

DICOM Correction Proposal

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Correction Number	CP1969
Log Summary: Clarifications of Modulated Scan Mode Type (300A,0309) and related examples	
Name of Standard PS 3.3 2019e	
<p>Rationale for Correction:</p> <p>The current description of Modulated Scan Mode Type (300A,0309) does not clearly state that the defined terms LEAPING and LINEAR include support for turning off the beam between spots. This should be clarified to avoid unnecessary use of the more complicated Defined Term MIXED.</p> <p>Also, since LEAPING and LINEAR support turning off the beam between spots, there is no need for any combination between either of them and STATIONARY. The new clarification of the definitions of LEAPING and LINEAR hence obsoletes the need for MIXED; this term can be retired. To further clarify how the scan mode types are related, this CP also includes updates to the provided examples. The MIXED examples are removed. See the correction wording for further details.</p> <p>In an adjacent section, the Ion Control Point Sequence examples are incorrect. New wording for these examples is detailed below.</p> <p>These changes are important to avoid confusion in standard interpretation.</p>	

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	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.
...			
>Scan Mode	(300A,0308)	1	The method of beam scanning to be used during treatment. Defined Terms: NONE No beam scanning is performed. UNIFORM Between control points, the beam is scanned to create a uniform lateral fluence distribution across the field. MODULATED Between control points, the beam is scanned to create a modulated lateral fluence distribution across the field. MODULATED_SPEC Between control points, the beam is scanned to create a modulated lateral fluence distribution across the field. The specific scan mode is defined by Modulated Scan Mode Type (300A,0309).
>Modulated Scan Mode Type	(300A,0309)	1C	Defines the specialization of a modulated scan mode. Defined Terms: STATIONARY The Meterset is delivered while the beam spot is at the specified position. <u>The Meterset is delivered while the beam spot is at the specified position. The beam is always turned off when the position changes.</u> LEAPING The delivery of the specified Meterset for the current spot position begins when the spot is at the previous spot position but the spot moves as quickly as possible to the current specified spot position where most of the Meterset is delivered. <u>The Meterset is mainly delivered at the specified spot position, while some of the Meterset is delivered while the spot is moved from the prior spot position. This mode also supports turning off the beam between spot positions.</u>

			<p>LINEAR The beam spot is delivered with uniform flux while traveling from one position to the next position (continuous). <u>The Meterset is delivered uniformly while the beam spot position changes. This mode also supports turning off the beam between line segments.</u></p> <p>MIXED The meterset is delivered by a combination of STATIONARY and LINEAR or LEAPING and LINEAR.</p> <p><u>See Note.</u></p> <p>Required if Scan Mode (300A,0308) is MODULATED_SPEC. See Section C.8.8.25.8.</p>
...			

Note: For attribute Modulated Scan Mode Type (300A,0309) the Defined Term MIXED was previously defined. It is now retired.

C.8.8.25.7 Ion Control Point Sequence

The control point sequence for RT Ion Beams is defined using the same rule set as in the [RT Beams Module](#) (see [Section C.8.8.14.5](#)). Specifically, the following rules apply:

- All parameters that change at any control point of a given beam shall be specified explicitly at all control points (including those preceding the change).
- All parameters of an irradiation segment (i.e., with values of the Cumulative Meterset Weight (300A,0134) different at the beginning and at the end of the segment) shall therefore be specified in 2 separate control points denoting the beginning and at the end of this segment. Each irradiation segment is therefore represented by 2 control points.
- Parameters changing during the segment shall be represented by their different values at those control points. Parameters that do not change during the segment shall be represented with equal values at both control points (unless they are constant for all control points of the beam). For example, a beam delivery involving two independent irradiation segments will require 4 control points. Control Points 0 and 1 define the first irradiation segment. Between control points 1 and 2, no radiation is given (Meterset is constant), but other parameters may change. Finally, the second irradiation segment occurs between control points 2 and 3.

This definition allows unambiguous and explicit determination of those parameters changing while irradiation is occurring, as opposed to those parameters that change between irradiation segments. No assumptions are made about the behavior of machine parameters between specified control points and communicating devices shall agree on this behavior outside the Standard.

The following example illustrates this rule (not all parameters are shown), in the case of a scanning beam with 2 segments and ~~Total Cumulative Meterset~~ Final Cumulative Meterset Weight (300A,010E) of 70.

~~Control Point 0: All applicable treatment parameters defined, Cumulative Meterset Weight = 0
Nominal Energy: 200 Scan Spot Position Map: -40, -35, -40, -30 (Positions for 1st segment) Scan
Spot Meterset Weight: 0.5, 0.3, 1.2, (Values add up to Meterset difference between Control Points 0
and 1)~~

Control Point 0: All applicable treatment parameters defined, Cumulative Meterset Weight
(300A,0134) = 0 Nominal Energy: 200 Scan Spot Position Map: (-40, -35), (-40, -30) [positions for 1st
segment] Scan Spot Meterset Weight: 10, 20. Values add up to the Cumulative Meterset Weight
difference between Control Points 0 and 1.

~~Control Point 1: All applicable treatment parameters defined, Cumulative Meterset Weight = 30.0
Nominal Energy: 200 Scan Spot Position Map: -40, -35, -40, -30 (Positions for 1st segment) Scan
Spot Meterset Weight: 0.0, 0.0, 0.0, ... (All values are 0.0, because Meterset Weight difference
between Control Point 1 and 2 is 0.0)~~

Control Point 1: All applicable treatment parameters defined, Cumulative Meterset Weight
(300A,0134) = 30.0 Nominal Energy: 200 Scan Spot Position Map: (-40, -35), (-40, -30) [positions for
1st segment] Scan Spot Meterset Weight: 0.0, 0.0. All values are 0.0, because the Cumulative
Meterset Weight difference between Control Point 1 and 2 is 0.0.

~~Control Point 2: All applicable treatment parameters defined, Cumulative Meterset Weight = 30.0
Nominal Energy: 180 Scan Spot Position Map: -55, -40, -55, -35, (Positions for 2nd segment) Spot
Meterset Weight: 0.7, 0.8, 1.5 (Values add up to Meterset difference between Control Points 2 and
3)~~

Control Point 2: All applicable treatment parameters defined, Cumulative Meterset Weight (300A,0134) = 30.0 Nominal Energy: 180 Scan Spot Position Map: (-55, -40), (-55, -35) [positions for 2nd segment] Scan Spot Meterset Weight: 25, 15. Values add up to the Cumulative Meterset Weight difference between Control Points 2 and 3.

~~Control Point 3: All applicable treatment parameters defined, Cumulative Meterset Weight = 70.0 Nominal Energy: 180 Scan Spot Position Map: -55, -40, -55, -35, (Positions for 2nd segment) Spot Meterset Weight: 0.0, 0.0, 0.0, (All values are 0.0, because there is no following control point (end of sequence).~~

Control Point 3: All applicable treatment parameters defined, Cumulative Meterset Weight (300A,0134) = 70.0 Nominal Energy: 180 Scan Spot Position Map: (-55, -40), (-55, -35) [positions for 2nd segment] Scan Spot Meterset Weight: 0.0, 0.0. All values are 0.0, because there is no following control point (end of sequence).

In PS 3.3, Section C.8.8.25.8 Scan Spot Maps, change the following examples (note that almost the entire section is re-written).

C.8.8.25.8 Scan Spot Maps

The Scan Spot Position Map (300A,0394) and Scan Spot Meterset Weights (300A,0396) shall be used as follows.

The following specifies for each value of Modulated Scan Mode Type (300A,0309) the definition of the map which is included in the Control Point 1 having Cumulative Meterset Weight (300A,0134) = 20, followed by a Control Point 2 having Cumulative Meterset Weight (300A,0134) = 20.

If Modulated Scan Mode Type (300A,0309) is STATIONARY or LEAPING:

Position (X,Y)	(1.0, 2.0)	(3.0, 2.0)	(5.0, 2.0)	(7.0, 2.0)	(9.0, 2.0)
Meterset Weights	5	4	6	2	3

Delivery Description:

- ~~• The beam is positioned at Scan Spot Position (1.0, 2.0).~~
- ~~• The beam is delivered with a Cumulative Meterset Weight of 5.~~
- ~~• The beam is switched off or quickly moved and positioned at Scan Spot Position (3.0, 2.0).~~
- ~~• The beam is delivered with a Cumulative Meterset Weight of 4.~~
- ~~• The beam is switched off or quickly moved and positioned at Scan Spot Position (5.0, 2.0).~~
- ~~• The beam is delivered with a Cumulative Meterset Weight of 6.~~
- ~~• The beam is switched off or quickly moved and positioned at Scan Spot Position (7.0, 2.0).~~
- ~~• The beam is delivered with a Cumulative Meterset Weight of 2.~~
- ~~• The beam is switched off or quickly moved and positioned at Scan Spot Position (9.0, 2.0).~~
- ~~• The beam is delivered with a Cumulative Meterset Weight of 3.~~

If Modulated Scan Mode Type (300A,0309) is LINEAR:

Position (X,Y)	(1.0, 2.0)	(3.0, 2.0)	(5.0, 2.0)	(7.0, 2.0)	(9.0, 2.0)
Meterset Weights	0	4	6	7	3

Delivery Description:

- ~~• The beam is positioned at Scan Spot Position (1,0 2.0).~~
- ~~• The beam is continuously delivered with a Cumulative Meterset Weight of 4, while being moved from Scan Spot Position (1.0, 2.0) to Scan Spot Position (3.0, 2.0).~~
- ~~• The beam is continuously delivered with a Cumulative Meterset Weight of 6, while being moved from Scan Spot Position (3.0, 2.0) to Scan Spot Position (5.0, 2.0).~~
- ~~• The beam is continuously delivered with a Cumulative Meterset Weight of 7, while being moved from Scan Spot Position (5.0, 2.0) to Scan Spot Position (7.0, 2.0).~~
- ~~• The beam is continuously delivered with a Cumulative Meterset Weight of 3, while being moved from Scan Spot Position (7.0, 2.0) to Scan Spot Position (9.0, 2.0).~~

If Modulated Scan Mode Type (300A,0309) is MIXED:

Position (X,Y)	(1.0, 2.0)	(1.0, 2.0)	(3.0, 2.0)	(5.0, 2.0)	(5.0, 2.0)	(7.0, 2.0)	(7.0, 2.0)
Meterset Weights	0	4	6	5	2	0	3

Delivery Description:

- ~~The beam is positioned at Scan Spot Position (1.0, 2.0).~~
- ~~The beam is delivered with a Cumulative Meterset Weight of 4 while staying at Scan Spot Position (1.0, 2.0).~~
- ~~The beam is continuously delivered with a Cumulative Meterset Weight of 6, while being moved from Scan Spot Position (1.0, 2.0) to Scan Spot Position (3.0, 2.0).~~
- ~~The beam is continuously delivered with a Cumulative Meterset Weight of 5, while being moved from Scan Spot Position (3.0, 2.0) to Scan Spot Position (5.0, 2.0).~~
- ~~The beam is delivered with a Cumulative Meterset Weight of 2 while staying at Scan Spot Position (5.0, 2.0).~~
- ~~The beam is switched off or quickly moved and positioned at Scan Spot Position (7.0, 2.0).~~
- ~~The beam is delivered with a Cumulative Meterset Weight of 3 while staying at Scan Spot Position (7.0, 2.0).~~

If Modulated Scan Mode Type (300A,0309) is STATIONARY:

Position (X,Y)	(1.0, 2.0)	(6.0, 2.0)	(6.0, 3.0)	(2.0, 3.0)	(2.0, 5.0)	(7.0, 5.0)
Meterset Weights	2	6	1	5	3	3

Delivery Description:

- The beam is positioned at Scan Spot Position (1.0, 2.0).
- The beam is delivered with Meterset Weight of 2.
- The beam is switched off and positioned at Scan Spot Position (6.0, 2.0).
- The beam is delivered with Meterset Weight of 6.
- The beam is switched off and positioned at Scan Spot Position (6.0, 3.0).
- The beam is delivered with Meterset Weight of 1.
- The beam is switched off and positioned at Scan Spot Position (2.0, 3.0).
- The beam is delivered with Meterset Weight of 5.
- The beam is switched off and positioned at Scan Spot Position (2.0, 5.0).
- The beam is delivered with Meterset Weight of 3.
- The beam is switched off and positioned at Scan Spot Position (7.0, 5.0).
- The beam is delivered with Meterset Weight of 3.

If Modulated Scan Mode Type (300A,0309) is LEAPING:

Position (X,Y)	(1.0, 2.0)	(6.0, 2.0)	(6.0, 3.0)	(2.0, 3.0)	(7.0, 5.0)	(7.0, 5.0)
Meterset Weights	1	5	4	6	0	4

Delivery Description:

- The beam is positioned at Scan Spot Position (1.0, 2.0).
- The beam is delivered with Meterset Weight of 1.

- The beam is moved and positioned at Scan Spot Position (6.0, 2.0).
- The beam is delivered until a Meterset Weight of 5 is reached (including the Meterset delivered when the beam position changes).
- The beam is moved and positioned at Scan Spot Position (6.0, 3.0).
- The beam is delivered until a Meterset Weight of 4 is reached (including the Meterset delivered when the beam position changes).
- The beam is moved and positioned at Scan Spot Position (2.0, 3.0).
- The beam is delivered until a Meterset Weight of 6 is reached (including the Meterset delivered when the beam position changes).
- The beam is switched off and positioned at Scan Spot Position (7.0, 5.0).
- The beam is delivered with Meterset Weight of 4.

If Modulated Scan Mode Type (300A,0309) is LINEAR:

Position (X,Y)	(1.0, 2.0)	(6.0, 2.0)	(6.0, 3.0)	(2.0, 3.0)	(7.0, 5.0)	(7.0, 5.0)
Meterset Weights	0	6	4	6	0	4

Delivery Description:

- The beam is positioned at Scan Spot Position (1.,0, 2.0).
- The beam is continuously delivered with Meterset Weight of 6, while being moved from Scan Spot Position (1.0, 2.0) to Scan Spot Position (6.0, 2.0).
- The beam is continuously delivered with Meterset Weight of 4, while being moved from Scan Spot Position (6.0, 2.0) to Scan Spot Position (6.0, 3.0).
- The beam is continuously delivered with Meterset Weight of 6, while being moved from Scan Spot Position (6.0, 3.0) to Scan Spot Position (2.0, 3.0).
- The beam is switched off and positioned at Scan Spot Position (7.0, 5.0).
- The beam is delivered with Meterset Weight of 4.

In PS 3.3, Section C.8.8.26 RT Ion Beams Session Record Module, the following changes are to be made.

C.8.8.26 RT Ion Beams Session Record Module

Table C.8.8.26-1 specifies the Attributes that describe the measured and recorded settings acquired during Ion Radiation Treatments.

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

Attribute Name	Tag	Type	Description
Referenced Fraction Group Number	(300C,0022)	3	Identifier of fraction group within referenced RT Ion Plan.
...			
>Modulated Scan Mode Type	(300A,0309)	1C	<p>Defines the specialization of a modulated scan mode.</p> <p>Defined Terms:</p> <p>STATIONARY The Meterset is delivered while the beam spot is at the specified position. <u>The Meterset is delivered while the beam spot is at the specified position. The beam is always turned off when the position changes.</u></p> <p>LEAPING The delivery of the specified Meterset for the current spot position begins when the spot is at the previous spot position but the spot moves as quickly as possible to the current specified spot position where most of the Meterset is delivered. <u>The Meterset is mainly delivered at the specified spot position, while some of the Meterset is delivered while the spot is moved from the prior spot position. This mode also supports turning off the beam between spot positions.</u></p> <p>LINEAR The beam spot is delivered with uniform flux while traveling from one position to the next position (continuous). <u>The Meterset is delivered uniformly while the beam spot position changes. This mode also supports turning off the beam between line segments.</u></p> <p>MIXED The meterset is delivered by a combination of STATIONARY and LINEAR or LEAPING and LINEAR.</p> <p><u>See Note.</u></p> <p>Required if Scan Mode (300A,0308) is MODULATED_SPEC. See Section C.8.8.25.8.</p>

Note: For attribute Modulated Scan Mode Type (300A,0309) the Defined Term MIXED was previously defined. It is now retired.