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Graphic technology — Colour data exchange format (CxF/X)

Part 2: Scanner target data (CxF/X-2)

National foreword

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**Graphic technology — Colour data
exchange format (CxF/X) —**

**Part 2:
Scanner target data (CxF/X-2)**

*Technologie graphique — Échange des données de couleur en
utilisant CxF —*

Partie 2: Données cibles du scanner entrantes



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Foreword

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: [Foreword - Supplementary information](#).

The committee responsible for this document is ISO/TC 130, *Graphic technology*.

ISO 17972 consists of the following parts, under the general title *Graphic technology — Colour data exchange format (CxF/X)*:

- *Part 1: Relationship to CxF3 (CxF/X)*
- *Part 2: Scanner target data (CxF/X-2)*
- *Part 3: Output target data (CxF/X-3)*
- *Part 4: Spot colour characterisation data (CxF/X-4)*

Introduction

ISO 17972 defines methods for the use of CxF3 to exchange measurement data and associated metadata within the graphic arts industry and for the exchange of these files between graphic arts users. It is a multi-part document where each part is intended to respond to different workflow requirements. The goal throughout the various parts of ISO 17972 has been to maintain the degree of flexibility required while minimizing the uncertainty of the data exchanged.

ISO 17972-1 defines the use of the publicly available Colour Exchange Format, version 3 (CxF3), for prepress data exchange and verification.

This part of ISO 17972 covers the use of CxF when exchanging data from ISO 12641. This part of ISO 17972 is not designed to replace ISO 12641, but to define an updated, verifiable, method of data exchange using CxF, acting as a supplement to ISO 12641:1997, 4.6 and 4.7. X-Rite Inc., the original creator of the CxF file format, claims no intellectual property rights to the materials used in this part of ISO 17972.

Scanner targets are one of the earliest defined data exchange use cases in the graphic arts and continue to be used for calibration and characterization of scanners and other devices. Traditionally, data has been provided in ACSII format using a keyword file. The direct mapping of existing data to the updated CxF/X-2 encoding was one of the primary concerns in writing this part of ISO 17972.

The following files are part of this part of ISO 17972, and are included as electronic inserts:

- CxF3_Core.xsd;
- CxF3_Schema_Diagram.pdf;
- Scannertarget CxF/X-2.cxf;
- Scannertarget.txt.

Graphic technology — Colour data exchange format (CxF/X) —

Part 2: Scanner target data (CxF/X-2)

1 Scope

This part of ISO 17972 defines an exchange format for target input values, colour and process control data relating to scanner targets (and the associated metadata necessary for its proper interpretation) in electronic form. This part of ISO 17972 includes the use of a CustomResource element within the CxF framework to define a minimum set of data for exchange and identify the data as being part of ISO 12641.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 12641:1997, *Graphic technology — Prepress digital data exchange — Colour targets for input scanner calibration*

ISO 17972-1, *Graphic technology — Colour data exchange format — Part 1: Relationship to CxF3 (CxF/X)*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply

3.1 Terms

NOTE The spelling of terms taken from Colour Exchange Format v3.0 is not altered from that used in the normative reference. A specific example is the word *color* instead of *colour*.

3.1.1

ColorSpecification

information about the *ColorValue* (3.1.2) including its source (measurement specifications), illuminant/observer calculation method (tristimulus specifications) and physical attributes of the *objects* (3.1.5) (size, quantity, finish, etc.)

3.1.2

ColorValue

one of a number of defined color space types that can hold values and associated information related to that specific type of device independent colour space

[SOURCE: Color Exchange Format v3.0]

3.1.3

CustomResources

“extensible” part of CxF3, additional information not included in the CxF3 Core about colour objects and the file itself that is considered application specific in nature and not generally of use to all other applications

[SOURCE: Colour Exchange Format v3.0]

3.1.4

DeviceColorValue

one of a number of defined colour space types that can hold values and associated information related to that specific type of device dependent colour space

[SOURCE: Color Exchange Format v3.0]

3.1.5

object

used to identify each specific “Colour item” that is being described

3.2 Definitions

3.2.1

profile

set of mathematical values or binary structure that allows transformation to/from one device colour space to another

Note 1 to entry: Profiles are stored in the ProfileCollection and are shared and referenced by the ColourValues.

3.2.2

resources

information about each colour object that is of interest to all readers of the CxF file

Note 1 to entry: Also referred to as the “CxF3 Core”, it is defined by the CxF3-Core namespace schema.

3.2.3

schema

XML document that, conforming to the specifications established by the World Wide Web Consortium, defines the structure of a class of XML documents

3.2.4

extensible markup language

XML

set of rules for encoding documents electronically

3.2.5

XSD

XML schema definition

4 Symbols and abbreviated terms

The following documentation conventions are used.

Names of XML elements are shown in bold type, for example, **Resources**.

Names of XML attributes are shown in italics, for example, *SpotColorName*.

XML XPath expressions are used to identify XML elements. For example, **container/contained** refers to an element (**contained**) that is a child of another element (**container**).

Similarly, XML XPath expressions are used to refer to XML attributes, for example, **element1/@Name** refers to an attribute (*Name*) of an element (**element1**).

5 Requirements

5.1 General description of a CxF/X file for data exchange

The standard Colour Data Exchange Format as presented in ISO 17972-1 captures file information such as creation and ownership, core colour information (the Resources) and any extended information (CustomResources). In this part of ISO 17972, CustomResources are used to define the minimum required data for ISO 12641 data exchange via CxF/X-2. Any CxF/X file shall meet the following requirements.

The FileInformation. element of a CxF/X file shall include Creator, CreationDate and Description.

The Description element of a CxF/X file shall include “CxF/X” and the number of the applicable International Standard with which the CxF/X file complies.

If the file is to be used in support of an International Standard, it shall include the number of the International Standard in the Comment text.

A CxF/X file shall validate against the CxF3 Schema (see [Annex B](#)). In all cases, a CxF/X document should have the extension “.CxF”.

A CxF/X file shall be structured as shown in [Figure 1](#).

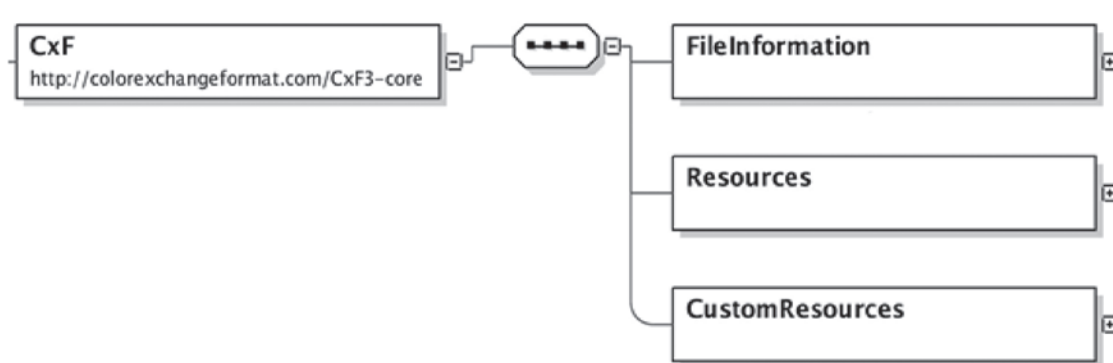


Figure 1 — CxF/X file structure

NOTE The spelling of terms and elements taken from Color Exchange Format v3.0 are not altered from that used in the normative reference. A specific example is the word color instead of colour.

5.2 Requirements of a CxF/X-2 file for ISO 12641 data exchange

There are several data requirements stated in ISO 12641:1997, 4.6. Originators of targets are required to provide the following:

- for all targets batch specific mean and standard deviation colourimetric, data shall be available for each patch in the form of corresponding colorimetric values to two decimal places;
- calibrated targets shall supply the measured colorimetric data for all target patches.

[Table 1](#) enumerates the required elements for CxF/X data exchange of scanner target data. [Annex A](#) provides a complete mapping of all keywords from ISO 28178 which is a superset of the keywords used in ISO 12641. An example of the use of these in a CxF/X-2 file is provided in [Annex C](#).

Table 1 — CxF/X-2 required fields

ISO 12641	CxF/X-2
Required Fields	
Originator	FileInformation.Creator
File Descriptor	FileInformation.Description
Created	FileInformation.CreationDate
TargetType	FileInformation.Tag ("12641_TargetType");
Manufacturer	FileInformation.Tag ("Manufacturer");
Prod_Date	FileInformation.Tag ("Prod_Date");
Serial	FileInformation.Tag ("Serial");
Measurement_Geometry	MeasurementSpec.GeometryChoice
Measurement_Source	MeasurementSpec.Device.DeviceIllumination
Filter	MeasurementSpec.Device.DeviceFilter
Polarization	MeasurementSpec.Device.DevicePolarization
Weighting_Function	TristimulusSpec.Observer
Sample Backing	MeasurementSpec.Backing
Input values	
RGB_R (G,B)	ColourRGB
Measured values (Either XYZ or Lab)	
One is required	
XYZ_X (Y,Z)	ColourCIEXYZ
LAB_L (A,B)	ColourCIELab
Required of Manufacturers only	
MEAN_DE	Tag ("Mean_DE")
STDDEV_X (Y,Z)	Tag ("STDDEV_X")

Annex A (informative)

Colour exchange format mapping to ISO 28178

A.1 General

ISO 28178 is the standard text file format for exchanging colour measurement data and provides mapping in both ASCII and XML. The widely used ASCII text file consists of a Preamble section containing originator information, keyword definitions, etc. followed by one or more data sections, each consisting of header and data subsections. The BEGIN_DATA_FORMAT and END_DATA_FORMAT delimiters define the actual data types contained in the following tables. The BEGIN_DATA and END_DATA delimiters mark the subsection containing the actual colour information in tabular form. ISO 28178 text files can contain device, colorimetric (Lab, XYZ, etc.), densitometric, spectral, naming and other information.

[Table A.1](#) demonstrates that all significant data contained in a ISO 28178 file can be captured and maintained in a CxF file. A brief description of the definition of the original ASCII keyword is also provided. This demonstration does not use a CustomResource in this case, but, a CustomResource could be used to make some of the application specific data more structured with defined enumerations and requirements.

A.2 Field and Element mapping

Table A.1 — 28178 fields to CxF3 equivalents

<i>ISO 28178</i>	<i>CxF 3.0</i>	<i>Description</i>
Required Fields		
Originator	FileInformation/Creator	Identifies the specific system, organization or individual that created the data file.
File Descriptor	FileInformation/Description	Describes the purpose or contents of the data file.
Created	FileInformation/CreationDate	Indicates the creation date of the data file. The form for this date is CCYY-MM-DDThh:mm:ss[Z ± hh:mm].
Number of Fields	<i>Not Required (inherent in XML structure).</i>	<i>Number of fields (data format identifiers) that are included in the data format definition that follows.</i>
Data Format	<i>Not Required (inherent in XML structure).</i>	<i>Marks the beginning and end of a data format definition. END_DATA_FORMAT shall be preceded by BEGIN_DATA_FORMAT.</i>
Number of Sets of Data	<i>Not Required (inherent in XML structure).</i>	<i>Number of repetitions or sets of data, i.e. the number of rows in the data table. The associated value is an integer.</i>
Data Table	<i>Not Required (inherent in XML structure).</i>	<i>Marks the beginning and end of a data table.</i>

Table A.1 (continued)

ISO 28178	CxF 3.0	Description
Optional Fields		
Comment	FileInformation/Comments	Comments are ignored by automated readers. Comments indicate to users that the information that follows is of informative interest. Comments need not be enclosed in quotes. Comments may occur anywhere except within a table.
TargetType	FileInformation/Tag	Used to report an enumerated list of IT8 target types.
Instrumentation	MeasurementSpec/Device...	Used to report the specific instrumentation used (e.g. manufacturer, model number and serial number, etc.) to generate the data reported.
Manufacturer	MeasurementSpec/Device/Manufacturer	Name of the device manufacturer.
Model	MeasurementSpec/Device/Model	Both the device model number and revision may be recorded here.
Serial_Number	MeasurementSpec/Device/SerialNumber	Device serial number.
Measurement Geometry	MeasurementSpec/GeometryChoice	The type of measurement, either reflection or transmission, should be indicated along with details of the geometry and the aperture size and shape.
Measurement Source	MeasurementSpec/Device/DeviceIllumination	Illumination (e.g. incandescent, daylight, colour temperature, etc.) used during spectral measurement.
Filter	MeasurementSpec/Device/DeviceFilter	Identifies the use of physical filter(s) during measurement. This is typically used to denote the use of filters such as none, D65, Red, Green or Blue.
Polarization	MeasurementSpec/Device/DevicePolarization	Identifies the use of a physical polarization filter during measurement. Allowed values are “yes”, “none” or “na”.

Table A.1 (continued)

ISO 28178	CxF 3.0	Description
Weighting Function	TristimulusSpec/Observer	Indicates such functions as: the CIE standard observer functions used in the calculation of various data parameters (2° and 10°); CIE standard illuminant functions used in the calculation of various data parameters (e.g. D50, D65, etc.); density status response; etc.
Computational Parameter	Tag [name]/@value	Parameter that is used in computing a value from measured data. Name is the name of the calculation, parameter is the name of the parameter used in the calculation and value is the value of the parameter.
Sample Backing	MeasurementSpec/Backing	Identifies the backing material used behind the sample during measurement. Allowed values are “black”, “white”, “self” or “na”.
Manufacturer	FileInformation/Tag/@ “Manufacturer”	Indicates the manufacturer of the sample from which the data was measured.
Material	FileInformation/Tag/@“Material”	Identifies the material or substrate on which the target was produced, using a code identifying the material.
Target Type	(“28178_TargetType”)	Identifies the type of target being measured, e.g. IT8.7/1, IT8.7/3, user-defined, etc.
Colorant(s)	DeviceColorValues/ColourRecipe	Identifies the colourant(s) used in creating the target.
Production Date	FileInformation/Tag/@ “Prod_Date”	Identifies year and month of production of the target in the form yyyy:mm
Print Conditions	FileInformation/Tag/@Print Conditions	Used to define the characteristics of the printed sheet being reported. Where standard conditions have been defined (e.g. SWOP at nominal) named conditions may suffice. Otherwise, detailed information shall be provided.
Serial Number	Object/Id	Uniquely identifies physical samples.
Process colour identification	Object/Object Type and ColourValueType/Name	Uniquely identifies colour and sequence associated with the numerical values assigned to each process colour set.

Table A.1 (continued)

ISO 28178	CxF 3.0	Description
Spot colour identification	Object/ObjectType and ColourValueType/Name	Uniquely identifies colour associated with the numerical value assigned to each spot colour (or line colour).
Copyright	FileInformation.Tag/@Name = "Copyright"s	Identifies any specific copyright information associated with the file.
User-defined tags and keywords	Supplied by use of a Custom Resource.	Declares a user-defined tag or keyword. This is primarily intended for vendor-specific information, but can also be used as a mechanism to add new keywords in the future without breaking automated readers in existence prior to tag/keyword revision.
Data Table Fields		
Table Descriptor	Not Required (inherent in XML structure).	Describes the purpose or contents of a data table.
Table Name	Not Required (inherent in XML structure).	Provides a short name for a data table.
Defined Data Format Identifiers		
SAMPLE_ID	Object/Id	Sample identifier as defined in ISO 12642-1 or ISO 12642-2.
SAMPLE_NO	Not Required (inherent in XML structure).	Sample sequential number assigned based on read order or other user defined criteria.
STRING	Labels not required – XML elements used are already named.	Identifies label, or other non-machine readable value. Value shall begin and end with a " symbol.
CMYK_C (M,Y,K)	ColourCMYK	The component of CMYK data expressed as a percentage.
PC _m _n	DeviceColorValues/CMYK or CMYKPlusN	Data associated with the process colour identified in tag/keyword Process colour identification from ISO 28178:2009, 4.2.3.18 expressed as a percentage. The value <i>m</i> represents the number of colours in the process colour set. The value <i>n</i> is used to identify the individual colour within the process colour set and is assigned according to the order of laydown (sequence of printing).
SPOT _n	DeviceColorValue/ColourRecipe	Data associated with the spot colour <i>n</i> identified in tag/keyword Spot colour identification expressed as a percentage, where <i>n</i> is a numerical value.

Table A.1 (continued)

ISO 28178	CxF 3.0	Description
D_RED (GREEN,BLUE,VIS)	ColourDensity	Colour filter density.
RGB_R (G,B)	DeviceColorValue/ColourRGB	The component of RGB data expressed as a code value in the range 0–255.
SPECTRAL_NM (DEC,PCT)	ReflectanceSpectrum ...	Wavelength of measurement expressed in nanometers in equal increments of 1 nm, 2 nm, 5 nm, 10 nm or 20 nm.
XYZ_X (Y,Z)	ColourCIEXYZ	Component of tristimulus data.
XYY_Y (X,CAPY)	ColourCIExyY	Component of chromaticity data.
LAB_L (A,B)	ColourCIELab	Component of CIELAB data.
LAB_L (C,H)	ColourLCH	Component of CIELCH data.
LAB_DE (DE94,CMC,2000)	LAB_DE (DE94,CMC,2000)	ΔE using different formula.
MEAN_DE	Tag/Mean_DE	Mean ΔE^*_{ab} (LAB_DE) of samples compared to batch average.
STDDEV_X (Y,Z)	Tag/STDDEV_X	Standard deviation of (tristimulus data X, Y, Z).
STDDEV_L (A,B)	Tag/STDDEV_L	Standard deviation of $L^*a^*b^*$ data.
CHI_SQD_PAR	Tag/@name/@value	Average of the standard deviations of L^* , a^* or b^* .

Annex B **(informative)**

CxF3 schema

B.1 General

To validate a CxF file or validate a CustomResource that references the CxF3 Schema, it is necessary to have access to the CxF3 schema itself. The CxF3 Schema is included in this part of ISO 17972 as electronic file CxF3_Core.xsd along with CxF3_Schema_Diagram.pdf.

NOTE Files with .xml, .xsd or .cxf can be opened with a standard text editor though the use of a dedicated XML tool which can help with formatting and visual mapping tools.

B.2 Modification of the CxF3 Schema

It is important to note that the CxF3 schema itself shall not be modified except to point to an associated CustomResource. Arbitrary modification or additions to the CxF3 core schema would affect interoperability of the file. Modification is the function of CustomResources.

Annex C (informative)

Example file

Electronic files that illustrate the ASCII keyword format and the CxF/X-2 format for scanner are available in the directory named Annex C of the accompanying electronic files.

Bibliography

- [1] ISO 28178:2009, *Graphic technology — Exchange format for colour and process control data using XML or ASCII text*
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