

# **Carestream INDUSTREX 5.0**

## **DICOM/DICONDE Conformance Statement**

**2017.10.26 Revision 10**

DR

## Revision History

Version	Date	Description
First Draft	March 2005	Initial creation of document.
Second Draft	November 2009	Update for v3.0
Third Draft	July 2010	Update for v3.5
Fourth Draft	January 2011	Update for v4.0
Fifth Draft	January 2012	Update for v4.1
Sixth Draft	April 2012	Update for v4.1 DR SP1
Seventh Draft	August 2013	Update for 4.1 DR SP2
Eighth Draft	October 2014	Update for v4.2
Ninth Draft	July 2016	Update for v4.2 DR SP2
Tenth Draft	October 2017	Update for v5.0

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## **1. Overview**

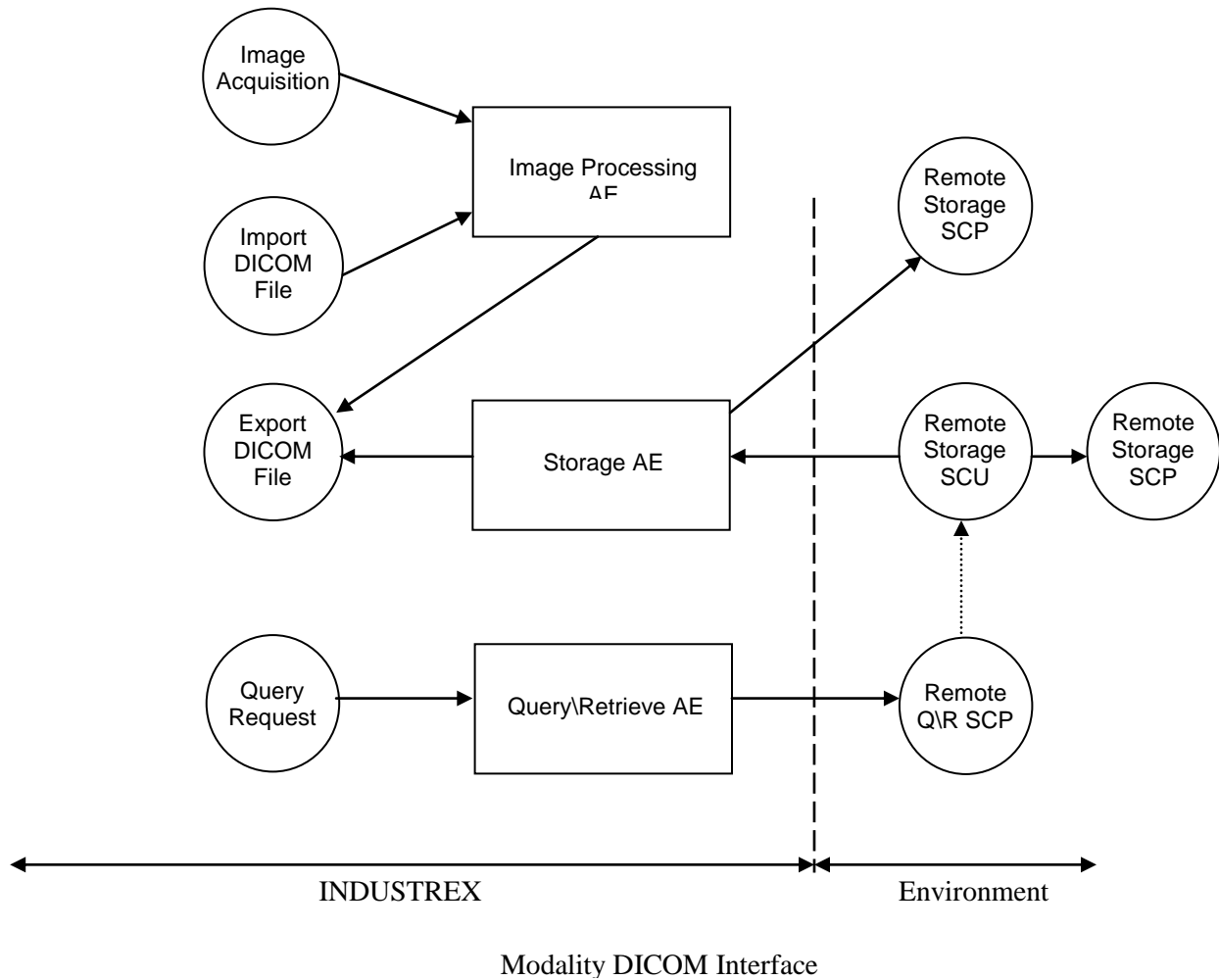
This conformance statement was written in accordance with PS3.3-2009 of DICOM as well as ASTM DICONDE (Digital Imaging and Communication in Nondestructive Evaluation) designation E2339, which provides a standard set of industrial NDE specific information object definitions that are outside the scope of DICOM. The application described in this conformance statement is the implementation of Carestream INDUSTREX Digital Viewing Software (“INDUSTREX,” hereafter), which supports the writing, import, and export of DICONDE files. INDUSTREX also provides a DICONDE Store module that can be used to interact with a DICOM compliant archive server. It uses the DICOM Storage SCU, Storage SCP, and Query/Retrieve SCU. This allows the module to interact with any DICOM compliant server that provides Storage SCU, Storage SCP, and/or Query/Retrieve SCP, given the appropriate licensing and configuration.

## 2. Implementation Model

### 2.1. Application Data Flow

The INDUSTREX software is an image processing application that can interface with a device to acquire imagery as well as import and export DICOM formatted images from disk.

**Figure 1 - Application Data Flow Diagram**



## 2.2. Functional Definition of Applications and AE's

INDUSTREX allows a user to acquire imagery or read DICOM images, view the images, manipulate and analyze those images. INDUSTREX allows the user to create or clone DICOM images, and then export them either to valid DICOM Part 10 format files or using the DICOM communication networking protocol, push study, series, images to a DICOM-compliant data archive. INDUSTREX can also query and retrieve study, series, images to and from a DICOM-compliant data archive.

INDUSTREX allows the user to create a DICOMDIR file when DICOM images are being cloned (copied) to removable media (CD or DVD).

When images are created or cloned, INDUSTREX fills out the following information:

Module	Item	Description
Study	SOP Instance UID	INDUSTREX Generated Unique Number + .1
Series	SOP Instance UID	INDUSTREX Generated Unique Number + .2
Image	SOP Instance UID	INDUSTREX Generated Unique Number

## 3. Application Entity Specifications

### 3.1. Processing Application Specification

#### 3.1.1. SOP Classes

This application provides standard conformance to the following DICOM SOP classes:

**Table 1 SOP Classes for Processing Application**

SOP Class Name	SOP Class UID
Computed Radiography Image Storage	1.2.840.10008.5.1.4.1.1.1
Digital X-Ray Present	1.2.840.10008.5.1.4.1.1.1.1
Digital X-Ray Process	1.2.840.10008.5.1.4.1.1.1.1.1

#### 3.1.2. Proposed Presentation Context

The processing application can accommodate reading the following transfer syntaxes of the objects stored in a Part 10 format:

**Table 2 Supported Transfer Syntax for Processing Application**

Compression Type	Transfer Syntax UID	Description
Implicit VR Little Endian	1.2.840.10008.1.2	Default transfer syntax for DICOM
Explicit VR Little Endian	1.2.840.10008.1.2.1	Little Endian data encoding
Explicit VR Big Endian	1.2.840.10008.1.2.2	Big Endian data encoding

Compression Type	Transfer Syntax UID	Description
JPEG Baseline	1.2.840.10008.1.2.4.50	Default Transfer Syntax for Lossy JPEG 8 Bit Image Compression
JPEG Extended	1.2.840.10008.1.2.4.51	Default Transfer Syntax for Lossy JPEG 12 Bit Image Compression (Process 4 only)
JPEG Lossless, non-hierarchical, first-order prediction	1.2.840.10008.1.2.4.70	Lossless JPEG Image Compression. First-Order Prediction (Process 14 [Selection Value 1])
JPEG 2000 Image Compression (Lossless Only)	1.2.840.10008.1.2.4.90	Lossless, reversible wavelet and color component transformation, and no quantization.
JPEG 2000 Image Compression (Lossy)	1.2.840.10008.1.2.4.91	Lossy, irreversible wavelet transformation and color component transformation, and optional quantization.

### 3.2. Query, Retrieve, and Store Application Entity Specifications

The functionality can be divided into the following categories:

1. Ability to configure the application as a node in a DICOM network
2. Ability to Query an archive
3. Ability to Retrieve images, series, and studies from an archive
4. Ability to Store images, series, and studies in an archive.

**Table 3 Networking SOP Classes**

Networking SOP Classes	User of Service (SCU)	Provider of Service (SCP)
<b>Image Transfer</b>		
Computed Radiography Image Storage	Yes	Yes
Digital X-Ray Present	Yes	Yes
Digital X-Ray Process	Yes	Yes
<b>Query/Retrieve</b>		
Component (Patient) Root Q/R – FIND	Yes	No
Component (Patient) Root Q/R – MOVE	Yes	No
Study Root Q/R – FIND	Yes	No
Study Root Q/R – MOVE	Yes	No

Fields that can be used to query are shown in the table below.

**Table 4 Component/Study-Level fields:**

<b>TAG</b>	<b>Description</b>	<b>Type</b>
0010,0010	Component Name	Text
0010,0020	Component ID	Text
0008,0020	Study Date	Date
0008,0030	Study Time	Time
0008,0050	Accession Number	Text
0020,0010	Study ID	Text

Fields that can be used to directly query are shown in the table below.

**Table 5 Series-Level fields:**

<b>TAG</b>	<b>Description</b>	<b>Type</b>
0008,0060	Modality	Text
0020,0011	Series Number	Text

No image level fields are directly available for query in the user interface. The user can still navigate to the image level in the query results shown on the "Remote" tab.

## 4. Communication Profiles

This section specifies the communication options. In practice, each device always supports an Application level interface to the OSI level 4 (Transport layer), i.e. TCP/IP stack. However, the Physical Media of two devices have to match for connectivity. Note that matching physical media can be achieved by standard off the shelf devices. For example, if one device supports standard Ethernet 10BaseT, it can be bridged to a Fast Ethernet, ATM, or whatever is supported.

### **Supported Communication Stacks**

DICOM Upper Layer over TCP/IP is supported.

### **OSI Stack**

Not supported.

### **TCP/IP Stack**

The TCP/IP stack is inherited from the underlying operating system

### **Physical Media Support**

DICOM is indifferent to the physical medium over which TCP/IP executes. TCP/IP over Ethernet and phone lines is supported.



## 5. Configurable Parameters for Storage Service, Storage User Entity, and Query User Entity

The following configurable parameters can be set in the following configuration file: DICONDE\_Store\_config.xml.

### 5.1. Configuration for a processing application workstation (node) to communicate with other nodes:

#### Storage SCU

Default AE Name: ="IDX Send"

#### Storage SCP

Default AE Name="IDX Storage"

Default Port: 2510

#### Echo SCU – Listed in the IDL conformance statement

AE Title:

#### Query/Retrieve SCU

AE Name: "IDX Query User"

Default Port: 9999

### 5.2. Configuration to allow for the processing application workstation to communicate with an archive server:

#### Storage SCP

AE NAME="Storage Server"

#### Storage SCU

AE NAME="Send Server"

#### Query/Retrieve SCP:

AE NAME="Query Server"

## 6. Support of Extended Character Sets

The following character sets are supported:

- ISO-IR 100

## 7. Information Object Definitions (IOD)

### 7.1. Module Tables

#### 7.1.1. Study Module Table

##### 7.1.1.1. Study Classification

Attribute Name	Tag	Type	DICOM Definition	Carestream Extension
Study Comments	(0032,4000)	2	User-defined comments about the study	DICONDE Attribute Name- Examination Notes. Description: user defined notes on the examination.

#### 7.1.2. CR Image IOD Module Table

The following is a list of the modules used for the CR image storage SOP class:

Information Entity	Module	Reference
Patient	<a href="#">Patient</a>	7.1.5.1
	<a href="#">DICONDE-Component</a>	7.1.5.2
Study	<a href="#">General Study</a>	7.1.6.1
	<a href="#">DICONDE-Study</a>	7.1.6.2
Series	<a href="#">General Series</a>	7.1.7.1
	<a href="#">CR Series</a>	7.1.7.2
Equipment	<a href="#">General Equipment</a>	7.1.9.1
Image	<a href="#">General Image</a>	7.1.8.1
	<a href="#">Image Plane</a>	7.1.8.2
	<a href="#">Image Pixel</a>	7.1.8.3
	<a href="#">Contrast/Bolus</a>	7.1.8.4
	<a href="#">Multi-Frame</a>	7.1.8.5
	<a href="#">CR Image</a>	7.1.8.8
	Overlay Plane	Not Supported.
	Curve	Not Supported.
Lookup Table	<a href="#">NDE Source Radiography</a>	7.1.12.1
	<a href="#">Modality LUT</a>	7.1.10.1
	<a href="#">VOI LUT</a>	7.1.10.2
Private	<a href="#">Private Common</a>	7.1.14.1
General	<a href="#">SOP Common</a>	7.1.4.1

#### 7.1.3. DX Image IOD Module Table

The following is a list of the modules used for the DX image storage SOP class. Reference is section 5.1.16 DX Image Module.

Information Entity	Module	Reference
Patient	<a href="#">Patient</a>	7.1.5.1
	<a href="#">DICONDE-Component</a>	7.1.5.2

Study	<a href="#">General Study</a>	7.1.6.1
	<a href="#">DICONDE-Study</a>	7.1.6.2
Series	<a href="#">General Series</a>	7.1.7.1
	<a href="#">Digital X-Ray Series</a>	7.1.7.3
Equipment	<a href="#">General Equipment</a>	7.1.9.1
DX Anatomy Imaged	<a href="#">DX Anatomy Imaged</a>	7.1.13.1
DX Detector	<a href="#">NDE DX Detector</a>	7.1.11.1
	NDE Indication	Not supported
	NDE Geometry	Not supported
	<a href="#">NDE DX Calibration Data</a>	7.1.11.2
	<a href="#">NDE Source Radiography</a>	7.1.12.1
Acquisition Content	<a href="#">X-Ray Acquisition</a>	7.1.12.2
	<a href="#">X-Ray Acquisition Dose</a>	7.1.12.3
	<a href="#">Acquisition Context</a>	7.1.12.4
Private	<a href="#">Private Common</a>	7.1.14.1
General	<a href="#">SOP Common</a>	7.1.4.1

#### 7.1.4. General

##### 7.1.4.1. SOP Common Module

Attribute Name	Tag	Type	DICOM Definition	Carestream Extension
SOP Class UID	(0008,0016)	1	Identifies the SOP class uniquely	
SOP Instance UID	(0008,0018)	1	Identifies the SOP instance uniquely.	
Specific Character Set	(0008,0005)	1C	Character Set that expands or replaces the Basic Graphic Set	
Instance Creation Date	(0008,0012)	3	Date the SOP Instance was created.	
Instance Creation Time	(0008,0013)	3	Time the SOP Instance was created.	
Acquisition Date	(0008,0022)	1	The date the acquisition of data that resulted in this image started	
Acquisition Time	(0008,0032)	1	The time the acquisition of data that resulted in this image started	

#### 7.1.5. Patient IE Module

##### 7.1.5.1. Patient Module

Attribute Name	Tag	Type	DICOM Definition	Carestream Extension
Patient's Name	(0010,0010)	2	Patient's full name	DICONDE attribute name – Component Name. Component Name or Part Name
Patient ID	(0010,0020)	2	Primary hospital ID no. or code for the patient	DICONDE attribute name – Component ID Number. Component ID or

				Part ID.
Patient's Birth Date	(0010,0030)	2	Patient's date of birth	DICONDE attribute name – Component Manufacturing Date
Patient Sex	(0010,0040)	2	Sex of the named patient. Enumerated Values: M = male F = female O = other	Tag will be empty.
Other Patient IDs	(0010,1000)	3	Other identification numbers or codes used to identify the patient.	DICONDE attribute name –Other Component IDs. Additional Component IDs when multiple parts in one image.
Other Patient Names	(0010,1001)	3	Other names to identify the patient.	DICONDE attribute name – Other Component Names. Additional Component IDs when multiple parts in one image.
Ethnic Group	(0010,2160)	3	Ethnic group or race of the patient.	DICONDE attribute name – Material Name
Patient Comments	(0010,4000)	3	User-defined additional information about the patient.	DICONDE attribute name – Component Notes. If obsolete tag (0033,1060) is present, it will be appended to the contents of this tag.
Current Patient Location	(0038,0300)		Current Patient Location	DICONDE attribute name – Volume Description

7.1.5.2. DICONDE-Component Module

This module is comparable to DICOM Patient Module.

Attribute Name	Tag	Type	DICONDE Definition	Carestream Extension
Component Manufacturing Procedure	(0014,0025)	3	None	
Component Manufacturer	(0014,0028)	3	None	
Component Welder IDs	(0014,0010)	3	A text string identifying the individual or machine performing welding operations on the	

			component	
Material Thickness	(0014,0030)	3	Wall/material thickness in mm.	
Material Pipe Diameter	(0014,0032)	3	Diameter in mm/in	
Material Isolation Diameter	(0014,0034)	3	Diameter in mm/in.	
Material Property Description	(0014,0044)	3	None	
Material Grade	(0014,0042)	3	None	
Material Notes	(0014,0046)	3	None	
Component Shape	(0014,0050)	3	General description of the shape of the test piece.	
Curvature Type	(0014,0052)	3	Type of curvature present in the test piece.	
Outer Diameter	(0014,0054)	3	Outer diameter of curved test specimen in mm.	
Inner Diameter	(0014,0056)	3	Inner diameter of curved test specimen in mm	

### 7.1.6. Study IE Module

#### 7.1.6.1. General Study Module

Attribute Name	Tag	Type	DICOM Definition	Carestream Extension
Study Instance UID	(0020,000D)	1	Identifier unique for the study	When not obtained, INDUSTREX will generate this information by appending “.1” as a suffix to the UID generated for each image.
Study Date	(0008,0020)	2	Date study began.	
Study Time	(0008,0030)	2	Time study began.	
Referring Physician’s Name	(0008,0090)	2	Physician making referral	DICONDE attribute name – Component OwnerName. Company that owns the component being tested.
Study ID	(0020,0010)	2	Study identifier issued by user or equipment.	

Accession Number	(0008,0050)	2	RIS-issued number for identifying order of the study.	
Study Description	(0008,1030)	3	Institution-issued description or classification of study (component element) conducted	DICONDE description: User generated description or classification
Physicians(s) of Record	(0008,1048)	3	Names of physician(s) who are responsible for overall patient care at time of Study	DICONDE attribute name- Inspecting Company Name. DICONDE description: Company responsible for the inspection.
Name of Physicians(s) Reading Study	(0008,1060)	3	Names of the physician(s) reading the Study.	DICONDE attribute name- Certifying Inspector Name. DICONDE description: Name of inspector certifying.

7.1.6.2. DICONDE-Study Module

These attributes were previously private tags-This module is comparable to DICOM General Study Module.

Attribute Name	Tag	Type	DICONDE Definition	Carestream Extension
Expiry Date	(0014,1020)	2	Date on which the validation expires.	
Actual Environmental Conditions	(0014,1010)	3	Actual conditions at exposure.	
Environmental Conditions	(0014,1040)	3	Nominal environmental conditions. Isolated, non-isolated, hot, cold	

**7.1.7. Series IE Module**

7.1.7.1. General Series Module

Attribute Name	Tag	Type	DICOM Definition	Carestream Extension
Modality	(0008,0060)	1	Type of equipment that originally acquired the data used to create the images in this Series.	INDUSTREX supports read/write of CR type. DX type with additional module.
Series Instance UID	(0020,000E)	1	Identifier unique to series	When not obtained, INDUSTREX will generate this information by appending “.2” as a

				suffix to the UID generated for each image.
Series Number	(0020,0011)	2	Series ID number	
Series Date	(0008,0021)	3	Date the Series started	
Series Time	(0008,0031)	3	Time the Series started	
Performing Physicians' Name	(0008,1050)	3	Name of the physicians administering the Series.	DICONDE attribute name- Inspector Name. DICONDE description: Person responsible for the inspection.
Series Description	(0008,103E)	3	User provided description of the Series	
Operators' Name	(0008,1070)	3	Names(s) of the operator(s) supporting the Series	DICONDE attribute name – Operator Name
Body Part Examined	(0018,0015)	3	Part examined	DICONDE attribute name – Part Examined

7.1.7.2. CR Series Module

Attribute Name	Tag	Type	DICOM Definition	Carestream Extension
Collimator Name	(0018,1180)	3	Label describing the collimator used.	
Focal Spot	(0018,1190)	3	Size of the focal spot in mm. For devices with variable focal spot or multiple focal spots, small dimension followed by large dimension.	
Plate Type	(0018,1260)	3	Label of the type of storage phosphor plates used in this series.	
Phosphor Type	(0018,1261)	3	Label of type of phosphor on the plates.	
View Position	(0018,5101)	3	Radiographic view of the image relative to the imaging subject's orientation.	

7.1.7.3. Digital X-Ray Series Module

Attribute Name	Tag	Type	DICOM Definition	Carestream Extension
Presentation Intent Type	(0008,0068)	1	Identifies the intent of the images that are contained within this Series. Enumerated Values: FOR PRESENTATION FOR PROCESSING.	Allowed values: FOR PRESENTATION, FOR PROCESSING

### 7.1.8. Image IE Module

#### 7.1.8.1. General Image Module

Attribute Name	Tag	Type	DICOM Definition	Carestream Extension
Image Type	(0008,0008)	3	Image identification characteristic.	On scanning of an image this is set to Original/Primary. When an image (pixel data) is modified, this is set to Derived/Secondary.
Instance Number	(0020,0013)	2	Image instance number	
Component Orientation	(0020,0020)	2C	Component orientation	Component orientation
Content Date	(0008,0023)	2C	The date the image pixel data creation started. Required if image is part of a series in which the images are temporally related. Note: This Attribute was formerly known as Image Date.	Image Date
Content Time	(0008,0033)	2C	The time the image pixel data creation started. Required if image is part of a series in which the images are temporally related.	Image Time
Acquisition Date	(0020,0022)	3	The date the acquisition of data that resulted in this image started	
Acquisition Time	(0020,0032)	3	The time the acquisition of data that resulted in this image started	
Icon Image Sequence	(0088,0200)	3	This icon image is representative of the Image.	

#### 7.1.8.2. Image Plane Module

Attribute Name	Tag	Type	DICOM Definition	Carestream Extension
Pixel Spacing	(0028,0030)	1	Physical distance, within the patient, between the centers of each pixel. Expressed as a numerical set: Space between adjoining rows (delimiter), space between adjoining columns. Unit: mm	Physical distance, within the part, between the centers of each pixel.

#### 7.1.8.3. Image Pixel Module

Attribute Name	Tag	Type	DICOM Definition	Carestream Extension
Samples per Pixel	(0028,0002)	1	Number of samples (planes) an image has.	



Photometric Interpretation	(0028,0004)	1	Specifies the intended interpretation of image data.  MONOCHROME1 Indicates that pixel data has a single monochrome image plane. Minimum sample value is to be displayed in white following VOI gray scale conversion.  MONOCHROME2  Indicates that pixel data has a single monochrome plane. Minimum sample value is to be displayed in black following VOI gray scale conversion.
Rows	(0028,0010)	1	Number of rows in an image.
Columns	(0028,0011)	1	Number of columns in an image.
Bits Allocated	(0028,0100)	1	Number of bits allocated to each pixel sample. Each sample has the same number of bits allocated.
Bits Stored	(0028,0101)	1	Number of bits stored for each pixel sample. Each sample will have the same number of bits stored.
High Bit	(0028,0102)	1	Most significant bit for pixel sample data. Each sample will have the same high bit.
Pixel Representation	(0028,0103)	1	Data representation of the pixel samples. Each sample will have the same pixel representation.  Enumerated values:  0000H: Unsigned Integer.  0001H: Complement of 2.
Pixel Data	(7FE0,0010)	1	Stream of pixel samples that compose the image.
Smallest Image Pixel Value	(0028,0106)	3	The minimum actual pixel value encountered in this image.
Largest Image Pixel Value	(0028,0107)	3	The maximum actual pixel value encountered in this image.
Planar Configuration	(0028,0006)	1C	Image plane configuration
Imager Pixel Spacing	(0018,1164)	3	Pixel spacing of the imaging device

7.1.8.4. Contrast/Bolus Module

Attribute Name	Tag	Type	DICOM Definition	Carestream Extension
Contrast/Bolus Agent	(0018,0010)	2	Contrast or bolus agent	

7.1.8.5. Multi-Frame Module

Attribute Name	Tag	Type	DICOM Definition	Carestream Extension
Number of Frames	(0028,0008)	1	Number of frames in a multi-frame image.	

7.1.8.6. X-Ray Image Module

Attribute Name	Tag	Type	DICOM Definition	Carestream Extension
Scan Options	(0018,0022)	3	Parameters of scanning sequence.	
Anatomic Region Sequence	(0008,2218)	2	Sequence that identifies the anatomic region of interest in this frame (i.e. external anatomy, surface anatomy, or general region of the body).	Written to DICONDE file for compliance
> Code Value	(0008,0100)	1		
> Code Scheme Designator	(0008,0102)	1	The value of a Coding Scheme Designator, used in this SOP Instance, which is being mapped.	
> Code Meaning	(0008,0104)	1		

7.1.8.7. Frame Reference Module

Attribute Name	Tag	Type	DICOM Definition	Carestream Extension
Frame of Reference UID	(0020,0052)	1	Uniquely identifies the frame of reference for a Series.	

7.1.8.8. CR Image Module

Attribute Name	Tag	Type	DICOM Definition	Carestream Extension
kVp	(0018,0060)	3	Peak kilo voltage output of the x-ray generator used.	
Plate ID	(0018,1004)	3	The ID or serial number of the sensing plate upon which the image was acquired	
Distance Source to Detector	(0018,1110)	3	Distance in mm from source to detector center.	
Distance Source to Patient	(0018,1111)	3	Distance in mm from source to the table, support or bucky side that is closest to the Imaging Subject, as measured along the	

			central ray of the X-Ray beam.	
Exposure Time	(0018,1150)	3	Time of x-ray exposure in msec	
X-ray Tube Current	(0018,1151)		X-Ray Tube Current in mA.	
Exposure	(0018,1152)	3	The exposure expressed in mAs, for example calculated from Exposure Time and X-Ray Tube Current.	
Exposure in $\mu$ As	(0018,1153)	3	The exposure expressed in $\mu$ As, for example calculated from Exposure Time and X-ray Tube Current.	
Filter Type	(0018,1160)	3	Label for the type of filter inserted into the x-ray beam.	
Generator Power	(0018,1170)	3	Power in kW to the x-ray generator.	
Cassette Orientation	(0018,1402)	3	Orientation of cassette, used to properly position the image for display. Enumerated Values: LANDSCAPE PORTRAIT	
Cassette Size	(0018,1403)	3	Size of cassette. Defined Terms: 18CMX24CM 8INX10IN 24CMX30CM 10INX12IN 30CMX35CM 30CMX40CM 11INX14IN 35CMX35CM 14INX14IN 35CMX43CM 14INX17IN	
Exposures on Plate	(0018,1404)	3	Total number of x-ray exposures that have been made on the plate identified in Plate ID (0018,1004)	
Relative X-Ray Exposure	(0018,1405)	3	Relative x-ray exposure on the plate. Meaning of values is implementation specific. May be used to adjust the dynamic range of the plate digitizer (scanner).	

7.1.8.9. DX Image Module

Attribute Name	Tag	Type	DICOM Definition	Carestream Extension
Acquisition	(0018,1400)	3	Provides some indication in	

Device Processing Description			human readable text of the digital processing on the images before exchange. Examples of this processing are: edge enhanced, subtracted, time filtered, gamma corrected, convolved (spatially filtered).	
Acquisition Device Processing Code	(0018,1401)	3	Code representing the device-specific processing associated with the image (e.g. Organ Filtering code) Note: This Code is manufacturer specific but provides useful annotation information to the knowledgeable observer.	
Burned in Annotation	(0028,0301)	1	Indicates whether or not image contains sufficient burned in annotation to identify the patient and date the image was acquired.	Allowed values: Yes, No
Lossy Image Compression	(0028,2110)	1	Specifies whether an Image has undergone lossy compression. Enumerated Values:00 = Image has NOT been subjected to lossy compression/ 01 = Image has been subjected to lossy compression.	Allowed values: 00,01
Lossy Image Compression Ratio	(0028,2112)	1C	Required if Lossy Compression has been performed on the Image.	
Presentation LUT Shape	(2050,0020)	1	Specifies an identity transformation for the Presentation LUT, other than to account for the value of Photometric Interpretation (0028,0004), such that the output of all grayscale transformations defined in the IOD containing this Module are defined to be P-Values. Enumerated Values: IDENTITY - output is in P-Values - shall be used if Photometric Interpretation (0028,0004) is MONOCHROME2. INVERSE - output after inversion is in P-Values - shall be used if Photometric Interpretation (0028,0004) is MONOCHROME1. See C.8.11.3.1.2 for further	Allowed values: IDENTITY, INVERSE

			explanation.	
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**7.1.9. Lookup Table**

7.1.9.1. Modality LUT Module

Attribute Name	Tag	Type	DICOM Definition	Carestream Extension
Rescale Intercept	(0028,1052)	1C	Output unit specified within storage value (SV) and rescale type (0028,1054) is $m * SV + b$ . Necessary when modality LUT sequence (0028,3000) does not exist.	
Rescale Slope	(0028,1053)	1C	m in the equation specified by Resale Intercept (0028,1052). Required if Rescale Intercept is present.	
Rescale Type	(0028,1054)	1C	Specifies the output units of Rescale Slope (0028,1053) and Rescale Intercept (0028,1052).	
Pixel Intensity Relationship	(0028,1040)	1	The relationship between the Pixel sample values and the X-Ray beam intensity.	
Pixel Intensity Relationship Sign	(0028,1041)	1C	The sign of the relationship between the Pixel sample values stored in Pixel Data (7FE0,0010) and the X-Ray beam intensity.	

7.1.9.2. VOI LUT Module

Attribute Name	Tag	Type	DICOM Definition	Carestream Extension
Window Center	(0028,1050)	3	Window center for display purposes.	
Window Width	(0028,1051)	1C	Window width for display purposes. Required if Window Center (0028,1050) is sent.	

**7.1.10. Nondestructive Evaluation**

7.1.10.1. NDE DX Detector Module

Attribute Name	Tag	Type	DICOM Definition	Carestream Extension
Detector Type	(0018,7004)	2	The type of detector used to acquire projection data	Allowed values: DIRECT, SCINTILLATOR, STORAGE, FILM
Detector Configuration	(0018,7005)	3	The physical configuration of the detector.	Allowed values: AREA, SLOT
Detector Description	(0018,7006)	3	Free-text description of the detector.	

Detector Mode	(0018,700A)	3	Text description of the operating mode of the detector	
Detector ID	(0018,7008)	3	The ID or serial number of the detector used to acquire projection data.	
Date of Last Detector Calibration	(0018,700C)	3	Date of the last calibration for the equipment.	
Time of Last Detector Calibration	(0018,700E)	3	Time of the last calibration for the equipment.	
Detector Active Time	(0018,7014)	3	Time in msec that the detector is active during acquisition of this data.	
Detector Activation Offset from Exposure	(0018,7016)	3	Offset time in msec that the detector becomes active after the X-ray beam is turned on during the acquisition of this data. May be negative.	
Detector Binning	(0018,701A)	3	Number of active detectors used to generate a single pixel. Specified as the number of row detectors per pixel followed by the number of column detectors.	
Internal Detector Frame Time	(0014,3011)	3	The time in msec that the detector is acquiring an image.	
Number of Frames Integrated	(0014,3012)	3	The number of frames integrated to form an image.	
Detector Manufacturer's Name	(0018,702A)	3	Name of the manufacturer of the detector component of the acquisition system.	
Detector Manufacturer's Model Number	(0018,702B)	3	Model number of the detector component of the acquisition system.	
Detector Conditions Nominal Flag	(0018,7000)	3	A flag that indicates whether or not the detector is operating within normal tolerances during data acquisition. This flag is intended to indicate whether there has been some compromise of the diagnostic quality of the data due to some operating condition (for example, overheating).	Allowed values: YES,NO
Sensitivity	(0018,6000)	3	Detector sensitivity in	

			manufacturer specific units.	
Field of View Shape	(0018,1147)	3	Shape of the Field of View, that is, the image pixels.	Allowed values: RECTANGLE, ROUND, HEXAGONAL
Field of View Dimension(s)	(0018,1149)	3	Dimensions in mm of the Field of View.	
Field of View Origin	(0018,7030)	1C	Required if the Field of View has been rotated or flipped. Offset of the Top Left Hand Corner (TLHC) of a rectangle circumscribing the Field of View before rotation or flipping, from the TLHC of the physical detector area measured in physical detector pixels as a row offset followed by a column offset.	
Field of View Rotation	(0018,7032)	1C	Required if the Field of View has been rotated. Clockwise rotation in degrees of the Field of View relative to the physical detector.	
Field of View Horizontal Flip	(0018,7034)	1C	Required if the Field of View has been rotated. Whether or not a horizontal flip has been applied to the Field of View after rotation relative to the physical detector as described in the Field of View Rotation.	Allowed values: YES, NO
Imager Pixel Spacing	(0018,1164)	1	Physical distance measured at the front plane of the detector housing between the center of each image pixel specified by a numeric pair – row spacing value followed by a column spacing value in mm.	
Detector Element Physical Size	(0018,7020)	3	Physical dimensions of each detector element in mm that comprises the detector matrix. Expressed as the row dimension followed by the column dimension.	
Detector Element Spacing	(0018,7022)	3	Physical distance between the center of each detector element, specified by a numeric pair –row spacing value in mm followed by column spacing value in mm.	
Detector Active Shape	(0018,7024)	3	Shape of the active area.	Allowed values: RECTANGLE, ROUND, HEXAGONAL

Detector Active Dimension(s)	(0018,7026)	3	Dimension(s) in mm of the active area	
Detector Active Origin	(0018,7028)	3	Offset of the LHC of a rectangle circumscribing the active detector area from the TLHC of a Rectangle circumscribing the physical detector area, measures in physical detector pixels as a row offset followed by a column offset.	

7.1.10.2.NDE DX Calibration Data Module

Attribute Name	Tag	Type	DICOM Definition	Carestream Extension
Dark Current Sequence	(0014,3040)	2		
> Photometric Interpretation	(0028,0103)	1	Pixel representation.	
> Bits allocated	(0028,0100)	1	Number of bits allocated.	
> Bits stored	(0028,0101)	1	Number of bits stored.	
> High bit	(0028,0102)	1	Most significant bit.	
> Dark Current counts	(0014,3050)	1	A data stream of the pixel samples which comprise the dark current counts.	
Gain Correction Reference Sequence	(0014,3060)	2		
> Photometric Interpretation	(0028,0103)	1	Pixel representation.	
> Bits allocated	(0028,0100)	1	Number of bits allocated.	
> Bits stored	(0028,0101)	1	Number of bits stored.	
> High bit	(0028,0102)	1	Most significant bit.	
> Air counts	(0014,3070)	1	A data stream of the pixel samples which comprise the air counts.	
> kV Used in Gain Calibration	(0014,3071)	3	Kilovoltage Used in Gain Calibration.	
> mA Used in Gain Calibration	(0014,3072)	3	mA * Sec Used in Gain Calibration.	
> Number of Frames	(0014,3073)	3	Number of Frames Used for Integration.	
> Filter Material Used in Gain Calibration	(0014,3074)	3	Filter Material Used in Gain Calibration.	
> Filter	(0014,3075)	3	Filter Thickness of Material Used in	



Thickness Used in Gain Calibration			Gain Calibration.	
> Date of Gain Calibration	(0014,3076)	3	Date of Gain Calibration.	
> Time of Gain Calibration	(0014,3077)	3	Time of Gain Calibration.	
Bad Pixel Image	(0014,3080)	3	Byte image with the same number of rows and columns as the Pixel Data (7FE0,0010). The pixel data of this image will contain a 919 for a good pixel and a 909 for a bad pixel.	
Calibration notes	(0014,3099)	3	User-generated notes on the calibration data.	
Image Quality Indicator Type	(0014,40A0)	3	Description of the type of Image Quality Indicator used.	
Image Quality Indicator Material	(0014,40A1)	3	Description of the material used to manufacture the Image Quality Indicator.	
Image Quality Indicator Size	(0014,40A2)	3	Description of the size of the Image Quality Indicator used. A typical size designation is '2-2T' where the first number indicates that the IQI thickness is two percent of the test material thickness and second number defines the hole diameter as twice the IQI thickness	

7.1.10.3.NDE Equipment Module

<b>Attribute Name</b>	<b>Tag</b>	<b>Type</b>	<b>DICOM Definition</b>	<b>Carestream Extension</b>
Software Versions	(0018,1020)	1	The version identifier of the DICONDE file.	
Manufacturer	(0008,0070)	3	Manufacturer of the equipment that produced the composite instance	
Institution Name	(0008,0080)	3	Company where the equipment that produced the composite instance is located	DICONDE attribute name: Company Name
Institution Address	(0008,0081)	3	Mailing address of the company where the equipment that produced the composite instance is located	DICONDE attribute name: Company Address
Station Name	(0008,1010)	3	User defined name identifying the machine that produced the composite instances	
Institutional Department	(0008,1040)	3	Department in the company where the equipment that produced the	DICONDE attribute name: Department

Name			composite instances is located	Name
Manufacturer's Model Name	(0008,1090)	3	Manufacturer's model name of the equipment that produces the composite instances	
Device Serial Number	(0018,1000)	3	Manufacturer's serial number of the equipment that produces the composite instances	
Scanner ID	(0018,1008)	3	Identifier of the gantry, scanning system or positioner used to produce the composite instances	
Spatial Resolution	(0018,1050)	3	The inherent limiting resolution in mm of the acquisition equipment for high contrast objects for the data gather and reconstruction technique chosen. If variable across the images of the series, the value at the image center.	
Date of Last Calibration	(0018,1200)	3	Date when the image acquisition device calibration was last changed in any way. Multiple values may be used.	
Time of Last Calibration	(0018,1201)	3	Time when the image acquisition device calibration was last changed in any way. Multiple values may be used.	
Pixel Padding Value	(0028,0120)	3	Value of pixels not present in the native image added to an image to pad to rectangular format.	

7.1.10.4.NDE Approval Module

Attribute Name	Tag	Type	DICOM Definition	Carestream Extension
Approval Status	(300E,0002)	3	Status of a review of the object	Allowed Values: APPROVED NOT REVIEWED REJECTED NO DISPOSITION RETEST REPAIR FURTHER REVIEW
Review Date	(300E,0004)	2C	Date on which the object was reviewed. Required if Approval Status (300E,0002) is not NOT REVIEWED.	
Review Time	(300E,0005)	2C	Time at which the object was reviewed. Required if Approval Status (300E,0002) is not NOT	

			REVIEWED.	
Reviewer Name	(300E,0008)	2C	Name of the person who reviewed the object. Required if Approval Status (300E,0002) is not NOT REVIEWED.	
Secondary Approval Status	(0014,0101)	3	Status of an additional review of the object if required.	Allowed Values: APPROVED NOT REVIEWED REJECTED NO DISPOSITION RETEST REPAIR FURTHER REVIEW
Secondary Review Date	(0014,0102)	2C	Date on which secondary review of the object was performed. Required if Secondary Approval Status (0014,0101) is not NOT REVIEWED.	
Secondary Review Time	(0014,0103)	2C	Time at which secondary review of the object was performed. Required if Secondary Approval Status (0014,0101) is not NOT REVIEWED.	
Secondary Reviewer Name	(0014,0104)	2C	Name of person who performed the secondary review of the object. Required if Secondary Approval Status (0014,0101) is not NOT REVIEWED.	
Repair ID	(0014,0105)	3	Text string to identify the repair if Approval Status has a value of REPAIR.	

### 7.1.11. Acquisition

#### 7.1.11.1.NDE Source Radiography Module

Attribute Name	Tag	Type	DICOM Definition	Carestream Extension
Source Type	(300A,0214)	1	Type of Source: Defined Terms: POINT LINE CYLINDER SPHERE	Allowed Values: POINT LINE CYLINDER SPHERE
Source Manufacturer	(300A,0216)	3	Manufacturer of Source	
Active Source	(300A,0218)	3	Diameter of active source (mm)	

Diameter				
Active Source Length	(300A,0220)	3	Length of active source (mm)	
Material ID	(300A,00E1)	3	User-supplied identifier for encapsulation material of active Source	
Source Encapsulation Nominal Thickness	(300A,0222)	3	Nominal thickness of wall of encapsulation (mm)	
Source Encapsulation Nominal Transmission	(300A,0224)	3	Nominal transmission through wall of encapsulation (between 0 and 1)	
Source Isotope Name	(300A,0226)	1	Name of Isotope	
Source Isotope Half-Life	(300A,0228)	1	Half-life of Isotope	
Source Strength Units	(300A,0229)	1C	Measurement of Source Strength Required if the source is not a gamma-emitting (photon) source. May be present otherwise. Enumerate values: AIR Kerma Rate = Air Kerma Rate if Source is Gammaemitting Isotope	
Reference Air Kerma Rate	(300A,022A)	1	Air Kerma Rate in air of Isotope specified at Source Strength Reference Date (300A,022C) and Source Strength Reference Time (300A,022E) (in $\mu\text{Gy h}^{-1}$ at 1 m). Values shall be zero for non-gamma sources.	
Source Strength	(300A,022B)	1C	Source Strength of Isotope at Source Strength Reference Date (300A,022C) and Source Strength Reference Time (300A,022E), in units specified in Source Strength Units (300A,0229). Required if the source is not a gamma-emitting (photon) source.	
Source Strength Reference Date	(300A,022C)	1	Reference date for Reference Air Kerma Rate (300A,022A) or Source Strength (300A,022B) of Isotope.	
Source Strength Reference Time	(300A,022E)	1	Reference time for Reference Air Kerma Rate (300A,022A) or Source Strength (300A,022B) of Isotope.	

7.1.11.2.X-Ray Acquisition Module

Attribute Name	Tag	Type	DICOM Definition	Carestream Extension
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Radiation Setting	(0018,1155)	1	Identify the general level of X-Ray dose exposure. Enumerated values are: SC = low dose exposure generally corresponding to fluoroscopic settings (e.g. preparation for diagnostic quality image acquisition); GR = high dose for diagnostic quality image acquisition (also called digital spot or cine);	
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7.1.11.3.X-Ray Acquisition Dose Module

Attribute Name	Tag	Type	DICOM Definition	Carestream Extension
Exposure Time in Microseconds	(0018,8150)	3	Duration of X-Ray exposure in microseconds.	
X-Ray Tube Current in Microamps	(0018,8151)	3	X-Ray Tube Current in $\mu$ A.	
Comments on Radiation Dose	(0040,0310)	3	User-defined comments on any special conditions related to radiation dose encountered during the acquisition of this image.	

7.1.11.4.Acquisition Context Module

Attribute Name	Tag	Type	DICOM Definition	Carestream Extension
Acquisition Context Sequence	(0040,0555)	2	A sequence of repeating items that describes the conditions present during the acquisition of an Image. Zero or more items may be included in this sequence.	Written to DICONDE files for compliance
> Concept Name Code Sequence	(0040,A043)	1C	A concept that constrains the meaning of (i.e. defines the role of) the Observation Value. The “Name” component of a Name/Value pair. This sequence shall contain exactly one item. Required if a sequence item is present.	
>> Code Value	(0008,0100)	1		
>> Code Scheme Designator	(0008,0102)	1	The value of a Coding Scheme Designator, used in this SOP Instance, which is being mapped.	
>> Code Meaning	(0008,0104)	1		
> Date	(0040,A121)	1C	This is the Value component of a Name/Value pair when the Concept implied by Concept Name Code	

			Sequence (0040,A043) is a date. Note: The purpose or role of the date value could be specified in Concept Name Code Sequence (0040,A043). Required if Concept Name Code Sequence (0040,A043) is present and the value it requires (implies) is a date. Shall not be present otherwise.	
> Text Value	(0040,A160)	1C	This is the Value component of a Name/Value pair when the Concept implied by Concept Name Code Sequence (0040,A043) is a Text Observation Value. Required if Date (0040,A121), Time (0040,A122), and Person Name (0040,A123) do not fully describe the concept specified by Concept Name Code Sequence (0040,A043). Shall not be present otherwise.	

### 7.1.12. DX Anatomy Imaged

#### 7.1.12.1. DX Anatomy Imaged Module

Attribute Name	Tag	Type	DICOM Definition	Carestream Extension
Image Laterality	(0020,0062)	1	(Digital X-Ray Anatomy Imaged Module) Laterality of (possibly paired) body part (as described in Anatomic Region Sequence (0008,2218)) examined. Enumerated Values: R = right L = left U = unpaired B = both left and right Note: This Attribute is mandatory, in order to ensure that images may be positioned correctly relative to one another for display. Shall be consistent with any laterality information contained in Primary Anatomic Structure Modifier Sequence (0008,2230), if present. Note: Laterality (0020,0060) is a Series level Attribute and must be the same for all Images in the Series, hence it must be absent.	Allowed values: R,L,U,B (for DX module)

### 7.1.13. Private

7.1.13.1. Private Common Module

Tag	VR Type	Description	Carestream Extension
(0033,XX10)	DS	The version of INDUSTREX that created the file.	CSH Private Tag: A company identifier and INDUSTREX version number
(0033,XX40)	OB	Internal data	
(0033,XX50)	OB	Internal data	
(0033,XX71)		Presentation Image	
(0033,XX72)		Display Filter	

**7.2. DICOM File Meta Information**

Attribute Name	Tag	Type	DICOM Definition	Carestream Extension
Transfer Syntax	(0002,0010)	1	Uniquely identifies the Transfer Syntax used to encode the following Data Set. This Transfer Syntax does not apply to the File Meta Information. Note: It is recommended to use one of the DICOM Transfer Syntaxes supporting explicit Value Representation encoding to facilitate interpretation of File Meta Element Values. JPIP Referenced Pixel Data Transfer Syntaxes are not used. (See PS 3.5 of the DICOM Standard).	

**7.3. Query/Retrieve Information Model**

Attribute Name	Tag	Type	DICOM Definition	Carestream Extension
Number of Study Related Series	(0020,1206)		The number of series that match the Study level Query/Retrieve search criteria	
Number of Study Related Instances	(0020,1208)		The number of composite object instances that match the Study level Query/Retrieve search criteria	
Number of Series Related Instances	(0020,1209)		The number of composite object instances in a Series that match the Series level Query/Retrieve search criteria	