



This slide has a dark blue header with the APEC logo on the left and the text "Capacity Building Workshop On Understanding Conformity Requirements For Software Controlled Weight And Measuring Instruments For Sustainable Trade 2022" and the large APEC logo on the right. The main content is a white box with a dark blue border containing the following text:

The Plan of The Talk



1. **Motivation for Software Examination**
2. Terminology
3. Overview of OIML R76-1:2006
4. Software Examination of NAWIs in Japan
5. Software Examination of other measuring instruments in Japan

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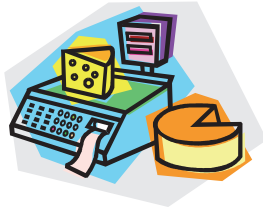
Weighing Instruments

● The old days

Mechanically Controlled

● Today





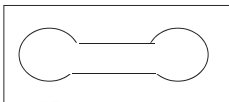
Controlled by Computer

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Operational Point Of View of Weighing Instruments

Weight	Unit Price	Price	Tare	Zero
g	¥	¥	0g	●
Beef	Pork	Lamb		
				Print

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Operational Point Of View of Weighing Instruments

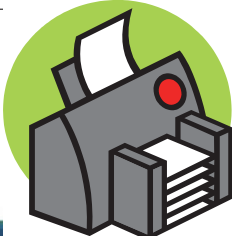

Weight	Unit Price	Price	Tare	Zero
125 g	132 ¥	165 ¥	0g	○

Beef

Pork

Lamb

Print

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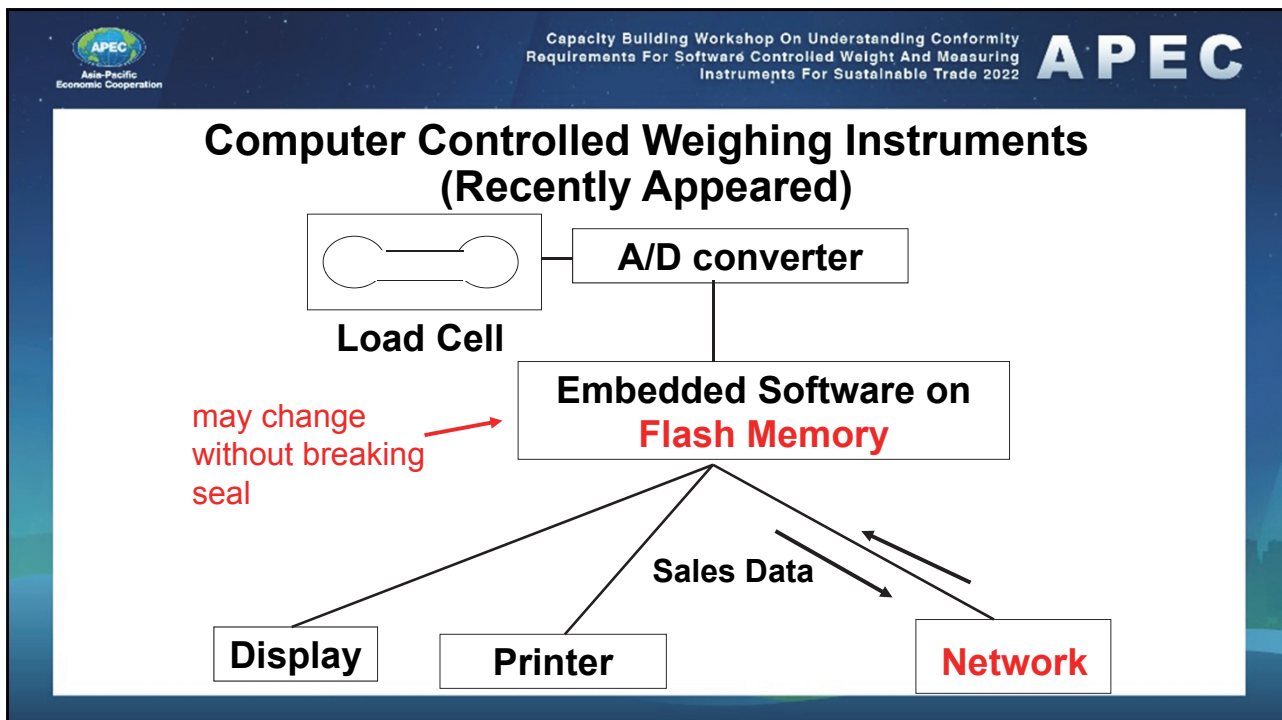
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Computer Controlled Weighing Instruments (Traditional Type)

```

    graph TD
      LC[Load Cell] --- ADC[A/D converter]
      ADC --- ESS[Embedded Software on ROM]
      ESS --- D[Display]
      ESS --- P[Printer]
  
```

cannot change without breaking seal →



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Summary

- Currently most weighing instruments are **computer-controlled**.
- So far the software of a weighing instrument **could not be changed** without breaking a physical seal.
- But the software of many of today's weighing instruments **may be changed** after type approval or verification.



Legal Metrology

- Responsible for controlling measuring instruments **legally** (**Measurement Law**)
- **Tests** and **approves** measuring instruments
- Until very recent years only doing **hardware tests**



Needs for Software Examination

- Computer-controlled measuring instruments depend on software
- If software changes, then the **measurement characteristics** of the measuring instrument may change
- In order to avoid **unintentional changes**, the **software** of measuring instruments under legal control must be **identified** and **protected**.



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Terminology

- Reference
OIML D31:2019
General requirements for software-controlled measuring instruments
- Can be downloaded from OIML website
https://www.oiml.org/en/files/pdf_d/d031-e19.pdf



Software Identification

(OIML D31) Sequence of readable characters (e.g. **version number**, **checksum**) that represents the software or *software module* under consideration.

It can be checked on an instrument whilst in use.

Comments:

- Software has no shape. It's pure information.
In order to mention and examine specific software, the software must be identified
- In weighing instrument, basically **software identification** should be **displayed on the screen** because it is very natural
- In some exceptions (with reasonable reasons), it is ok to use a **sticker** (or plate) to show software identification



Legally Relevant

(OIML D31, old version) **Software/hardware/data** or part of the software/hardware/data of a **measuring instrument** which **interferes with properties regulated by legal metrology**, e.g., the accuracy of the measurement or the correct functioning of the measuring instrument.

(OIM D31, latest version) Subject to legal control

Comments:

- To decide or identify which part **is legally relevant or not** is an important issue
- Basically the **notified body** can decide it (**not the manufacturer**)



Legally Relevant Software

Legally Relevant Software consists of

1. Legally Relevant **Program** (program module, machine code)
2. Legally Relevant Parameters
 - (a) **Type specific parameters**

always the same if the instrument has the same type
 - (b) **Device specific parameters**
 - may be different among instruments with the same type
 - may change during in use of the measuring instrument
 - But device specific parameter can not be changed if the instrument is secured and/or sealed.



Software Protection

(OIM D31) Protection of measuring instrument software or data domain by a hardware or software implemented seal

The seal must be removed damaged or broken to obtain access to change software.

Comments:

- In Japan, password protection is allowed.
- But in EU, password protection is not allowed.



Audit Trail

- (OIML D31) Continuous data file containing a time stamped **information record of events**, e.g. changes in the values of the parameters of a device or software updates, or other activities that are legally relevant and which may influence the metrological characteristics.

Comments:

- A kind of “change log” of legally relevant software
- Should be protected itself
- Must not be changed if the instrument has been secured and/or sealed



Software Separation

(OIML D31) Separation of software in measuring, which can be divided into a **legally relevant part** and a **legally non-relevant part**. These parts communicate via a **software interface**.

- The **manufacturer should explain** how the instrument realizes software separation and software interface



Software Interface

(OIML D31) Program code and a dedicated data domain; receiving, filtering, or transmitting data between *software modules*

Comments:

- **Software interface** is also **legally relevant** software (not non legally relevant software)
- Closely linked with the notion of **software separation**
- Software interface is a kind of software design issue



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Overview of Software Examination of OIML R76-1

Software related parts of OIML R76-1:

- 5.5 Additional requirements for software-controlled electronic devices:
Software requirements
- Annex G Additional examinations and tests for software-controlled digital devices and instruments:
How to examine software
- 4.1.2.4 “Securing of components and pre-set controls” also related



Important Decisions in Software Examination of R76-1

1. To classify software controlled NAWIs into “**Embedded**” type and “**PC**” type
2. To classify software controlled NAWIs into that **with data storage devices(DSD)** and that **without DSD**



Software Examination in OIML R76-1 (Embedded Type)

- Definition: the software of the NAWI
 1. Used in a **fixed** hardware and software environment
 2. **Cannot** be **modified** or **uploaded** via any interface or by other means **after securing** and/or **verification**
- Documentation:
 - Description of the **legally relevant functions**
 - **Software identification**
 - **Securing measures**
- Basically **software identification** has to be **displayed** on the screen at the boot time or key operation
- Not so difficult to examine (compared to “PC” type)



Software Examination in OIML R76-1 (PC Type)

- Definition: Personal computers and other instruments/devices with programmable or loadable software
- Further classification into
 - Software with closed shell (**no access** of the OS and/or program possible for user)(G.2.2.1)
 - Operating system and/or program(s) **accessible for the user**: the instrument can start other software when in use(G.2.2.2)



Software Examination in OIML R76-1 (PC Type) (continued)

OIML R76-1 requires:

- A **complete set** of **commands** and **declaration** of **completeness**
- **Checksum** generated from the **machine code** of LR software and **type-specific parameters** (only for the case with **user access G.2.2.2**)
- Protection of the device specific parameters (**checksum** and **audit trail**)
- Documentation for software interface
- Indication of **software identification**



Software Examination in OIML R76-1(PC Type) (continued)

- 5.5.2.2 Software requirements
 - (a) The legally relevant software shall be adequately protected against accidental or intentional changes.

Evidence of an intervention such as changing, uploading or circumventing, the legally relevant software shall be available until the next verification or comparable official inspection.
- refers to **software protection**




Software Examination in OIML R76-1(PC Type) (continued)

- 5.5.2.2 Software requirements
- (b) When there is associated software which provides other functions besides the measuring function(s), **the legally relevant software** shall be **identifiable** and **shall not be inadmissibly influenced** by the associated software.
- refers to **software separation** and **software interface**




Software Examination in OIML R76-1(PC Type) (continued)

- 5.5.2.2 Software requirements
- (c) **Legally relevant software** shall be **identified** as such and shall be **secured**. Its **identification** shall be easily provided by the device for metrological controls or inspections.
- refers to **software identification** and **checksum comparison**

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Software Examination in OIML R76-1(PC Type) (continued)

- 5.5.2.2 Software requirements
- (d) In addition to the documentation outlined in 8.2.1.2, the special **software documentation** shall include:
 -
- refers to **documentation**

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Software Examination in OIML R76-1 (Data Storage)

- Classification of **data storage device** into “**Embedded**” and “**PC**”
- **Correctness** of stored data and their associated data
- **Protection** of stored data (including protection during transmission)
- **Indication** of stored data



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Regulation for NAWIs in Japan

- **Measurement Law**
- A NAWI is specified to be under legal control.
- Others include utility meters, fuel dispenser, taxi meter
- Measurement Law refers to Japanese Industrial Standards (for short JIS)
- **JIS B 7611-2** is for NAWIs, which is basically, Japanese translation of OIML R76-1:2006



Japanese Industrial Standards (JIS) B7611-2

- Basically corresponds to OIML R76-1:2006
- Updated in 2009
- Written in Japanese
- Slightly different:
 - Introducing classification Level **H** and Level **L**
 - Level **H** is compatible with new R76-1: immunity test with field strength **10V/m** and **software examination**
 - Level **L** is domestic standards, but close to old R76-1: immunity test with **3V/m** and **no software exam**
 - **Password protection** for software protection is allowed



What we have done in Japan (in general)

- Japanese translation of new OIML R76
- Introducing **module** tests (**indicator** only, **load cell** only)
- System for the Issue of module test reports



What we have done in Japan (software)

- Japanese translation of the software part of OIML R76-1
 - Traditional examiners of measuring instruments did not have knowledge of software so much
 - Software experts did not know legal metrology system. In addition, several requirements were difficult to be interpreted precisely
- Preparation of the **template** for documentation of a manufacturer: based on PTB's "Struktur der einzureichenden Softwaredokumentation bei freiprogrammierbaren Waagen und Wägesystemen"
- Making **internal manuals** of NMIJ for software examination: quite different from manuals for metrological tests



Excerpt of Our Template

B.5. 法定計量に関連するソフトウェアの保護対策

B.5.1. ソフトウェアの封印(OIML R76-1 5.5.2.2(c), 5.5.2.2(d)項目 6)

(1) ソフトウェアを封印していますか?

はい いいえ

(2) "(1)"で「はい」と答えた場合、どのような手法を用いて保護しているのか説明してください。

注：ソフトウェアの一部でも封印している場合は、「はい」と答えてください。


注：プログラム・コードとパラメータとで封印方法が異なる場合は別々にお書きください。

参考：封印の例：ドングル（鍵が入ったハードウェア）、上書き不能の記憶媒体、ハードウェア封印（封印シール、ワイヤー封印など）、監査記録


B.5.2. プログラム・コードの不正操作からの保護（ソフトウェア技術的保護）(OIML R76-1

5.5.2.2(c), 5.5.2.2(d)項目 6, G.2.2.2 項目 2)

プログラム・コード及び型式特有のパラメータの不正操作からの保護のために何か対策を採りましたか？




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Features of Our Template

- Different colors about “Embedded”, “PC with no user access”, “PC with user access”, and storage devices
- Q and A form: makes examiner’s judgment relatively easy



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Our Experience

- Started in 2009
- We received 24 submissions from five companies
- Two submissions were “PC” type
- The others are “Embedded” type
- Each examination took at least a half day

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Example of Software Identification

法定計量プログラム	5800
法定計量データ	28BE

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Example of Legally Relevant Parameters

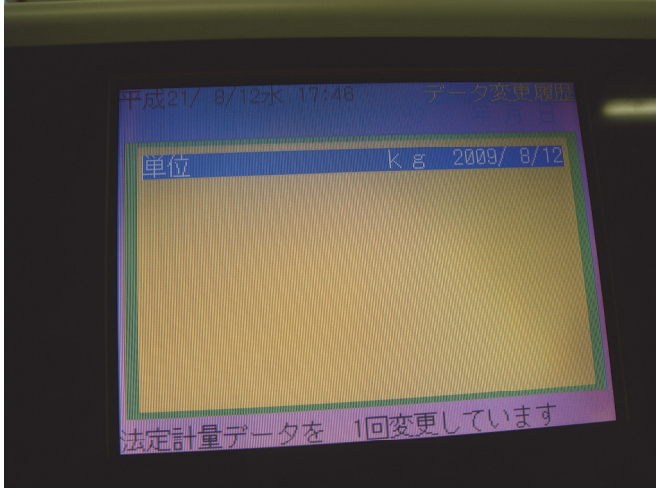
単位	kg
小数点	10
最小自量	40000t
ひょう量	8回
平均化回数	1d / 1秒
安定検出	10%
パワーONゼロ範囲	2%
ゼロ補正範囲	1秒
ゼロトラック時間	未使用
ゼロトラック幅	未使用
デジタルディスプレイ	

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Example of Audit Trail



The screenshot shows a software interface with a date and time stamp at the top: 平成21/ 8/12水 17:46. Below this, there is a header row with the text '単位' (Unit) and 'kg 2009/ 8/12'. The main area of the screen is filled with a grid of data points. At the bottom of the screen, there is a message in Japanese: '法定計量データを 1回変更しています' (Changing the legal measurement data once).

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Principle of Taxi Meters

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Principle of Taxi Meters (Cont.)

```

    graph LR
      A[Electric Pulses] --> B[Distance between origin and destination]
      B --> C[Fare, e.g., 2,000 Yen]
      D[Convert Rate, e.g., 0.3m/Pulse] --> A
      E[Convert Rates: initial rate, subsequent rate] --> B
      D --- F[Legally Relevant Parameters (device specific parameters)]
      E --- F
  
```



Regulation for Taxi Meters in Japan

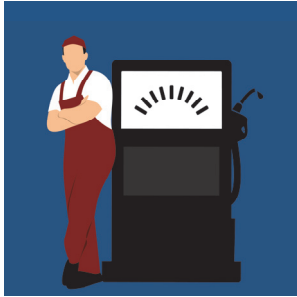
- If one changes pulse-distance convert rate, then the meter must be re-verified.
- A change of distance-fare convert rates (we call these tariff parameters) need not be re-verified (since 2005).
- We started **software examination for tariff parameters** from 2005.



Software Examination for Taxi Meters in Japan

- We ask manufactures
 1. to incorporate self-checking facility into taxi meters: in the beginning of each day checksums are compared(one originally stored in meter and the other just generated).
 2. to submit documents:
 - a. How to protect tariff parameters(e.g.,check sum protection)
 - b. How to change tariff parameters(e.g., using SD cards)

Software Examination for Fuel Flow Meters in Japan



- Started in 2021
- Conforming to OIML R-117 "Dynamic measuring systems for liquids other than water"
- Have made similar Template to NAWIs

Conclusion

- Running software examination for three kinds of measuring instruments
- NAWIs's examination is most complicated



Future Work

- Software Examination for Automatic Weighing Instruments
- Remote Verification: Japan is suffering from serious decrease in population