Handbook on Software Controlled Metrological Instrument Workshop

Strengthening Legal Metrology Infrastructure for Trade Facilitation(CTI 46/2009T)

APEC

Asia-Pacific
Economic Cooperation

APLMF

Asia-Pacific
Legal Metrology Forum

August 3–6, 2010
Bangkok, Thailand

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Group photo

Photos taken during the training course

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Foreword

This handbook is one of outcomes of the APEC/APLMF Training Programs titled "Strengthening Legal Metrology Infrastructure for Trade Facilitation: Workshop on Software Controlled Metrological Instruments" which was held on August 3 – 6, 2010 in Bangkok, Thailand.

This course was organized by APLMF secretariat and arranged as one of the APEC TILF projects, CTI46/2009T. Also, it was supported by Central Bureau of Weights and Measures (CBWM), Thailand. I would like to extend my sincere gratitude to staffs of CBWM Thailand for their outstanding preparation and generous hospitality. I also would like to thank two keynote speakers, Dr. Ulrich Grottker from Germany and Dr. Satoshi Matsuoka for their excellent and informative presentations. Also, special thanks should be extended to the APEC Secretariat for their great contributions.

Fraud in the use of electronic instruments has been reported in many developed economies. Unauthorized changes to software codes in measuring instruments is also a widespread problem. Organizing such a workshop on software controlled measuring instruments was to meet the demands of several economies in the Asia Pacific region who have expressed concerns about the role and use of software in measuring instruments including fuel dispensers, electrical weighing instruments and track scale etc.

The workshop included presentations on comprehensive introduction of software requirements of the International Legal Metrology Organization (OIML) D31, legal metrology software conformity inspection in EU market given by German expert Dr. Ulrich Grottker and Case study of development of software examination conforming to the latest OIML R76 ("Non-automatic weighing instruments Part 1: Metrological and technical requirements——Tests") in Japan by Dr. Satoshi Matsuoka. In addition, participants for member economies also shared the current situation, experience and lessons learnt on the measuring instruments software examination. All participants agreed to continue to exchange information and share technical experience in this area.

Due to the great contributions from the speakers and participants as well as the effective collaboration between the CBMW Thailand and APLMF Secretariat, I would like to say that this workshop is certainly a fruitful activity!

Finally, I would like to express my deeply appreciate again to the APEC Secretariat's generosity in contributing to the development in legal metrology among the APLMF member economies.

Sept. 25, 2010

Mr. Pu Changcheng

APLMF President

Summary Report

The Workshop on Software Controlled Metrological instrument which was held on August 3 – 6, 2010 in Bangkok, Thailand at the Holiday Inn Silom, Thailand. It was hosted by Central Bureau of Weights and Measures (CBWM), Thailand.

The course was attended by:

- 19 Oversees participants from the following economies: People's Republic of China, Indonesia, Mexico, Malaysia, New Zealand, Papua New Guinea, Peru, Philippines, Singapore, Thailand and Viet Nam.
- 2 speakers from Germany and Japan.
- 16 local participants.

The main objective of this course was:
to share the knowledge on the current legislations on metrological control for software in economies, software requirements of metrological instruments to ensure free and open trade over electronic instruments by the elimination of fraud and protection of consumer's interest.

The course started with welcoming addresses from the host economy and the APLMF Secretariat. The official group photograph was then taken. Following the formal opening addresses two speakers gave the keynote presentations in day one.

1. Dr. Ulrich Grottker (Physikalisch-Technische Bundesanstalt (PTB), Germany) The presentations outlined the following:
   - software requirements of the International Legal Metrology Organization (OIML) D31,
   - Legal metrology software conformity inspection in EU market,
   - Metrological Data Flow Analysis,
   - Validation Tutorium: Secure Linux Configuration.

2. Dr. Satoshi Matsuoka (National Metrology Institute of Japan (NMIJ), Japan)
   - The presentation is a case study of development of software examination conforming to the latest OIML R76 ("Non-automatic weighing instruments Part 1: Metrological and technical requirements-Tests").

On the day two, representative from attending member economies presented the current status on software examination for the metrological instruments in their respective economies. The presentations were:

- Software requirements of Measuring Instruments in China (by Mr. Huang Songtao,

China),

- Security Control on Measuring Instruments Using Software for Type Evaluation and Type Approval (by Mr. Dhani Kartika, Indonesia),
- Software verification of fuel dispensers: The Mexican Case (by Mr. Maximiliano Benavides Mexico),
- Type Approval Function in New Zealand (by Mr. Srinivas Reddy Bobbala, New Zealand),
- Current Situation On Software Controlled Measuring Instrument In Papua New Guinea (by Ms. Edna Egu, Papua New Guinea),
- Current situation on Software controlled Measuring Instrument in Peru (by Mr. Leonardo de la Cruz's, Peru),
- Current Situation on Software Controlled Measuring Instruments in the Philippines (by Mr. Sabino Paulo B. Leones, Jr., Philippines),
- Measuring Instruments in Singapore (by Mr. Adrian Ang, Singapore),
- Current Situation on Software Controlled Measuring Instruments in Thailand (by Mr. Sakchai Hasamin, Thailand),
- Current Situation on Software Controlled Measuring Instruments in Viet Nam (by Bui, Trung Dung & Dang Nhat Kien, Viet Nam).

These presentations represented the current situation, problems and possible solutions and needs associated with the software on metrology instruments in several APEC economies.

In the morning of day three, all participants visited the Thai Scale, a local famous weighing instrument manufacturer in Thailand. A brief introduction of the manufacturer was given firstly following by the demonstration of the products using the customized software programming. In the afternoon, the participants have an opportunity to visit the CBWM in Choburi. The local experts demonstrated the cheating means to alter the actual weights of the loaded truck. Participants were very interested in these demonstration and they exchanged experiences and case study in their own economies.

On the morning of the final day of the workshop, the Question and Answer Session was conducted. The local experts presented 16 common softwares cheating case and also provided the solutions Thailand implemented. Heated discussion arose from the each case. During this session, the invited experts, Dr. Ulrich Grottker also gave some explanations regarding the relevant OIML Documentations.

The four-day activities which comprised of the experts lectures, individual economies reports and technical visits successfully achieved objects of the workshop. It enabled all participants exchange know ledges and experience and enjoy this workshop technically and socially. The thoughtful arrangements and generous hospitality were highly appreciated.

Asia-Pacific
Economic Cooperation

Asia-Pacific
Legal Metrology Forum

Strengthening Legal Metrology Infrastructure for Trade Facilitation:
Workshop on Software Controlled Measuring Instrument
(APEC CTI 46/2009T)
3 – 6 August, 2010
in Bangkok, Thailand

Program

Organizers:

1. Asia-Pacific Economic Cooperation (APEC)
2. Asia-Pacific Legal Metrology Forum (APLMF)

Supporting Organization:

Central Bureau of Weights and Measures (CBWM), Thailand

Invited Speakers:

1. Dr. Ulrich Grottker (PTB, Germany)
2. Dr. Satoshi Matsuoka (NMIJ, Japan)

Introduction:

Software controlled measuring instruments are involved in many devices and systems. The rapid development of technology of examination of the metrological software is undoubtedly useful for the users, because it enables faster measurements, higher accuracy and opens up the possibility of various analyses and further processing.

Many APEC member economies have expressed concerns about the role and use of software in measuring instruments such as fuel dispensers and electrical weighing instruments. Some of these concerns relate to the accuracy and security of the embedded software in deriving a measured value. Fraud in the use of electronic instruments (for example: taxi meters and fuel dispensers) has been reported in many developed economies. Unauthorized changes to software in electronic weighing instruments are also a widespread problem. The potential for fraud through the use of these instruments is increasing as the technological in them becomes increasingly sophisticated.

In this workshop, participants will discuss, learn and practice the latest techniques to inspect and verify software to ensure free and open trade over electronic instruments by the elimination of fraud and protection of consumer's interest. Main issues including the current legislations on metrological control for software in economies, software requirements, software conformity to type during the manufacturing period, software conformity inspection in market, OIML D31 and software security and so on will be addressed.

Venue and Accommodation:

Accommodation for the participants will be prepared in the **Holiday Inn Silom Bangkok** hotel, Bangkok Thailand with a rate of about **62** US dollars for a single room and about **72 US** dollars for a double room. Please complete the hotel reservation form to make the reservation.

Travel Support:

- **APEC travel support**, composed of a roundtrip airfare in a discount economy class and per diem including accommodation, would be prepared for the participants from **Chile**, **P. R. China**, **Indonesia**, **Malaysia**, **Mexico**, **Papua New Guinea**, **Philippines**, **Peru and Russian Federation.**
- **APLMF travel support** would be complementary prepared for the non-APEC and full-APLMF member economies; **Cambodia**, **DPR Korea and Mongolia.**
- The maximum number of supported participants is limited to **ONE** for each economy. The final eligible participants will be decided after an approval by the APEC/APLMF secretariat. All supported participants are required to prepare a presentation with a document during the course. The English proficiency of your selected participant will very much affect the training accomplishments, so we hope you can recommend the right participant for the right training course.
- The candidates of the **APEC support** will be **requested to submit an airfare quotation and itinerary in advance and have to wait to buy air ticket until it is approved by the APEC secretariat.** Basically, all payment will be reimbursed directly from APEC after the **travel is finished.** The supported participants have to pay their airfare and accommodation temporarily by themselves until the reimbursement.

Possible Topics:

- **Current legislations/regulations on software controlled measuring instrument software requirements**

- ◆ Protection of legally relevant software
- ◆ Software interface
- ◆ Software identification

- **Software conformity to type during the manufacturing period**
- **Software conformity inspection in Market**
  - ◆ Data Reliability for the virtual instrument software
  - ◆ Routine supervision and examination
- **OIML D 31**
- **Software Security**
- …

Registration:

Please complete the attached **"Registration Form"** and send it to the APLMF Secretariat by **Friday, 9 July 2010.**

Access Information:

It may take about **45** min to arrive at the hotel from the airport.

Currency and Credit Cards:

Thai's currency is the Thai Baht and show on currency table as THB. Bank note come in 1,000 baht, 500 Baht, 100 Baht, 50 Baht and 20 Baht denomination, along with 10 Baht, 5 Baht, 2 Baht, 1 Baht, 50 Satang and 25 Satang coins.

Opening bank hours are 9: 30 am to 4: 30 pm Monday to Friday. Automatic Teller Machines (ATM's) are available 24 hours at most banks, but you should avoid using them late at night, for security reasons.

Climate and Clothing:

The average temperature in August is generally about 32 Celsius.

Electricity Supply:

Electricity in Thailand is 220 Volts, 50 Hz. Plugs and sockets are of this type:

Local Time:

GMT +7

Contact Persons about the Seminar:

- **APLMF Secretariat** (registration and travel support)

  Dr. ZHANG Chao & Mr. GUO Su

  APLMF Secretariat

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  E-mail: sec@aplmf.org aplmf@aqsiq.gov.cn

- **Host in Thailand** (Visa assistance, accommodation, venue and access information)

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  Ms. Pattaraporn Surasit (E-mail: meawzuke@hotmail.com)

  Ms. Pisakorn Pisankul (E-mail: pisankul@hotmail.com)

  Tel: +662 -5474348

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Program

Day 1, August 3 Tuesday	08:30-09:00	*Registration*
	09:00-09:30	Welcoming address from the host economy Opening ceremony (APLMF Secretariat) Group photo taking
	09:35-10:35	**Keynote Lecture** (**by Dr. Ulrich Grottker, PTB, Germany**) Software requirements according to OIML D 31
	10:35-11:00	*Coffee break*
	11:00-12:00	**Keynote Lecture** (**by Dr. Ulrich Grottker, PTB, Germany**) Software requirements according to OIML D 31 (Continue)
	12:00-13:30	*Lunch break*
	13:30-15:00	**Keynote Lecture** (by Dr. Ulrich Grottker, PTB, Germany) Tutorial For Data Flow Analysis /Check The Security Of Linux Configuration
	15:00-15:30	*Coffee break*
	15:30-16:00	**Keynote Lecture** (**by Dr. Ulrich Grottker, PTB, Germany**) Legal Metrology Software Conformity inspection in EU Market
	18:30-21:00	*Welcome Dinner hosted by CBWM*
Day 2, August 4 Wednesday	09:00-10:00	**Keynote Lectures (by Dr. Satoshi Matsuoka)** Development of Software Examination Conforming to the latest OIML R76 in Japan
	10:00-10:45	Software requirements of Measuring Instruments in China (by Mr. Huang Songtao, China)
	10:45-11:00	*Coffee break*
	11:00-11:15	Security Control on Measuring Instruments Using Software for Type Evaluation and Type Approval (by Mr. Dhani Kartika, Indonesia)
	11:15-11:30	Software verification of fuel dispensers: The Mexican Case (by Mr. Maximiliano Benavides, Mexico)
	11:30 – 11:50	Type Approval Function in New Zealand (by Mr. Srinivas Reddy Bobbala, New Zealand)
	12:00-13:30	*Lunch break*
	13:30-13:40	Current Situation On Software Controlled Measuring Instrument In Papua New Guinea (by Ms. Edna Egu , Papua New Guinea)

Day 2, August 4 Wednesday	13:40-14:00	Current situation on Software controlled Measuring Instrument in Peru (by Mr. Leonardo de la Cruz's, Peru)
	14:00-14:20	Current Situation on Software Controlled Measuring Instruments in the Philippines (by Mr. Sabino Paulo B. Leones, Jr., Philippines)
	14:20-14:30	Current Situation on Software Controlled Measuring Instruments in Singapore (by Mr. Adrian Ang, Singapore)
	14:30-15:00	Current Situation on Software Controlled Measuring Instruments in Thailand (by Mr. Sakchai Hasamin, Thailand)
	15:00-15:10	Current Situation on Software Controlled Measuring Instruments in Viet Nam (by Bui, Trung Dung & Dang Nhat Kien, Viet Nam)
	15:10-15:30	*Coffee break*
Day 3, August Thursday	08:00-12:00	Technical Visit: Thaiscale Company Limited
	12:00-13:30	*Lunch break*
	13:30-17:00	**Technical Visit**: CBWM **Invited presentation by local Company**
	18:30-21:00	*Farewell Dinner hosted by APLMF Secretariat*
Day 4, August 6 Friday	09:00-10:30	**Review and Conclusion**
	10:30-11:00	*Coffee break*
	11:00-12:00	**Certificate and Closing Ceremony**
	12:00-13:30	*Lunch break*

Participants List
APEC/APLMF Seminar and Training Courses in Legal Metrology (CTI-46/2009T)
Workshop on Software Controlled Measuring Instrument

No.	Category	Economy	Name	Organization
1	APLMF	P. R. China	Dr. ZHANG Chao	APLMF Secretary, Department of Metrology, AQSIQ
2	APLMF	P. R. China	Mr. GUO Su	APLMF Secretary, Department of Metrology, AQSIQ
3	Speaker	Germany	Dr. Ulrich Grottker	Physikalisch-Technische Bundesanstalt-PTB
4	Speaker	Japan	Dr. Satoshi Matsuoka	National Metrology Institute of Japan
5	Participant	P. R. China	Mr. Huang Songtao	Jiangsu Institute of Metrology, China
6	Participant	Indonesia	Mr. Dhani Kartika	Directorate of Metrology
7	Participant	Malaysia	Mr. PETER J. BERINUS AGANG	MINISTRY OF DOMESTIC TRADE, CO-OPERATIVE AND CONSUMERISM
8	Participant	Peru	Mr. LEONARDO DE LA CRUZ GARCIA	National Institute for the defense of Competition and Protection of Intellectual Property
9	Participant	Philippines	Mr. Sabino Paulo B. Leones, Jr.	National Metrology Laboratory, Industrial Technology Development Institute
10	Participant	Papua New Guinea	Ms. Edna Egu	PNG National Institute of Standards and Industrial Technology
11	Participant	Mexico	Mr. Maximiliano Jesus Benavides salazar	Information Tecyhnology Department/ Centro Nacional De Me Metrogia (CENAM)

12	Participant	Viet Nam	Mr. Bui Trung Dung	Directorate for Standards, Metrology and Quality (STAMEQ)
13	Participant	P. R. China	Mr. Qiu yaohua	Zhejiang institute of metrology, China
14	Participant	Indonesia	Mr. Assiddiq Muliadin	Legal Metrology Standardization of Makassar
15	Participant	Indonesia	Mr. Nugroho	Regional Verification Office of Jakarta
16	Participant	Indonesia	Mr. Suryatna	Regional Verification Office of Jakarta
17	Participant	Indonesia	Ms. Vera Firmansyah	Metrology Training Center
18	Participant	Indonesia	Mr. Wicaksono Febriantoro	Metrology Training Center
19	Participant	New Zealand	Mr. Srinivas Reddy Bobbala	Measurement and Product Safety Service (MAPSS), Ministry of Consumer Affairs
20	Participant	Papua New Guinea	Mr. Roland Tagis	PNG National Institute of Standards and Industrial Technology
21	Participant	Singapore	Mr. Adrian Ang	SPRING Singapore
22	Participant	Singapore	Ms. Lena Soh	SPRING Singapore
23	Participant	Viet Nam	Mr. Dang Nhat Kien	SEEN Tecnologies Joint Stock Company
24	Participant	Thailand	Mr. Sakchai Hasamin	Central Bureau of Weights and Measures (CBWM)
25	Participant	Thailand	Mr. Chartree Areewong	Central Bureau of Weights and Measures (CBWM)

26	Participant	Thailand	Mr. Surachai Sungzikaw	Central Bureau of Weights and Measures (CBWM)
27	Participant	Thailand	Mr. Samanya Theppbutra	Central Bureau of Weights and Measures (CBWM)
28	Participant	Thailand	Mr. Jaroonsak Busabon	Central Bureau of Weights and Measures (CBWM)
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32	Participant	Thailand	Ms. Lamoon Chanatalay	Central Bureau of Weights and Measures (CBWM)
33	Participant	Thailand	Ms. Khemsai Rahannok	Central Bureau of Weights and Measures (CBWM)
34	Participant	Thailand	Ms. Metta niem-prem	Central Bureau of Weights and Measures (CBWM)
35	Participant	Thailand	Mr. Phongchai Khunkum	Central Bureau of Weights and Measures (CBWM)
36	Participant	Thailand	Mr. Peerayut Chamrak	Central Bureau of Weights and Measures (CBWM)
37	Participant	Thailand	Mr. Warachai Triarun	Central Bureau of Weights and Measures (CBWM)

38	Participant	Thailand	Mr. Warapong pakkut	Central Bureau of Weights and Measures (CBWM)
39	Participant	Thailand	Asst. Prof. Siripun Thongchai	Central Bureau of Weights and Measures (CBWM)
40	Staff	Thailand	Ms. Pattaraporn Surasit	Central Bureau of Weights and Measures (CBWM)
41	Staff	Thailand	Ms. Pisakorn Pisankul	Central Bureau of Weights and Measures (CBWM)
42	Staff	Thailand	Ms. Panawan Khamlor	Central Bureau of Weights and Measures (CBWM)
43	Staff	Thailand	Mr. Thanwarat Sa-ng uansing	Central Bureau of Weights and Measures (CBWM)

Workshop on Software Controlled Measuring Instruments
3-6 August 2010
Bangkok, Thailand

Software Requirements according to OIML D31

Ulrich Grottker
PTB, Germany

- OIML TC5 / SC2 (Part 1)
- D31 Software Requirements
  - General Requirements
  - Specific Requirements
- D31 Validation Methods (Part 2)
  - Simple Methods
  - Advanced Methods
- Practical Demonstration of Validation Methods (Part 3)
  - Dataflow Analysis
  - Checking Linux Configuration
- Summary

TC 5: Electronic measuring instruments and software
MIRS (Slovenia)

TC 5 / SC 1: Electronic measuring instruments
NMi (The Netherlands)

TC 5 / SC 2: Software
PTB (Germany) + OIML (previously France)

P - Members

Australia	Czech Republic	Norway
Belgium	Denmark	Romania
Belarus	Finland	Russia
Brazil	France	Slovenia
Canada	Germany	United Kingdom
China	Japan	U.S.A
Cuba	The Netherlands	

O - Members

Austria	Mexico	Spain
Bulgaria	New Zealand	Sweden
Egypt	Poland	Switzerland
Indonesia	Slovakia	Serbia
Ireland	South Africa	+ Liaisons

Basis for the Document

Aims in Legal Metrology according to the Principles of OIML:

*Obtain **confidence in measurements** for trade, surveillance, environment, and safety*

Consequences regarding Software:

- *Correctness of software*
- *Protection of software*
- *Conformity of each instrument with the examined pattern*

D31 Contents

1 Introduction
2 Scope and field of application
3 Terminology
4 Instructions for use of this Document in drafting OIML Recommendations
5 Requirements for measuring instruments with respect to the application of software
5.1 General requirements
5.2 Requirements specific for configurations
6 Type approval
7 Verification
8 Assessment of severity (risk) levels
Annexes

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Terminology

3.1 General terminology
e.g. electronic device, error, durability…

3.2 Software terminology
e.g. hash function, interface, data domain…

3.3 Validation and Verification Terminology
e.g. sealing, validation, securing…

APLMF – WorkshopSoftware Controlled Measuring Instruments – 3-6 August 2010, Bangkok

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Structure of the requirement part

Set of requirements is variable, depending on the features and complexity of the measuring system:

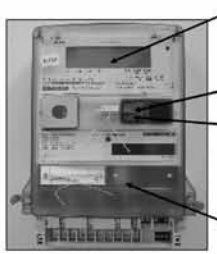
- General software requirements (all instruments)
- Specific software requirements (specific configurations)

Two severity levels for acceptable technical solutions, depending on the area of application, kind of measurement:

(I) Normal severity level
(II) Raised severity level

5.1 General Requirements > Examples

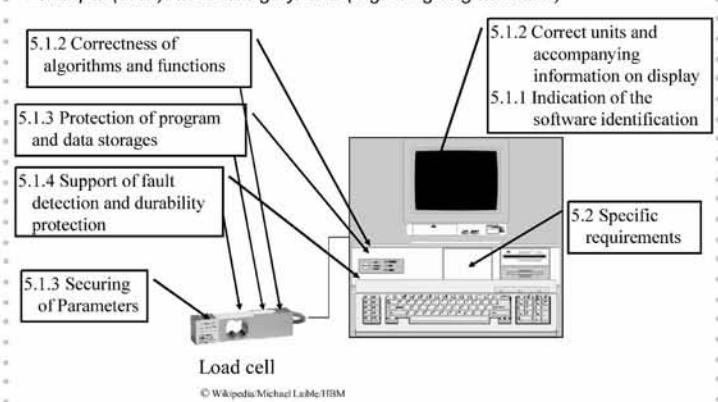
Example (5.1a): "Simple" instrument (e.g. electricity meter)



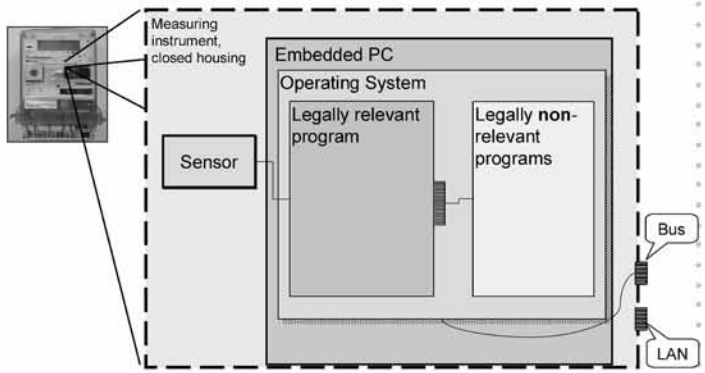
5.1.1 Indication of the software identification
5.1.2 Correctness of algorithms and functions, correct units and accompanying information on display
5.1.3 Protection of program and data storages
5.1.3 Securing of Parameters
5.1.4 Support of fault detection and durability protection

5.1 General Requirements > Examples

Example (5.1b): Measuring system (e.g. weighing machine)



Example (5.1c): Future (?) Smart Meter → Example 5.2.4



The legally relevant software … shall be clearly identified…

- Identification inextricably linked with the software
- Displayed or printed at start-up, on demand, or continuously

(I) V1.5.12a V1.5.12a-2D7F (II)

- Output on the display of the instrument or on another sub-assembly

  Exception under certain conditions.

The measuring algorithms and functions … shall be appropriate and functionally correct …

- Take MPE into consideration when constructing or examining an algorithm
- Examples for obviously essential impact of the software to the MPE
  - quantisation, number of digits, rounds in successive approximation and abort criterion
  - arithmetic, type of numbers (Integer, float …)
  - analogue-digital conversion
- Specific complex applications
  - image processing
  - dynamic weighing

- Protection of programme code, measurement values and other relevant data, parameters
- … possibilities for … misuse shall be minimal. Presentation of the measurement result should be unambiguous for all parties affected.

  Example: Guided menus for the user for crucial actions
  Keep man-machine-interface simple

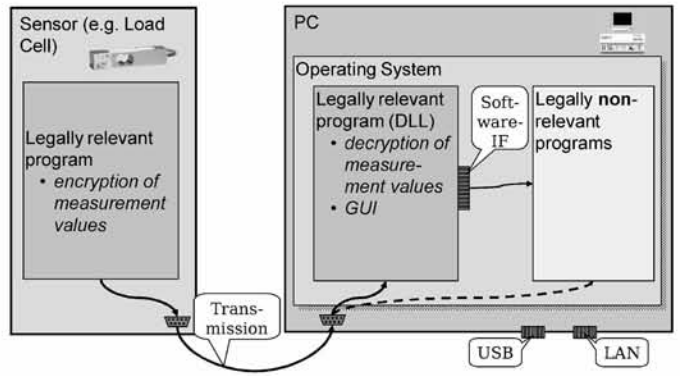
a) The legally relevant software shall be secured against unauthorized modification, loading, or changes by swapping the memory device.

Examples (5.1.3.2-a1):

- The housing containing the memory devices is sealed or the memory device is sealed on the PCB.
- Rewritable device: write-enable input inhibited by a switch that can be sealed. …

(I) (II)

Example (5.1.3.2-a2): Encapsulated PC program + encrypted transmission (I)



b) Only clearly documented functions are allowed to be activated by the user interface …

Example (5.1.3.2-b):

- All inputs from the user interface are redirected to a programme that filters incoming commands. It only allows and lets pass the documented ones and discards all others.

(I) (II)

c) Parameters that fix the legally relevant characteristics of the measuring instrument shall be secured against unauthorized modification …

Example (5.1.3.2-c):

- Device specific parameters to be secured are stored in a non-volatile memory. The write-enable input of the memory is inhibited by a switch that can be sealed.

(I) (II)

d) Software protection comprises appropriate sealing by mechanical, electronic and/or cryptographic means, making an unauthorized intervention impossible or evident.

Example (5.1.3.2-d), Electronic sealing:

- The metrological parameters of an instrument can be input and adjusted by a menu item.
- The software recognises each change and increments an event counter.
- The event counter value can be indicated.
- The initial value is registered (e.g. on the plate).
- If the indicated value differs from the registered one, the instrument is in an unverified state (equivalent to a broken seal).

(I)

Fault detection described in D11 may be supported by software. … An appropriate reaction on the fault is required.

Example (5.1.4.1):

- On each start-up the legally relevant program calculates a checksum of the program code and legally relevant parameters.
- The nominal value of these checksums has been calculated in advance and stored in the instrument.
- If the calculated and stored values don't match, the program stops execution.

(I) (II)

Durability protection described in D11 may be supported by software. … An appropriate reaction on the fault is required.

Example (5.1.4.2):

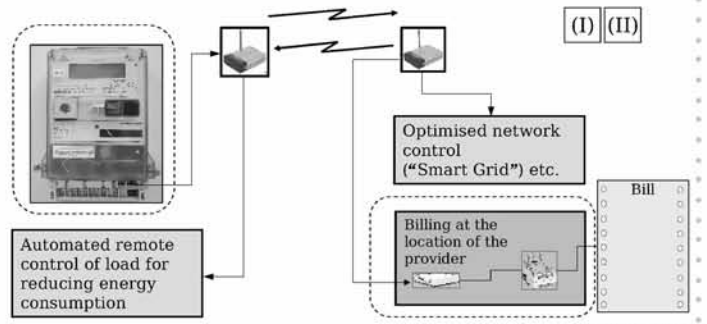
- Some kinds of measuring instruments need an adjustment after a prescribed time interval.
- The software gives a warning when the maintenance interval has elapsed.
- The software stops measuring, if it has been exceeded for a certain time interval.

(I) (II)

1 Introduction
2 Scope and field of application
3 Terminology
4 Instructions for use of this Document in drafting OIML Recommendations
5 Requirements for measuring instruments with respect to the application of software
5.1 General requirements
5.2 Requirements specific for configurations
6 Type approval
7 Verification
8 Assessment of severity (risk) levels
Annexes

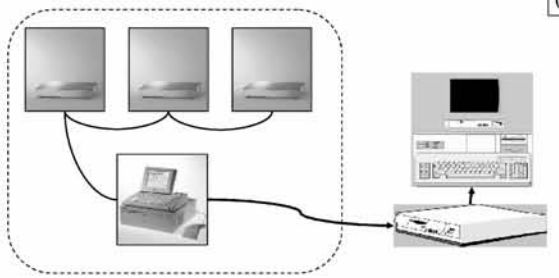
a) Sub-assemblies or electronic devices of a measuring system that perform legally relevant functions shall be identified, clearly defined, and documented. They form the legally relevant part of the measuring system.

Example (5.2.1.1-1): Smart meter, simple configuration

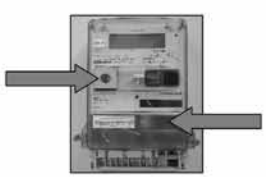


a) Sub-assemblies or electronic devices of a measuring system that perform legally relevant functions shall be identified, clearly defined, and documented. They form the legally relevant part of the measuring system.
Example (5.2.1.1-2): Weighing system connected to a merchandize management system

(I) (II)

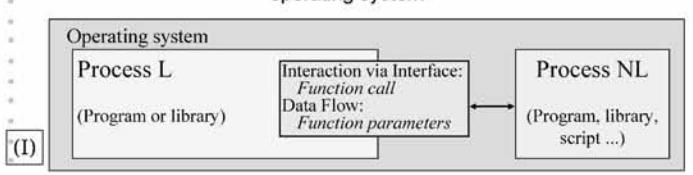


b) Relevant functions and data of sub-assemblies and electronic devices shall not be inadmissibly influenced by commands received via the interface.
This implies that there is an unambiguous assignment of each command to all initiated function or data change in the sub-assembly or electronic device.

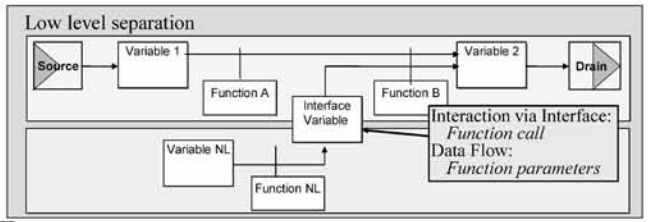


a) All software modules (programs, subroutines, objects etc.)
that perform legally relevant ***functions*** or
that contain legally relevant ***data domains***
form the legally relevant software part of a measuring instrument.
b) All communication shall be performed ***exclusively via*** the software ***interface***.
c) Same requirements as for hardware interfaces concerning ***commands and data flow***.

Example (5.2.1.2-1): High level separation, using features of the operating system



Example (5.2.1.2-2): Low level separation, using features of the programming language



(I)

d) The legally relevant software shall have ***priority*** using the resources over non-relevant software.
The measurement task … must not be delayed or blocked by other tasks.

a) … The window containing the legally relevant data shall have ***highest priority*** i.e.
- it shall not be deleted by other software
- or overlapped by windows generated by other software
- or minimised
- or made invisible

as long as the measurement is running and the presented results are needed for the legally relevant purpose.

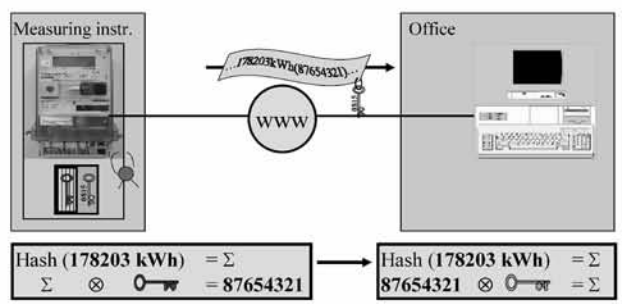
5.2.3.1 The measurement value stored or transmitted shall be accompanied by ***all relevant information*** necessary for future legally relevant use.

5.2.3.2/3 The data shall be ***protected*** by software means to guarantee authenticity, integrity / correctness of the information of the time of measurement … If an irregularity is detected, the data shall be discarded or marked unusable.

5.2.3.4 Measurement data must be stored ***automatically*** when the measurement is concluded, i.e. when the final value used for the legal purpose has been generated…

5.2.3.5/6 The measurement shall not be ***inadmissibly influenced*** by a transmission delay. If network services become unavailable, no measurement data shall be lost…

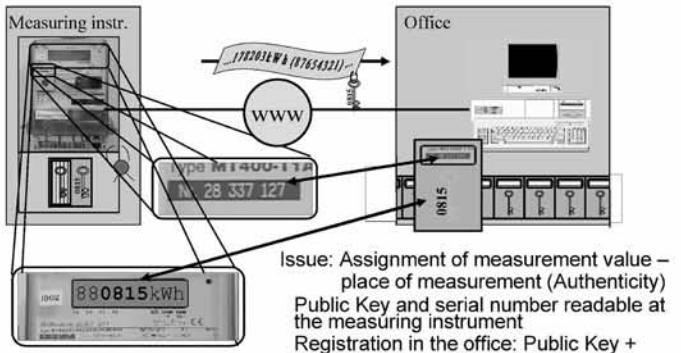
5.2.3.7 The ***time stamp*** shall be read from the clock of the device. … setting the clock may be legally relevant and appropriate protection means shall be taken…



(II)

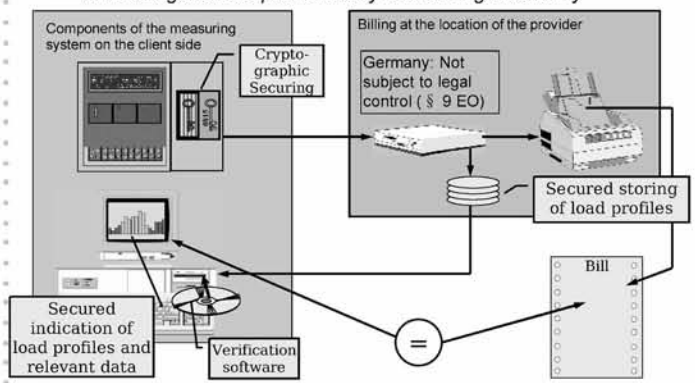
Public Key System: Secret Key hidden in the measuring instrument
Approved algorithms for high security: RSA or "Elliptic Curves"

Relevant data + signature + public key sent: **Integrity** verifiable

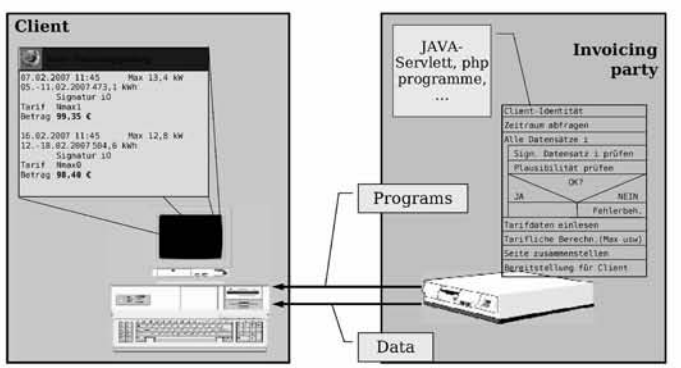


Example (5.2.3): Smart Meter, complex configuration (1)

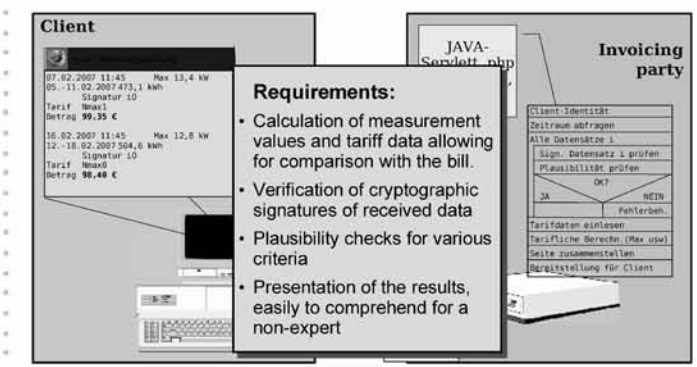
—— Measuring the load profile locally and storing it centrally



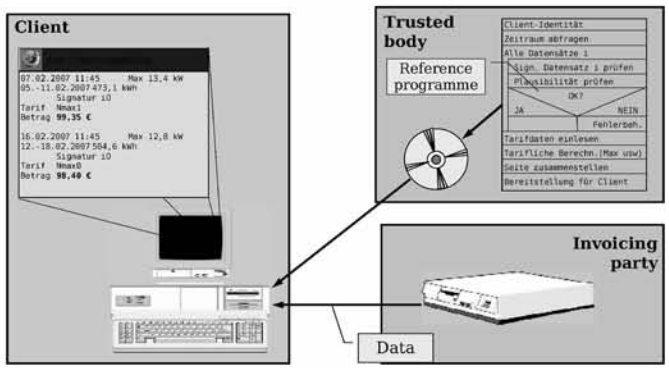
Software for the verification of the bill by the client:
(a) Programme stored on the web site of the invoicing party.



Software for the verification of the bill by the client:
(a) Programme stored on the web site of the invoicing party.



Software for the verification of the bill by the client:
(a) Programme stored on the web site of the invoicing party.



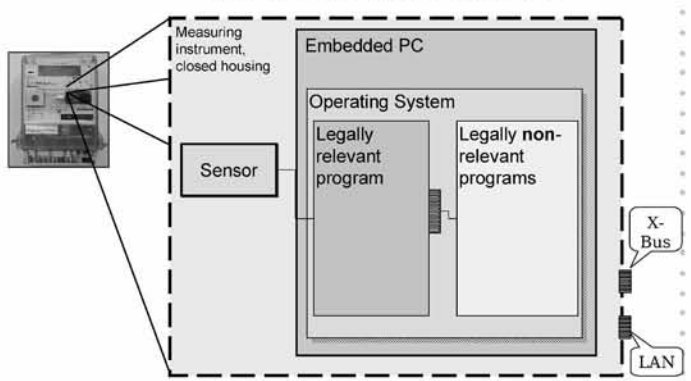
5.2.4.1 The manufacturer shall identify the ***hardware and software environment***, minimal resources and a suitable configuration …

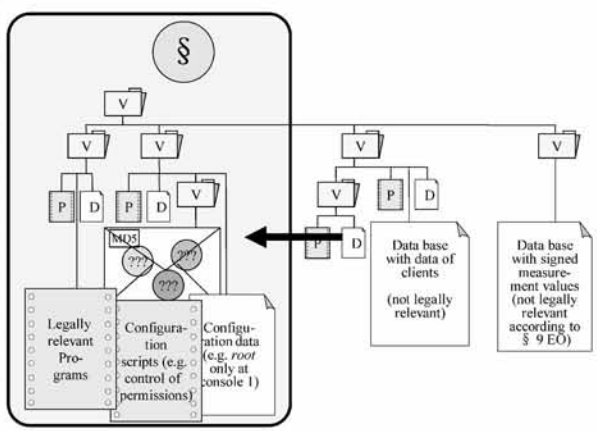
5.2.4.2 Technical means shall be provided in the legally relevant software to ***prevent operation***, if the minimal configuration requirements are not met.

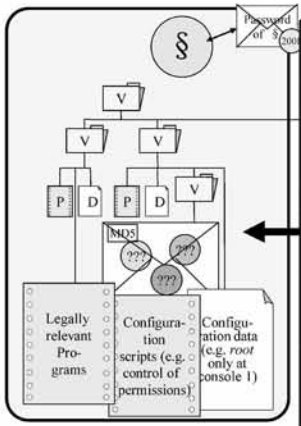
The system shall be ***operated only*** in the ***environment specified*** by the manufacturer for its correct functioning.

… in case an invariant environment is specified …, means shall be provided to keep the ***operating environment fixed***.

Examples (5.2.4): Weighing instruments, fuel dispensers, future (?) Smart Meters, Taximeters, …







Means to keep environment fixed:

- Separate software
- Make use of the multi-tasking protection means of the operating system: lock the role “admin” or “root”.
- Adjust read-write-execute permissions
- Reduce functionalities of the OS by installing “Security Policies”
- Reduce functionality: no plug&play interfaces allowed (USB, Firewire, PCMCIA, …)
- Highest protection of LAN interface (Firewall)

5.2.5 The manufacturer shall produce devices and the legally relevant software that conform to the approved type and the documentation submitted.

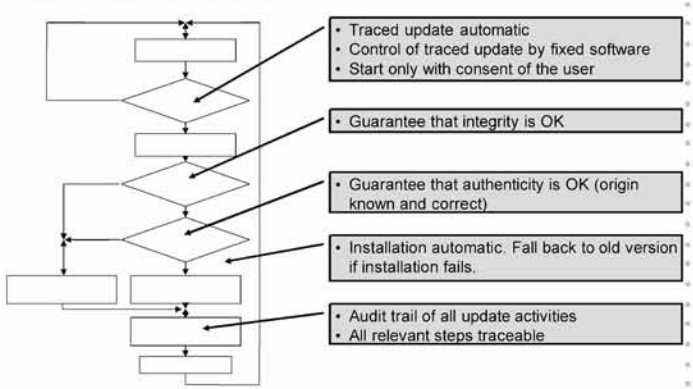
Levels of conformity:

(I)
- (a) identity of the ***legally relevant functions*** described in the documentation
- (b) identity of ***parts of the legally relevant source code*** (for the rest of the source code: (a))
- (c) identity of ***parts of the legally relevant executable code*** (for the rest: (a) or (b))

(II)
- (d) identity of the ***whole legally relevant source code***
- (e) identity of the ***whole executable code***

Except for (e) there may be a software part with no conformity requirements, see 5.2.1.2.

Traced Update procedure



- Traced update automatic
- Control of traced update by fixed software
- Start only with consent of the user

- Guarantee that integrity is OK

- Guarantee that authenticity is OK (origin known and correct)

- Installation automatic. Fall back to old version if installation fails.

- Audit trail of all update activities
- All relevant steps traceable

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- 6.1 Documentation to be supplied for type approval
- 6.2 Requirements on the approval procedure
- 6.3 Validation methods
- 6.4 Validation procedure

7 Verification
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Annexes

Validation methods

Abbr.	Description	Application	Preconditions	Special skills
AD	Analysis of documentation	Always	Documentation	-
VFTM	Validation by functional testing of metrological features	Correctness of the algorithms, uncertainty, compensating and correcting algorithms	Documentation	-
VFTSw	Validation by functional testing of software features	Handling by the user, correct functioning of communication, indication, fraud protection	Documentation text editor	-
DFA	Data flow analysis	Software separation, evaluation of the impact of commands on the instrument's functions	Source code, text editor	Programming languages.
CIWT	Code inspection, Walkthrough	All purposes	Source code, text editor	Programming languages
SMT	Software module testing	All purposes when input and output can clearly be defined	Source code, testing environment, special software tools	Programming languages. Instruction for using the tools

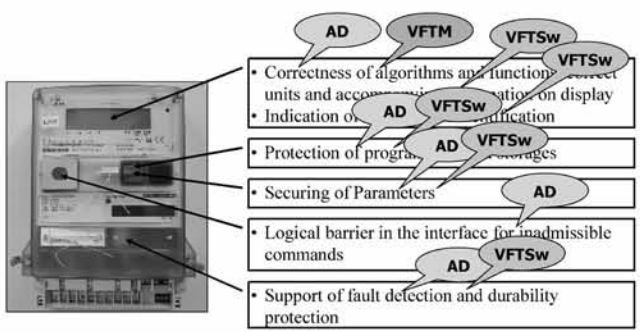
Validation procedures (1)

	Requirement	Validation procedure A (normal examination level)	Validation procedure B (extended examination level)	Comment
5.1.1	Software identification	AD + VFTSw	AD + VFTSw + WT	Select »B« if high conformity is required
5.1.2	Correctness of algorithms and functions	AD + VFTM	AD + VFTM + WT/SMT	
5.1.3.1	Prevention of accidental misuse	AD + VFTSw	AD + VFTSw	
5.1.3.2	Fraud protection	AD + VFTSw	AD + VFTSw + DFA/WT/SMT	Select »B« in case of high risk of fraud
5.1.4.1	Support of fault detection	AD + VFTSw	AD + VFTSw + WT + SMT	Select »B« if high reliability is required
5.1.4.2	Support of durability protection	AD + VFTSw	AD + VFTSw + WT + SMT	Select »B« if high reliability is required

Validation procedures (2)

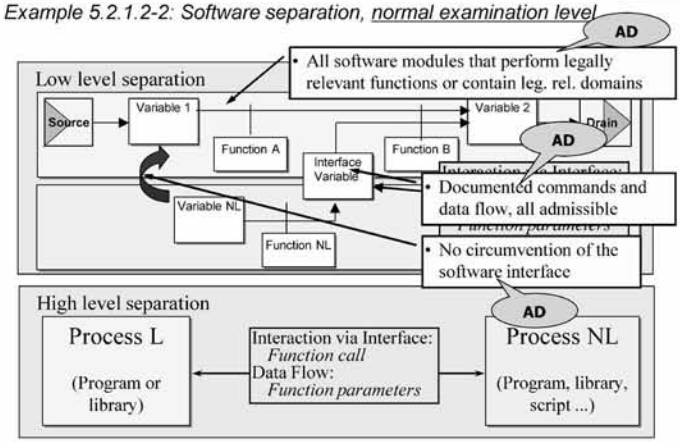
Normal examination level

Example (5.1a): "Simple" instrument (e.g. electricity meter)



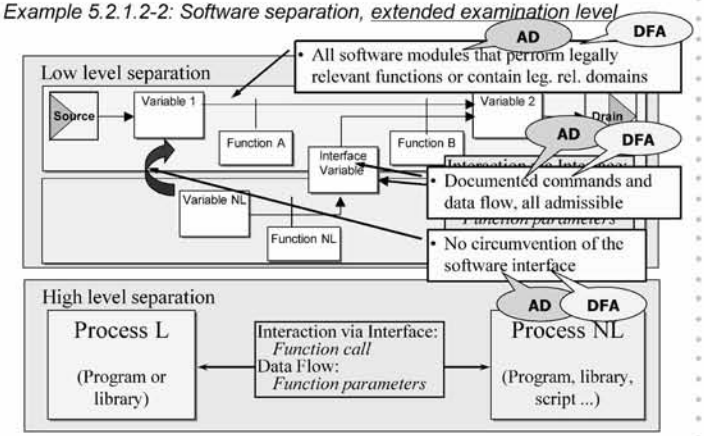
Validation procedures (3)

Example 5.2.1.2-2: Software separation, normal examination level



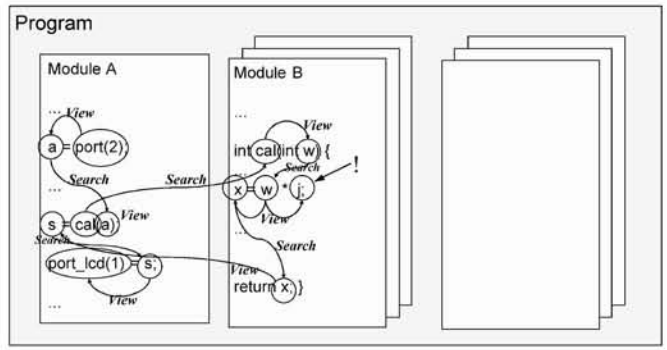
Validation procedures (4)

Example 5.2.1.2-2: Software separation, extended examination level



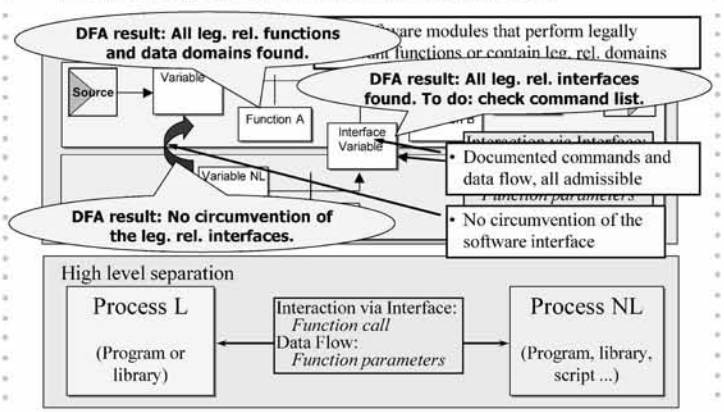
Validation procedures (5)

Manual Data Flow Analysis, extended examination level



Validation procedures (6)

Example 5.2.1.2-2: Software separation, analysis result



Summary

D31 is a basis for future Recommendations

- Software requirements based on the Principles of OIML for Legal Metrology
- Structure very similar to D11
- Requirements take into consideration current state of Information Technology
- Tools for identifying legally relevant parts of a measuring system
- Flexible toolbox of requirements and validation methods for adaptation to the needs of TCs
- New concepts will not be limited more than necessary

Thank you for your attention!

Workshop on Software Controlled Measuring Instruments
3-6 August 2010
Bangkok, Thailand

Legal Metrology Software Conformity inspection in EU Market

Ulrich Grottker
PTB, Germany

- **"New Approach" of Legislation in the European Union (EU)**
  Directive defining the "New Approach": Objectives, Requirements
- **Measuring Instruments Directive —— MID**
  Structure and Contents
  Essential Requirements, Relation to Software
  Conformity Assessment
- **Conformity Assessment Procedures**
  Assessment options for measuring instruments
  Market Surveillance, Usage Surveillance
  Specific Problems concerning Software
- **Summary, outlook**

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- ***Objectives***
  —— Basically: boost inner trade, remove barriers to trade
  —— Framework for Directives to be developed
  —— Harmonisation of the legal basis of the EU
  —— Acceleration of the development of EU Directives
  —— Allow/don't hinder technical innovation
  —— Enhance (global) competitiveness of EU industry
  —— Reduce governmental responsibility, shift it to manufacturers

- ***Requirements***
  —— Directives should contain only essential requirements
  —— Detailed technical specifications laid down in normative documents
  —— Modular Conformity Assessment procedures
  —— Obligation of the Member States to transpose the Directives to national laws

Overview

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Overview

- ***Objectives***
  —— Consumer protection
  —— Fair trade
  —— Confidence in measurements by the government
- ***Structure and contents***
  —— Articles for area of application, procedures, roles and responsibilities, requirements on Notified Bodies
  —— Annex containing Essential Requirements for measuring instruments
  —— Annexes containing definitions of the conformity assessment procedures
  —— Annexes containing specific requirements for the 10 types of instruments under consideration

Measuring Instruments Directive - MID

MID-annexes	*Type of Measuring Instrument*	*Category / Field of Application*
MI-001	Water Meters	provision of energy
MI-002	Gas Meters	
MI-003	Electrical Energy Meters	
MI-004	Heat Meters	
MI-005	Systems for Liquids, other than Water	business transactions
MI-006	Automatic Weighing Instruments	
MI-007	Taximeters	
MI-008	Material Measures	
MI-009	Lenght/Dimensional Measuring Instr.	
MI-010	Exhaust Gas Analysers	environment, health

Measuring Instruments Directive – MID (cont.)

- **Relation of requirements to software**
  —— Basic requirements on software exist
  —— specification for practical application necessary
- **Conformity Assessment**
  —— Modular approach
  ——Traditional procedures like "type approval" or "legal verification" still exist but new procedures added
  ——Notified Bodies may be governmental or corporate

Overview

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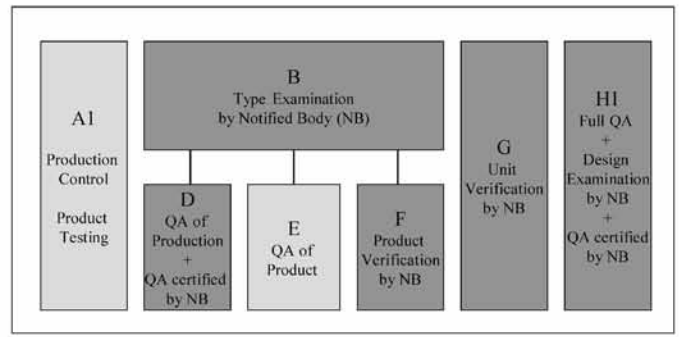
MID Conformity Assessment Procedures

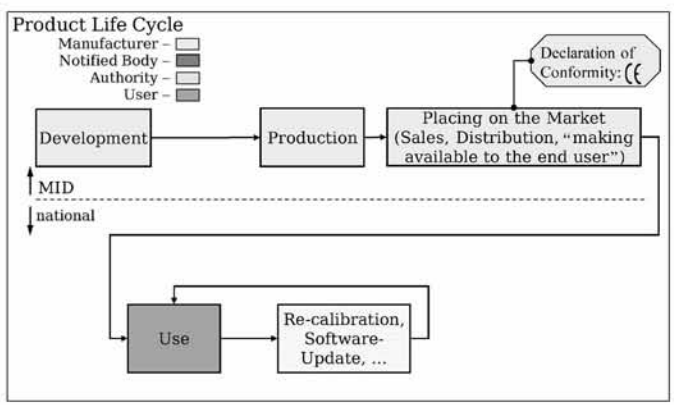
Selected Modules relevant for MID

Blue: Notified Body (NB) involved



MID Conformity Assessment Procedures

Conformity Assessment during the Life Cycle of a Measuring Instrument



MID Conformity Assessment Procedures

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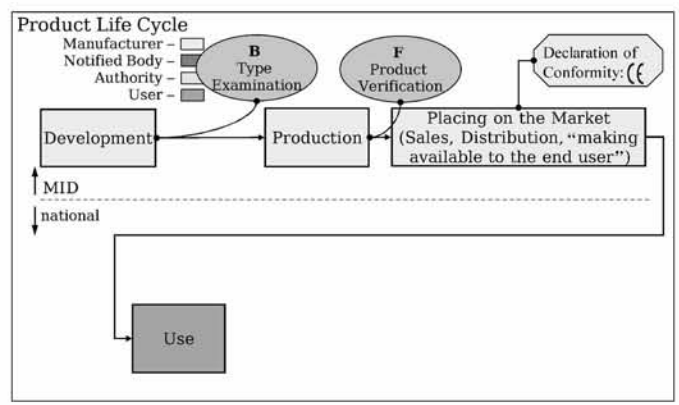
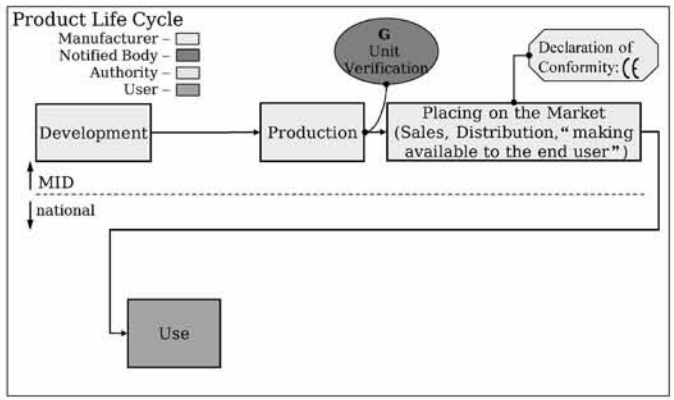
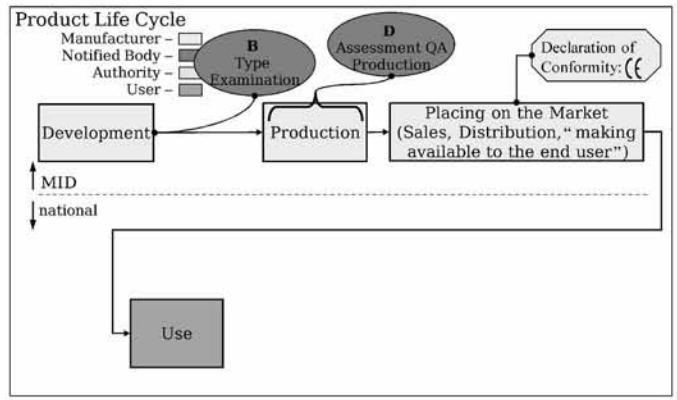


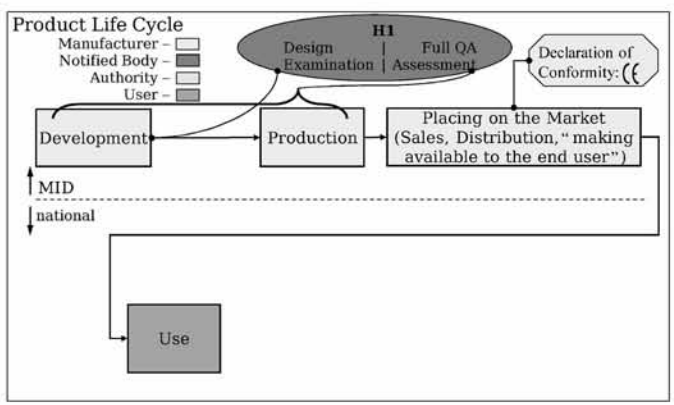
Conformity Assessment during the Life Cycle of a Measuring Instrument



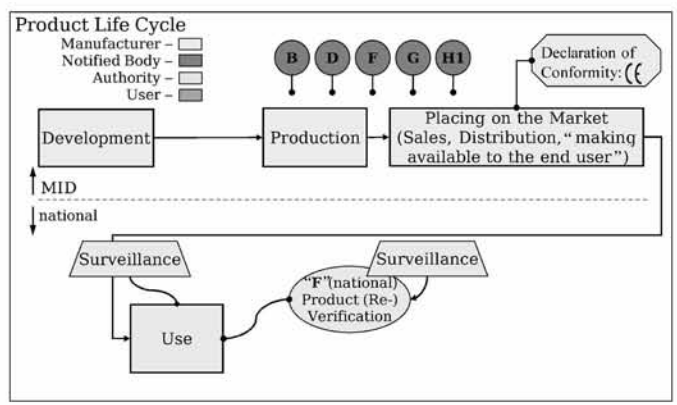
Conformity Assessment during the Life Cycle of a Measuring Instrument



Conformity Assessment during the Life Cycle of a Measuring Instrument

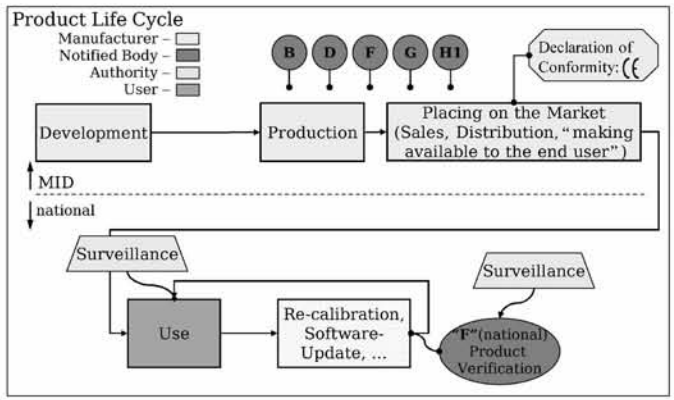


Conformity Assessment and Surveillance



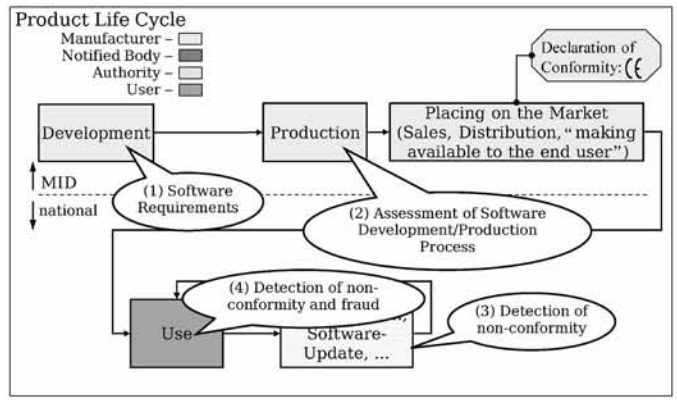
Surveillance (Germany)

Conformity Assessment and Surveillance



Surveillance (Germany)

Software Issues



Software issues during life cycle of the measuring instrument

MID:

(1) Development process: requirements

- *Software requirements WELMEC Guide 7.2 (2.3, 2.5 for NAWIs)*
- *OIML Document (2CD) by TC5/SC2*

(2) Assessment of QA of Production or of full QA:

- *Questionnaires, check lists (by PTB)*

National:

(3) Detection of non-conformity ((re-)verification)

- *Check accordance with certificate*
- *Problem, if manufacturer doesn't co-operate*
- *Problem, if a legal proof of conformity is required*

(4) Detection of fraud (surveillance of correct use)

- *Check securing means according to the certificate*
- *Difficult and expensive to detect sophisticated attacks*
- *Problem, if a legal proof of a sophisticated fraud is required*

Summary, outlook

- ***"New Approach" of Legislation in the EU***
  - *Super-ordinated concept and framework for Directives*
  - *Supports inner trade, reduces governmental responsibilities and tasks*
- ***Measuring Instruments Directive - MID***
  - *Consumer protection, fair trade, confidence in measurements*
  - *Essential requirements*
  - *Modular conformity assessment procedures*
  - *Termination at "Placing product on the market"*
  - *Software requirements derived from essential requirements available*
- ***Issues, challenges***
  - *Communication EU partners — national notified bodies and authorities*
  - *Software: detection of fraud and non-conformities*

Metrological Data Flow Analysis

- Manual Examination -

Guide for the Example Project

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1 Scope

- Examination of software separation, fixing of the free part of the software, definition of the software interface and sectioning of the display
- Examination of the software barrier of interfaces (protective interfaces)

2 Prerequisites

- Used aids: Search programm for text in files in deliberate file systems (e.g. grep for unix/Linux; integrated tools in Windows Explorer or TotalCommander)
- Editor for searching within a file
- Data sheet of the microcontroller, details about the runtime system of the compiler (here: names of the port registers, the link between the hardware and the software)
- Block diagramme
- Nassi-Shneidermann diagramme or flow diagramme or rough description of the functionning of the programme
- Source code
- Compiler not necessary

3 Procedure

3.1 Documentation of the Datapaths

3.1.1 Finding the Start or End of a Path

- Schematic of the example: Analogue channels on pins PA0 and PA1 -> Search in file system failes. From the manual of the microcontroller (ATmega32): Name of the Port -> Port A -> Search in the file system: IOm32.h//#define PORTA ... -> Search for PORTA in file system succeeds, source found!
- Addressing of the source in adc.c//read_adc(char channel) found -> From manual (ATmega32): understand the conversion algorithm, find the register where the value can be read: 2 Bytes ADCL and ADCH -> from here datapath can be developed.
- Development of the datapath by "incremental devopment"
- Drain: Search for Port C (found in the schematic) -> #define PORTC -> Data are sent serially on PORTC.0, controlling of the transmission and LCD functions on PORTC.0, PORTC.1, PORTC.2

3.1.2 Incremental Development of the datapath using grep/editor

1. Search a variable / a port / a constant in the whole file system.
2. Identify the subroutine / function / PROCEDURE, where this variable / ... is declared (= finding the data domain); register name und domain in the datapath diagramme.
3. Find all write accesses to this domain in the whole file system:
   - Search for assignments that have the respective domain **left** hand side of the '='-character.
   - Search for assignments to **current input parameter values** of a subroutine, if the respective domain is a formal parameter of this subroutine.
   - Search for **assignments of the address** of the respective domain to a pointer variable. Then search for assignments where the respective pointer variable is left hand side of the '='-character or where the pointer variable is a current input parameter of a subroutine.

   Register this flow a input edges of the respective domain in the datapath diagramme.
4. Backtrace all unknown input edges of the respective domain.
5. Continue the datapath. Find all read accesses to the respective domain in the whole file system:
   - Search for assignments where the respective domain is **right** hand side of the '='-character.
   - Search for **assignments of the address** of the respective domain to a pointer variable. Then search for assignments where the respective pointer variable is **right** hand side of the '='-character.

   Register these output edges in the datapath diagramme and find the destination domain. Continue with the destination domain starting again at step 1 and repeat until the drain is reached.

3.2 Examination (Separation, Interface, Barrier, Circumvention of Interfaces, Sectioning of the Display)

- Value of pointer variables are not allowed to be transferred via the software intervace out of the legally relevant part. All datapaths con-

taining pointer variables pointing to members of relevant datapaths are legally relevant themselves. Datapaths with normal variables are allowed to go outside the legally relevant part.

— ...

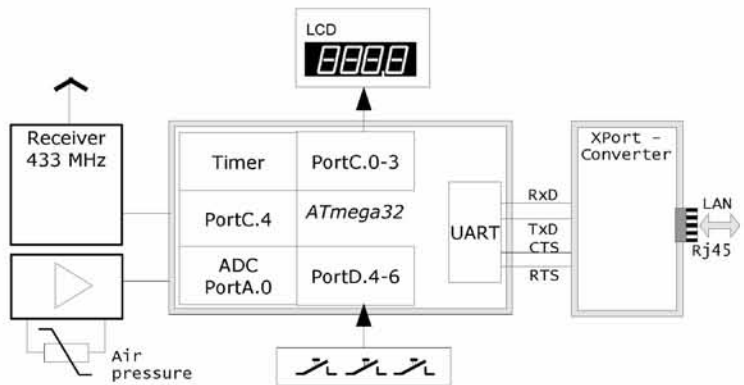
4 Example

The example is a experimental assembly named "W-Logg32". It is not a commercial measuring instrument and it is not subject to legal control. The assembly has the following functions:

- Measurement of air pressure, temperature, and moisture.
- Presentation of data from a heating facility (power, energy of the day etc.). These data are received by radio transmission (433 MHz).
- The device is connected via a converter to a compact http server unit, allowing to communicate with the device via a LAN.

4.1 Hardware

4.1.1 Block Diagramme



4.1.2 Photos

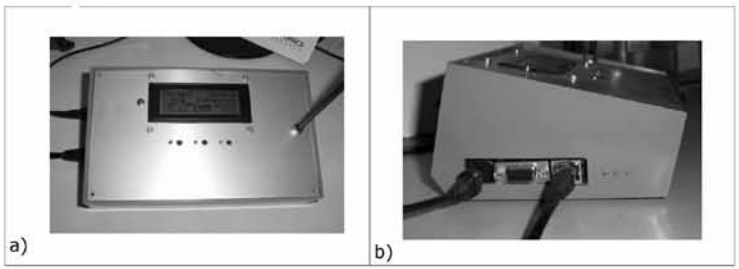


Figure 1: Device W-Logg32

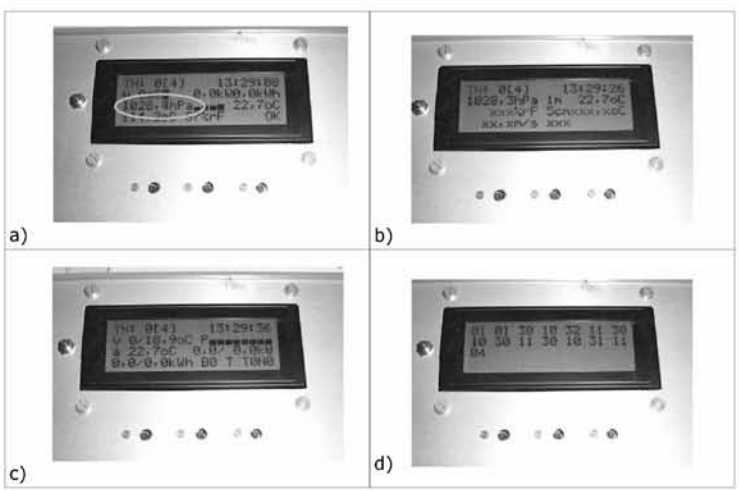
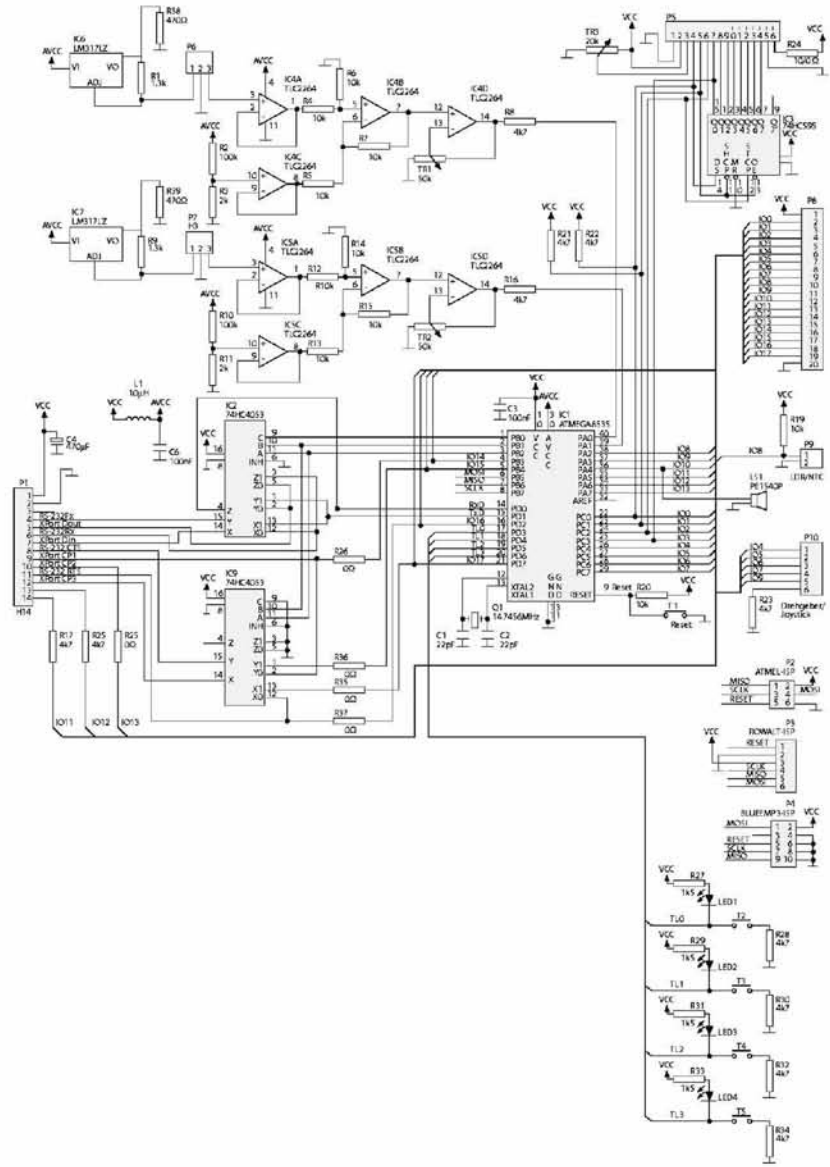
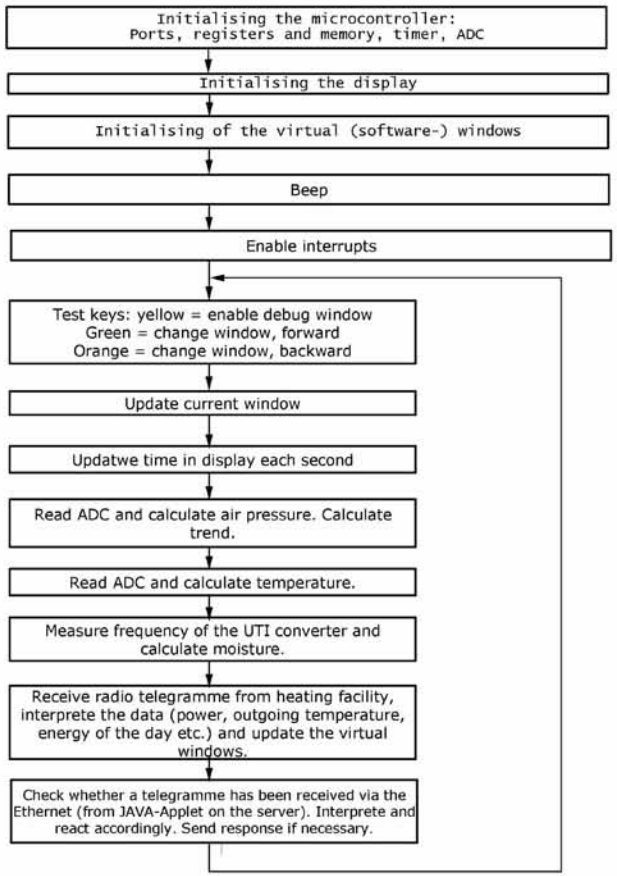


Figure 2: Software windows (relevant measurement value marked)

4.1.3 Schematic



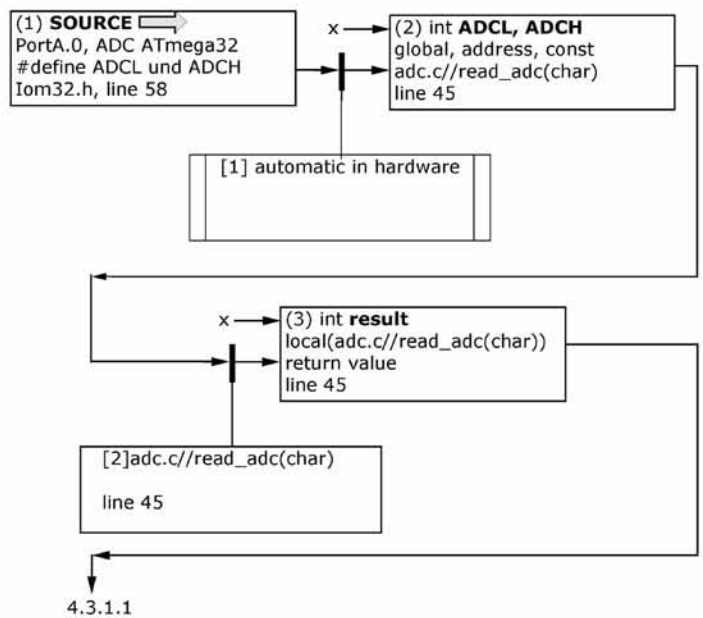
4.2 Flow Diagramme

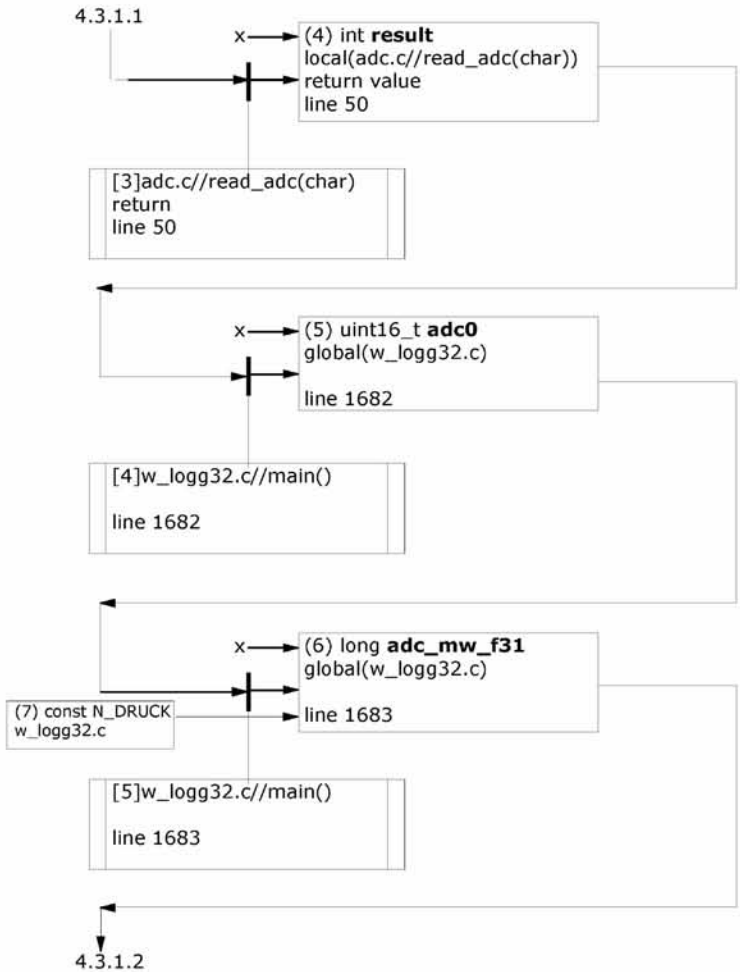


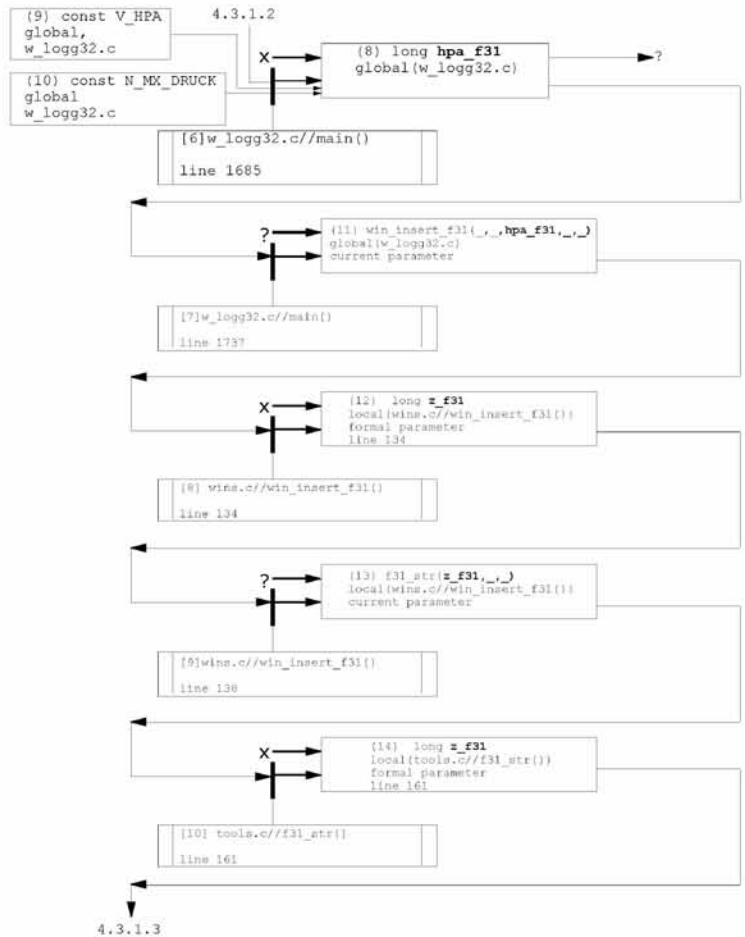
4.3 Diagramme of the Measuring Path

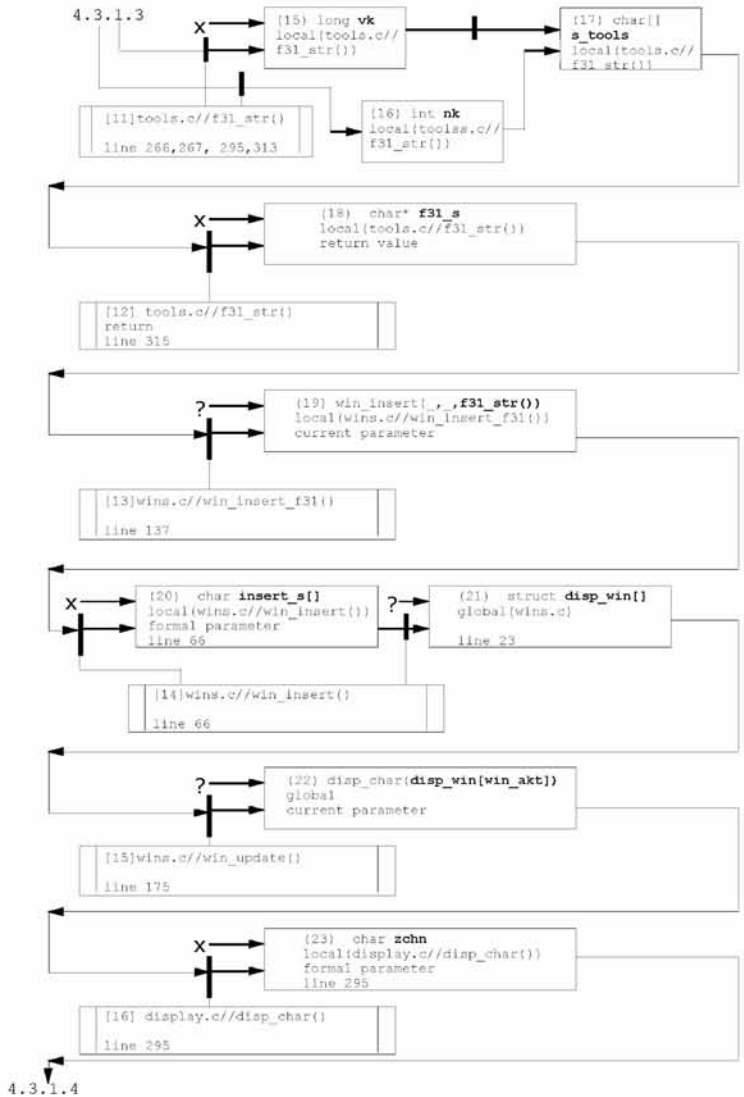
The task of this exercise is to recognise the path of the measurement values in the software using the source code and check all branches whether measurment values could be influenced by other programme parts.

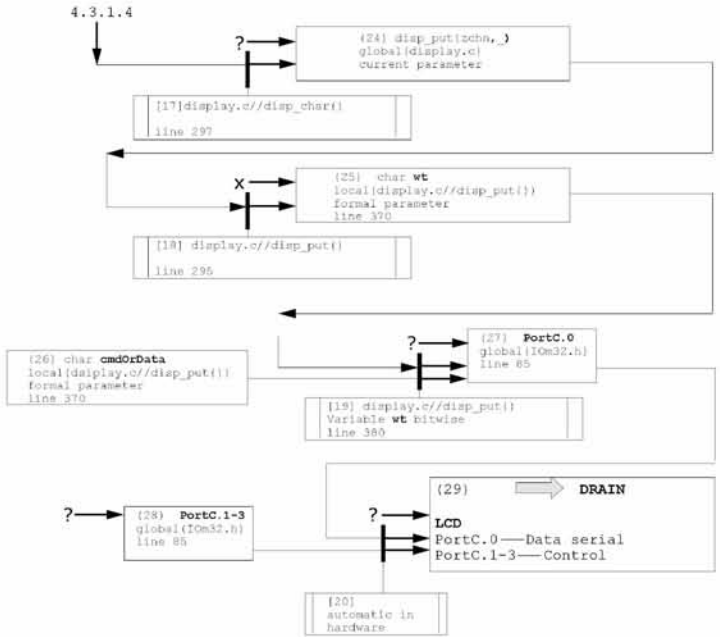
4.3.1 Detailed Presentation of the Path of the Measurement Values




4.3.1.1
x
(4) int **result**
local(adc.c//read_adc(char))
return value
line 50
[3]adc.c//read_adc(char)
return
line 50
x
(5) uint16_t **adc0**
global(w_logg32.c)
line 1682
[4]w_logg32.c//main()
line 1682
x
(6) long **adc_mw_f31**
global(w_logg32.c)
line 1683
(7) const N_DRUCK
w_logg32.c
[5]w_logg32.c//main()
line 1683
4.3.1.2


(9) const V_HPA
global,
w_logg32.c
(10) const N_MX_DRUCK
global
w_logg32.c
4.3.1.2
x
(8) long **hpa_f31**
global(w_logg32.c)
?
[6]w_logg32.c//main()
line 1685
?
(11) win_insert_f31(_,_,**hpa_f31**,_,_)
global(w_logg32.c)
current parameter
[7]w_logg32.c//main()
line 1737
x
(12) long **z_f31**
local(wins.c//win_insert_f31())
formal parameter
line 134
[8] wins.c//win_insert_f31()
line 134
?
(13) f31_str(**z_f31**,_,_)
local(wins.c//win_insert_f31())
current parameter
[9]wins.c//win_insert_f31()
line 130
x
(14) long **z_f31**
local(tools.c//f31_str())
formal parameter
line 161
[10] tools.c//f31_str()
line 161
4.3.1.3





4.3.2 Evaluation of the Path of the Measurement Values

The software separation was not realised in the example. There are various paths with unknown or arbitrary source that lead into the measuring path. Though the beginning of the path is isolated, the call of `win_insert_f31()` (see datapath element (11)) makes it possible for any caller to infiltrate data into the measuring path. The whole presentation on the LCD including the virtual windows is not dedicated for software separation.

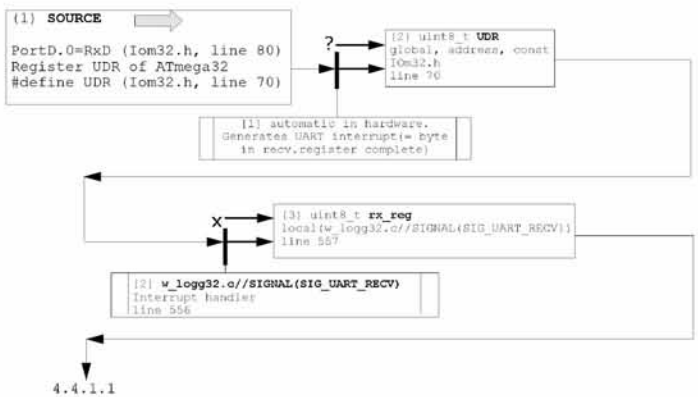
Proposal for correction: The measurement values should reside in a module local variable (like `disp_win[]`) however, in a new module (eg. `disp_mw.c`).

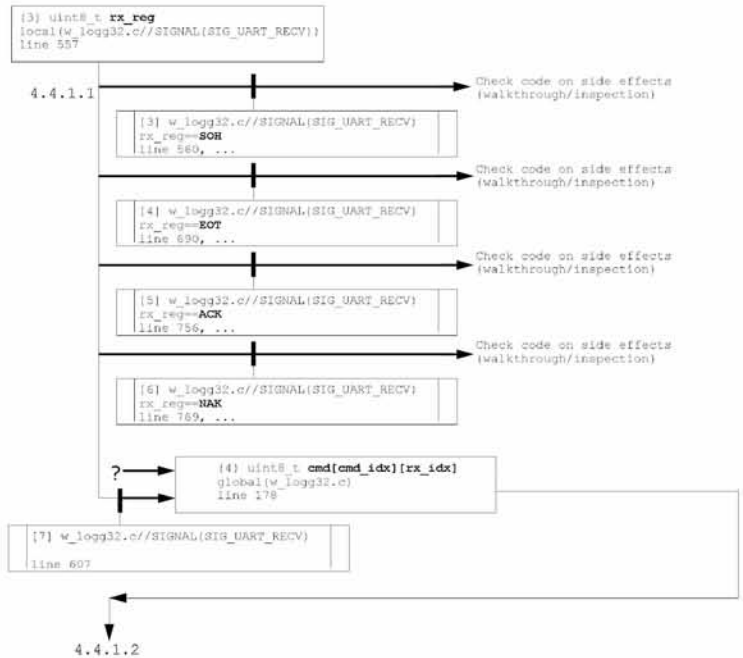
There should be a function for passing the values to callers (eg. `disp_mw_get()`). In `display.c` there should be a new function `disp_mw_lcd()` that calls `disp_mw_get()` and outputs the values in the first line of the LCD display that should be preserved only for these values. The function `disp_mw_lcd()` should be behind `disp_put()` to ensure that values other than the from the measurement don't get to the restricted first line.

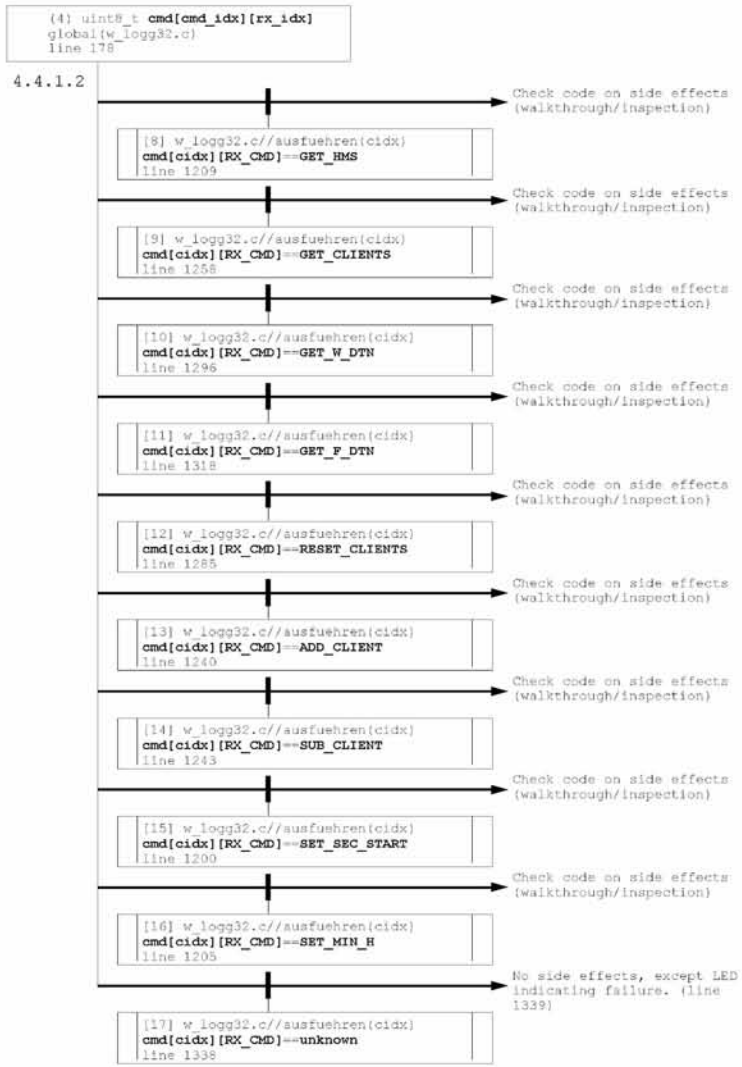
4.4 Datapath Diagramme of the Input Path via the serial Interface

Another task besides analysis of the measuring path is the examination of the software barrier of open hardware interfaces of the device (protective interfaces). This will be demonstrated in the following section. Again the datapath is derived from the source code first. Subsequently it is analysed.

4.4.1 Detailed Presentation of the Input Command Path







4.4.2 Evaluation of the Input Command Path

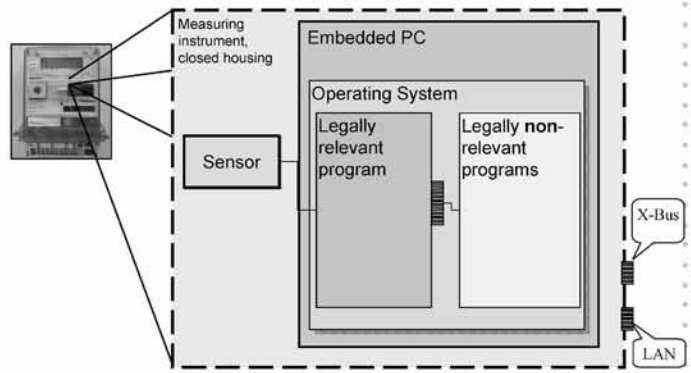
The software barrier is implemented correctly. Neither by the lower levels of protocol control nor by the higher level for transferring commands and data the device can be influenced inadmissibly. The interpretation of commands is always invariant and does not depend on previous states of the communication. There cannot be “undocumented” hidden combinations of commands.

Workshop on Software Controlled Measuring Instruments
3-6 August 2010
Bangkok, Thailand

Validation Tutorium: Secure Linux Configuration

Ulrich Grottker
PTB, Germany

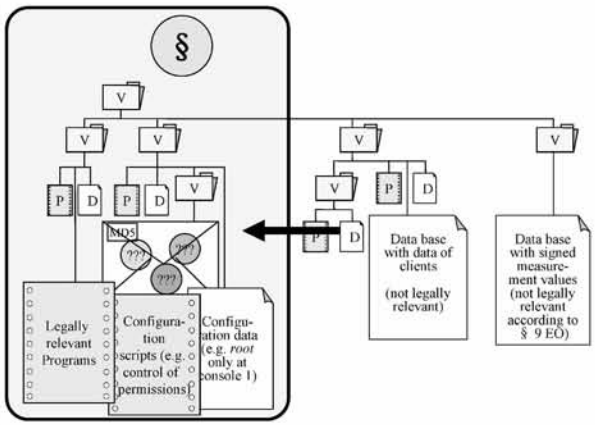
Examples (5.2.4): Weighing instruments, fuel dispensers, future (?) Smart Meters, Taximeters, …



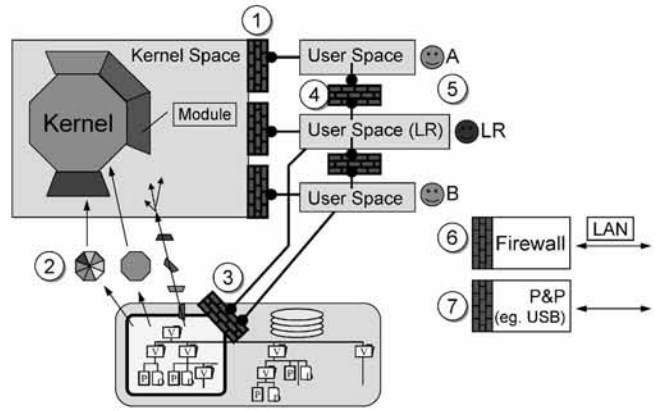
- Motivation for securing OS
- Technical Background
- Practical Demonstration

- Programmers of measuring instruments have detected the advantages: GUI, TCP/IP stack, plug&play etc. —— all ready to use
- Security of operating systems (OS) is an ubiquitous issue: Common Criteria (CC); ISO/IEC 15408 —— Certificates EAL4+for
  - Microsoft Windows (2000, XP, Vista, 7)
  - Linux (Red Hat 5.0)
  - **Precondition:** very thorough configuration eg.
    —— Windows XP Security Guide, Microsoft
    —— Guide to the Secure Configuration of Red Hat Enterprise Linux 5, NSA
- Existing guides not directly applicable to measuring instruments
  - PTB: Checklist based on various guides and internet sources (for desktops and servers)
  - One main source: NSA Guide (basis for EAL4+ certification)
- Parties involved underestimate the impact on LM goals (eg. D31) and/or fear the complexity and costs!

Securing the File System



Protection of a Linux system

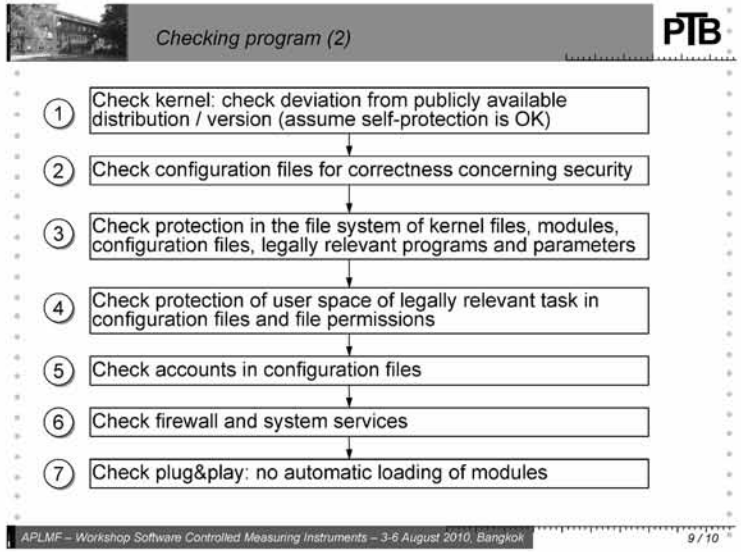


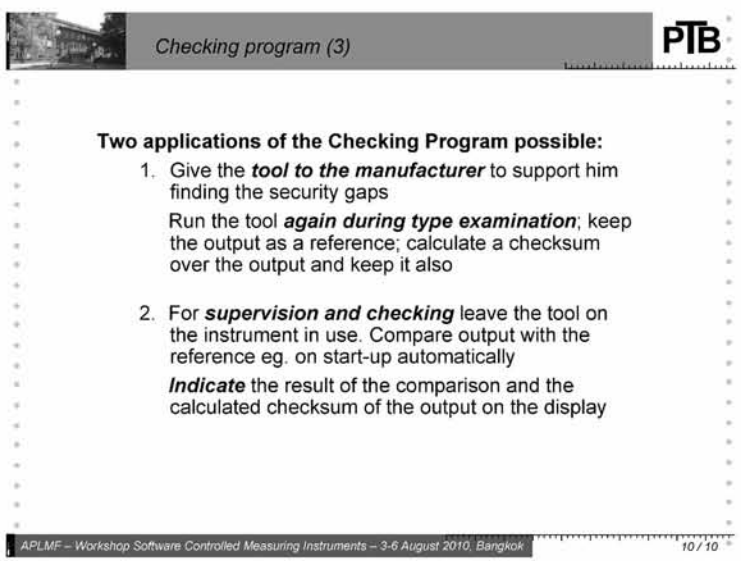
Checking program (1)

- A lot of settings necessary: error-prone and time-consuming
- ***Write programs / skripts*** for this procedure (available ones are not appropriate for measuring instruments)

Checking program (2)

1. Check kernel: check deviation from publicly available distribution / version (assume self-protection is OK)
2. Check configuration files for correctness concerning security
3. Check protection in the file system of kernel files, modules, configuration files, legally relevant programs and parameters
4. Check protection of user space of legally relevant task in configuration files and file permissions
5. Check accounts in configuration files
6. Check firewall and system services
7. Check plug&play: no automatic loading of modules





Development of Software Examination Conforming to the latest OIML R76 in Japan

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1. Introduction

In December of 2007 the latest OIML R76−1"Non-automatic weighing instruments Part 1: Metrological and technical requirements —Tests" was published in the OIML web site (we call the version OIML R76−1:2006). The recommendation includes new features with regard to tests for non-automatic weighing instruments: it includes not only module tests, but also software examination. In this report, we concentrate on software examination. In particular we explain our experience about software examination of NAWIs in Japan.

2. Overview of software examination of OIML R76−1:2006

While OIML R76−1:2006 is 144 pages long, its software related part is about seven pages long: it is T.2.8 "Software", 4.1.2.4 "Securing of components and pre-set controls", 5.5 "Additional requirements for software-controlled electronic devices" and Annex G "Additional examination and tests for software-controlled digital devices and instruments".

It classifies software controlled NAWIs into two categories: devices with embedded software (5.5.1, G.1, for short we call the category "embedded" type) or, personal computers and other devices with programmable or loadable software (5.5.2, G.2, for short we call the category "PC" type). Moreover, if a NAWI has a data storage device, then the software for the device has to be examined (5.5.3, G.3). Furthermore, "PC type" NAWIs are classified into software with closed shell (G.2.2.1) or operating system and/or program(s) accessible for the user (G.2.2.2).

The judgment whether or not a NAWI is "embedded" or "PC" is based on the manufacturer's description and declaration: if the NAWI is used in a fixed hardware and software environment and cannot be modified or uploaded via any interface or by other means after securing and/or verification, then it is "embedded", and otherwise, "PC".

The software examination for "embedded" type is simpler than that of "PC" type: in the case we just check the securing methods and software identification based on the machine and documents for it. There are a lot of things to be done for the software examination for "PC" type: in addition to documentation checks about

parameter protection, software interface, and software identification, if the NAWI is classified into "software with closed shell", then a declaration of the completeness of the set of commands must be required and if it is classified into "OS and/or program(s) accessible for the user", then the check for the checksum generation method from the machine code and the "destruction test" for the machine code must be done (see G2.2.2 of OIML R 76:2006).

3. Software examination based on OIML R 76-1:2006 in Japan

From April in 2009, National Metrology Institute of Japan (for short, NMIJ) started software examination of NAWIs. The software examination is carried out as part of module test for indicators of NAWIs. Before the start of the software examination, we prepared the following documents:

(a) An internal test manual: it describes concrete test procedures based on OIML R 76-1:2006

(b) A documentation form for manufacturers: we prepared this form as Q&A style.

Since the start, we have received a few applications: among them there were both "embedded" and "PC" NAWIs. Although during their test procedures, manufactures and we did trial and error, they all passed our software examination.

4. Conclusion

In this report, we briefly overviewed the software examination based on OIML R 76-1 and its practice in Japan. Japan participates in OIML MAA (mutual acceptance arrangement) of OIML R 76. Therefore we concerns international harmonization of tests and type approval of NAWIs. We hope that the workshop is a good opportunity for discussing this subject.

AIST

Development of Software Examination Conforming to the latest OIML R76 in Japan

National Metrology Institute of Japan
Satoshi Matsuoka

AIST

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 Taxi meters in Japan

AIST

Weighing Instruments

- The old days

Mechanically Controlled

- Today

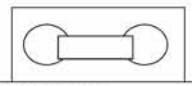
Controlled by Computer

AIST

Operational point of view of Weighing Instruments

Weight	Unit Price	Price	Tare	Zero
125 g	132 円	165 円	0g	●

Beef | Pork | Lamb | Print



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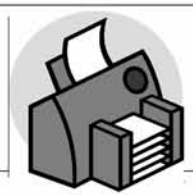
Operational point of view of Weighing Instruments

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

Beef | Pork | Lamb | Print



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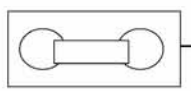
Computer Controlled Weighing Instruments (traditional type)



Load Cell

A/D converter

Embedded Software on ROM

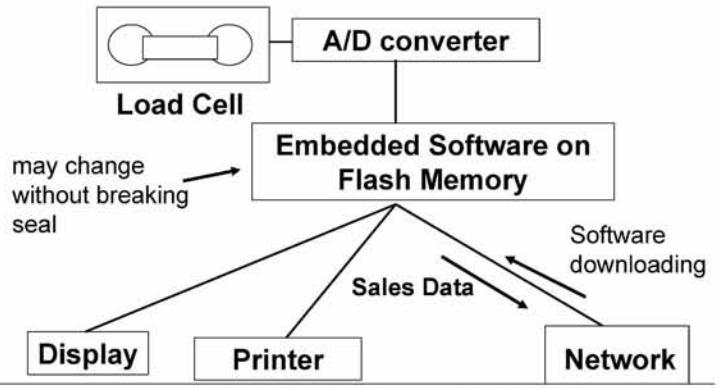
cannot change without breaking seal

Display

Printer

AIST

Computer Controlled Weighing Instruments (recently appeared)



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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

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Legal Metrology

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

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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

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 Taxi meters in Japan

Software Identification

(OIML D31) Sequence of readable characters (e.g. version number, checksum) that is inextricably linked to 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 exception (with reasonable reasons) it is ok to use a sticker (or plate) to show software identification

Legally Relevant

(OIML D31)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.

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

- (OIML D31) Securing 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:

- Hardware method (e.g. using wire) is ok for software protection.
- Software method for software protection is under discussion.
- In Europe, password protection is not allowed, but audit trail (discussed next) is ok.
- In Japan, password protection is allowed. Audit trail is also ok.

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) Software in measuring instruments/electronic devices/sub-assemblies 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 realize software separation and software interface

Software Interface

(OIML D31) Consists of program code and a dedicated data domain; it receives, filters, or transmits data between *software modules* (not necessarily legally relevant).

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

AIST

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 Taxi meters in Japan

AIST

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

AIST

The Main Points of 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

AIST

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)

AIST

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 theOS 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)

AIST

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 no user access G.2.2.2)
- Protection of the device specific parameters (checksum and audit trail)
- Documentation for software interface
- Indication of software identification

AIST

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

AIST

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

AIST

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

AIST

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

AIST

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

AIST

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 Taxi meters in Japan

AIST

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
- Basically Japanese translation of OIML R76-1:2006

AIST

Japanese Industrial Standards (JIS) B7611－2 (2009)

- Published in March last year
- Basically corresponds to OIML R76–1
- 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

AIST

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

AIST

What we have done in Japan (software)

- Japanese translation of the software part of OIML R76-1 (difficult)
  - ——Traditional examiners of measuring instruments do not have knowledge of software so much
  - ——Software experts do not know legal metrology system. In addition, several requirements are 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

AIST

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(a), 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違う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）、監査証跡

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(a), 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施していますか?

AIST

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

AIST

Our Results

- We received three submissions from two companies
- One is “PC” type
- The others are “Embedded” type
- Each examination took a half day

AIST

The plan of the talk

1. Motivation for Software Examination
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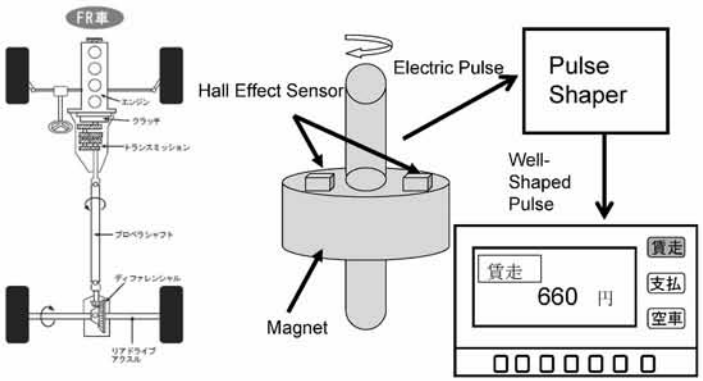
5. Software Examination of Taxi meters in Japan

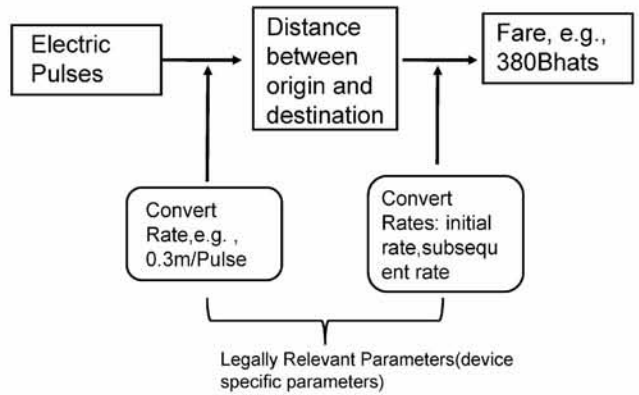
AIST

Principle of Taxi Meters



AIST

Principle of Taxi Meters(Cont.)



AIST

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 covert rates (we call these tariff parameters) need not be re-verified (since 2005).
- But we started software examination for tariff parameters from 2005.

AIST

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)

AIST

Software Examination for Taxi Meters in Japan(Cont.)

- Since 2005, we have done software examination for 15 types from 7 manufactures.
- All types passed.
- But there were several trial and errors: mainly modifications of documents

JSMI

Requirements of Software controlled instruments in China

JiangSu Institute of Metrology
Bangkok Thailand 2010.08

Huang songtao

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Summary

- Introduction of JSMI
- Requirements of software from OIML
- Requirements of software in China
- Requirements of JJF 1182—2007
  《Guide for software testing of measuring instruments》
- 1 example

Introduction of JSMI

- Founded in 1956, Nanjing (provincial capital of Jiangsu)
- 1 national center (National Quality Inspection Center for Electricity Meters)
- 5 provincial test centers
- Main tasks
- Staff: 300(estimated), 30 seniors ,100 engineers,
- Labs: 9000 m^2, 2000 m^2 constant temperature
  - New examine base in being built, larger and modern

OIML D31

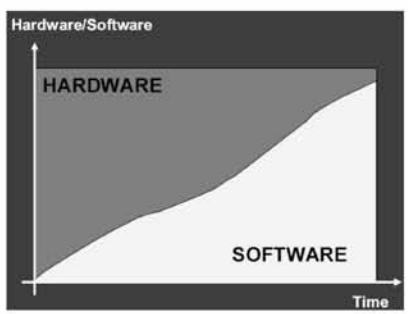
- Background
- D31 General requirements for software controlled measuring instruments

Background

- Development of Measuring Instruments
  - Mechanical → Electronic → Software controlled
  - D1 → D11 → D31

Background (continued)

- No metrology, No modern Science.
- No software, No modern measuring instruments.



technologies

- Micro-electronic
  - Chip ,ADC …
- IT
  - Universal Computer, encryption algorithm, audit trail…
- Network
  - Internet, protocol, interface…

D31

- Primary Aim
  - to provide OIML Technical Committees and Subcommittees with guidance , for
  - establishing appropriate requirements for software related functionalities , in
  - measuring instruments covered by OIML Recommendations.

Note:

- This Document does not cover all the technical requirements specific to software controlled measuring instruments
- software controlled devices are always electronic, it is also necessary to consider OIML D11 *General requirements for electronic measuring instruments*

Situations in China

- Metrology control covers all common areas
- Beginning of testing for software controlled instruments
- Habit of using popular instruments
  - forget to get invoice or receipt after deal,
  - no printer assembled in price-computing weighing instruments at vegetable market

Principles of software requirements in china

- OIML Documents and Recommendations combine to situations of China
  - More stronger requirements necessary when consideration of people's daily lives or sale directly to public or national interest
- Securing measures provide evidence
  - Non-resetting counter
  - Audit trail
  - Integrity of information

(continued)

- Software identification
  - Inextricably linked to the software
  - Can be checked in using
- Data storage
  - All measured data
  - Operation for modifying parameters
  - Update of software

JJF1182-2007

- What is JJF
  - JJF is a standard system of technology specification on Metrology in China
  - Comprehensive, Foundational Metrological requirements and technology management requirements couldn't be contained in regulation of metrology verification (JJG)
  - Similar to DIN (Deutsch Industrial standard)

JJF1182(continued)

- Reference
  - D-SW (draft of D31)
  - WELMEC 7.1(*Informative Document* Development of Software Requirements)
  - WELMEC 7.2(Software Guide *Measuring Instruments Directive 2004/22/EC*)
- Consideration of situations in China

JJF1182（continued）

- First metrology specification for software controlled measuring instruments
- Guide for
  development (manufactures)/
  verification (NB)/
  management (Government) of software
- Guide for drafting requirements for specific measuring instruments (NAWI/R76)

JJF1182(continued)

- Software testing is a series actions of procedure—— analysis of test requirement, design of test plan, compose of test cases, executing of test
- Most important step——development
- Now——validation and verification
- Later——all procedure of lifecycle of the software

JJF1182（continued）

- The key point
  - Prevent fraud use of instrument, especially the instruments used for trade or sale directly to the public
  - Keep the conformance of software between market and type approved

JJF1182（continued）

- Type approval for software controlled instruments
- Conformance of metrology characters
- Securing measures
  - Software solutions
  - Hardware solutions
  - Combination of software and hardware solutions

Hardware secure solution

- In a sense, hardware is more important than software secure measures
- Hardware design:
  - CPU or main chip burned with software code couldn't be removed randomly unless remain an obvious mark
  - Prohibit modifying parameters, update software without opening shell or breaking sealing
  - How to protect the data area and code area of the CPU
  - How to protect the data stored for long-term time ?

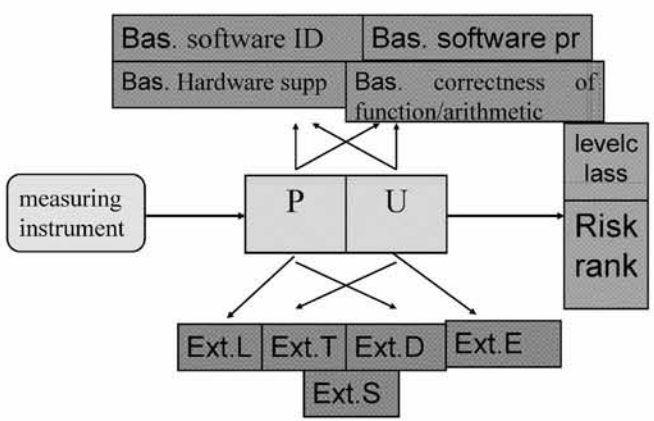
Software solution

- CRC16/32 checksum
- Misuse protect
- Encryption
- Software separate

Combination solution

- Legal chip
  - Custom-made chip with functions of monitoring, comparing, storing…
  - private encryption arithmetic
  - Legal control

JJF1182—2007 structure



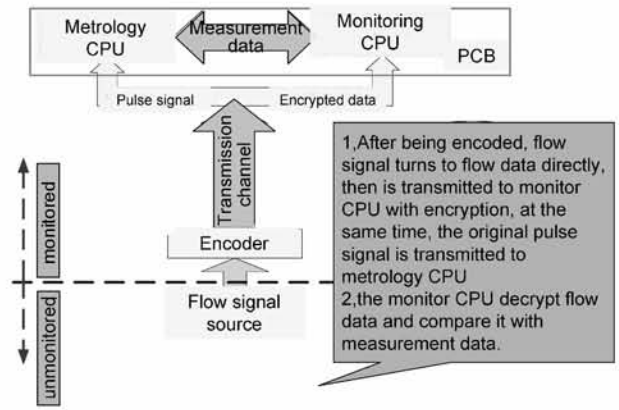
Fraud use of fuel dispensers

- background
  - Autos come into Chinese families more and more
  - complains to insufficient of fuel from private car hosts more and more
  - Couldn't validate indication
  - Recompose for standard and regulation

Solution for fuel dispenser

- Combined solution
- Most complex fuel dispenser system in the world(13 CPUs)
- Characters of fraud use
  - Falsify software program, modify transmission channel or pulse signal source
  - Falsify parameters by back-ground PC
  - Modify pulse signal source by remote control

Design of system



Effect of new system

- Since 2007, less report on fuel insufficient gasoline station in city
- Revenue raised
- JJG 443—2006

  《Verification Regulation of Fuel ispensers》

Thank your attention

- Questions?

Security Control on Measuring Instruments Using Software for Type Evaluation and Type Approval

Directorate of Metrology
Ministry of Trade

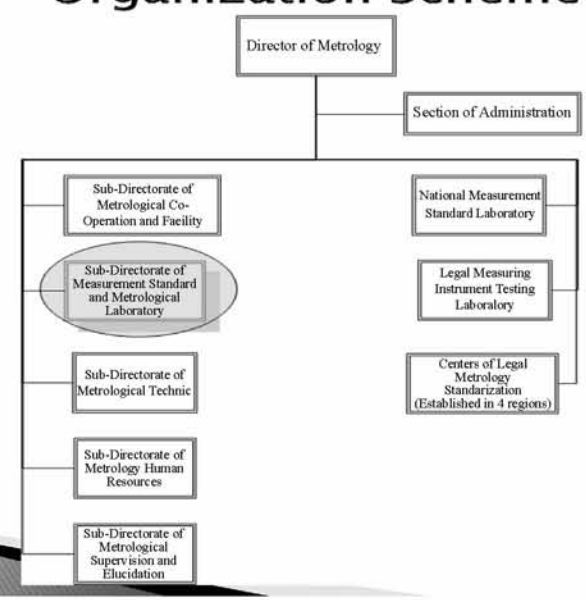
Self Introduction

Name: Dhani Kartika
E-mail:kartikadhani@yahoo.com
Position: Sub-Directorate of Measurement Standard and Metrology Laboratory, Directorate of Metrology, Ministry of Trade
Task: To prepare the regulation and policy concerning the measurement standard of legal metrology

Outline

- Metrological control system
- Electronic Measuring Instrument
- Case of fruid measuring instrument
- Security control using software

Organization Scheme



Legal Metrology System in Indonesia

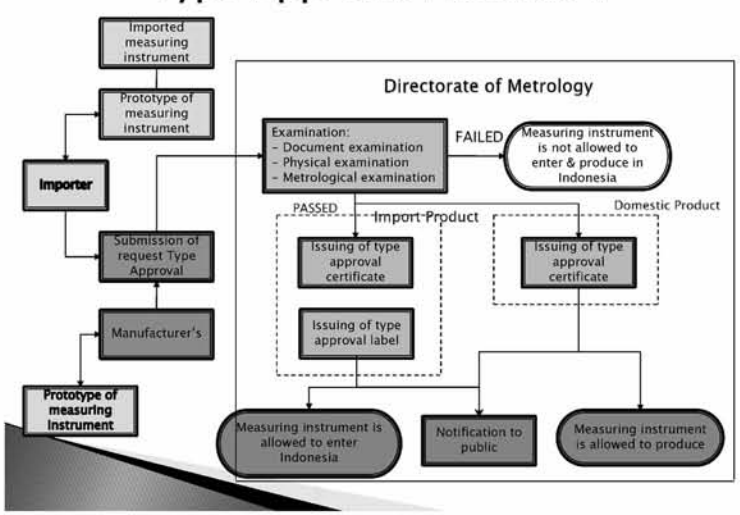
- In general, legal metrology system in Indonesia consists of legal control of measuring instruments, legal control of pre-packaged goods, and metrological supervision.
- Type approval is one of a metrological control system for provide legal assurance for any measuring instrument meet technical. requirements especially national regulations
- Directorate of Metrology is a public institution under Ministry of Trade, having responsibility to manage legal metrology activities, especially related with trade in Indonesia.

Supervision Pre-market

Legal Metrology

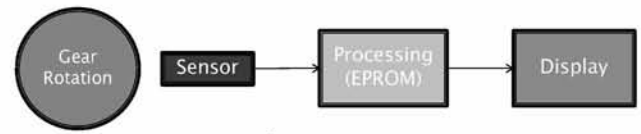
1. Prototype of measuring instruments;
2. Determination of characteristics:
   a) Document examination
   b) Testing (ISO/IEC 17025)
3. Review (evaluation);
4. Decision of type approval;
5. Marking;
6. Initial verification to each measuring instruments.

Type Approval Procedure

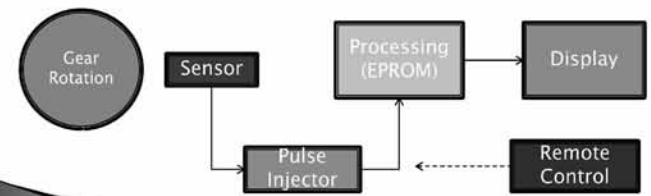


- Nowadays, many measuring instruments use electronic devices and some use software as their main function or system
- Some software has a weakness for any modification that can be influenced its accurateness. For example: Taxi meters and fuel dispensers

Measuring system of taxi meter

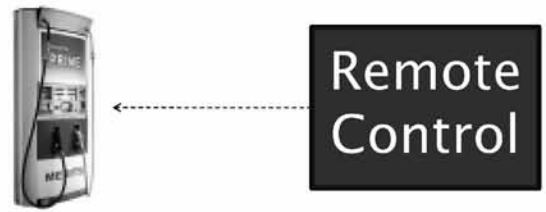


Normal taxi meter process



Manipulation taxi meter

Fuel Dispenser



Prevent the fraud

- Software testing procedure included in the type evaluation or examination process
- Protect the software program by using an encryption method

Problems

- Metrology supervision is not optimal yet
- Technical requirements for software controller not available yet
- Lack of facility and personnel to carry out a software testing in the type evaluation for the measuring instrument

Thank You

CENAM

Software verification of fuel dispensers: The Mexican Case

Workshop on Software Controlled Measuring Instrument

August 3-6, 2010 - Bangkok, Thailand

Maximiliano Benavides
CENAM - Mexico

CENAM

Outline

- Background
- Prototype and model approval
- Fuel dispensers verification
- Learned Lessons
- Next Steps
- Conclusions and recommendations
- End

Context

- Experience of technicians at the National Center of Metrology in Mexico
- Specifically related to hardware and software verification
  - Electronic Dispensary Module of the fuel dispenser
  - 12 trademarks in the Mexican Market
- Based on the Mexican Official Norm specifications (NOM-005-SCFI-2005)

Law and regulations

- Metrology and Normalization Law, 10th article
  - The approval for measure instruments and standards are subject under the Mexican official norm and apply for:
    - Those that act as a base of a commercial trade or
    - Those to determine the price of a service
  - Either, if they are manufactured in the national territory or abroad
  - Previous to their commercialization, they should obtain the product certification and model approval of the Economy Secretariat

Law and regulations

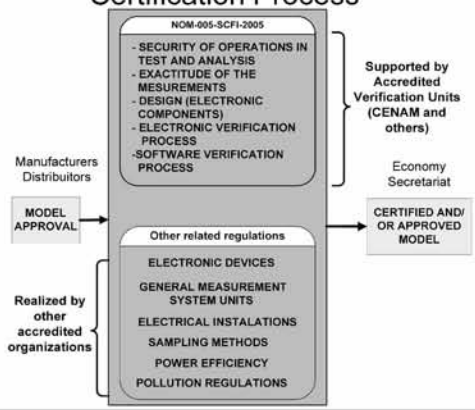
- Standard's Mexican Official specifications NOM-005-SCFI-2005
  - Specification of test methods and verification for instruments or systems of measurement for gasoline and other liquid fuels

Law and regulations

- Policies and procedures for conformity evaluation and for certification and verification of products, subject to the Mexican official norms responsibility of the Economy Secretariat
  - Annex 3 general criteria to obtain the NOM certification (applies for grouping of models)

Outline

Certification Process



Current requirements

- Certification of products under the official proceeding (SE-04-005)
- Model or prototype approval for measurement instruments and standards under the official proceeding (SE-04-002)
- Agreement to include the following additions of trustworthiness to as a part request (technical annex of the agreement between manufacturers and authorities):
  - NOM-005-SCFI-2005 fulfillment
  - Non mobile electronic devices (use of serial port communications)
  - 128 bits MD5 software authentication
  - Embedded event log for audit trail

Current requirements

- From the NOM-005-SCFI-2005 norm:
  - The model or prototype approval for the electronic components should be determined by means of:
    - information provided by the manufacturer (design)
    - checking directly the electronic components
      - Of the dispenser
      - Of the remote control system
    - To fulfill the specifications and nomenclature used by the manufacturer

Current requirements

- From the NOM-005-SCFI-2005 norm (continue…).
  - The verification is focused on:
    - Electronic cards
      - Control
      - Preset
      - Communication
      - External access to the electronic module
    - A physical and visual inspection (required for each component)

Current requirements

- From the NOM-005-SCFI-2005 norm (continue…).
  - The electronic circuit card must include the following identities:
    - Brand (name, letter, hologram or logo identification of the brand)
    - Origin ("Made in México", "Made in USA", ...)
    - Card number (corresponding to the identification and function of this device)
    - Version or revision number
    - Production or modification year
    - There must be a document that validates the change, substitution or repair if the information presented does not match
    - Software Identification
    - Design and connection diagrams

Outline

Hardware verification

- Identification of the prototype or model to evaluate
- Brand registration, model, serial number, load position, prices of the product, conversion factor, total of volume and amount of the sale.
- Electrical and communication verification at the harness wired, as declared by the manufacturer
- Revision of the pulse generator (transducer) based in the information declared by the manufactures

Software verification

- Control program of the electronic circuit:
  - Identify the electronic circuits components
  - Verify if in any component of the control program can be updated
  - Identify how the contained program was authenticated
    - ASCII —— American Standard Code for Information Interchange coded
    - HEX—— hexadecimal coded
    - BIN—— binary coded
- Download the source code version that operates the dispenser

Software verification (continue…)

- Checksum to confirm the binary sum as established in norm (NOM-005-SCFI-2005)
- Each manufacturer should present the procedure that demonstrate how to verify, the intervention or manipulation of the dispenser

Outline

Learned lessons

- There still the need to include the software validation for embedded and **fuel inventory control software**, to guarantee the fulfillment of the regulations.
- The relationship between the **stakeholders** (authorities, manufacturers, technicians…) has to be narrowed in the normalization process, in order to facilitate the periodical verification's tasks.

Outline

Next steps

- Currently efforts and regulations are limited to the physical metrology matter: **assurance of the measurement of volume**, however, actions had been anticipated to regulate on chemical metrology matters, in the dispensers of liquid fuels: **verification of the octane content in gasoline.**
- The additions of trustworthiness will be included in the corresponding regulation. This are:
  - The use of non mobile electronic devices.
  - Cryptographic reduction at 128 bits MD5.
  - Embedded event log for audit trail.

Next steps (continue…)

- The current fiscal dispositions about the inventories control of fuel, will also be part of the regulation.
- The validation of the software that operates the dispensers, besides the current software authentication will be included in the regulation.
- Aspects and characteristics of robustness in electric harness and measurement systems, will be included in the regulation.

Outline

Conclusions and recommendations

- Hardware and software authentication regulations for fuel dispensers, must include the participation of experienced technicians and foresee, the infrastructure to carry out in a systemic way the verification tasks.
- Without validation of the software, its verification is subordinated to the manufacturer's technological level.

Conclusions and recommendations (continue…)

- The dependencies of the manufacturer must be controlled in order to have the verification of hardware and software assured.

Thank you for your attention

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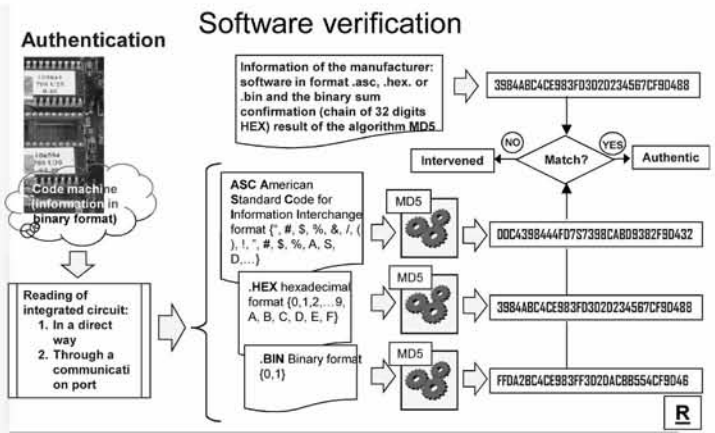
Technological Support Division
CENAM - Mexico

Software verification



Current requirements

- The information provided by the manufacturer, which will include but it won't be limited to:
  - Brand
  - Model
  - Ways of identify
    - The family models .
    - The serial numbers.
  - Manuals
    - Installation.
    - Service.
    - Operation.
    - Configuration.
  - Connection diagrams for the electronic system
  - The way of identify each one of the cards
  - Description of the functions that they carry out

R

Law and regulations

- Ways of grouping model prototype families
  - The models of the product are considered the same family, provided they fulfill the following conditions:
    - Same Brand
    - Same materials used in their construction
    - Same operation principle
    - Same kind of display device
    - Same resolution

Law and regulations

- Ways of grouping model prototype families (continues…).
  - For electric or electronic instruments:
    - Same kind of computers or controllers
    - To have the same electric or electronic circuit, according to the model
    - Same power consumption
    - Identical power supply

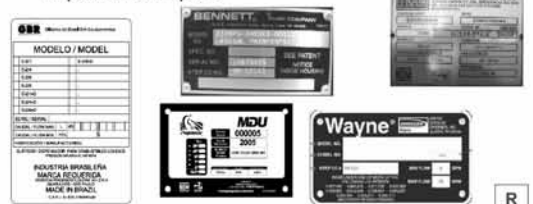
R

Current requirements

- Ways of identify the family models and serial numbers.
  - Identified through an id plate, fixed to the dispenser.
    - Brand
    - Family
    - Model and the serial number
  - Id information should be verified in the operation, configuration or programming manuals.

Current requirements

- Ways of identify the family models and serial numbers (continues…).
  - Id plates examples:



R

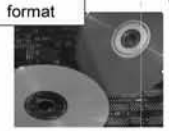
Current requirements

- Manuals are:
  - Provided directly by the manufacturers
  - Base of the authentication works for hardware and software.
  - Reference point for verifications.
    - Operation
    - Configuration

Current requirements

- Manual's presentation

Electronic format



- ✓ Easy handling
- ✓ Up to date
- ✓ Reduced time for verification

Hard copied

- Bigger time for verification
- Slow to bring up to date

R

Current requirements

- Connection charts and how to identify the electronic cards
  - The current regulation doesn't indicate how should it be shown
    - It is presented in different ways
    - Depends exclusively on manufacturer's way of documentation
    - Some of them are presented as follow:

Current requirements

- Computer application with technology WEB .html format

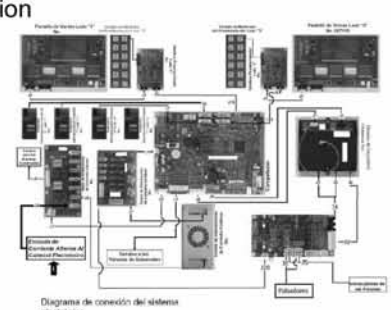
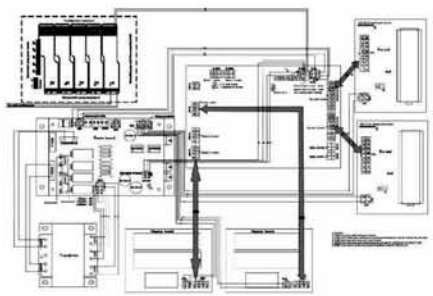


Diagrama de conexión del sistema electrónico

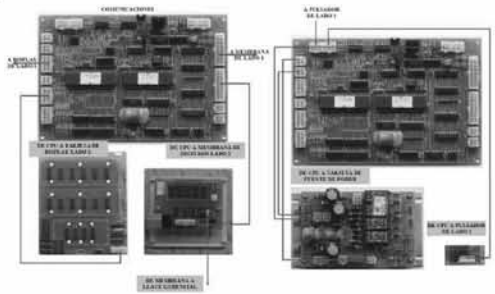
Current requirements

- CAD (Computer Aided Design) file



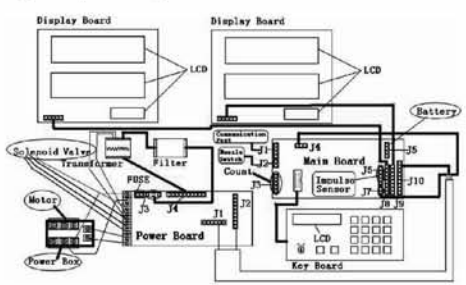
Current requirements

- Photographic file



Current requirements

- Design using simple diagram



Current requirements

- Other formats
  - Windows media video (*.wmv) format
  - Charts in worksheets
  - Charts in word processors

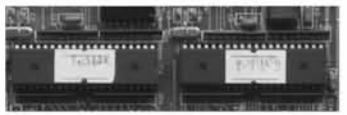
R

Software verification

- Identification of programmable components, and control of Software versions.
  - Most of the systems include programmable logical devices.
    - Microprocessors.
    - Microcontrollers.
    - Chip memories.
  - The authentication include.
    - Identification of these components.
    - The procedure that allows the control of software version.

Software verification

- Identification of programmable components, and control of Software versions (continues…).
  - The id tag in each electronic integrated circuit is an indispensable requirement.



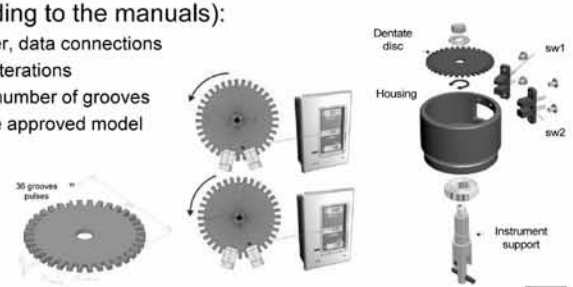
Labels elaborated by hand with pen

Labels elaborated by a printer

R

Hardware verification

- The physical state of the transducer must have (according to the manuals):
  - Power, data connections
  - No alterations
  - The number of grooves of the approved model



R

Context

- Trademarks of fuel dispensers in the Mexican market.

Brand	Country	Mexican Brands
BENNETT	USA	DIGIKRÖNE
DHPUMP	USA	PEGASUS
GILBARCO	USA	SOFTEL
HONGYANG	CHINA	SUPRAMAX
DRESSER WAYNE/ TOKHEIM	USA	TEAM
LANFENG	CHINA	
GBR	BRAZIL	

R

Type Approval Function in New Zealand

Supporting Consumers and Businesses transacting with confidence

Presented By
Srinivas Reddy Bobbala
Measurement and Product Safety Service
Ministry of Consumer Affairs
NEW ZEALAND

August 2010

Ministry of Economic Development
Manatū Ōhanga

Outline of Presentation

- Legal Metrology in New Zealand
- MAPSS——Type Approvals Function
- Type Approvals Function-Where to from now on

Ministry of Economic Development
Manatū Ōhanga

Legal Metrology in New Zealand

- Introduction
- Legal Metrology —— Economic Importance
- MAPSS Organisational structure
- Weights and Measures Act 1987

Ministry of Economic Development
Manatū Ōhanga

Legal Metrology in New Zealand

Introduction

- Measurement and Legal Metrology are cornerstones of global trade and consumer protection
- Metrology (AKA 2nd) has a documented history dating back to the Shang dynasty in China (1766-1050 BC)
- In New Zealand, the roots of metrology can be seen to date back well before European settlement. Concept of measurement was a central part of Māori life (Elsdon Best. (1918) "Maori system of measurement").
- Māori skill and understanding of measurement is reflected in the accounts given of their trading activities
- Māori were prolific and expert traders dominating coastal trade in the early days of European settlement.

Ministry of Economic Development
Manatū Ōhanga

Legal Metrology in New Zealand

The standards of measurement employed by Māori were derived from measurements of the human body as practical solutions to their **economic** and **social** measurement needs.

Measurement Standards:

- **kōnui** —— defined by the length to the first joint of the thumb – used in measurement of where the umbilical cord of a new born infant was to be severed
- **rauru** ——measuring rod derived from the arm span of a man of person of importance, such as a leading chief, marked on a cord or rod - used in construction of homes and waka
- **Tākoto**—— length of body lying prone plus that of the arm outstretched beyond the head

The value of these standards to Māori society was shown in the great esteem that was associated with the physical possession of each standard

Legal Metrology in New Zealand

Legal Metrology ——Economic Importance

Estimates of NZ exports in 2009

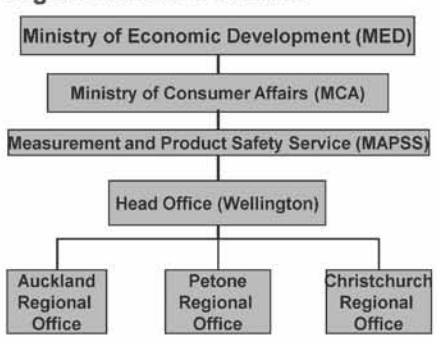
——Dairy Produce: $8.1 billion of diary produce were exported through trade based on measurement (20% of total exports from NZ)

—— Meat, edible meat offal: $ 5.1 billion of produce were exported (12% of total exports from NZ)

(Source: Exports for Overseas Merchandise Trade, Statistics New Zealand)

Legal Metrology in New Zealand

MAPSS – Organisational Structure



MAPSS currently has 16 staff based at Auckland, Petone, Christchurch and Wellington Head Office

Legal Metrology in New Zealand

MAPSS has 3 key responsibilities in the area of consumer protection:

- **Legal Metrology** (Trade Measurement in particular) —— ensuring that goods are exchanged on the basis of recognised, informed and accurate weight and measure, also responsible for Type Approval of measuring instruments used for trade
  - ——providing information for businesses to comply with Weights and Measures act
- **Product Safety** ——upholding consumers' rights to safe products and services

Legal Metrology in New Zealand

- **Fuel Quality Monitoring** — managing the Fuel Quality Monitoring programme to establish the compliance of New Zealand's retail fuel supply with the Engine Fuel Specifications Regulations 2008

Legal Metrology in New Zealand

Weights and Measures Act 1987

- Dates back to 1846
- Based on United Kingdom
- Consistent with the relevant OIML Recommendations

It sets in place:

- system for calibrating and verifying **physical standards** of l mass to ensure **traceability** to National Standards
- **accreditation scheme** where private sector verifiers (Accredited Persons) ensure trade equipment is verified correctly and offer annual voluntary certification

In total we have 48 companies accredited which are made up of 296 individuals, each individual is accredited

- **type approval regime** for conducting pattern approval examinations of new weighing and measuring instruments to ensure they do not facilitate fraud
- provisions aimed at ensuring trader compliance with legislative requirements through effective **enforcement**

Weights and Measures Legislation can be found at: www.legislation.govt.nz

MAPSS ——Type Approval Function

- **Overview**
- **Key International Relationships**
- **Software requirements**

Type Approval Function——Overview

The Weights & Measures Act requires all equipment in use for trade to be of an **APPROVED TYPE**

Different Methods of Type (Pattern) Approval (based on OIML recommendations):

1. Full Approval (currently on hold)
2. Overseas Based Approval
3. In-situ Approvals (modular approach)
4. Variant Approvals (for existing patterns)

Each year MAPSS processes more than 50 Approval Applications on an average.

Total Application processed for the year 2009-2010 is 54
Overseas Based Approvals: 24
In-situ Approvals: 15
Variant Approvals: 15

Type Approval Function —— Key International Relationships

Legal Metrology Organisations

Ministry of Consumer Affairs (MCA) holds New Zealand's full membership of the International Organisation of Legal Metrology (**OIML**) and is a signatory to the declaration of mutual confidence in OIML Mutual Acceptance Arrangements for:

- Non-automatic weighing Instruments (OIML R76) as a Utilising Authority
- Load Cells (OIML R 60) as a Utilising Authority
- Water Meters (OIML R49) as a Utilising Authority

MCA is also a full member of the Asia Pacific Legal Metrology Forum (**APLMF**), which is a specialist regional body reporting to the APEC Sub Committee on Standards and Conformance (SCSC).

OIML

APLMF

Economic Development

Type Approval Function —— Key International Relationships

Mutual Recognition Agreements

In the Trade Measurement area Ministry of Consumer Affairs (MCA) has signed Mutual Recognition Agreements with our counterparts in Australia and the United Kingdom on certain pattern approval functions for weighing and measuring instruments

Australian Government
National Measurement Institute

Ministry of Consumer Affairs
Manatū Kaihokohoko

NWML

Economic Development

Type Approval Function —— Software Requirements

MAPSS currently has limited knowledge in this area and the APLMF training workshop is seen as important to develop our ongoing capability.

OIML

MAPSS always tries to adopt best international practice and in doing so relies on International Documentation such as:

- OIML D31 —— General Requirements for Software Controlled Measuring Instruments
- WELMEC 2.3——Guide for Examining Software (NAWI)
- WELMEC 7.2——Software Guide

OIML – International Organisation of Legal Metrology
WELMEC – European Cooperation in Legal Metrology
NAWI – Non-automatic Weighing Instruments

European Cooperation in Legal Metrology
WELMEC

Economic Development

Type Approval Function —— Software Requirements in Normative Documents on Legal Metrology

- OIML R76 —— Non-automatic Weighing Instruments

5.5 Additional requirements for software-controlled devices

—— software identification and identification easily provided
—— securing measures
—— embedded software
—— hardware requirements
—— legally relevant software adequately protected
—— evidence of intervention
—— data storage devices
—— etc...

Economic Development

Type Approval Function —— Software Requirements in Normative Documents on Legal Metrology

- Other OIML Recommendations —— details about
  - —— electronic sealing
  - —— memory devices
  - —— auxiliary devices interface

Only recent OIML recommendations contain Software Requirements

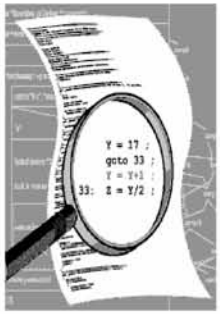
Need for a systematic approach to Software Requirements

Type Approval Function —— Software Examination for Type Approval Testing

All Approval Applications processed are based on Overseas Approvals

Not sure if this is major concerning factor, basic information is recorded and examined during in-situ and for verification purposes during field inspections

- —— software details
- —— easy of identification
- —— conformity assessment of software version
- —— memory devices requirements
- —— software sealing and check even counters



Type Approval Function —— Where from now

Increasing Scope of Legal Metrology in terms of Software Requirements

Under the NZ Weights and Measures Regulations 1999 the Secretary of Commerce must only approve a type or weighing or measuring instrument on satisfaction that it, complies with requirements of the regulations, is suitable for trade and will not facilitate fraud.

Way forward:

- —— Introduction of software requirements
- —— Review of verification test procedures
- —— Training MAPSS officers on software requirements for in-field inspections
- —— Training Accredited Persons carrying certification/verification tests
- —— Develop Business Fact Sheets

Thank you for your attention

Any Questions?

Email:
srinivas.bobbala@mca.govt.nz

APEC/APLMF
Strengthening Legal Metrology Infrastructure for Trade Facilitation:
Workshop on Software Controlled Measuring Instrument

Presenter:
Ms. Edna Egu
Legal Metrologist
National Institute of Standards and Industrial Technology Papua New Guinea

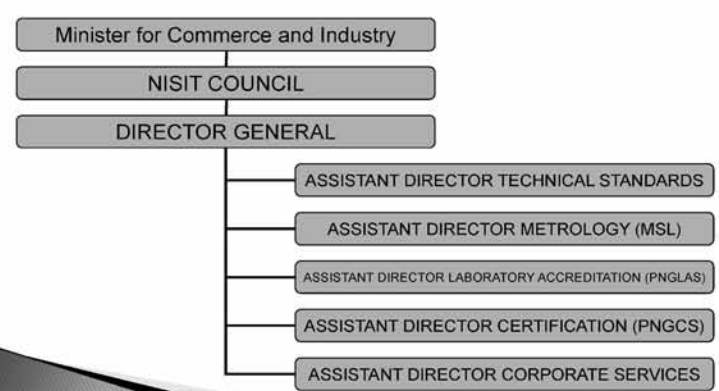
CURRENT SITUATION ON SOFTWARE CONTROLLED MEASURING INSTRUMENT IN PAPUA NEW GUINEA

PNG – NISIT

The National Institute of Standards and Industrial Technology (NISIT) is the National Standards Body responsible for overseeing to all standardization and conformance activities in Papua New Guinea.
Enacted as an Act of Parliament in 1993 – NISIT Act 1993 and commenced operations in 1994.

In summary, NISIT is obligated under NISIT Act-1993 to perform the following:
- Standards Development and Publication
- Standards Information Dissemination and Sales of Standards or Publications
- Calibration, Verification and Testing of Measuring Equipment and Artifacts
- Laboratory Accreditation
- Management System Certification
- Conduct Professional Training programs on standardization and quality assurance.

Standards and Conformance Infrastructure (National Institute of Standards & Industrial Technology)



Measurement Standards Laboratory (MSL)

Metrology is the national body in charge of Legal and Physical Metrology in PNG. Empowered by our mandated functions and responsibilities, the Institute through the Metrology Division is nationally recognized as the custodian of Papua New Guinea National Standards of Measurement

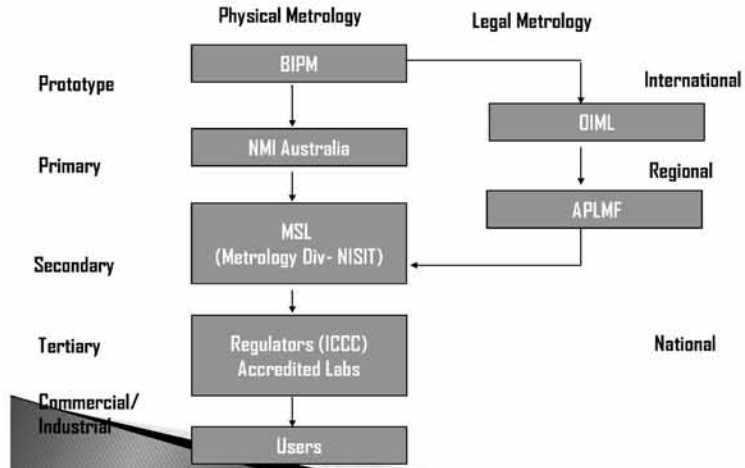
At present, all measurement services offered come under the Metrology (Measurement Standards) Division of the Institute and are facilitated or conducted through the Measurement Standards Laboratory.

The Measurement Standards Laboratory in its current capacity and capability is responsible for the provision of Calibration and Verification Services in Papua New Guinea.

The services offered by MSL to date include:

- Calibration Services
- Verification Services
- Training Services
- Advisory & Consultation Services (Measurement)

Traceability of Measurement



ECONOMY OF PAPUA NEW GUINEA IN BRIEF

- Papua New Guinea Is Rich in Natural resources
  - Such as Oil,gas,minerals and timber etc.
  - Minerals, timber and fish are dominated by foreign investors.
  - 75% of country's population relies primarily on subsistence economy.
  - Manufacturing has grown since 2007.

- PNG Economy is highly dependent on imports for manufactured goods. The small domestic market, relative high wages, and high transport costs are constrains to constraints to industrial development.

- The PNG LNG Project proposes to develop gas fields in the Southern Highlands and Western Province of PNG and transport the gas via pipeline to an LNG facility near Port Moresby for shipment to markets overseas.
  The Project will provide energy for the Asia-Pacific region, jobs and economic benefits for PNG.

SOFTWARE USAGE IN PAPUA NEW GUINEA

- Software has been used in some of our industries for measurement taking.
  - Eg. Insyde Software System – V5.09-06 (Check Weigher)

- Integrity of Programs, data or parameters?
  - Is PNG assured that the programs, data and parameters have not be subjected to any unauthorized or unintended changes while inuse, transfer, storage, repair or maintenance?

- Form of Control used
  - Password

- Current Legislation on Control of Software
  - Not established in PNG yet

WAY FORWARD

- Learn the Techniques to Inspect and Verify Software
- To ensure Free and Open trade over Electronic Instruments
- Prevent Fraud and Protect Consumers Interest
- Develop Legislation on the Control of Software requirements

THE END.

CURRENT SITUATION ON SOFTWARE CONTROLLED MEASURING INSTRUMENT IN PERU

Leonardo De la cruz García

INDECOPI suma esfuerzos al servicio del mercado

WHERE IS PERU?

Peru is located in the central and occidental part of South America

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INFORMATION ABOUT PERU

- **Country (long form) : Republic of Peru**
- **Capital : Lima**
- **Total Area: 1 285 220,00 square kilometers**
- **Population: 29 132 013 (July 2007 est.)**
- **Languages:Spanish (official)**
- **Religions : Roman Catholic 90 %**
- **Government Type Constitutional Republic**
- **Currency : 1 Nuevo Sol (S/.) = 2.80 Dollar (US$)**

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Principal Economic Activities in Peru

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Principal Economic Activities in Peru

- **Industry mining of metals, petroleum, fishing, textiles, clothing, food processing, cement, auto assembly, steel, metal fabrication**
- **Agriculture coffee, cotton, sugarcane, rice, wheat, potatoes, plantains, poultry, beef, dairy products, wool; fish**
- **Natural Resources copper, silver, gold, petroleum, timber, fish, iron coal, phosphate, potash, hydropower**

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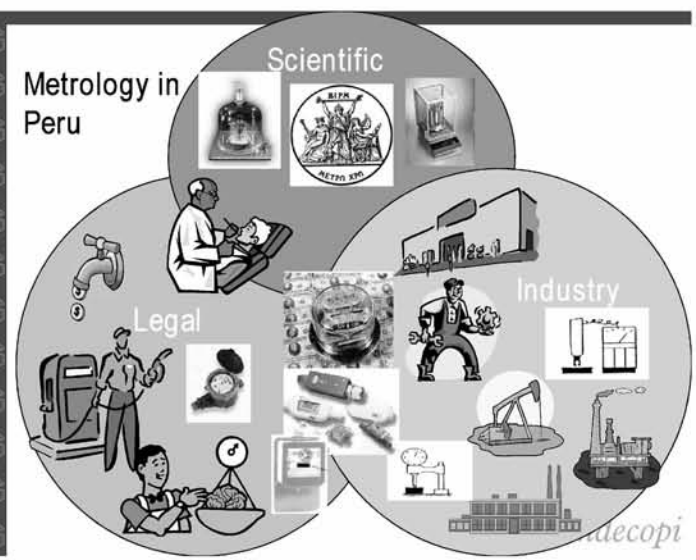
Metrology in Peru



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System of Metrology in Peru

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Peruviam Metrological System

INDECOPI

National Metrology Service

Consumers Protection Commission (CPC)

Metrological Service Companies

Accreditated Calibration Laboratories

Contrasting Companies Authorized

Technical and Commercial Standards Commission

Consumer

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Support of Control in Peru

A.- LEGAL DEVICES

Consumers Protection Law

B.- CONTROL INSTITUTIONS

*** INDECOPI**

—— Consumers Protection Commission (CPC)

—— Technical and Commercial Standards Commission

—— National Metrology Service (NMS)

*** MINISTRY OF HEALTH**

*** MINISTRY OF AGRICULTURE**

*** MINISTRY OF FISHING**

*** MINISTRY OF ENERGY AND MINES**

*** MINISTRY OF TRANSPORT, COMMUNICATION, HOUSING AND CONSTRUCTION**

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Electronic Measuring Instruments use in Peru which are controlled by Software

Electronic Measuring Instruments use in Peru which are controlled by Software

- **Automatic Weighing Instruments.**

*** Automatic gravimetric weighing Instrument**

***Automatic Catchweigher**

***Highway weigh-in-motion System (WIM)**

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Electronic Measuring Instruments use in Peru which are controlled by Software

- **Measuring systems for the continuous and Dynamic measurement of quantities of liquids and Gas**

Water meter

Gas meter

Fuel dispenser

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Electronic Measuring Instruments use in Peru which are controlled by Software

- **Measuring of Energy Systems**

Electricity meter

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Actually Works in Peru

All this measuring instruments are only calibrated in Peru. However, we believe that is important to know how to control the software of those equipments.

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Standards Use to Calibrate

- Automatic gravimetric filling instruments OIML R61
- Continuous totalizing automatic weighing instruments (belt weighers) OIML R50
- Dynamic measuring systems for liquids other than water —— OIML R117
- Standard Specification for Highway Weigh-in-Motion (WIM) - ASTM E1318 - 09

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THANK YOU VERY MUCH

Leonardo De la cruz Garcia

ldelacruz@indecopi.gob.pe

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Current Situation on Software Controlled Measuring Instruments in the Philippines

CTI 46/2009T Strengthening Legal Metrology Infrastructure for Trade Facilitation:
Workshop on Software Controlled Measuring Instrument
3-6 August 2010
Bangkok, Thailand

Sabino Paulo B. Leones, Jr.
National Metrology Laboratory (NML)
Industrial Technology Development Institute (ITDI)
Department of Science and Technology (DOST)
DOST Science Complex, Gen. Santos Avenue
Bicutan, Taguig City, Metro Manila, Philippines

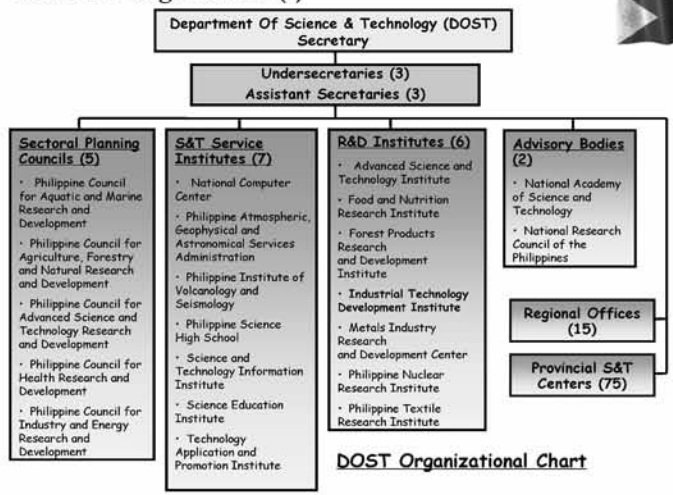
Outline of Presentation

- Self-Introduction
- About our Organization
- Legal Metrology in the Philippines
- Structures of Metrological control Authorities
- Custodian of Philippine National Standards
- Range of measuring instruments subject to Legal Metrology
- Republic Act 9236 (National Metrology Law 2003)
- Software Controlled Measuring Instruments
- Summary

Self Introduction (1)

I am **Sabino Paulo B. Leones, Jr.,** Science Research Specialist II working at the Electrical, Time and Frequency Section of the National Metrology Laboratory (NML) of the Industrial Technology Development Institute (ITDI) an agency of the Department of Science and Technology (DOST) and already more than 16 years in service. My duty is to maintain the primary and working standards of electricity, time and frequency and the calibration of ac and dc voltage and current meters/sources, standard resistors, digital multimeters, frequency meters/sources from the industry.

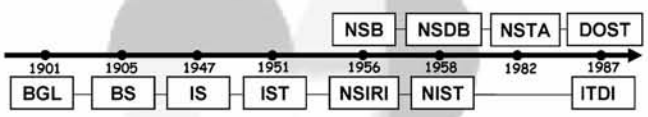
About our Organization (1)



DOST Organizational Chart

Historical Timeline

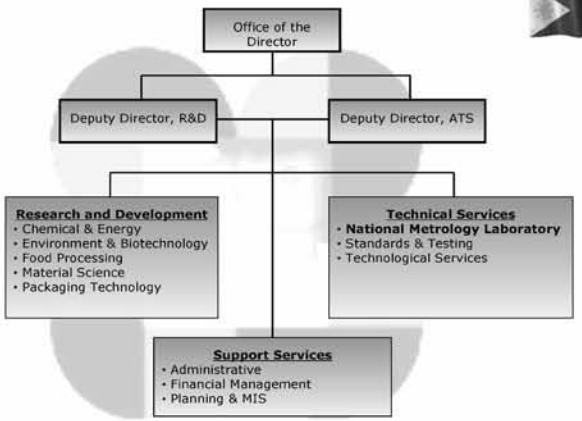
(DOST and ITDI)



BGL – Bureau of Government Laboratories
BS – Bureau of Science
IS – Institute of Science
IST – Institute of Science and Technology
NSIRI – National Scientific and Industrial Research Institute
NIST – National Institute of Science and Technology
ITDI – Industrial Technology Development Institute
NSB – National Science Board
NSDB – National Science Development Board
NSTA – National Science and Technology Authority
DOST – Department Of Science and Technology

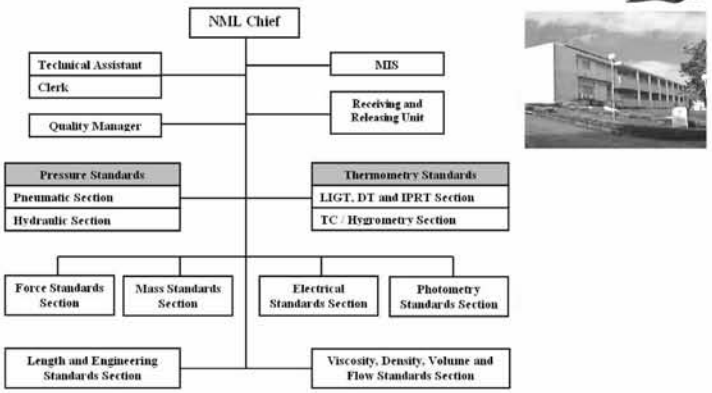
The Industrial Technology Development Institute or ITDI is one of the research and development institutes (RDIs) under the Department of Science and Technology (DOST). By virtue of Executive Order No. 128 dated January 30, 1987, ITDI is mandated to render variety of services to local industries. It is the flagship agency of DOST generating a large pool of technologies while providing technical services to industry.

About our Organization (2)



ITDI Organizational Chart

About our Organization (3)



NML Organizational Chart

About our Organization (4)

INTERNATIONAL LINKAGES

The Philippines through NML-ITDI is a full member of the Asia Pacific Metrology Program (APMP) and Asia Pacific Legal Metrology Forum (APLMF) and an Associate Member of the General Conference On Weights and Measures (CGPM). It is also a signatory to the Global Mutual Recognition Arrangement (MRA) among national metrology institutes.

Legal Metrology in the Philippines (1)

Some laws concerning Legal Metrology

- Republic Act, R.A, 2067, known as the Science Act 1958
- Batas Pambansa Blg. 8, PB Blg. 8 (National Law No. 8)
- Consumer Act of the Philippines, R.A. 7394
- National Internal Revenue Code and Local Tax Code
- Moisture Meter Law
- Republic Act No. 9236 also known as the National Metrology Act of 2003.

Legal requirements for traceability & units of measurement

Under "Batas Pambansa Blg, 8" (National Law No. 8) and Consumer Act of the Philippines, use of the metric system and national standards shall be traceable to the SI. Under the National Internal Revenue Code and the Local Tax Code, standards used in the inspection of weights and measures shall be traceable to the national standards (NML-ITDI).

Range of measuring instruments subject to Legal Metrology

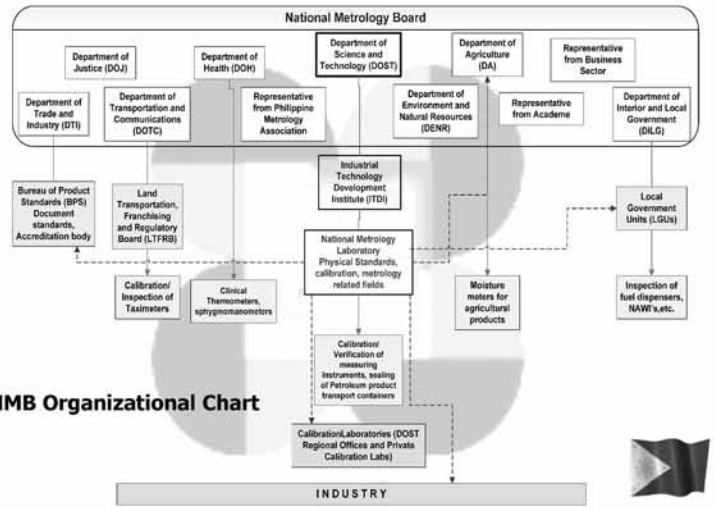
- Under the National Internal Revenue Code and the Local Tax Code, weighing scales, linear measures and volume measures shall be officially sealed before use in any trade or commercial transaction.
- Also under the Consumer Act of the Philippines, all instruments for weights and measures in all consumer and consumer related transactions shall be tested, calibrated and sealed.

The **National Measurement Laboratory of the Philippines (NML)** is the organization responsible for establishing and maintaining national physical standards for basic and derived quantities such as mass, length, temperature, time interval, voltage and resistance. Dissemination of standard values to users at the best uncertainty levels attainable is performed through the calibration and measurement services offered by the Laboratory.

National Metrology Law

Republic Act No. 9236 (National Metrology Act of 2003)

- Establishment of a National Measurement Infrastructure System (NMIS) providing measurement standards (internationally traceable to the SI).
- It shall cover units of measurement, measuring instruments, their application and metrological controls, establishment of a laboratory accreditation system, and a system of appropriate penalties.
- Creation of a National Metrology Board to supervise the NMIS with ITDI serving as the laboratory arm to carry out the technical, calibration and laboratory functions.
- **Meant to harmonize all existing laws, rules, regulations, policies, decrees on all forms of measurements.**



NMB Organizational Chart

Software Controlled Measuring Instruments

- there are still no current legistration regarding the control, inspection and verification on the accuracy and security of the embedded software of electronic measuring instruments.
- readings of some electronic measuring instruments are only checked during the verification process and the imbedded software is not inspected and verified.

Strengthening Legal Metrology Infrastructure for Trade Facilitation:
Workshop on Software Controlled Measuring Instrument

Summary

- The National Metrology Laboratory (NML) of ITDI is the laboratory arm of National Metrology Board.
- Philippine legal metrology is governed by different laws (present).
- The National Metrology Act of 2003 was created to **harmonize** all existing laws, rules, regulations, policies, and decrees on all forms of measurements relative to weights and measures (future).
- No regulations yet on the control, inspection and verification on the accuracy and security of the embedded software of electronic measuring instruments.
- This workshop on Software Controlled Measuring Instruments will help us to learn and practice the latest techniques to inspect and verify software to ensure free and open trade over electronic instruments by the elimination of fraud and protection of consumer interest.

Strengthening Legal Metrology Infrastructure for Trade Facilitation:
Workshop on Software Controlled Measuring Instrument

Thank you very much!!!

Strengthening Legal Metrology Infrastructure for Trade Facilitation: Workshop on Software Controlled Measuring Instruments

Presented by
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Inspector, Weights and Measures Office (WMO)
SPRING Singapore
3 August 2010

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Outline

1. Singapore Weights and Measures Programme
2. Activities of WMO, SPRING Singapore
3. Software in Measuring Instruments in Singapore
4. Next Steps

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The Weights and Measures Programme

- Governed by the Weights and Measures Act & Regulations
  - ——regulates weighing and measuring instruments for trade use and net contents of pre-packaged goods
  - ——penalises suppliers on short weights and measures
- Ensures a uniform and accurate system of weights and measures so that buyers get what they paid for
- Ensures fair trade and correct excise tax computation

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Activities of WMO

Manages Authorised Verifier (AV) Scheme

- Weights and Measures Act and Regulations were amended in Dec 2005, allowing SPRING Singapore to designate AVs.
- AV Scheme took effect from 1 Jan 2006. From 1 Jan 2009, 100% verification work is undertaken by AVs.
- To date, 22 AVs have been designated.
- The AV Scheme increases the pool of verifiers resulting in lower cost and reduced turnaround time for businesses.

Activities of WMO

Registers patterns of new instruments for trade use

- All patterns of new weighing and measuring instruments for trade use have to be tested and certified to meet the applicable OIML Recommendation e.g. Flow Meter to OIML R117.
- This is to ensure that they are designed to be robust and can maintain their accuracy under different climatic and operating conditions.
- To date, over 250 patterns of weighing and measuring instruments have been registered with SPRING Singapore for trade use.

Activities of WMO

The Accuracy Label

- To further boost the confidence of consumers and businesses alike, Accuracy Labels (above) are affixed on all verified weighing and measuring instruments for trade use.
- Contain AV's identification code, eg, "01", "02" and date of verification.
- All 40,000 weighing and measuring instruments for trade use are affixed with the Accuracy Label.

Activities of WMO

Post-market Surveillance and Audit Inspections

- Inspects weighing and measuring instruments for inaccuracies & tampering
- Conducts audit reviews on Authorised Verifiers
- Investigates complaints on short weights & measures

Software in Measuring Instruments in Singapore

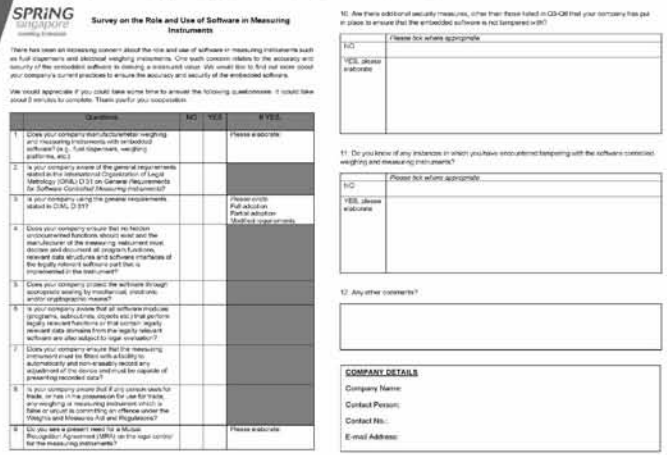
OBJECTIVE

To find out more about the practices of our local companies in ensuring the security and accuracy of the embedded software.

METHODOLOGY

A survey was conducted amongst our 11 relevant Authorised Verifiers or AVs.

Survey Questionnaire



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Survey on the Role and Use of Software in Measuring Instruments

There has been an increasing concern about the role and use of software in measuring instruments such as fuel dispensers and electronic weighing instruments. One such concern relates to the accuracy and security of the embedded software in delivering a measured value. We would like to find out more about your company's current practices to ensure the accuracy and security of the embedded software.

We would appreciate if you could take some time to answer the following questionnaire. It could take about 5 minutes to complete. Thank you for your cooperation.

	Questions	NO	YES	If YES,
1	Does your company manufacture/retail+ weighing and measuring instruments with embedded software? (e.g., fuel dispensers, weighing platforms, etc.)			Please elaborate.
2	Is your company aware of the general requirements stated in the International Organization of Legal Metrology (OIML) D 31 on General Requirements for Software Controlled Measuring Instruments?			
3	Is your company using the general requirements stated in OIML D 31?			Please circle Full adoption Partial adoption Method unascertainable
4	Does your company ensure that no hidden undocumented functions should exist and the manufacturer of the measuring instrument must declare and document all program functions, relevant data structures and software interfaces of the legally relevant software part that is implemented in the instrument?			
5	Does your company protect the software through cryptographic sealing by mechanical, electronic and/or cryptographic means?			
6	Is your company aware that all software modules (programs, subroutines, objects etc.) that perform legally relevant functions or that contain legally relevant data domains from the legally relevant software are also subject to legal metrology?			
7	Does your company ensure that the measuring instrument must be fitted with a facility to automatically and non-erasably record any adjustment of the device and must be capable of preserving recorded data?			
8	Is your company aware that if any person uses for trade, or has in his possession for use for trade, any weighing or measuring instrument which is false or unjust is committing an offence under the Weights and Measures Act and Regulations?			
9	Do you see a present need for a Mutual Recognition Agreement (MRA) on the legal control for the measuring instruments?			Please elaborate.

10. Are there additional security measures, other than those listed in Q9-Q8 that your company has put in place to ensure that the embedded software is not tampered with?

	Please tick where appropriate
NO	
YES, please elaborate	

11. Do you know of any instances in which you have encountered tampering with the software controlled weighing and measuring instruments?

	Please tick where appropriate
NO	
YES, please elaborate	

12. Any other comments?

COMPANY DETAILS

Company Name:

Contact Person:

Contact No.:

E-mail Address:

Survey Findings

- 50% (6) are aware of the of the general requirements stated in OIML D 31 on *General Requirements for Software Controlled Measuring Instruments.*
- 27% (3) use the general requirements stated in OIML D 31. One AV fully adopted the requirements under OIML D 31, while another partially adopted OIML D 31.
- 78% (8) indicated that they take measures to appropriately seal the measuring instruments to prevent tampering.
- 82% (9) are aware that any person that uses for trade, or has in his possession for use for trade, any weighing or measuring instrument which is false or unjust is committing an offence under the Weights and Measures Act and Regulations.

Next Steps

1. Expand the scope of the Authorised Verifiers to include new areas like verification of CNG dispensers, working standards, etc.
2. Develop verification capabilities in emerging areas such as Hydrogen Dispensers
3. Equip WMO Inspectors/Authorised Verifiers with latest updates on relevant OIML Recommendations

Thank You

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Enabling Enterprise

Software Control for the Truck Scale

Network System and Software Security Requirement

Asst. Prof. Dr. Siripun Thongchai

Department of Teacher Training in EE

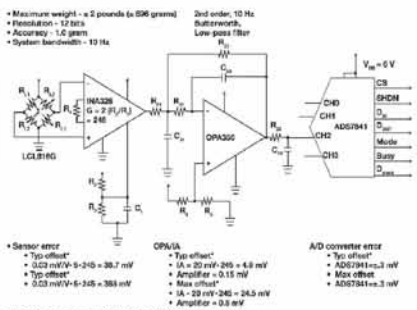
KMUTNB

Outline

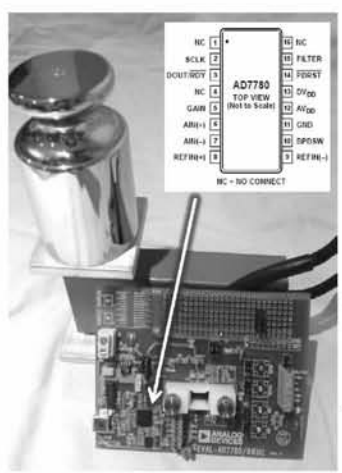
1. Electronic Scales
2. Computer-based Instrumentation
3. Network System
4. Software Control

1) Electronic Scales

Electronic circuits are applied for weigh scales. A/D is also used to interface with digital system.



Weigh Scale System Setup Using the AD7780



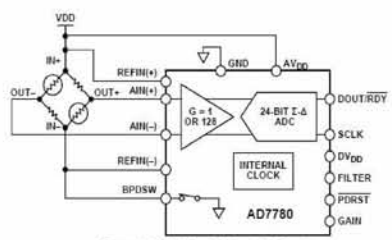
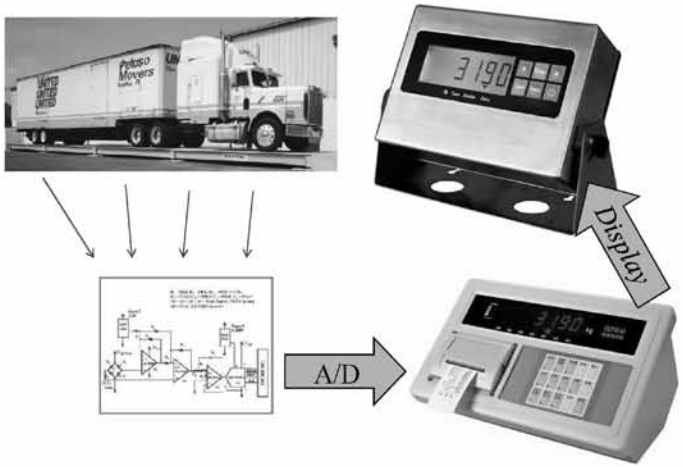


Figure 23. Weigh Scales Using the AD7780

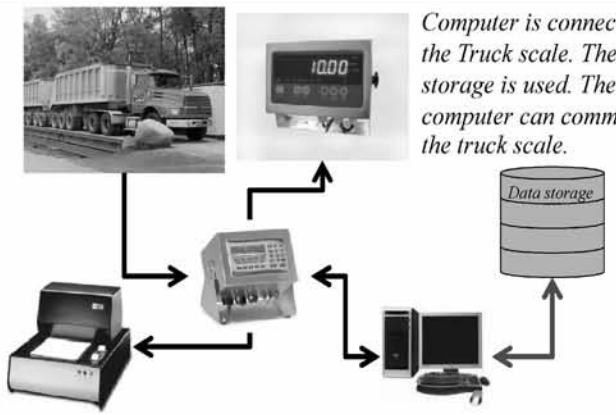
Table 1.

Parameter	Gain = 128		Gain = 1	
Output Data Rate	10 Hz	16.7 Hz	10 Hz	16.7 Hz
RMS Noise	44 nV	65 nV	2.4 µV	2.7 µV
P-P Resolution	17.6	17.1	18.8	18.7
Settling Time	300 ms	120 ms	300 ms	120 ms

Simple Electronic Weighing Platform for the Truck scale

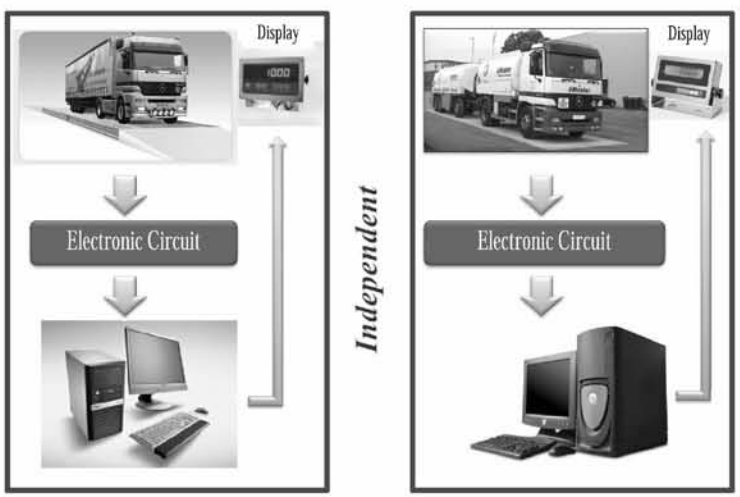


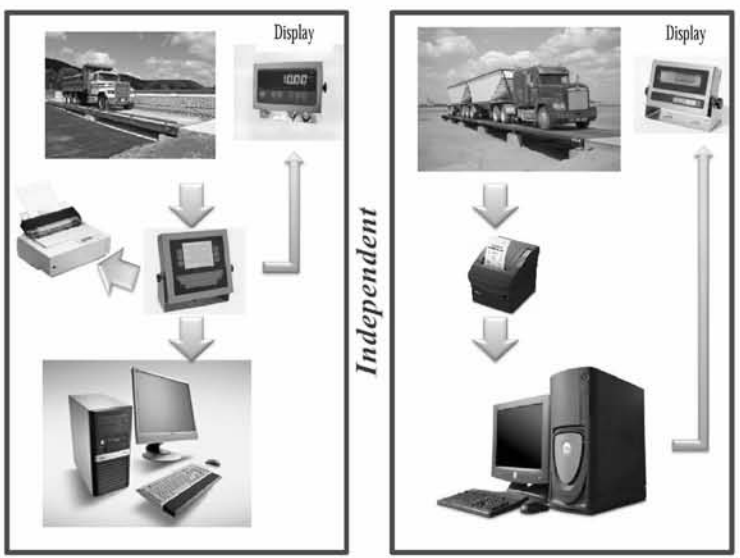
2) Computer-based Instrumentation



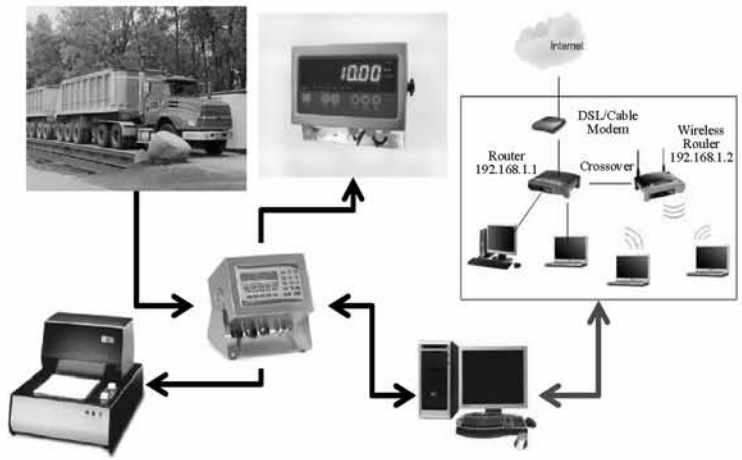
Computer is connected to the Truck scale. The data storage is used. The computer can command the truck scale.

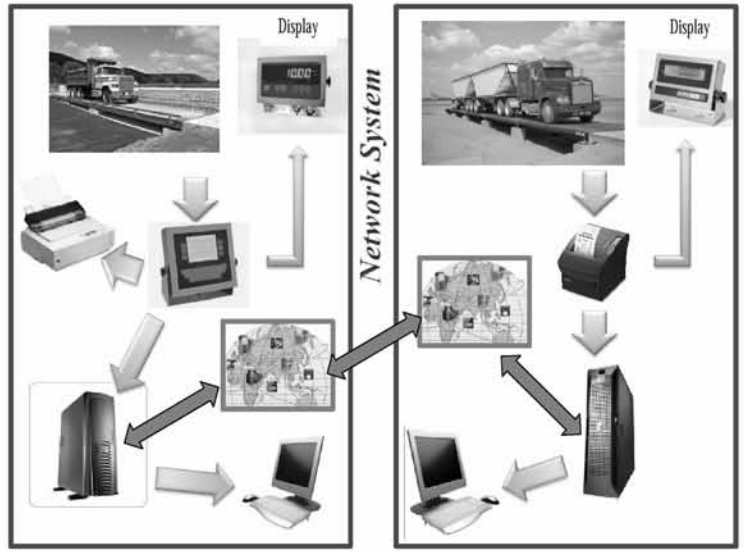
Each system is standalone



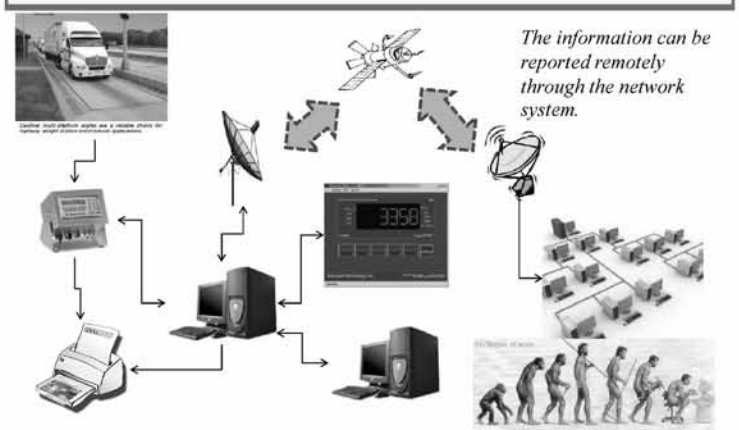


The system connects to the network



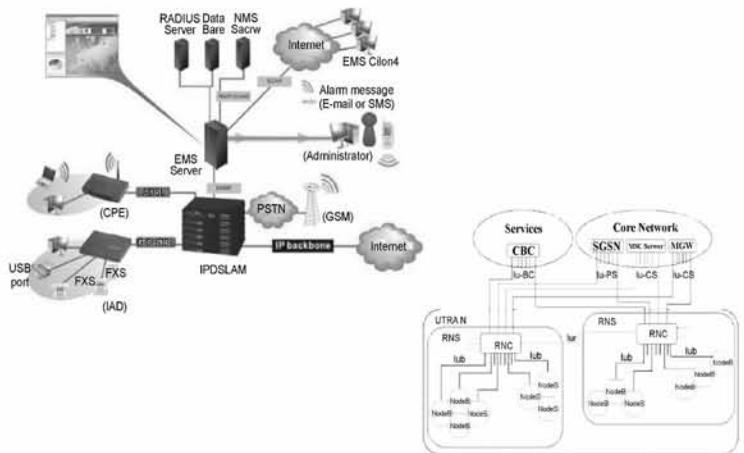


3) Network System

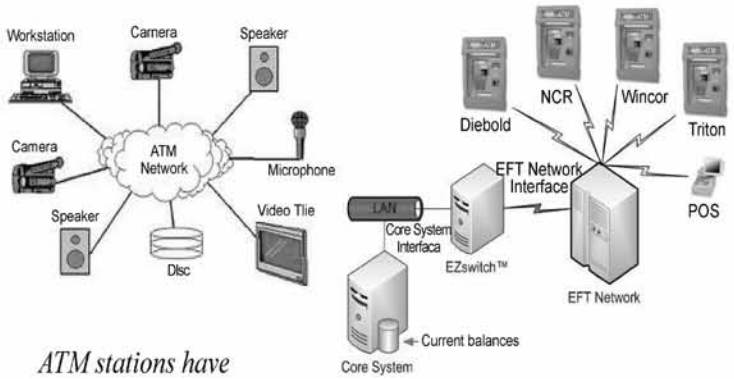


The information can be reported remotely through the network system.

How ATM works!

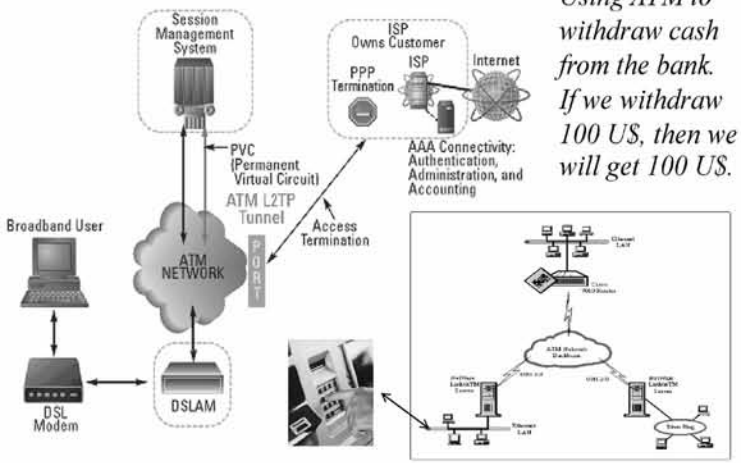


How ATM works!



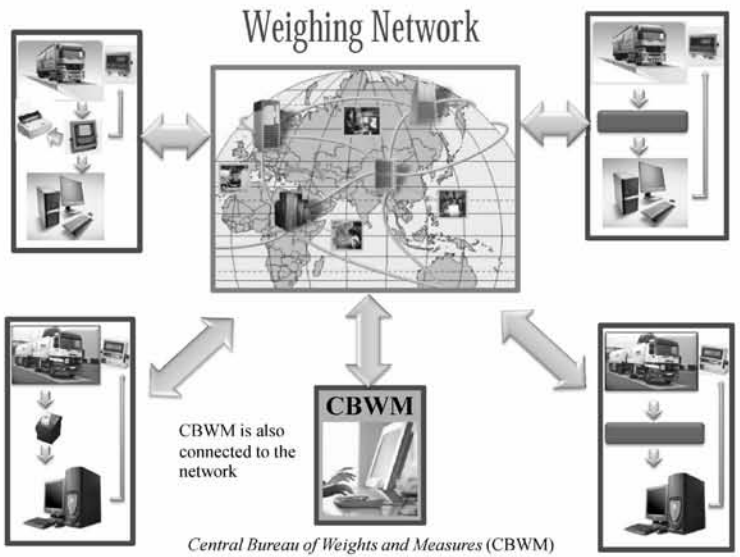
ATM stations have camera, speaker, monitors, and others.

How ATM works!



Using ATM to withdraw cash from the bank. If we withdraw 100 US, then we will get 100 US.

Weighing Network

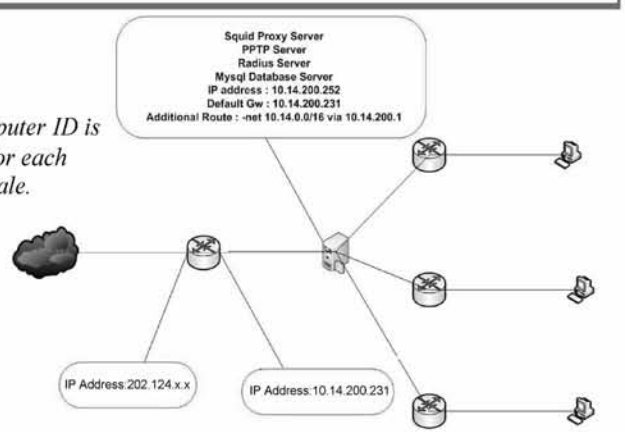


CBWM is also connected to the network

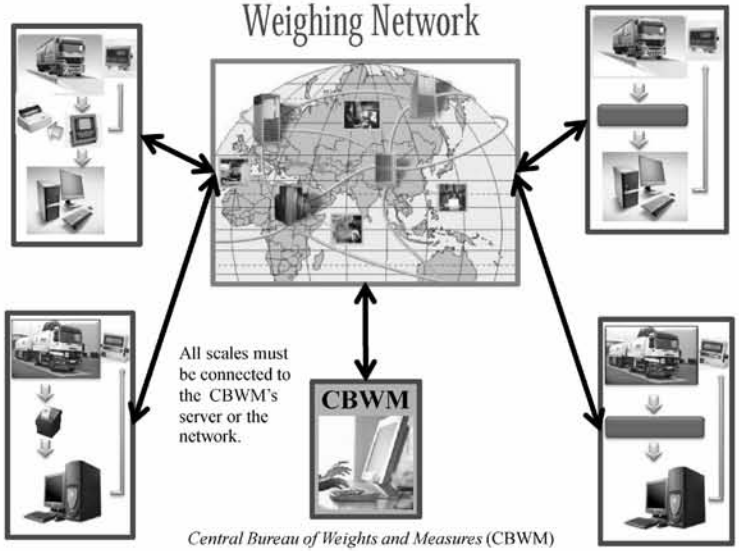
Central Bureau of Weights and Measures (CBWM)

4) Software Control

The computer ID is needed for each weigh scale.



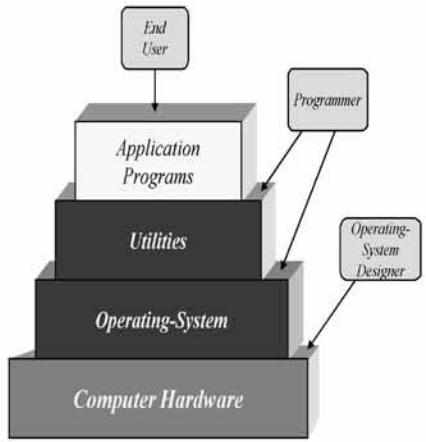
Weighing Network



Central Bureau of Weights and Measures (CBWM)

Security is needed!

- End users should not have the authorization to change the utilities and OS.
- Inspectors have ability to check the working process and the storage data.



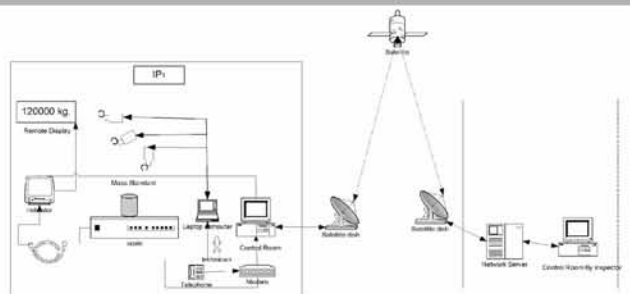
Recoded Information

- The following data will be recorded:
  - —— Times (timestamp) ,
  - —— zero setting times,
  - —— zero setting gains,
  - —— usage values,
  - —— others.
- All measuring instruments are required to install the data logger.
- In Principle the following procedures will follow OIML R 76-1.
- The first time calibration is needed for all registered measuring instruments.
- Real usage data need to be saved for the next calibration.

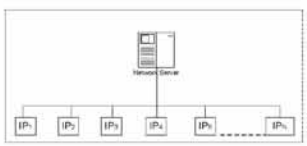
Further Applications

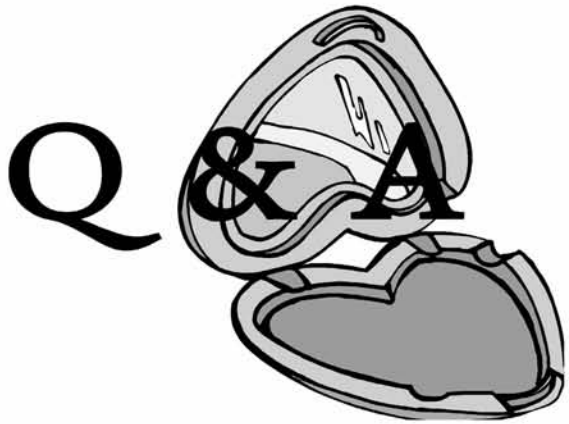
- It can be verified/calibrated by remote control.
- Analyze the Data of weighing form data locker.
- The measuring instruments are classified and separated the ID.
- The identification technique can be designed for identified the measuring instruments.
- Neural network or other self adjusting techniques will be used for gain calculation. (for calibration and verification).

Calibration and Verification



The measuring instruments need to be connected to the network for remote calibration.





Software cheating cases

Problem 1

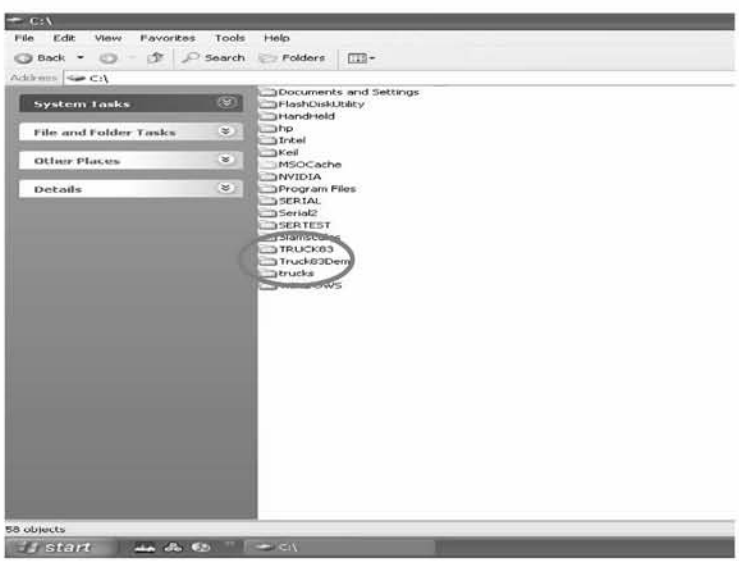
- computer connected to load-measuring device has more than 1 fraudulent weighing-software.

How to notice and check

1. use function“search”in computer to check quantity of software.
2. make sure that software has correct features prescribed in the Ministerial Regulations.

Problem 2

- verify a scale through internet or by telephone with hardware system and software which can convert signal in computer.



How to notice and check

1. Type of transmitting signal which has both of Tx and Rx (RS 232, RS 485, RS 422) is a wrongly type.
2. use signal-port checking device which has only transmitting signal (Tx) and ground wire.

Problem 3

- user states that because of running out of weighing result card, it necessary to write weighing data on paper as evidence sometime.

How to notice and check

1. make sure that user really ran out of weighing result card.
2. make sure that remote display works properly. If external remote display doesn't work properly, user may do fraud easily because weighing data isn't showed.
3. do weighing process again, then compare the latest weighing data to the writing weighing data.

Problem 4

- computer has many external ports, such as DB9 port, USB port, telephone line port, and receiving signal port, which allow user to do fraud easily.

How to notice and check

- make sure that computer connected to only load-measuring device and printer.

Problem 5

- weighing-software can use for inputting weighing data or receiving signal from load-measuring device.

How to notice and check

1. compare weighing data showed by software to weighing data showed by load-measuring device ,and weighing data showed on remote display.
2. try to input weighing data using this software. if this software can input the weighing data, it may assume that weighing-software is fraud.

Problem 6

- weighing-software can modify weighing data in the purpose of modify account data ,or check a stock product.

How to notice and check

- 1. make sure that this software has correct features prescribed in the Ministerial Regulations.
- 2. compare any detailed or source code of this software to find any change from the previous version.

Problem 7

- user states that there are a lot of error in weighing process, so that user need to modify weighing data.

How to notice and check

1. make sure that weighing-software cannot modify any weighing data. if software can modify any weighing data, it may assume that this software is fraud.
2. this software can use for modifying some detail such as truck plate detail.

Problem 8

- modify both of in-out truck weighing data.

How to notice and check

- check whether software can modify both of in-out truck weighing data.

Problem 9

- driver and weighing person accompany to do fraud, such as use previous truck weight exclude total weight, or/and driver weight.

How to notice and check

1. observe the weighing person and the driver behavior.
2. check whether in each weighing time, truck weight are the same. In fact, truck weight at different weighing time are not the same.
3. compare the exactly truck weight to the weighing data on weighing result card.

Problem 10

- One computer are used for two scales.

How to notice and check

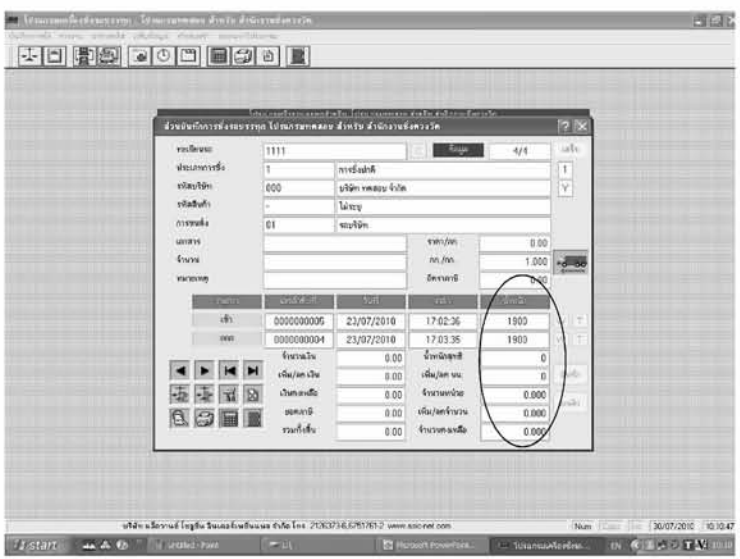
- check whether signal wires from two scales are connected to one computer.

Problem11

- modify any data on weighing result card and data in database.

How to notice and check

- Compare all data on the weighing result card to the data in computer.



Problem 12

- print lack of some detail on weighing result card; lack of contamination such as humidity, garbage, soil etc.

How to notice and check

- compare data on weighing result card to data in database.

Problem 13

- use other computer to print weighing result card by using Microsoft Excel or Microsoft word in order to do fraud.

How to notice and check

1. compare weighing data on weighing result card to weighing data showed on remote display.
2. weighing person weighs and prints weighing result card again, while officers observe this process.
3. make sure that computer doesn't receive any signal from load-measuring device but can print weighing result card.
4. using software which can input or modify weighing data itself.
5. using other software, such as Microsoft Excel or Microsoft word instead of using a certificate weighing software in weighing process.

Problem 14

- print lack of some detail of weighing result card such as lack of weighing person's name or date and time of weighing.

How to notice and check

weighing result card must include all data below

(1) Total weigh (The weight of truck including goods)

(2) Weight of truck

(3) Total weigh exclude contamination, humidity etc.

(4) Weigh of goods

(5) Signature of weighing person

(6) Date, Time and Location of weighing

Problem 15

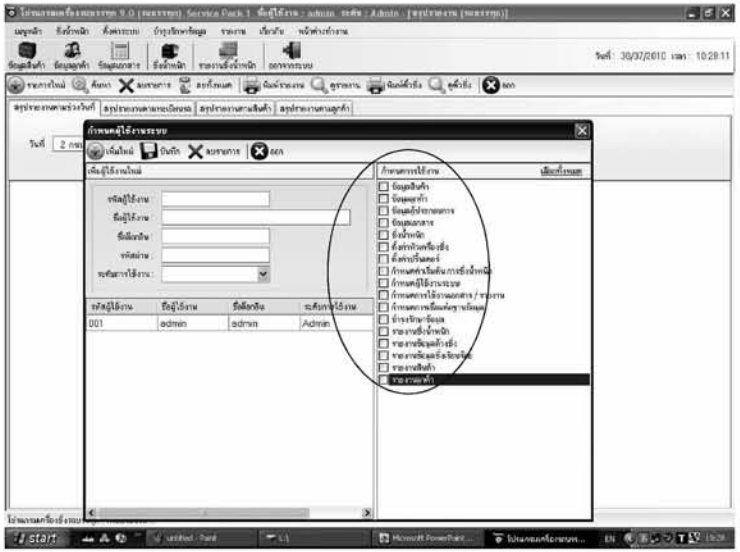
- First weighing-software installed on computer is verified by officers. after officers left, user installs a fraudulent weighing-software on the same computer.

How to notice and check

1. make sure that software installed on computer has correct features prescribed in the Ministerial Regulations.
2. check whether date when software was installed in computer is the same date which showed on certificate sheet. If two dates are not match, it may assume that user installs a fraudulent weighing-software again after the first one.

Problem 16

- weighing-software in computer have log in system to change weighing data.



How to notice and check

- user must log in to allow officers to check this software. If user restarts computer or runs this software again, it may assume that this software can modify weighing data.
- Restarting computer or running software again is the method to avoid officers found the fraudulent weighing-software.

Problem 17

- set different time in computer to make weighing software printed a wrong time weighing result card.

How to notice and check

1. make sure that time printed on the weighing result card is correct weighing time.
2. if officers didn't check carefully, scale owner can used it as evidence in the legal. proceedings, which makes officer difficulty take any action on the scale owner .

Problem 18

- weighing software in computer can use keyboard, such as press“Enter”3 times or press any key, to get weight before truck is parked steady.

How to notice and check

1. check the exactly weight by weighing truck and then press“Enter”1, 2 or 3 times to get weight. If officer still can get weight data while the truck is moving, this software is fraud.
2. try to press other key, especially the key which often in use, on keyboard to check whether it can get the weight.

Problem 19

- Scale owner uses the fraudulent weighing-software. When the officer find that this software in his scale is fraud, he states that the software was certified.

How to notice and check

- compare any detail or source code of this software to find any change from the previous version.

(Refer to :

108 cheating method for Truckscale,No.58—76)

The current situation on software controlled measuring instrument in Viet Nam

Presented by: Bui, Trung Dung & Dang Nhat Kien
DIRECTORATE FOR STANDARD, METROLOGY AND QUALITY (STAMEQ), VIET NAM

STAMEQ

Legislative control on measuring instrument

The measuring instruments apply for compulsory verification are specified measuring instruments used for the following purpose:

+ To measure good and service of quantification in trade and payment;
+ Ensuring safety, protecting people's health and environment;
+ Juridical expertise, using in other public duty activities of the state.

STAMEQ

There are 39 kinds of measuring instruments listed in the list equipment to be compulsory verification.

All types of measuring instruments must be approved pattern before verification.

STAMEQ is the appropriate authority takes the duty to organize a pattern approving.

STAMEQ

——In 2009, 510 pattern instruments was approved by STAMEQ.
—— Almost of approved pattern:
+ Taximeters
+ Fuel dispense
+ Water meter
+ electric power meters
+ electronic weighing scales
—— In 2009, there are approximately over 28 millions measuring instrument to be verified. Growing number of equipment is 10 % in every year.

STAMEQ

The use of measuring instrument have been used controlled software

+ About 28 000 taxi meters
+ Over 40 000 fuel dispensers
+ A half millions electronic power meters
+ About 65 000 electrical weighing instrument

STAMEQ

STAMEQ

Fuel dispenser in Viet Nam

Two main types of the software :

+ The embedded software on the program IC
+ The software installed on the computer system of measuring instruments

Almost of the software are written by the Vietnamese programmer.

The 8951 microcontroller family, AVR, PIC … (one chip) is widely used.

Control on software of measurement instruments is becoming much challenging to us because of some technical problems in the fact.

Fraudulence in measurement activities through using software to drive measuring values is increasingly sophisticated.

The violation in measurement through the software can be:

—— User can be changed the program's parameters,

—— Using wireless devices or keyboard through the software to change measuring results, especially to the fuel dispensers.

Legislative control on software of measuring instrument

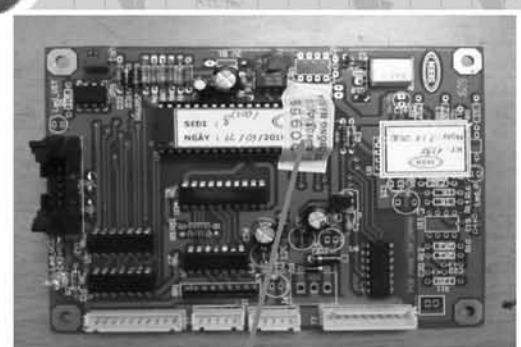
- The manufacturers take responsibility to manage their software of measuring instrument, implementing the technical solution preventing any unauthorized modification or access to the device (example: readjustment, remove program IC or rewrite code software of program IC).
- There are not any juridical management regulation or technical guide for testing or examination software of measuring instrument.

STAMEQ

We promulgated an regulation for pattern approval with requirement that the producers must submit an undertaking responsibility for their software of measuring instrument to the state metrological management authority (Directorate for Standards, Metrology and Quality).

We also conduct to verification bodies that verification officers have to put seals on the main program IC so that the users can not change it themselves.

STAMEQ



Seal on the program IC

STAMEQ

In 2008, we implemented to inspect at 3,890 fuel stations with over 8000 dispensers and found out that 159 fuel dispensers with metrological errors exceeded permitted values.

In fact we are facing some difficulties such as:

- —— Can not readout program code of the software installed on the program IC in order to compare with the source code from manufacture ;
- —— There haven't been any regulation stated that the manufacturers have to supply the software description of the instrument, source codes or the software identification to the managing authority;
- —— Measuring devices use the unregistered software or non copyright software.

.

We can not suggest that these fuel dispensers have cheating software to change the measurement results or not.

Expectation

Because of measuring fraud in Vietnam has been recorded 200 billion VND loss in a year. The management and metrological control for software of measurement devices is necessary. Therefore, Vietnam expressed concerns OIML D31, the related documents and techniques how to inspect and verify software of the measuring instrument.

Thank you for your attention!

and

Best regards!

STAMEQ