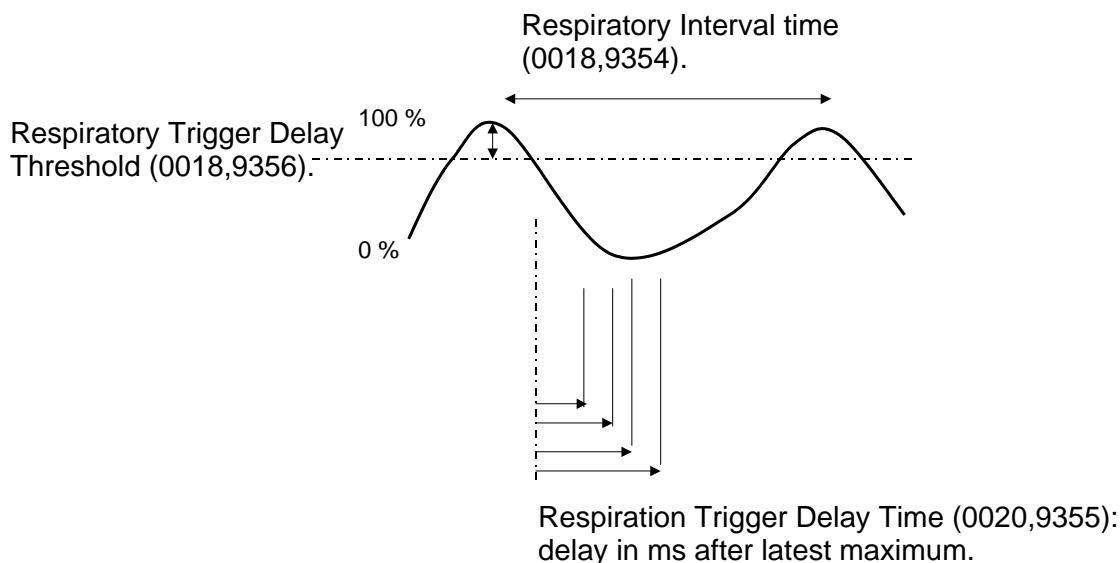
Table C.7.6.16-X specifies the attributes of the Respiratory Trigger Functional Group macro.

**Table C.7.6.16-X  
 RESPIRATORY TRIGGER MACRO ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Respiratory Trigger Sequence	(0018,9253)	1	Identifies respiratory trigger delay for this frame. Only a single Item shall be permitted in this sequence.
>Respiratory Interval Time	(0020,9254)	1	Measured interval time in ms from maximum respiration peak to the next peak for the respiratory cycle in which this frame occurs. See C.7.6.16.2.X.1 for further explanation.  Required if (Respiratory Motion Compensation Technique (0018,9170)) equals other than NONE or REALTIME) and (Respiratory Signal Source (0018,9171) is BELT). May be present otherwise.
>Respiratory Trigger Delay Time	(0020,9255)	1	Trigger delay time in ms from the time defined by value of Respiratory Trigger Delay Threshold (0018,93x6) following the previous maximum value of respiration, to the value of the Frame Reference Datetime (0018,9151). See C.7.6.16.2.X.1 for further explanation.

**C.7.6.16.2.X.1 Relationship of Respiratory Timing Attributes**

Figure C.7.6.16-X depicts the usage.



**Figure C.7.6.16-X  
 Respiratory Timing Tags**

**Item 8: Correct example in C.7.6.17.1 and replace Figure C.7.6.17-1**

Note: An example of the usage of the Dimension Index Sequence (0020,9222) and Dimension Index Values (0020,9157) attributes:

Dimension Index Sequence (0020,9222) specifies two indices:

- Cardiac** Trigger Delay Time (0020,9153)
- Image Position (Patient) (0020,0032)

The Dimension Index Sequence (0020,9222) is filled with the following contents:

Item	Attribute	Value
1	Dimension Index Pointer	(0020,9153)
	Functional Group Pointer	(0018,9118)
	.....	
2	Dimension Index Pointer	(0020,0032)
	Functional Group Pointer	(0020,9113)
	.....	

The Dimension Index Values (0020,9157) (in the Frame Content Functional Group) for each frame consists of two values:

Index of **Cardiac** Trigger Delay Time \ Index of Image Position

The SOP Instance creator is responsible for maintaining consistency between the actual value of the attribute listed as the Dimension Index Pointer (0020,9165) and the corresponding value in the Dimension Index Values (0020,9157) attribute.

See Figure C.7.6.17-1 for an illustration of this example.

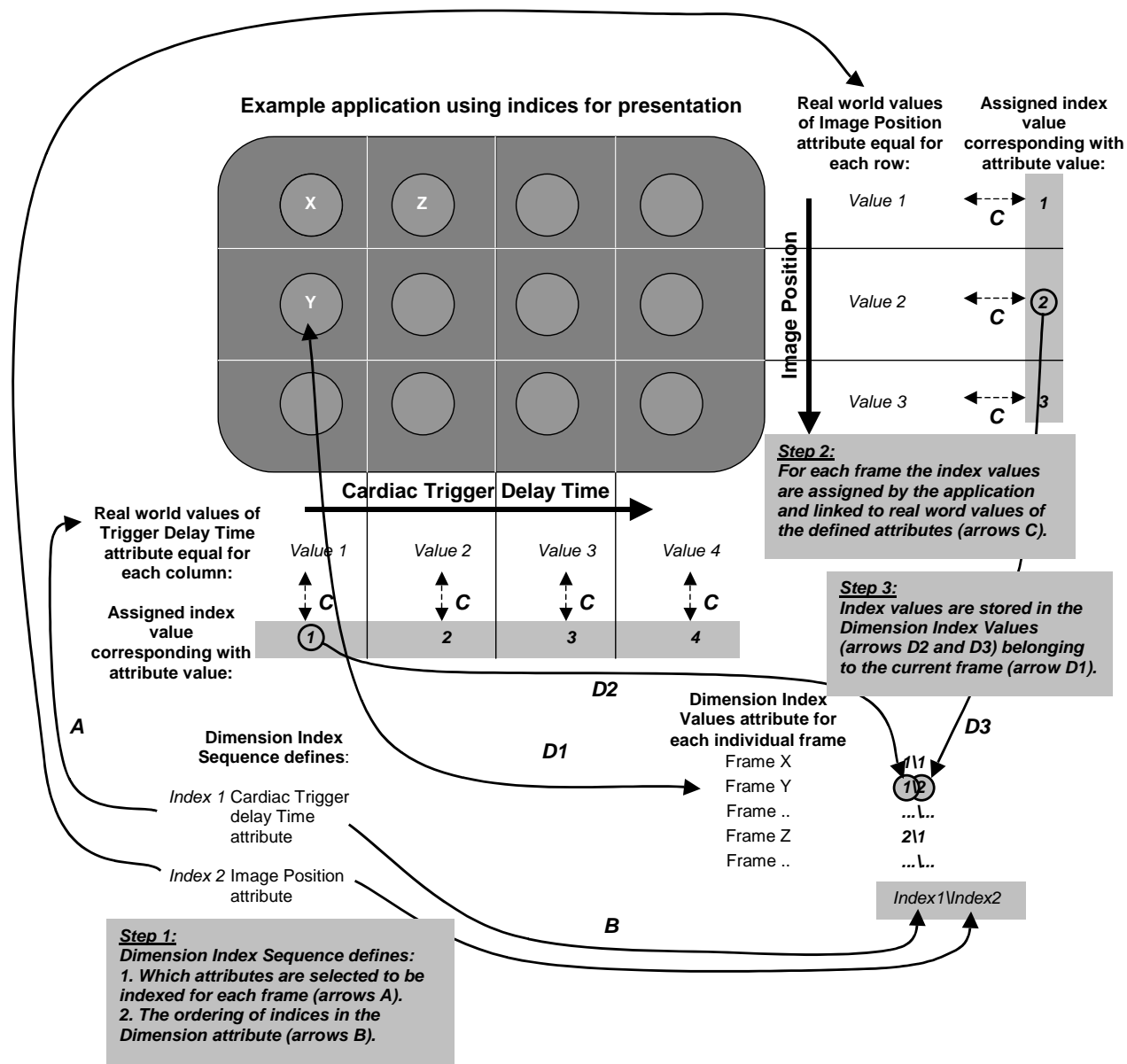


Figure C.7.6.17-1  
Example of Dimension Index Sequence and Dimension Index Values attributes

**Item 9: Add Respiration Trigger Delay Threshold to Table C.7.6.18-2**

**C.7.6.18.2 Respiratory Synchronization Module**

Table C7.6.18-2 specifies the attributes of the Respiratory Synchronization Module.

**Table C.7.6.18-2  
RESPIRATORY SYNCHRONIZATION MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Respiratory Signal Source	(0018,9171)	1C	Signal source from which respiratory motion is derived. Defined Terms:

			<p>NONE          BELT          NASAL_PROBE          CO2_SENSOR          NAVIGATOR = MR navigator                            and organ edge                            detection          MR_PHASE = phase (of center                            k-space line)          ECG = baseline                            demodulation of                            the ECG</p> <p>Required if Image Type (0008,0008)          Value 1 is ORIGINAL or MIXED and          Respiratory Motion Compensation          Technique (0018,9170) equals other than          NONE.</p> <p>Otherwise may be present if Image Type          (0008,0008) Value 1 is DERIVED and          Respiratory Motion Compensation          Technique (0018,9170) equals other than          NONE.</p>
<b><u>Respiratory Trigger Delay          Threshold</u></b>	<b><u>(0020,9256)</u></b>	<b><u>1C</u></b>	<p><b><u>Respiratory trigger threshold in percent          of the chest expansion for the frame          relative to the last Respiratory-Peak.          See C.7.6.16.2.X.1 for further          explanation.</u></b></p> <p><b><u>Required if Respiratory Motion          Compensation Technique (0018,9170)          equals other than NONE, REALTIME or          BREATH_HOLD and if Image Type          (0008,0008) Value 1 is ORIGINAL or          MIXED. May be present otherwise.</u></b></p>

***Item 10: Move from PS 3.3, Table C.8-155 image and frame type Values 3 to Common Table and add new terms***

**C.8.15.2.1.1.3 Image Flavor**

Table C.8-115 specifies the Defined Terms for CT additional to those defined in C.8.16.1.3 for Value 3 for Image Type (0008,0008) and Frame Type (0008,9007).

**Table C.8-115  
 IMAGE TYPE AND FRAME TYPE VALUE 3 FOR CT**

<b>Defined Term Name</b>	<b>Defined Term Description</b>
ATTENUATION	Collected for the purpose of performing attenuation corrections (e.g. PET attenuation correction)
<b>CARDIAC</b>	<b>Cardiac images</b>
<b>CARDIAC_GATED</b>	<b>Cardiac gated images</b>
REFERENCE	Collected for anatomical reference for PET or SPECT



**C.8.16.1.3 Image Flavor**

...

**Table C.8-115  
 IMAGE TYPE AND FRAME TYPE VALUE 3 COMMON**

Defined Term Name	Defined Term Description
ANGIO	Collected for the purpose of angiography
<b><u>CARDIAC</u></b>	<b><u>Images of the heart</u></b>
<b><u>CARDIAC_GATED</u></b>	<b><u>Cardiac gated images, other than of the heart</u></b>
<b><u>CARDRESP_GATED</u></b>	<b><u>Cardiac and respiratory gated images</u></b>
...	
POST_CONTRAST	Collected during or after contrast was administered
<b><u>RESP_GATED</u></b>	<b><u>Respiratory gated images</u></b>
...	

*Item 11: Change and add new attributes to PS 3.6, Section 6*

Tag	Name	VR	VM
(0020,9153)	<b><u>Cardiac</u></b> Trigger Delay Time	FD	1
<b><u>(0020,9251)</u></b>	<b><u>R – R Interval Time Measured</u></b>	<b><u>FD</u></b>	<b><u>1</u></b>
<b><u>(0020,9253)</u></b>	<b><u>Respiratory Trigger Sequence</u></b>	<b><u>SQ</u></b>	<b><u>1</u></b>
<b><u>(0020,9254)</u></b>	<b><u>Respiratory Interval Time</u></b>	<b><u>FD</u></b>	<b><u>1</u></b>
<b><u>(0020,9255)</u></b>	<b><u>Respiratory Trigger Delay Time</u></b>	<b><u>FD</u></b>	<b><u>1</u></b>
<b><u>(0020,9256)</u></b>	<b><u>Respiratory Trigger Delay Threshold</u></b>	<b><u>FD</u></b>	<b><u>1</u></b>