

DICOM Correction Proposal

STATUS	Final Text
Date of Last Update	2016/01/19
Person Assigned	Ulrich Busch (ulrich.busch@varian.com)
Submitter Name	Frederic Dessy
Submission Date	2014/10/01

Correction Number	CP-1460
Log Summary: Add Ion Range and Modulation	
Name of Standard PS3.3, PS3.6 2015c	
<p>Rationale for Correction:</p> <p>Multiple manufacturers (TPS, OIS and delivery systems) are currently using the following two private tags to be able to transfer the clinical data that are related to range and modulation (aka Spread Out Bragg Peak or SOBP):</p> <p>(300B,1004) PlannedDistalTargetDistance (300B,100E) NominalSOBPWidth</p> <p>As multiple vendors rely on these attributes, it is worthwhile to make them public and provide clarification about their use.</p> <p>Further on, these attributes are not well defined standing on their own: Different vendors use different definitions of range (ex. distal 80 or 90 %, of the distal Bragg peak used to construct the spread of Bragg peak). Therefore additional attributes are included in that change proposal which declare exactly the intended meaning of the 'range' and 'width'.</p>	
Correction Wording:	

In PS 3.3, Section C.8.8.25 RT Ion Beams Module, add the following attributes and section

C.8.8.25 RT Ion Beams Module

The RT Ion Beams Module contains information defining equipment parameters for delivery of external ion radiation beams.

Table C.8.8.25-1. RT Ion Beams Module Attributes

Attribute Name	Tag	Type	Attribute Description
Ion Beam Sequence	(300A,03A2)	1	Sequence of setup and/or treatment beams for current RT Ion Plan. One or more items shall be included in this sequence.
>Beam Number	(300A,00C0)	1	Identification number of the Beam. The value of Beam Number (300A,00C0) shall be unique within the RT Ion Plan in which it is created. See Section C.8.8.25.1.

...			
>Virtual Source-Axis Distances	(300A,030A)	1	Distance (in mm) from virtual source position to gantry rotation axis or nominal isocenter position (fixed beam-lines) of the equipment to be used for beam delivery. Specified by a numeric pair - the VSAD in the IEC Gantry X direction followed by the VSAD in the IEC Gantry Y direction. The VSAD is commonly used for designing apertures in contrast to the effective source-axis-distance (ESAD) that is commonly used with the inverse square law for calculating the dose decrease with distance. See Section C.8.8.25.4
>Depth Dose Parameters Sequence	(300A,0505)	3	Set of parameters describing the depth dose distribution. Only a single item is permitted in this sequence.
>>Reference Dose Definition	(300A,0512)	1	Definition of the 100% reference dose level. Defined Terms: - HIGHEST - MAXIMUM - CENTER See section C.8.8.25.X
>>Distal Depth	(300A,0502)	1	Penetration depth in water (mm) of the particle excluding any user-installed range modifying devices, measured at the Distal Depth Fraction (300A,0501). See C.8.8.25.X.
>>Distal Depth Fraction	(300A,0501)	1	Fraction of the value of dose relative to the 100% level defined by Reference Dose Definition (300A,0512). This determines the Distal Depth (300A,0502). A value of 1.0 refers to 100% of the reference dose level defined by the Reference Dose Definition (300A,0512). See C.8.8.25.X.

>>Nominal Range Modulated Region Depths	(300A,0504)	1C	<p>The depths of the proximal and distal limits of the range modulated region in water. Contains two values (in mm). The first value defines the depth of the proximal limit. The second value defines the depth of the distal limit. Required if Reference Dose Definition (300A,0512) has the value CENTER. See C.8.8.25.X.</p>
>>Nominal Range Modulation Fractions	(300A,0503)	1C	<p>Fractions of the Reference Dose Definition (300A,0512) defining the proximal and distal limits at which the range-modulated region is defined. Contains two values. The first value defines the modulation fraction value at the proximal limit and the second value defines the modulation fraction value at the distal limit. A value of 1.0 refers to the 100% reference dose level as defined in Reference Dose Definition (300A,0512). Required if Nominal Range Modulated Region Depths (300A,0504) is present. See C.8.8.25.X.</p>

C.8.8.25.1 Beam Identifying Information

....

C.8.8.25.X Depth Dose Parameters Sequence Attributes

Some delivery systems determine the settings of the range shifter (or beam energy) and range modulators internally based upon clinical parameters.

The attributes mentioned in this section represent those clinical parameters.

When the Depth Dose Parameters Sequence (300A,0505) is present, those specifications have precedence over the definitions of the Range Shifters defined in Range Shifter Settings Sequence (300A,0360) and the Range Modulator defined in Range Modulator Settings Sequence (300A,0380).

The following three figures explain the use of the Range Modulated Region attributes.

Figure C.8.8.25-Y1 shows an example of those attributes with the following values:

Nominal Range Modulated Region Depths (300A,0504) = 147/298

Reference Dose Definition (300A,0512) = CENTER

Distal Depth (300A,0502) = 301

Distal Depth Fraction (300A,0501) = 0.9

Nominal Range Modulation Fractions (300A,0503) = 0.95\0.98

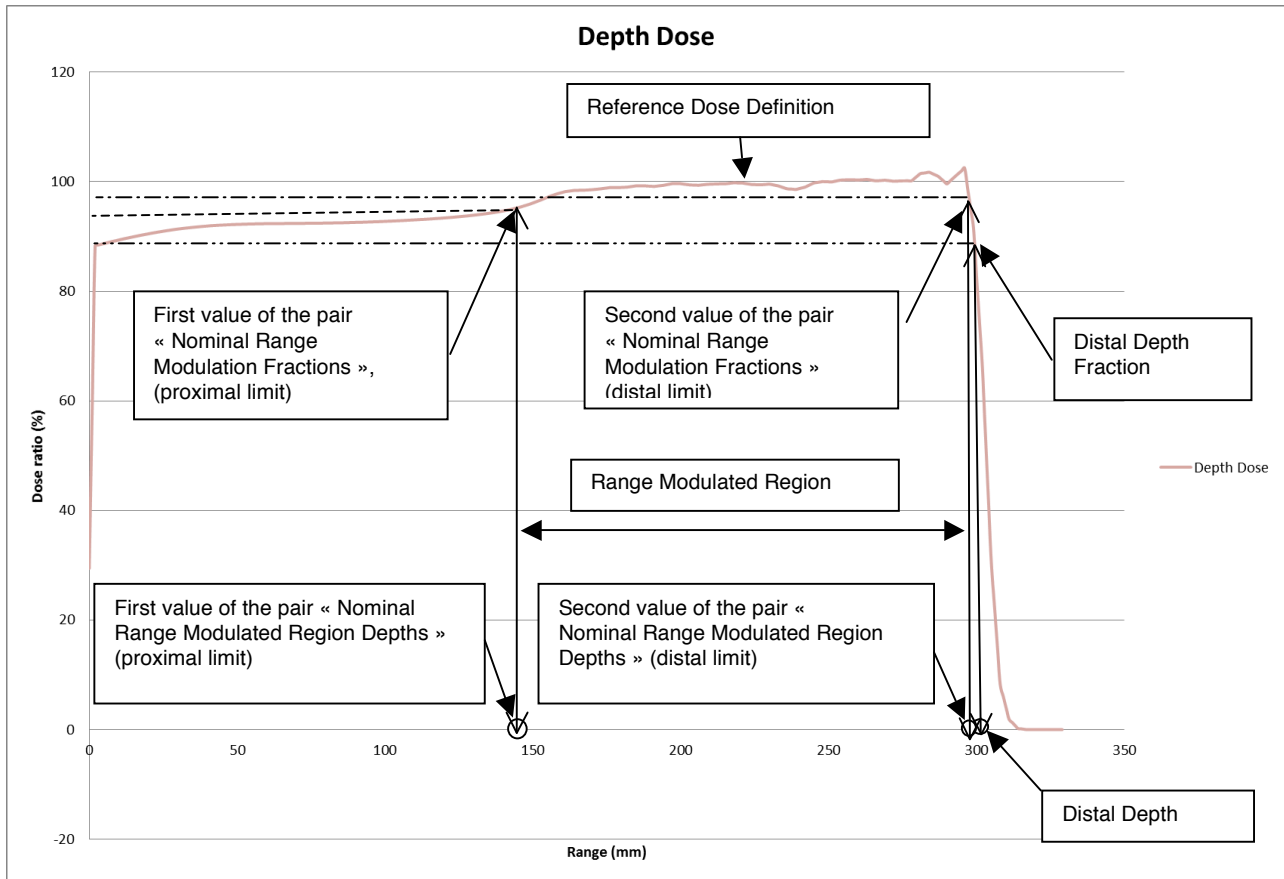


Figure C.8.8.25-Y1: Attributes specifying a depth dose distribution parameters in case of Reference Dose Definition (300A,0512) = CENTER

The following figure C.8.8.25-Y2 is an expansion of the steep-gradient part of the depth dose curve for better readability of the parameters annotating this part.

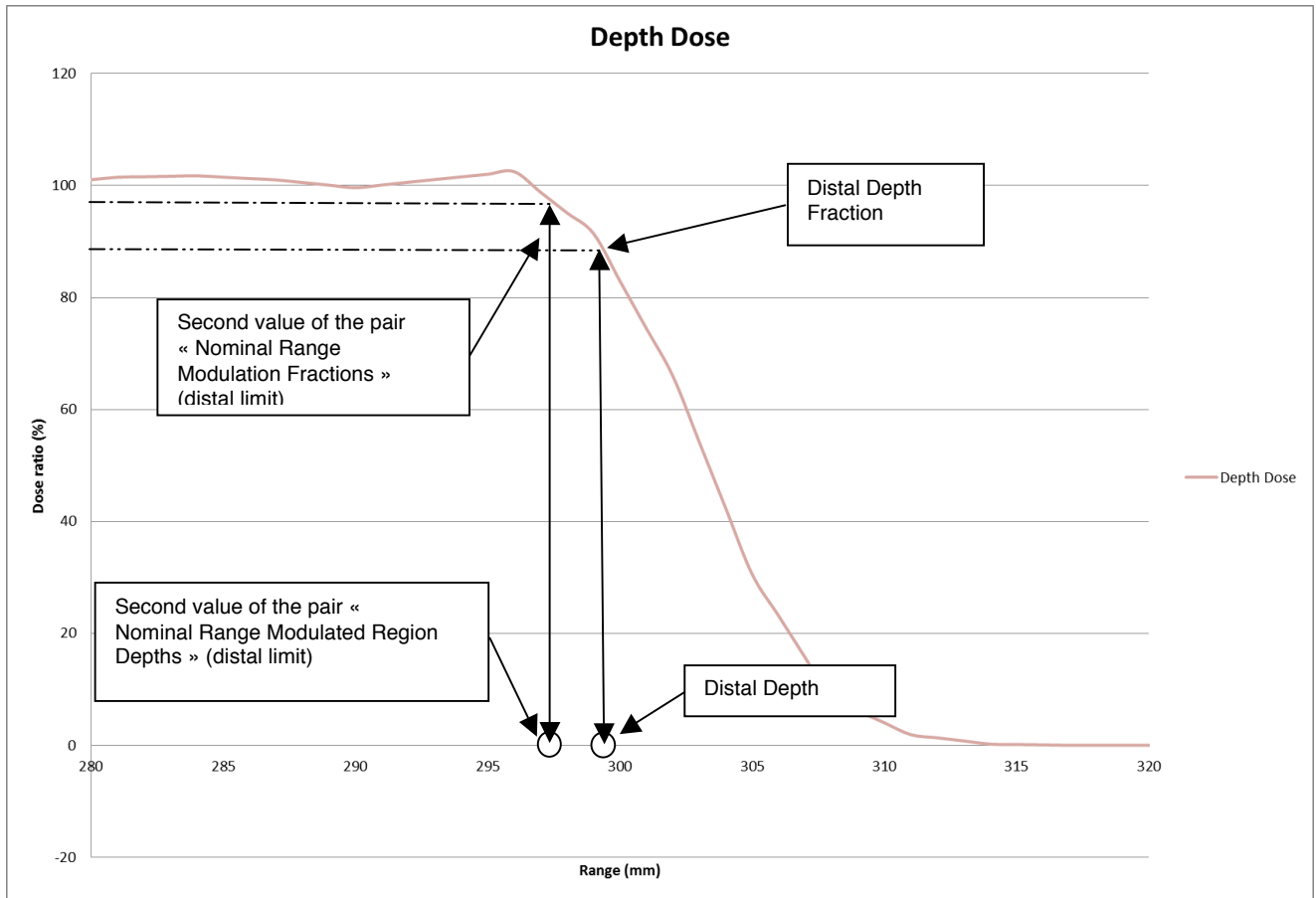


Figure C.8.8.25-Y2: Attributes specifying a generic depth dose distribution. Abscissa expanded near distal edge of dose distribution.

The Defined Terms in Reference Dose Definition (300A,0512) are defined as follows:

- **HIGHEST:** The maximum dose for the highest energy of the non-range modulated component is used for determining the fractions.
- **MAXIMUM:** The maximum dose of the range modulated depth dose distribution is used for determining the fractions.
- **CENTER:** The dose measured at the center of the range modulated region of the depth dose distribution is used for determining the fractions.

Figure C.8.8.25-Y3 shows the usage of the Defined Terms of Reference Dose Definition (300A,0512).

In Figure C.8.8.25-Y3, the modulated region is defined the same as in Figure C.8.8.25-Y1:

Nominal Range Modulated Region Depths (300A,0504) = (147\298)

In this example, the 100% reference level for the dose definition is determined for the Defined Terms specified in Reference Dose Definition (300A,0512) as follows:

- **HIGHEST:** The maximum dose for the highest energy of the non-range modulated component is located at 304 mm and used for determining the fractions.

- **MAXIMUM:** The maximum dose of the range modulated depth dose distribution is located at 300 mm and used for determining the fractions.
- **CENTER:** The dose measured at 220 mm depth at the center of the range modulated region of the depth dose distribution is used for determining the fractions.

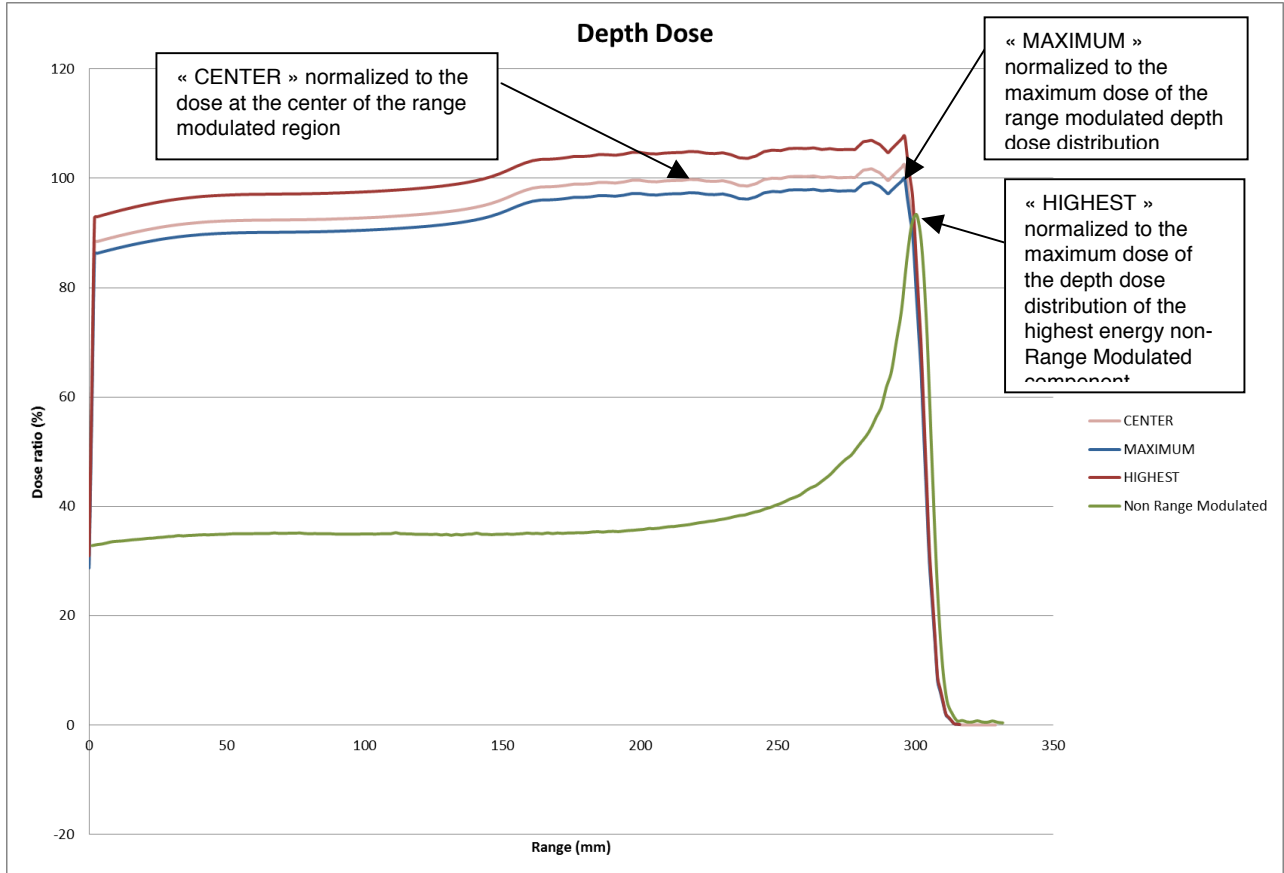


Figure C.8.8.25-Y3: Representation of the different Reference Dose Definition (300A,0512) using the range modulated depth dose distribution or highest energy component depth dose distribution.

In PS 3.3, Section C.8.8.26 RT Ion Beams Session Record Module, add the following attributes:

Table C.8.8.26-1. RT Ion Beams Session Record Module Attributes

Attribute Name	Tag	Type	Attribute Description
Treatment Session Ion Beam Sequence	(3008,0021)	1	Sequence of setup and/or Treatment beams administered during a treatment session. One or more items shall be included in this sequence.

>Referenced Beam Number	(300C,0006)	1	References Beam specified by Beam Number (300A,00C0) in Ion Beam Sequence (300A,03A2) in RT Ion Beams Module within the referenced RT Ion Plan.
...			
>Delivered Treatment Time	(3008,003B)	3	Treatment Time actually delivered (sec).
>Delivered Depth Dose Parameters Sequence	(300A,0506)	3	Set of parameters describing the depth dose distribution. Only a single item is permitted in this sequence.
>>Delivered Reference Dose Definition	(300A,0511)	1	Definition of the 100% delivered reference dose level. Defined terms: - HIGHEST - MAXIMUM - CENTER See C.8.8.25.X.
>>Delivered Distal Depth	(300A,0508)	1	Penetration depth in water (mm) of the delivered particle excluding any user-installed range modifying devices, measured at the Delivered Distal Depth Fraction (300A,0507). See C.8.8.25.X.
>>Delivered Distal Depth Fraction	(300A,0507)	1	Fraction of the value of dose relative to the 100% level defined by Delivered Reference Dose Definition (300A,0511). This determines the Delivered Distal Depth (300A,0508). A value of 1.0 refers to 100% of the reference dose level defined by the Delivered Reference Dose Definition (300A,0511). See C.8.8.25.X.
>>Delivered Nominal Range Modulated Region Depths	(300A,0510)	1C	The depths of the proximal and distal limits of the range modulated region in water. Contains two values (in mm). The first value defines the depth of the proximal limit. The second value defines the depth of the distal limit. Required if Delivered Reference Dose Definition (300A,0511) has the value CENTER. See C.8.8.25.X.

>>Delivered Nominal Range Modulation Fractions	(300A,0509)	1C	Delivered Fractions of the Delivered Reference Dose Definition (300A,0511) defining the proximal and distal limits at which the range-modulated region is defined. Contains two values. The first value defines the modulation fraction value at the proximal limit and the second value defines the modulation fraction value at the distal limit. A value of 1.0 refers to the 100% reference dose level as defined in Delivered Reference Dose Definition (300A,0511). Required if Delivered Nominal Range Modulated Region Depths (300A,0510) is present. See C.8.8.25.X.
---	--------------------	-----------	--

In PS 3.6, Section 6, add the following attributes:

(300A,0501)	Distal Depth Fraction	DistalDepthFraction	FL	1
(300A,0502)	Distal Depth	DistalDepth	FL	1
(300A,0503)	Nominal Range Modulation Fractions	NominalRangeModulatioFr actions	FL	2
(300A,0504)	Nominal Range Modulated Region Depths	NominalRangeModulatedR egionDepths	FL	2
(300A,0505)	Depth Dose Parameters Sequence	DepthDoseParametersSeq uence	SQ	1
(300A,0506)	Delivered Depth Dose Parameters Sequence	DeliveredDepthDosePara metersSequence	SQ	1
(300A,0507)	Delivered Distal Depth Fraction	DeliveredDistalDepthFract ion	FL	1
(300A,0508)	Delivered Distal Depth	DeliveredDistalDepth	FL	1
(300A,0509)	Delivered Nominal Range Modulation Fractions	DeliveredNominalRangeM odulationFractions	FL	2
(300A,0510)	Delivered Nominal Range Modulated Region Depths	DeliveredNominalRangeM odulatedRegionDepths	FL	2
(300A,0511)	Delivered Reference Dose Definition	DeliveredReferenceDoseD efinition	CS	1
(300A,0512)	Reference Dose Definition	ReferenceDoseDefinition	CS	1