Asia-Pacific Economic Cooperation

Universiti Kebangsaan Malaysia National University of Malaysia

SIRIM

NMIM NATIONAL METROLOGY INSTITUTE OF MALAYSIA

Daniel Peters

Outline OIML D31 and WELMEC 7.2

Differences

Asia-Pacific Economic Cooperation

Capacity Building Workshop On Understanding Conformity Requirements For Software Controlled Weight And Measuring Instruments For Sustainable Trade 2022

APEC

Braunschweig

- 1 Mechanics and Acoustics
- 2 Electricity
- 3 Chemical Physics and Explosion Protection
- 4 Optics
- 5 Precision Engineering
- 6 Ionizing Radiation
- 9 Legal and International Metrology
- Q Cross-Sectional Services
- Z Administrative Services
- quest QUEST Institute at PTB
- FPM Fundamental Physics for Metrology

Physikalisch-Technische Bundesanstalt ■ Braunschweig and Berlin

Berlin

7 Temperature and Synchrotron Radiation

8 Medical Physics and Metrological Information Technology

Physikalisch-Technische Bundesanstalt ■ Braunschweig and Berlin

Capacity Building Workshop On Understanding Conformity Requirements For Software Controlled Weight And Measuring Instruments For Sustainable Trade 2022
APEC
Asia-Pacific Economic Cooperation

Organization Chart of PTB

- Presidential Board (President, Vice President, Member of the Presidential Board)
- Presidential Staff Office
- Press and Information Office
- Conformity Assessment
- 1 Mechanics and Acoustics
- 2 Electricity
- 3 Chemical Physics and Explosion Protection
- 4 Optics
- 5 Precision Engineering
- 6 Ionizing Radiation
- Berlin
  - 7 Temperature and Synchrotron Radiation
  - 8 Medical Physics and Metrological Information Technology
- 9 Legal and International Metrology
- Q Cross-Sectional Services
- Z Administrative Services
- quest QUEST Institute at PTB
- FPM Fundamental Physics for Metrology

Metrological Information Technology

Working Fields

- Software testing and quality assurance
- Data communication and security
- IT in legal metrology
- Gaming machines
- Research in Operating Systems and Cloud Computing

Capacity Building Workshop On Understanding Conformity Requirements For Software Controlled Weight And Measuring Instruments For Sustainable Trade 2022

Metrological Information Technology

Type of activities

- Research and development in metrology
- Testing and type approval
- Advisory activities for industry, associations and government

WELMEC Commitee

- Founded November 1990
- European legal metrology
- establish a harmonized and consistent approach
- 37 members
- 8 Working Groups
- WELMEC Working Group 7 “Software”

Capacity Building Workshop On Understanding Conformity Requirements For Software Controlled Weight And Measuring Instruments For Sustainable Trade 2022

Software in Measuring Instruments

95-99 % of Measuring Instruments are Software Controlled

- **Advantages:**
  - Easy to adapt to the needs
  - More complex measuring algorithms possible than in hardware
  - Robust against physical effects (drift, EMC, …)
  - Easy exchange of data (measurement values) over large distances
- **Disadvantages (from the notified body point of view):**
  - Specific knowledge besides metrological skills necessary for examination (or at least helpful)
  - Because of increased complexity: more effort for examination
  - Fraud on measurement values often not obvious: software securing techniques necessary

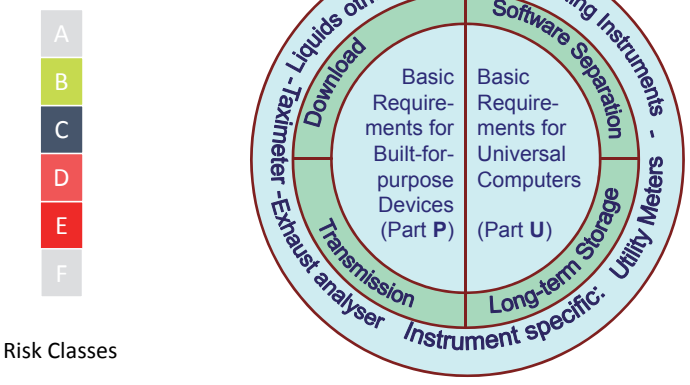
Software Requirements in MID

- **Security and software identification** (MID Annex I, 8.3)
- **Data transmission and data storage** (MID Annex I, 8.4)
- **Interfaces** (MID Annex I, 8.1)
- **Software separation** (MID Annex I, 7.6)

Capacity Building Workshop On Understanding Conformity Requirements For Software Controlled Weight And Measuring Instruments For Sustainable Trade 2022

Welmec 7.2 Software Guide

- Structure of the Guide



Definition of Risk Classes

Conformity
- low: functions identical
- middle: selected parts of the software identical
- high: whole software identical

Conformity

Software Protection	low	middle	high
middle	A	-	-
high	B	C	-
	-	D	E	F

Risk Classes A - F

Protection against manipulation
- low: no specific protection means
- middle: means against use of wide-spread simple tools (text editors, etc.)
- high: state of the art in e-commerce.

Examination level: low / middle / high

Examination
- low: functional test of the instrument
- middle: examination based on functional description of the software (documentation + selected practical tests)
- high: examination based on the source code

Capacity Building Workshop On Understanding Conformity Requirements For Software Controlled Weight And Measuring Instruments For Sustainable Trade 2022

Assignments to Risk Class B

Conformity:
low: functions identical

Protection against manipulation:
middle: means against use of wide-spread simple tools

Examination:
middle: examination based on functional description of the software (documentation + selected practical tests)

Conformity

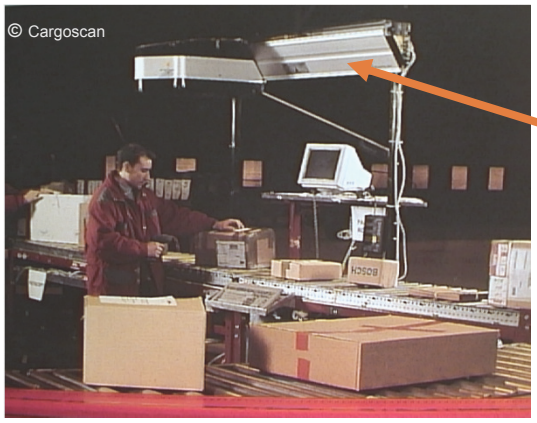
	low	middle	high
	A	-	-
	B	C	-
	-	D	E	F

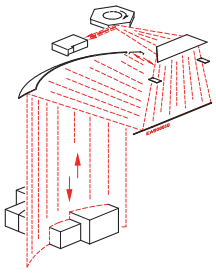
Risk Classes A - F

Examination level: low / middle / high

Examples for Risk Class B

Dimensional Measuring System for Cargo (Laser Scanner)





Automatic Balance for the control and surveillance of automatic filling processes

Assignments to Risk Class C

Conformity:
middle:
selected parts of the software identical

Protection against manipulation:
middle:
means against use of wide-spread simple tools

Examination:
middle:
examination based on functional description of the software (documentation + selected practical tests)

Conformity

	low	middle	high
	A	-	-
	B	C	-
	-	D	E	F

Risk Classes A - F

Examination level

low
middle
high

Examples for Risk Class C

Utility Meters

Volume Measurement of Liquids other than Water on Road Tankers

Assignments to Risk Class D

Conformity:
middle:
selected parts of the software identical

Protection against manipulation:
high:
state of the art in e-commerce

Examination:
middle:
examination based on functional description of the software (documentation + selected practical tests)

Conformity

low	middle	high
A	-	-
B	C	-
-	D	E	F

Risk Classes A - F

Examination level

low
middle
high

Example for Risk Class D

Taxameters

OIML

- The International Organization of Legal Metrology (OIML) is a worldwide, intergovernmental organization
- Primary aim is to harmonize the regulations and metrological controls
- Four main publications
  - OIML R: International Recommendations
  - **OIML D**: International Documents (informative nature)
  - OIML G: International Guides (give guidelines)
  - OIML B: International Basic Publications (operating rules)

OIML D31 Scope

- General requirements applicable to software related functionality in measuring instruments
- Gives **guidance** for verifying the compliance
- **Basis** for establishing specific software requirements and procedures in OIML Recommendations

Capacity Building Workshop On Understanding Conformity Requirements For Software Controlled Weight And Measuring Instruments For Sustainable Trade 2022

Security Level

- Two Levels: Normal (I) and Raised (II)
- Determined by **risk** of fraud, required conformity, required reliability, intest of defrauder, and the possiblity to repeat or interrupt a measurement
- Platform used (universal PC)

Software Requirements (General)

- 5.1 General Requirements
  - 5.1.1 Software Identification
  - 5.1.2 Correctness of algorithms and functions
  - 5.1.3 Software Protection
  - 5.1.4 Support of hardware features

Capacity Building Workshop On Understanding Conformity Requirements For Software Controlled Weight And Measuring Instruments For Sustainable Trade 2022

5.1.1 Software Identification

- Legally relevant software needs a software version or token
- Identification shall be linked to the software
- Should be stated in the type approval certificate
- Checksum is an acceptable solution

5.1.2 Correctness of algorithms and functions

- accuracy of the algorithms,
- price calculation according to certain rules
- rounding algorithms
- It shall be possible to examine algorithms and functions either by metrological tests, software tests or software examination

Capacity Building Workshop On Understanding Conformity Requirements For Software Controlled Weight And Measuring Instruments For Sustainable Trade 2022

5.1.3 Software protection

- A measuring instrument shall be constructed in such a way that possibilities for **unintentional**, **accidental**, or **intentional misuse** are minimal
- Only clearly documented functions are allowed to be activated by the user interface
- Apropriate sealing by mechanical, electronic and/or cryptographic means

5.1.4 Support of hardware features

- **Support of fault detection**
- Example: calculate checksum at boot and check with predefined value
- **Support of durability protection** (adjustment after time)
- Example: Software warning after time exceeds

Capacity Building Workshop On Understanding Conformity Requirements For Software Controlled Weight And Measuring Instruments For Sustainable Trade 2022

Software Requirements (Specific)

For certain technologies

- 5.2.1 Hardware/Software Separation (LR, NLR)
- 5.2.2 Shared indications (multiple windows)
- 5.2.3 Storage and Transmission of Data
- 5.2.4 Specifying minimal requirements (hardware)
- 5.2.5 Software conformity
- 5.2.6 Software update

5.2.1 Hardware/Software Separation

- Metrologically critical parts of a measuring system shall not be inadmissibly influenced
- applies if the measuring instrument has **interfaces** for communicating with other **devices**, with the **user**, or with other **software parts** besides the metrologically critical parts
- Identifying these parts and listing **all** communication **commands**
- Without software seperation, everything is legally relevant
- If the legally relevant software part communicates with other software parts, a software **interface** shall be defined
- the legally relevant software shall have priority

Capacity Building Workshop On Understanding Conformity Requirements For Software Controlled Weight And Measuring Instruments For Sustainable Trade 2022

5.2.2 Shared indications

- Software that realizes the indication of measurement values and other legally relevant information belongs to the legally relevant part
- The LR window shall not be deleted or overlapped by other software as long as the measurement is running
- The use of a universal computer is not appropriate as part of a measuring system if increased protection against fraud is necessary

5.2.3 Storage and Transmission of Data

- The measurement value stored or transmitted shall be accompanied by **all relevant information**
- The data shall be protected by software means to guarantee the **authenticity, integrity**
- For a high protection level it is necessary to apply **cryptographic** methods
- measurement data must be stored automatically when the measurement is concluded (sufficient memory)
- The measurement shall not be inadmissibly influenced by a transmission delay (timestamp)

Capacity Building Workshop On Understanding Conformity Requirements For Software Controlled Weight And Measuring Instruments For Sustainable Trade 2022

5.2.4 Specifying minimal requirements (hardware)

- Processor, RAM, HDD, etc. necessary for correct functioning shall be **declared by the manufacturer** and stated in the **type approval certificate**
- **Prevent operation**, if the minimal configuration requirements are not met

5.2.5 Software conformity

- The legally relevant software must conform to the approved type and the documentation submitted
- Four different levels:
  - identity of the legally relevant functions;
  - identity of parts of the legally relevant source code and the rest of the legally relevant software complying with
  - identity of the whole legally relevant source code
  - identity of the LR executable code

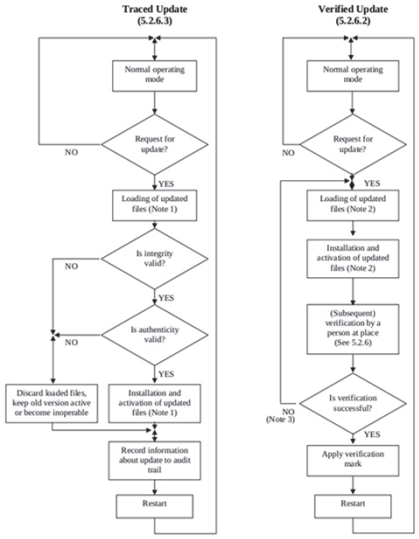
Capacity Building Workshop On Understanding Conformity Requirements For Software Controlled Weight And Measuring Instruments For Sustainable Trade 2022

5.2.6 Software update

- NLR software does not require verification after being updated
- After the update of the LR software the **verification** must be done (renewing seals)
- **Traced Update**: verification at place is not necessary. The software update is recorded in an **audit trail**; (fixed software) several steps: **loading, integrity checking, authenticity checking, installation, logging and activation**
- Depending on national legal legislation, the user has to give his consent to a download

Software update

Traced and verified update ->



Capacity Building Workshop On Understanding Conformity Requirements For Software Controlled Weight And Measuring Instruments For Sustainable Trade 2022

Documentation

- Manufacturer **declares and documents** all program functions, relevant data structures and software interfaces of the **legally relevant software part**.
- **No hidden** undocumented **functions**
- **Operating manual**
- **Software ID**
- List of commands
- **Overview of the systems hardware**

Validation Methods

Abbreviation	Description	Application	Preconditions, tools for application	Special skills for performing
AD	Analysis of the documentation and validation of the design (6.3.2.1)	Always	Documentation	-
VFTM	Validation by functional testing of metrological functions (6.3.2.2)	Correctness of the algorithms, uncertainty, compensating and correcting algorithms, rules for price calculation	Documentation	-
VFTSw	Validation by functional testing of software functions (6.3.2.3)	Correct functioning of communication, indication, fraud protection, protection against operating errors, protection of parameters, fault detection	Documentation, common software tool	-
DFA	Metrological data flow analysis (6.3.2.4)	Software separation, evaluation of the impact of commands on the instrument's functions	Source code, common software tool (simple procedure), tools (sophisticated procedure)	Knowledge of programming languages. Instruction for the method necessary.
CIWT	Code inspection and walkthrough (6.3.2.5)	All purposes	Source code, common software tool	Knowledge of programming languages, protocols, and other IT issues
SMT	Software module testing (6.3.2.6)	All purposes when input and output can clearly be defined	Source code, testing environment, special software tools	Knowledge of programming languages, protocols, and other IT issues. Instruction for using the tools necessary.

Capacity Building Workshop On Understanding Conformity Requirements For Software Controlled Weight And Measuring Instruments For Sustainable Trade 2022

Conclusion

- OIML D31 is similiar to WELMEC 7.2, but has no risk classes
- OIML D31 goes into more detail compared to WELMEC 7.2
- **Annex in both documents**: Checklist and Example