SmartCom

Good Practice Guides SmartCom Validation

(1) Test for communication interfaces used for the exchange of metrological data

(2) Conformity test for unified DCCs

(3) TraCIM system

TraCIM D-SI

EN

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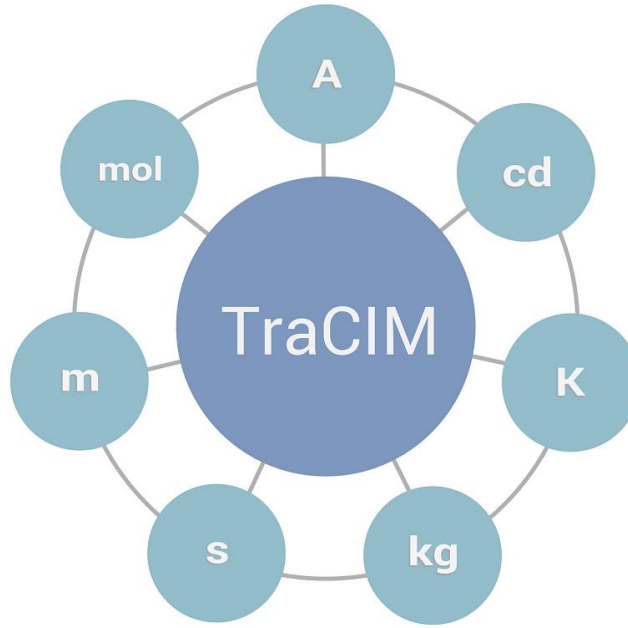

Good practice guide

Conformity test for unified DCCs

Version 1.0

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Editors

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Comprising the results from our research and the fruitful and intensive discussions with all our other project partners and stakeholders worldwide.

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1 Preliminary considerations

The SmartCom research project [1] collected and discussed minimum requirements for the content and use of unified Digital Calibration Certificates (DCCs) [2, 3]. The format for the storage and transmission of DCC data is not regulated and can be implemented in XML [4], JSON [5] or other well-established formats.

An XML implementation of the storage of DCC data was created based on the SmartCom project outcome [6]. It is currently hosted and maintained by the Physikalisch-Technische Bundesanstalt (PTB). This guide considers testing conformity against this XML structure for DCCs.

Testing the conformity of a DCC refers to a test of its XML syntax. It comprises testing the validity of the XML structure, the usage of all mandatory XML elements, and the compatibility of all information with the underlying data types. The conformity test is not intended to replace proper accreditation of the content of DCCs as it is typically undertaken for many paper-based calibration certificates through independent review. Furthermore, this test does not consider the conformity of information related to digital signatures and electronic seals to underlying cryptographic standards.

The tools for testing the conformity of the syntax of unified DCCs in XML format rely on third party software. It is possible to use these tools as a web-service or operate them locally.

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2 General XML structure of DCCs in SmartCom

This guide considers version 2.3.0 of the DCC XML structure which was implemented according to the minimum requirements for DCCs from the SmartCom project [2, 3]. Documentation of this XML structure is available at [7]. In addition, the XML Schema Definition (XSD) of the DCC can be obtained from [8].

The XML structure of the DCC will be outlined for an extract from the calibration example at [6]. This example is based on the calibration of a weight of nominal mass 10 g that was performed at PTB. Figure 1 shows an extract from the human-readable document that is issued by PTB as a calibration certificate. The corresponding machine-readable version of this document in the form of a DCC in XML format is given in Figure 2.

To facilitate comparison between the human-readable and machine-readable documents, all data providing the same information is marked by rectangular boxes of the same colour in Figures 1 and 2, i.e., data from a box with green colour in Figure 1 provides the same information as the XML data in a green box in Figure 2.

All data not marked by a box is only required in the human-readable format and not relevant for the machine-readable representation, e.g., the number of pages in Figure 1.

Values of the mass measurement (in a green box) are provided in the D-SI metadata model [9]. XML elements of this metadata format start with the namespace prefix “si” in Figure 2. All other XML elements have the prefix “dcc”.

Finally, the XML element “respPersons” (from the purple box in Figure 2) shows who is responsible for signing the DCC and applying an electronic seal (digital seal). The electronic seal is applied to the XML DCC document as a whole and hence is not part of the structure in version 2.3.0.

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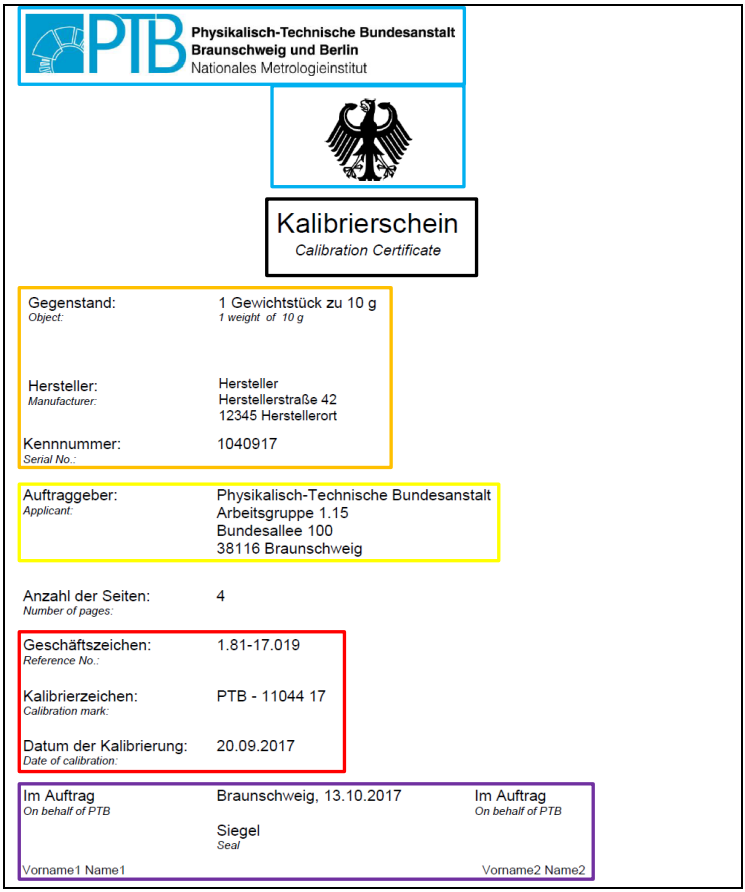

Physikalisch-Technische Bundesanstalt
Braunschweig und Berlin
Nationales Metrologieinstitut

Kalibrierschein
Calibration Certificate

Gegenstand: *Object:*	1 Gewichtstück zu 10 g *1 weight of 10 g*
Hersteller: *Manufacturer:*	Hersteller Herstellerstraße 42 12345 Herstellerort
Kennnummer: *Serial No.:*	1040917
Auftraggeber: *Applicant:*	Physikalisch-Technische Bundesanstalt Arbeitsgruppe 1.15 Bundesallee 100 38116 Braunschweig
Anzahl der Seiten: *Number of pages:*	4
Geschäftszeichen: *Reference No.:*	1.81-17.019
Kalibrierzeichen: *Calibration mark:*	PTB - 11044 17
Datum der Kalibrierung: *Date of calibration:*	20.09.2017

Im Auftrag
On behalf of PTB

Braunschweig, 13.10.2017

Siegel
Seal

Im Auftrag
On behalf of PTB

Vorname1 Name1

Vorname2 Name2

[...]

Messergebnisse
Measurement results

Masse
Mass

Nennwert *nominal value*	Kennzeichnung *marking*	Masse *mass*	Unsicherheit *uncertainty* $k = 2$
10 g	18L	10 g + 0,003 mg	0,004 mg

Figure 1: *Extract from a human-readable PTB certificate for a weight of nominal mass 10 g as it is typically issued at calibration.*

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```
<?xml version="1.0" encoding="UTF-8"?>
<dcc:digitalCalibrationCertificate
        xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
        xsi:schemaLocation="https://ptb.de/dcc https://ptb.de/dcc/v2.3.0/dcc.xsd"
        xmlns:dcc="https://ptb.de/dcc"
        xmlns:si="https://ptb.de/si"
        schemaVersion="2.3.0">
    <dcc:administrativeData>
        <dcc:dccSoftware>[...]</dcc:dccSoftware>
        <dcc:coreData>[...]</dcc:coreData>
        <dcc:items>[...]</dcc:items>
        <dcc:calibrationLaboratory>[...]</dcc:calibrationLaboratory>
        <dcc:respPersons>[...]</dcc:respPersons>
        <dcc:customer>[...]</dcc:customer>
        <dcc:statements>[...]</dcc:statements>
    </dcc:administrativeData>
    <dcc:measurementResults>
        [...]
        <dcc:result>
            <dcc:name>
                <dcc:content lang="de">Masse</dcc:content>
                <dcc:content lang="en">mass</dcc:content>
            </dcc:name>
            <dcc:data id="Mass">
                <dcc:list>
                    <dcc:quantity>
                        <dcc:name>
                            <dcc:content lang="de">Nennwert</dcc:content>
                            <dcc:content lang="en">nominal value</dcc:content>
                        </dcc:name>
                        <dcc:noQuantity>
                            <dcc:content>10 g</dcc:content>
                        </dcc:noQuantity>
                    </dcc:quantity>
                    <dcc:quantity>
                        <dcc:name>
                    <dcc:content lang="de">Kennzeichnung</dcc:content>
                            <dcc:content lang="en">marking</dcc:content>
                        </dcc:name>
                        <dcc:noQuantity>
                            <dcc:content>18L</dcc:content>
                        </dcc:noQuantity>
                    </dcc:quantity>
                    <dcc:quantity>
                        <dcc:name>
                            <dcc:content lang="de">Masse</dcc:content>
                            <dcc:content lang="en">mass</dcc:content>
                        </dcc:name>
                        <si:real>
                            <si:value>10.000003E-3</si:value>
                            <si:unit>\kilogram</si:unit>
                            <si:expandedUnc>
                                <si:uncertainty>0.000004E-3</si:uncertainty>
                                <si:coverageFactor>2</si:coverageFactor>
                                <si:coverageProbability>0.95
                                    </si:coverageProbability>
                            </si:expandedUnc>
                        </si:real>
                    </dcc:quantity>
                </dcc:list>
            </dcc:data>
        </dcc:result>
        [...]
    </dcc:measurementResults>

</dcc:digitalCalibrationCertificate>
```

Figure 2: *Extract from the machine-readable XML DCC structure for the example calibration certificate given in Figure 1. Some elements are deliberately left empty.*

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3 Testing the unified DCC syntax

3.1 Validation with DCC XML Scheme

Validation of the DCC against the underlying XSD file will test the following aspects of conformity with the DCC XML syntax:

- Valid XML file;
- All mandatory elements defined;
- Correct order of elements;
- Correct element tags (names);
- Correct data types used.

Many software development tools have plugins for validation of XML against an XSD file. Various free web-based services are also available.

3.2 Validation of D-SI Elements using TraCIM

The SmartCom TraCIM service is an additional tool for the validation of the correct usage of the D-SI metadata model in the XML DCC. Details are outlined in the first part of this series of guides. The SmartCom TraCIM service will be used to check all D-SI elements in a DCC for conformity to the following requirements:

- Compliance of the units used against SI units;
- Compliance with minimum required metrological information according to VIM [10] and GUM [11] as defined for the D-SI format;
- Compliance with D-SI XML Scheme Definition;
- All D-SI elements with correct tags, sequence of elements and data types.

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It is recommended to test the DCC with the XSD before applying TraCIM testing.

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[8] Online guide for using the DCC XML schema version 2.3.0 hosted by PTB, web page: https://www.ptb.de/dcc/v2.3.0/ (accessed May 2020).

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https://www.ptb.de/empir2018/smartcom
(accessed June 2020)

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