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Textiles — Standard data format for colorimetric communication — Textiles and related measurements

Textiles — Format de données standard pour la communication colorimétrique — Textiles et mesurages associés

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 10617 was prepared by Technical Committee ISO/TC 38, *Textiles*, Subcommittee SC 1, *Test for coloured textiles and colorants*.

Introduction

Spectrophotometers are now well established in the process and quality-control processes within the colour-using industries, as a tool for the measurement of colour, and subsequent computation of colour difference, that is required for colour approval. Colorimetric data has increasingly become the choice as a “standard” for use in the specification of a colour, in preference to a physical sample, due to the accuracy, stability and mobility of data compared to physical samples.

Textile production and sourcing, in particular, now have a truly global nature where manufacturing and retailing are literally continents apart. Product management and design have remained in the fashion centres (for example New York, Paris, London) whereas manufacturing goes where the economics of production dictate. In addition, retail sales are global. An essential element for speed of response to market needs and for cost reduction of colour development and production is the effective communication of colorimetric data between different measurement systems. This enables the remote operation of processes such as colour approval, trim and range of colour coordination, etc.

Currently, there are many suppliers of colour measuring instruments and software systems to support the computations associated with colour measurement. These include quality-control systems and recipe prediction systems, as well as on screen colour systems. Colorimetric information generated by such systems is not readily consumed by other systems, as it is in a format known only to the system maker. Some systems can decode the data formats of other systems and allow transformation into a compatible format.

New and existing systems are continually being developed and new data formats introduced. These new data formats will not be readily understood or useable in other colour systems.

In order that dissimilar systems can be used effectively in communicating colour, a common Data Standard is required. This would allow the colorimetric data output from any system to be readily consumed by any other system, whether it is a colour system or business system. Data would be readily viewable by standard browser software and other simple data tools.

XML is a meta-mark-up language developed for use with the Internet (WC3 endorsed standard) to allow the exchange of data between dissimilar systems. XML provides data about the data (meta-data), as well as the data itself, thereby allowing dissimilar systems to understand the contents of a standard XML document. It provides a standard format for data in a document form.

There are many utilities available to developers and users to enable the handling of data in this format and, since the underlying code is text-based, a simple editor can ‘see’ the data included.

The primary data communicated is usually the spectral data. Other data relating to illuminants and observers is a calculation based on the spectral data. The software receiving the spectral data must be more than capable of doing these well-defined calculations, according to internationally agreed ISO/CIE standards.

Where only colorimetric data is being exchanged, there is provision for the observer and illuminant data to be included (see 6.2.5).

Quality-control data, such as standard and batch association, profiling data, specific illuminant to be used, etc. is arbitrary and subject to agreement between the manufacturer and customer. This is outside the scope of this International Standard. The header of the data being exchanged, as described in 6.1, includes a section entitled “Comments”, where quality-control data could possibly be communicated.

Textiles — Standard data format for colorimetric communication — Textiles and related measurements

1 Scope

This International Standard is primarily concerned with the exchange of the spectral data, which is the fundamental data behind the colour being communicated.

This International Standard provides a standard format for the interchange of data between a colorimetric measurement instrument and software used to make calculations based on those measured data.

A key application is in the measurement and associated recipe formulation of dyes used in the textile industry. The application can, however, be to any industry where there is a need to communicate colorimetric data, e.g. pigment formulation in plastics and paints, colour management in the graphic arts and other colour reproduction industries.

2 Normative references

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

CIE[1)] Publication 15:2004, *Colorimetry*

CIE Publication 17.4:1987, *International Lighting Vocabulary*, 4th ed. (Joint publication IEC/CIE)

3 Abbreviations

For the purposes of this document, the following abbreviation applies.

cdf: colorimetric data exchange format

4 Principle

This International Standard describes the terms used in the colorimetric data exchange format (cdf). It shows the order of the fields and how the format is laid out. None of the fields in the format are mandatory; the requisite field for the term can be left blank, in which case a default value is assumed. It should, however, be noted that the more information that is provided with the measurements, the greater the confidence that the recipient can have in the data.

The format described is concerned solely with the data to be communicated. It is not concerned with how the data is created, read or processed by measurement software, data processing software, spreadsheets, etc. All data is communicated as an XML document.

1) Commission Internationale de l'Éclairage, CIE Central Bureau, Kegelgasse 27, A-1030 Vienna, Austria, www.cie.co.at

While this International Standard has been developed with the support of the textile industry, it can be applied in any industry that uses colour-measurement instrumentation. Care should be exercised to ensure that there are no other standards specific to the application area or industry that could be applied.

5 Terminology

The terms used to describe a valid measurement record form two sections. The first section, A, is the sample-identification section and is common to all measurements. It has descriptive information concerning the sample to be measured. The second section is made up of one or more data blocks, B to G, each representing a specific set of measurement data. Multiple measurement data blocks are useful when, for example, a sample has either been measured separately for two or more geometries, or simultaneously using two or more geometries (e.g. in the case of a multi-angle measuring instrument). Generally, the multiple data blocks will be of the same type. Examples of valid data records are ABB or ACCCCC or ABBC.

In each section, the headings of each parameter used for communication are given and then explained in the table below it. Since each parameter is optional, if omitted, they will either take on the default value (as indicated in the following descriptions) or, where no default is specified, should be regarded as *undefined* or *not applicable*.

6 Structure

A file containing measurement data would normally be structured as shown in Figure 1. This structure allows multiple data blocks within a single exchange file as described in Clause 5.

Sample identification
Measurement data block 1
Measurement data block 2
”
”
Measurement data block N

Figure 1 — Structure of a data measurement file

If more than one sample is to be measured then a complete data file shall be assembled for each sample.

Figure 2 shows the hierarchy between the various components of the colorimetric data exchange file. This allows for a description of the sample, spectral measurements and colorimetric measurements. The lower part of Figure 2 shows the relationship between the various parameters that can be associated with each measurement.

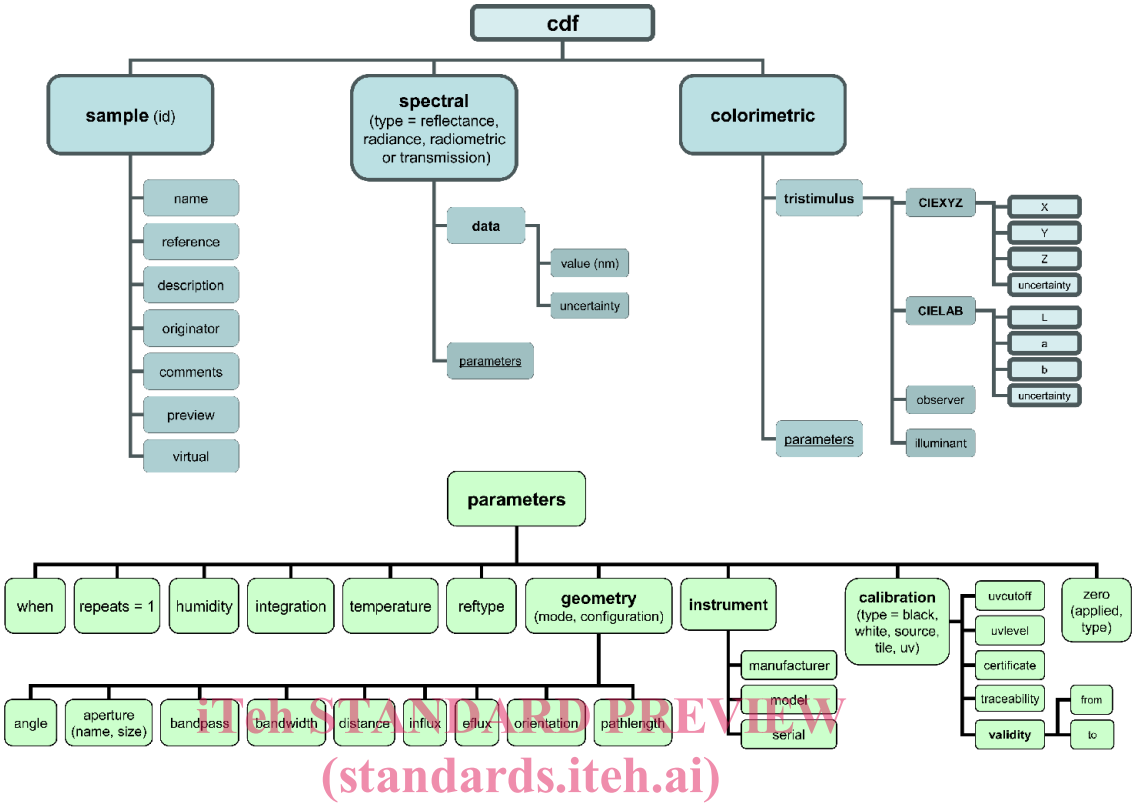

Figure 2 — Parameters that can be associated with each measurement block

6.1 Sample identification (A)

— Name

— Reference

— Description

— Backing

— Originator

— Unique identifier

— Comments

— Colour preview

This section is composed of text identifying and describing the sample being measured. It is the first section to be communicated and is followed by one or more measurement data blocks. See Table 1.

Table 1 — Sample identification (A)

Parameter	Type	Description
Name	Text	Name of sample being measured.
Reference	Text	User's identification of sample.
Description	Text	Details and attributes of sample.
Backing	Text	Details of material used behind the sample during measurement.
Originator	Text	Person making the measurement.
Unique identifier	Text	Identifier generated by measurement software. Ideally, this would be created from instrument serial number and a date/time stamp.
Comment	Text	Area for the user to add any other information that he/she may wish to transmit.
Colour preview	Numeric hexadecimal	The colour preview contains an approximate representation of the colour specified using the sRGB colour space and written as six hexadecimal digits: e.g. #FF0000 (red). There may be multiple previews if, for example, the record contains multi-angle or both specular included and excluded data. The colour preview is only meant to provide a visual approximation for sample identification and should not be used to transmit actual data.

6.2 Measurement data block

There are six possible measurement data blocks that can be associated with a sample. At least one of these must follow the sample block. When a sample has, for example, either been measured separately using two or more geometries or simultaneously for two or more geometries, then there follows a measurement data block for each geometry.

6.2.1 Spectral reflectance measurement (B)

The measurement, as a function of wavelength, of the ratio of the reflected radiant or luminous flux to the incident flux in the given conditions.

a) Wavelength (nm)

b) Value (%)

c) Uncertainty (± %)

d) **Measurement parameters**

- Date and time of measurement
- Number of measurements averaged
- Relative humidity (%)
- Temperature (°C)

e) **Geometry**

- Aperture diameter (mm) and description
- Bandpass corrected (“yes” or “no”)
- Bandwidth (nm)

— Configuration (specular “included” or “excluded”)

— Influx (degrees, “d” or “t”) (see Table 2)

— Efflux (degrees, “d” or “t”) (see Table 2)

— Orientation/Surround of sample (descriptive)

f) **Instrument identification**

— Manufacturer

— Model

— Serial number

g) **Source parameters**

— Source (descriptive)

— Filter (descriptive)

— Polarization (descriptive)

h) **Reference standard (black)**

— Certificate serial number

— To whom it is traceable

— Validity

i) **Reference standard (white)**

— Certificate serial number

— To whom it is traceable

— Validity

j) **UV component**

— Cut-off wavelength (nm)

— Level set

k) **Reference standard (UV)**

— Certificate serial number

— To whom it is traceable

— Validity

This covers measurements of reflectance where spectral data is output from an instrument with an integrating sphere. Two possible geometries are allowed, as defined by the CIE: specular included and specular excluded. See Table 2.

Table 2 — Spectral reflectance measurement (B)

Parameter	Type	Description
Wavelength (nm)	Numeric	Wavelength, in nanometres, at which the reflectance was measured. It has associated value and uncertainty parameters (see below). NOTE This is repeated along with the value and uncertainty (see below) for the number of spectral data points measured. A minimum of 16 wavelength, value and uncertainty data sets, consistent with the calculation of colorimetric data, shall be entered for meaningful colorimetric results (i.e. 400 nm to 700 nm at 20 nm intervals). Wavelength steps shall be at equal intervals and without "holes".
Value (%)	Numeric	Reflectance expressed as a percentage. It has associated wavelength and uncertainty parameters. (See also the Note to wavelength.)
Uncertainty (± %)	Numeric	Uncertainty in reflectance value expressed as ± %. It has associated wavelength and value parameters. (See also the Note to wavelength.)
Measurement parameters		
Date and time of measurement	Date: time	Expressed as year, month and day; and hours, minutes and seconds (CCYY-MM-DD-hh:mm:ss).
Number of measurements averaged	Integer [default = 1]	Some instruments may average over a number of measurements to create the final reported measurement result.
Relative humidity (%)	Numeric	The percentage relative humidity of the sample being measured.
Temperature (°C)	Numeric	The temperature, in degrees Celsius, of the sample being measured.
Geometry		
Aperture diameter (mm) and description	Numeric + text	The size, in millimetres, of the sample port aperture and a qualitative description, e.g. "large".
Bandpass corrected ("yes" or "no")	Text "yes" or "no"	Has the instrument result been corrected for the bandpass function not being triangular?
Bandwidth (nm)	Numeric	The bandwidth of the measurement, in nanometres.
Configuration	Text	Two options relating to the specular component; either "included" or "excluded".
Influx (degrees, "d" or "t")	Numeric, if degrees Text, if "d" or "t"	For directional illumination, the illuminating direction, in degrees, with respect to the normal to the sample plane (typically 8°). For integrating-sphere illumination, either "d" for diffuse illumination with specular component excluded, or "t" for diffuse illumination with specular component included.
Efflux (degrees, "d" or "t")	Numeric, if degrees Text, if "d" or "t"	For directional detection, the detecting/measuring direction, in degrees, with respect to the normal to the sample plane (typically 8°). For integrating-sphere detection, either "d" for diffuse detection with the specular component excluded, or "t" for diffuse detection with specular component included.
Orientation/Surround of sample (descriptive)	Text	Description of the placement of the sample with respect to the illumination, e.g. up, down, parallel to weave.
Instrument identification		
Manufacturer	Text	Name of the instrument manufacturer.
Model	Text	Instrument model number.
Serial number	Text	Instrument serial number.
Source parameters		
Source	Text	Source used during measurement. This provides a guide when measuring fluorescent samples. Examples could be "xenon flash" or "tungsten".

Table 2 (*continued*)

Parameter	Type	Description
Filter	Text	Identifies the use of a physical filter during measurement. Examples could be “D65”, “UV” or “none”.
Polarization	Text: “yes” or “no”	Indicates the use of a physical polarization filter during measurement.
Reference standard (black)		Standard used to calibrate instrument dark or black measurements.
Certificate serial number	Text	Certificate serial number or reference.
To whom it is traceable	Text	National standard laboratory, calibration laboratory or other organization to which the certified values are traceable.
Validity	From (date) to (date)	Certified dates (CCYY-MM-DD) between which measurements are valid.
Reference standard (white)		Standard used to calibrate instrument's 100 % level or white measurements.
Certificate serial number	Text	Certificate serial number or reference.
To whom it is traceable	Text	National standard laboratory, calibration laboratory or other organization to which the certified values are traceable.
Validity	From (date) to (date)	Certified dates (CCYY-MM-DD) between which measurements are valid.
UV component		Some instruments allow the UV component of the illumination light to be excluded.
Cut-off wavelength	Numeric	Wavelength, in nanometres, of the cut-off for an adjustable UV filter, if present.
Level set	Numeric	UV level set, if adjustable.
Reference standard (UV)		Standard used to set the UV cut-off wavelength or UV level.
Certificate serial number	Text	Certificate serial number or reference.
To whom it is traceable	Text	National standard laboratory, calibration laboratory or other organization to which the certified values are traceable.
Validity	From (date) to (date)	Certified dates (CCYY-MM-DD) between which measurements are valid.

6.2.2 Spectral radiance factor measurement (C)

The measurement, as a function of wavelength, of the ratio of the radiance of the surface element in the given direction to that of the perfect reflecting or transmitting diffuser identically irradiated and viewed.

a) Wavelength (nm)

b) Value (%)

c) Uncertainty (± %)

d) **Measurement parameters**

- Date and time of measurement
- Number of measurements averaged
- Relative humidity (%)
- Temperature (°C)