

# **AGFA MEDICAL IMAGING DICOM Conformance Statement**



## **SCU CR Image Storage Component (CRX) for ADC 70**

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## Document Information

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## Revision Record

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Revision Number	Date	Author	Reason for Change
-	16/9/96	Athoof	Create file "crx.ps: crx conformance claim"
-	30/7/96	Athoof	New MS-Word version, ported from Frame
3.1	27/1/97	Athoof	
3.2	4/3/97	Athoof	Conformance Statement instead of Conformance Claim
3.3	24/3/97	Athoof	
3.4	8/4/97	Athoof	Supported optional modules
3.5	14/4/97	Athoof	'Status code A700' modified
3.6	11/8/97	Athoof	Introduction updated
3.7	17/11/98	Athoof	Maximum PDU length is 65542 bytes
3.8	27/01/99	Amorris	Company name changed
3.9	9/07/99	Amorris	New introduction incorporated
3.10	28/12/99	Amorris	New style implemented
3.11	20/1/00	Amorris	Returned to old style
3.12	23/02/00	Amorris	Title updated
3.13	8/03/00	Amorris	Released 16.2.00
4.0	7/09/00	Cweise	New conventions to be implemented
4.1	7/09/00	Cweise	New conventions implemented

# 1 INTRODUCTION

## 1.1 Intended Audience

The user of this document is involved with system integration and/or software design. We assume that the reader is familiar with the terminology and concepts that are used in the DICOM 3.0 standard.

Readers not familiar with DICOM 3.0 terminology should first read the appropriate parts of the DICOM standard itself, prior to reading this conformance statement.

Although the use of this conformance statement in conjunction with the DICOM 3.0 standard is intended to facilitate communication with other medical imaging equipment, it is not sufficient to guarantee, by itself, the inter-operation of the connection. The following issues need to be considered:

### 1.1.1 Integration

The integration of any device into a system of interconnected devices goes beyond the scope of the DICOM 3.0 standard and this conformance statement when *interoperability* is desired. The responsibility for analyzing the applications requirements and developing a solution that integrates the Agfa equipment with other vendors' systems is the user's responsibility and should not be underestimated.

### 1.1.2 Validation

Testing the complete range of possibilities between the Agfa equipment and non-Agfa devices, before the connection is declared operational, is deemed to be a necessity. The user should ensure that any non-Agfa provider accepts full responsibility for all validation required for their connection with the Agfa equipment. The accuracy of image data once it has crossed the interface between the Agfa equipment and the non-Agfa device as well as the stability of the image data for the intended applications is the responsibility of the non-Agfa provider.

### 1.1.3 Future Evolution

As the DICOM 3.0 standard evolves to meet the user's growing requirements and to incorporate new features and technologies, Agfa will follow the evolution of the standard. This evolution of the standard may require changes to devices that have implemented DICOM 3.0. The user should ensure that any non-Agfa provider who connects with Agfa devices also plans future evolution of the DICOM standard. A refusal to do so may reflect in the loss of functionality and/or connectivity between the different products.

## 1.2 Purpose of this Document

This conformance statement specifies the compliance of the CR Image Storage Service Class (CRX) component (CRX, for CR image eXport) with the DICOM standard. The CR Image Storage Component is an implementation of the DICOM 3.0 standard for Computed Radiography SOP Class image storage. The CRX acts as an SCU and transfers images made with CR equipment to an SCP DICOM AE.

# 2 IMPLEMENTATION MODEL

## 2.1 Application Data Flow Diagram

Whenever a new study of CR images is on the local disk, the CR Image Storage Component is informed, and starts off a new Storage Service session.

The diagram for the SCU side looks like this:

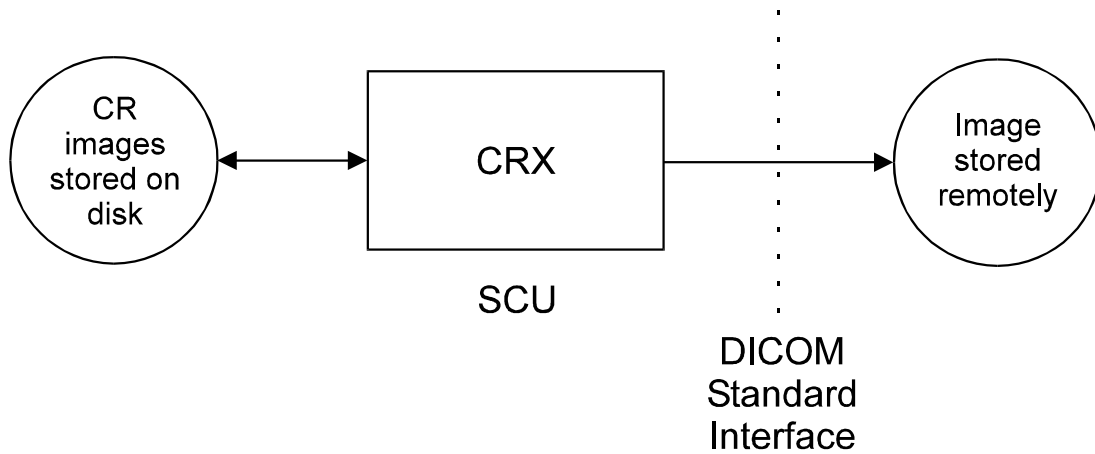


Figure 2.1 Implementation for the SCU side.

### 2.2 Functional Definitions of AEs

The CR Image Storage Component will start an association with the appropriate Presentation Context for the CR SOP class.

### 2.3 Sequencing of Real World Activities

If a Presentation Context for the CR Image Storage SOP Class is accepted, then all the images have to be transferred correctly to the SCP AE, before the Association is released by the SCU. If the Association is aborted for some reason, the images will be retried. On a successful image transfer, all images sent, are removed from internal storage.

## 3 AE SPECIFICATIONS

### 3.1 CRX – Specification

The CR Image Storage Component provides standard conformance to the following DICOM 3.0 SOP Class as SCU:

SOP Class Name	SOP Class UID
Computed Radiography Image Storage	1.2.840.10008.5.1.4.1.1.1

Table 3.1 SOP Class.

### 3.1.1 Association Establishment Policies

#### 3.1.1.1 General

Before any SOP Classes can be exchanged between the SCU AE and the SCP AE, an association stage has to take place to negotiate and exchange the capabilities of the SCU and SCP. The SCU AE will attempt to establish such an Association when a new study of images exists on the MG 3000.



The SCU and the SCP establish an Association by using the Association Services of the DICOM Upper Layer.

During association establishment the CR Image Storage Component AE negotiates the CR Image SOP class. Only the SCU AE shall release the Association. The Association may be aborted by the SCU AE or the SCP AE. The SCU AE attempts to initiate a new Association for each new study of images which has to be stored.

### **3.1.1.2 Number of Associations**

For the moment, the CR Image Storage Component will make only one Association for storage purposes at the same time.

### **3.1.1.3 Asynchronous Nature**

The CR Image Storage Component will do an operation on an Association and will wait for a response from the SCP AE, before attempting another operation on the same Association.

The CR Image Storage Component will only allow a single outstanding operation on an Association.

Therefore, no side of the CR Image Storage Component will perform asynchronous operations window negotiation.

### **3.1.1.4 Implementation Identifying Information**

The Implementation Version Name provided by the CR Image Storage Component is 'MG3000\_VERSION\_3'.

All Associations will use a single Implementation Class UID that is:

- ▶ Implementation Class UID: **1.3.51.0.1.3**
- ▶ Application Context Name: **1.2.840.10008.3.1.1.1**

CRX is supported from MeGa release 3.32 onwards.

## **3.1.2 Association Initiation Policy**

The CR Image Storage Component attempts to initiate an Association for each set of images it needs to transfer.

If the Association is rejected by the SCP AE, then the Image Storage Component issues a warning message.

In case of a time-out (e.g. no answer from the SCP) or a warning message the study will be retried after at least 20 seconds. In the mean time studies to other destinations will be handled.

The Maximum PDU length that the CR Image Storage Component can receive is 65542 bytes. This means that the maximum value for a PDU-length field is 65542 bytes.

### **3.1.2.1 Storage Encoded with Implicit or Explicit VR**

#### **3.1.2.1.1 Associated Real World Activity**

The associated Real World Activity is the storage of a set of images contained in a study that is encoded with Implicit or Explicit VR and requested over the network.

The Abstract Syntax will be determined by the SOP Class.

The CR Image Storage Component is able to translate the data into any of the specified Transfer Syntaxes. The SCU will attempt to initiate an Association with a list of all possible Transfer Syntaxes for the CR Image Storage Service Class to allow the destination AE (SCP) to choose a supported Transfer Syntax. Preferred is the first Transfer Syntax of the list.

### 3.1.2.1.2 Proposed Presentation Contexts for CRX

Any of the Presentation Contexts shown in the following tables is acceptable for the Image Storage Component.

Transfer Syntaxes for the CR Image Storage Service Class:

Transfer Syntax	UID
DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2
DICOM Explicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2.1
DICOM Explicit VR Big Endian Transfer Syntax	1.2.840.10008.1.2.2

**Table 3.2 Transfer syntaxes.**

Results in the following Presentation Context:

Abstract Syntax		Transfer Syntax	Role	Extended Negotiation
SOP Class	SOP Class UID			
Computed Radiography Image Storage	1.2.840.10008.5.1.4.1.1.1	All from Table 3.2	SCU	None

**Table 3.3 Presentation context.**

### 3.1.2.2 SOP Specific Conformance to the Computed Radiography Image Storage SOP Class

Standard conformance is provided to the Computed Radiography Storage SOP Class (1.2.840.10008.5.1.4.1.1.1.) of the DICOM Image Storage Service Class.

Type 1 attributes will always be sent with a length different from zero. Type 2 attributes will also always be sent, but the length may be equal to zero.

Next to the mandatory modules for CR Image Storage, the optional VOI LUT and MODALITY LUT modules are also supported.

The supported attributes for the mandatory modules are the following:

Group	Element	Name	Type	Default
0008	0005	Specific Character Set	1C	ISO_IR 100
	0008	Image Type	3	
	0012	Instance Creation Date	3	
	0013	Instance Creation Time	3	
	0016	SOP Class UID	1	
	0018	SOP Instance UID	1	
	0020	Study Date	2	
	0022	Acquisition Date	3	

Group	Element	Name	Type	Default
	0030	Study Time	2	
	0032	Acquisition Time	3	
	0050	Accession Number	2	
	0060	Modality	1	"CR"
	0070	Manufacturer	2	"AGFA"
	0080	Institution Name	3	
	0090	Referring Physicians' Name	2	
	1010	Station Name	3	
	1030	Study Description	3	
	103E	Series Description	3	
	1040	Department	3	
	1060	Name Physician reading study	3	
	1090	Manufacturer's Model Name	3	"5140"
0010	0010	Patient's Name	2	
	0020	Patient ID	2	
	0030	Patient's Birth Day	2	
	0040	Patient's Sex	2	
0018	0015	Body Part Examined	2	
	1000	Device Serial Number	3	
	1004	Plate ID	3	
	1260	Plate Type	3	
	1401	Acquisition Processing Code	3	
	1402	Cassette Orientation	3	
	1403	Cassette Size	3	
	1404	Exposures on Plate	3	
	5101	View Position	2	
	6000	Sensitivity	3	
0020	000D	Study Instance UID	1	
	000E	Series Instance UID	1	
	0010	Study ID	2	
	0011	Series Number	2	
	0013	Image Number	2	
	0020	Patient Orientation	2C	
	0060	Laterality	2C	
	1002	Images in Acquisition	3	1
	4000	Image Comments	3	
0028	0002	Samples per Pixel	1	1
	0004	Photometric Interpretation	1	MONOCHROME1
	0010	Rows	1	
	0011	Columns	1	
	0034	Pixel Aspect Ratio	1C	
	0100	Bits Allocated	1	
	0101	Bits Stored	1	
	0102	High Bit	1	
	0103	Pixel representation	1	0
7FE0	0010	Pixel data	1	

**Table 3.4 Supported attributes (mandatory modules).**

The 'Study ID' (0020, 0010) has the following format:

- ▶ <one character ID station ID><ID station session nr>

The 'Station Name' (0008, 1010) has the following format:

- ▶ <Digitizer Name><ID Station ID>

The 'Image Comment' (0020, 4000) has the following format:

- ▶ <Comment proper><User info 1>...<User info N>

For the 'Photometric Interpretation' (0028, 0004) attribute, the following value is known to DICOM:  
MONOCHROME1

If the value for the 'Department' (0008, 1040) attribute is not known, the value of the 'Institution Name' (0008, 0080) is copied into the 'Department' attribute.

For the 'Image Type' (0008, 0008) attribute the following value is known to DICOM: DERIVED\PRIMARY

The following attributes will always be sent with a length equal to zero:

- ▶ Accession number (0008, 0050)
- ▶ Ref. Physicians Name (0008, 0090)
- ▶ Study ID (0020, 0010)
- ▶ Laterality (0020, 0060)

The following standard element in the X-ray Angiographic Image Object is added: 'Imager Pixel Spacing' (0018, 1164) with:

- ▶ <row spacing>\<column spacing > in millimeter

The 'Imager Pixel Spacing' value is copied into the following additional standard attribute 'Pixel Spacing' (0028,0030).

Group	Element	Name	Type	VR	Default
0018	1164	Imager Pixel Spacing	2	DS	
0028	0030	Pixel Spacing	2	DS	

**Table 3.5 Supported attributes (additional elements).**

A number of private elements are sent, using group 0019. An identification code of "AGFA" is sent in (0019, 0010).

Group	Element	Name	Type	VR	Default
0019	0010	Private Identification Code	1	LO	"AGFA"
	1010	Image Processing Parameters	3	LO	Note 1
	1011	Identification Data	3	LO	Note 2
	1013	Sensitometry Name	3	LO	
	1014	Window/Level List	3	ST	Note 3
	1015	Dose Monitoring	3	LO	Note 4
	1016	Other Info	3	LO	Note 5

**Table 3.6 Supported attributes (private elements).**

**Notes:**

1. MENU=menu CC=cc MC=mc EC=ec LR=lr NR=nr, where:  
 menu is an integer image processing number.  
 cc is an integer specifying the collimation configuration.  
 mc is a real number specifying the musica contrast.  
 ec is a real number specifying the edge contrast.  
 lr is a real number specifying the latitude reduction.  
 nr is a real number specifying the noise reduction.  
 All real numbers are written with 2 digits after the decimal point. All above undescribed parts must be literally included.

2. x name, where:  
 x is a one-character ID station identification.  
 name is an image-identifying string consisting of either pyramidname\_version0 or spooling-ID.

3. W1/L1,W2/L2,...,Wi/Li,Wn/Ln, where:  
 Wi is the i-th window width specification as a real number  
 Li is the i-th window level specification as a real number  
 i is an integer number in the interval [1,n], n being the total number of window/level specifications.  
 All real numbers are written with 2 digits after the decimal point.  
 All above undescribed parts must be literally included.  
 The notation ... means any number of specifications.

4. D1,D2,...,Di,...,Dn, where:  
 Di is the i-th LgM (dose) specification as a real number.  
 i is an integer number in the interval [1,n], n being the total number of LgM (dose) specifications  
 All real numbers are written with 2 digits after the decimal point.  
 All above undescribed parts must be literally included.  
 The notation ... means any number of specifications.

5. Reserved for future extensions. The following optional modules are supported:

VOI LUT module  
 MODALITY LUT module

Either a VOI LUT Sequence (0028, 3010) or Window Center (0028, 1050) and Window Width (0028, 1051) is sent, but not both. The supported attributes are the following:

Group	Element	Name	Type	Default
0028	1050	Window Center	3	
	1051	Window Width	1C	
	1052	Rescale Intercept	1	
	1053	Rescale Slope	1	
	1054	Rescale Type	1	
	3010	VOI LUT sequence	3	
	3002	> LUT descriptor	1C	
	3004	> LUT Explanation	3	
	3006	> LUT Data	1C	

**Table 3.7 Supported attributes (optional module).**

The 'LUT descriptor' (0028, 3002) will be, if present, include table\_size, table\_zero and table\_depth) with:

- ▶ table\_size: number of entries in LUT table (US type)
- ▶ table\_zero: input pixel value for first element in LUT table (US type)
- ▶ table\_depth: number of bits per table entry (16)

Three types of images are supported:

- ▶ The VOI LUT will be present only if the SCU did not process the image for window/level and sensitometry. In that case the 'Rescale Type' (0028, 1054) must be 'LOG\_E\_REL'. The pixel values are linearly related to the Log exposure on the image plate. The maximum pixel value corresponds to a delta LogE of 3.2767 above the LogE for the minimum pixel value. The 'Rescale Slope' will be set to 1.0 and the 'Rescale Intercept' to 0.0. The 'Bits Allocated' attribute value will be set to 16, 'Bits Stored' will be set to 12 and the 'High Bit' will be set to 11.
- ▶ The SCU did process the image the 'Rescale type' will be 'OD\_REL' and the VOI LUT will be absent. The 'Rescale Slope' will be set to 1.0 and the 'Rescale Intercept' to 0.0. The 'Window Center' attribute value will be set to 2048 and the 'Window Width' to 4096. The 'Bits Allocated' attribute value will be set to 16, 'Bits Stored' will be set to 12 and the 'High Bit' will be set to 11.
- ▶ The SCU produces an OD image. The 'Rescale type' will be 'OD'. The 'Rescale Slope', 'Rescale Intercept', 'Window Center' and the 'Window Width' attribute values are present.

⇒ C-STORE: The CR Image Storage Component will process the C-STORE confirmation and response Status Codes. The following status codes can be received for C-STORE:

Code	Status	Meaning
0000H	Success	The image was stored successfully on the SCP system. Normally returned by the SCP AE. The CR Image Storage Component will send a C-STORE for the next study.
A700H	Error	Refused: SCP was out of resources. Status message will be logged by the CR Image Storage Component. The CR Image Storage Component will retry a C-STORE command for this study, until success or a status different from A700H is returned.
A9xxH	Error	Data Set does not match SOP Class (indicates that the Data Set does not encode an instance of the SOP Class specified according to the SCP). Status message will be logged by the CR Image Storage Component. The CR Image Storage Component will stop sending C-STORE commands for this study.
CxxxH	Error	Can not understand (indicates that the Data Set could not be parsed into elements by the SCP). Status message will be logged by the CR Image Storage Component. The CR Image Storage Component will stop sending C-STORE commands for this study.
B000H	Warning	Coercion of Data Elements. Status message will be logged by the CR Image Storage Component. The CR Image Storage Component will send a C-STORE command for the next study.
B007H	Warning	Data Set does not match SOP Class Status message will be logged by the CR Image Storage Component. The CR Image Storage Component will send a C-STORE command for the next study.
B0006H	Warning	Elements discarded Status message will be logged by the CR Image Storage Component. The CR Image Storage Component will send a C-STORE command for the next study.

### 3.1.3 Association Acceptance Policy

Not applicable.

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## 4 COMMUNICATIONS PROFILES

### 4.1 Supported Communications Stacks

The CR Image Storage Component uses TCP/IP for the protocol stacks.

The CR Image Storage Component listens by default to port number 104, unless this is configured differently for the MG 3000 (See Section 6).

## 5 EXTENSIONS / SPECIALIZATIONS / PRIVATIZATIONS

Not applicable.

## 6 CONFIGURATION

This document describes the CR Image Storage Component conformance to DICOM 3.0 for MeGa release 3.32.

The CR Image Storage Component obtains the configuration information from a configuration table. Each parameter is configured with a single line in the configuration file.

### 6.1 Configurable Parameters

This configuration is part of the MG 3000 installation procedures and is described in a separate document (see MG 3000 install).

One configurable parameter is the name of the source application. (calling\_AE). The port number and IP address are determined by using the MG 3000 configuration.

## 7 ACRONYMS AND ABBREVIATIONS

The following acronyms and abbreviations are used in this document:

AE	Application Entity
CRX	Computed Radiography Export
DICOM	Digital Imaging and Communications in Medicine
DIMSE	DICOM Message Service Element
NEMA	National Electrical Manufacturers Association
PDU	Protocol Data Unit
SCP	Service Class Provider
SCU	Service Class User
SCP	Service Class Provider
SOP	Service-Object Pair
TCP/IP	Transmission Control Protocol/Internet Protocol
UID	Unique Identifier