



Asia-Pacific
Economic Cooperation



Asia-Pacific
Legal Metrology Forum

Handbook on Electricity Meters

APEC/APLMF Training Courses in Legal Metrology
(CTI 11/2006T)

March 19 - 22, 2007
Beijing, People's Republic of China

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Seminar on Electricity Meters
March 19 – 22, 2007



Photos taken at the seminar in Beijing, PR China

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Foreword

This booklet is one of outcomes of the APEC Seminars and Training Courses in Legal Metrology titled ‘Seminar on Electricity Meters’ which was held on March 19-22, 2007 at the Yu Tang Hotel in Beijing, the People’s Republic of China. This seminar was organized as a follow-up of the past training courses held under the APEC/APLMF project. This seminar was, again, arranged as one of the APEC TILF projects, CTI-11/2006T. The APLMF organized the seminar with the support fund by APEC. The seminar was also supported by (1) General Administration of Quality Supervision, Inspection and Quarantine of the People’s Republic of China (AQSIQ); (2) Japan Electric Meters Inspection Corporation (JEMIC); (3) National Metrology Institute of Japan (NMIJ) and (4) Measurement Canada, Government of Canada. Having this result, I would like to extend my sincere gratitude to all the staffs of AQSIQ; three speakers from JEMIC; one speaker from Fuji Electric Systems Co. Ltd; one speaker from National Institute of Metrology, PR China; and the Working Group on Utility Meters of APLMF chaired by Measurement Canada. Also, special thanks should be extended to the APEC Secretariat for their great contributions.

We have conducted the surveys among the APEC member economies concerning seminar and training programs in legal metrology to find their needs as well as possible resources available in the region. The survey shows that there is still a strong need for repeating training courses on electricity meters which is one of the most essential categories of instruments in legal metrology and is also closely connected to our daily life. In addition, according to the worldwide globalization of international trade, the compliance to international recommendations related to electricity meters, which are represented by the ISO/IEC 62053 series and the OIML Recommendation R46, is becoming an important issue for the APEC and APLMF member economies.

The target of this training course was the experts in charge of type approval/verification and government officials involved in managing the regulations and legislations on electricity meters in the APEC/APLMF member economies. The main objective was to learn in depth and to develop common understanding about the regulations and standards based on the ISO and OIML recommendations. Thus the target would meet the APEC objective to harmonize metrology legislation within the OIML framework. The contents of the seminar were focused on understanding the basic principle and construction of electricity meters, gaining information on the international and national recommendations related to the electricity meters, and learning of actual test procedures.

In this view, this seminar achieved its objectives and gave a sure basis of confidence in

managing the legal metrology on electricity meters to the APEC/APLMF member economies. I would like to say that this is certainly a valuable step to fruitful activities in legal metrology related to electricity meters in the Asia-Pacific region.

I am really pleased to have this outcome from the seminar and again deeply appreciate the APEC Secretariat's generosity in contributing to the development in legal metrology among the APLMF member economies.

May 15, 2007

A handwritten signature in black ink, appearing to read "Akira Ooiwa". The signature is fluid and cursive, with the first name "Akira" being more prominent than the last name "Ooiwa".

Dr. Akira Ooiwa
APLMF President

**Report on the APEC/APLMF
Seminars and Training Courses in Legal Metrology:
Seminar on Electricity Meters**

As we all are aware, electrical energy is one of the most important commodities necessary to maintain industries in every country. Its demand is drastically increasing in the Asia-Pacific region as the revitalization of the world economy expands, and therefore, the consumers of both industrial and household energy are now very much interested in how to reduce the cost of energy consumption. In addition, the world concern for environmental conservation has been rising as indicated in the agreement on the Kyoto Protocol and the proposal of the EU Action Plan for Energy Efficiency. The world is now standing up for energy saving. Thus, the accurate measurement of energy consumption using electricity meters becomes essential to monitor the effect of energy saving. In order to respond to the world concern, it is significant for the APEC/APLMF member economies to share common recognitions on basic concepts of electricity meters concerning legal metrology.

With the purpose to reflect the world needs, the APLMF Working Group (WG) on Utility Meters chaired by Measurement Canada and APLMF Secretariat have been organizing training courses on electricity meters in the last few years under the APEC TILF projects. This year, APLMF changed its style of instruction to a seminar in order to give emphasis on the information exchange among economies. The Seminar on Electricity Meters was held at the Yu Yang Hotel in Beijing from March 19 to 22, 2007 and attended by 30 individuals from 12 economies: Cambodia, Chile, PR China, Indonesia, DPR Korea, Malaysia, Mongolia, Papua New Guinea, Peru, Chinese Taipei, Thailand, and Viet Nam. It was supported by four organizations: General Administrations of Quality Supervision, Inspection and Quarantine of the People's Republic of China (AQSIQ); National Metrology Institute of Japan (NMIJ); Japan Electric Meters Inspection Corporation (JEMIC); and Measurement Canada, Government Canada. Among them, AQSIQ was the host of the seminar.

Five speakers from Japan and PR China contributed speeches. From Japan, Mr. Masaru Nagashima of Fuji Electric Systems Co., Ltd. presented a speech titled "Development of Electricity Meters" from the perspective of electricity meters manufacturers. He provided valuable information such as progress of electricity meters and tariff system in Japan. Other three speakers from JEMIC: Mr. Takao Oki, Mr. Masatoshi Tetsuka and Mr. Kazunori Hata, covered a broad area about legal metrology on electricity meters. They explained in detail about the legislations, regulations, type approval, verification, verification standard, IEC standards, and current situation on the revision of the OIML Recommendation. Because this recommendation might be modified in the process of reviewing, we all need to keep eyes on the movement in OIML/IEC. From PR China, Dr. Lu Zuliang of National Institute of

Metrology (NIM) gave a speech titled “Overview of the Primary Standards in Legal Metrology of Electricity Energy in PR China.” He described the production of electricity meters, the national standards of electricity energy, and its maintenance and control. The speech indicated the significant role of NIM in maintaining the traceability in PR China.

On the other hand, the audience also provided information about the current status and perspectives on electricity meters used in their economies on Day 1 where all the participants learned the situations going on in other economies. Provided with such information and the lectures, the audience had an opportunity on Day 4 to throw questions, exchange additional information with other participated economies, and discuss the outcome of the seminar. Plus, they made a summary report based on the information gathered on the current situation on metrological control implemented in each participated economy. The participants are involved in verification, type approval and metrological control in their economies; therefore, they were all very enthusiastic about exchanging questions and answers even on coffee break. Some of them threw very specific questions, and the speakers wished to have more time to discuss on those questions with them. We hope the outcome of this discussion will help the APEC/APLMF economies improve their legal metrology system.

The seminar also provided a technical tour at the State Power Banner Electric Equipment Co. Ltd. (a manufacturer of electricity meters) and the National Institute of Metrology (NIM). At the manufacturer, we had an opportunity to observe the whole process of manufacturing and adjustment/inspection of electricity meters. There, the assembling procedure was being done efficiently, and its prompt process was remarkable. At NIM, We had a hands-on practice of an error test of electricity meters. A staff of NIM explained about wiring, settings of the power supply, adjustment of the pulse detector and the whole process through testing, and then some of the participants had a chance to experience an error test. We believe that this hands-on exercise at a real testing laboratory will give precise vision of the procedures to the participants, and this will help their economies review and improve their verification operation. The technical tour was certainly a great opportunity for all of us.

During the technical tour, the host guided us to the Tian’an Men Square. We were overwhelmed by the vast picture and a number of people who visit the scene even on weekdays. The central Beijing has many high rise buildings and apartments built next to each other, and even more construction is underway. The preparation for the Olympic 2008 seems to be going on wheels. The national gymnastics stadium, which is going to be the main stadium, and national swimming center were also under construction.

Finally, we would like to express our appreciation to the APLMF WG on Utility Meters who extends a sufficient consideration towards the improvement of APLMF member

economies in electricity meters and AQSIQ who provided an outstanding dedication in hosting this seminar. With such great support from various organizations, the seminar was a success and was a valuable opportunity to the APEC/APLMF member economies.

Mr. Takao Oki
Mr. Masatoshi Tetsuka
Mr. Kazunori Hata
Japan Electric Meter Inspection Corporation (JEMIC)

Dr. Tsuyoshi Matsumoto
APLMF Secretariat

**APEC/APLMF Seminars and Training Courses in Legal Metrology
Seminar on Electricity Meters (CTI-11/2006T)**

19-22 March, 2007

at the Yu Yang Hotel in Beijing, the People's Republic of China

Final Program

Organizers:

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

Supporting Organizations:

1. General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China (AQSIQ)
2. Japan Electric Meters Inspection Corporation (JEMIC)
3. National Metrology Institute of Japan (NMIJ)
4. Measurement Canada, Government of Canada

Speakers:

1. Mr. Takao Oki, Director, Technical Research Laboratory, Japan Electric Meters Inspection Corporation (JEMIC)
2. Mr. Masatoshi Tetsuka: Senior Staff of Verification Management Division, Japan Electric Meters Inspection Corporation (JEMIC)
3. Mr. Kazunori Hata: Type Test Group, Verification Management Division, Japan Electric Meters Inspection Corporation (JEMIC)
4. Mr. Masaru Nagashima, General Manager, Meter Design Dept., Energy Metering System Div., Fuji Electric Systems Co., Ltd, Japan
5. Dr. Lu Zuliang, Director, Division of Electricity and Quantum Metrology, National Institute of Metrology (NIM), PR China

Main Objective of the Seminar:

Electricity metering is one of the essential technical infrastructures, which will ensure safety and welfare for the citizens in all economies. In addition, according to the enhanced international free trade, it is getting more important to remove technical or legislative barrier to trade electricity and/or electricity meters (watt-hour meters). However, there remain some problems due to unconformity in the regulations and systems on electricity meters employed in each economy or region.

Main target of this seminar is to assist APEC and APLMF member economies to develop common understanding about the current standards and regulations on electricity meters and thus meet the APEC objective to establish a harmonization in legal metrology with OIML international recommendations. This seminar also put importance on the international communication and exchange of information between the participating economies.

Actual contents of the seminar would be focused on the understanding of basic knowledge on electricity metering, overview and construction of electricity meters, and current situation about the international standards and regulations related to the electricity meters.

Target Audience:

Technical experts in charge of type approvals and verifications of electricity meters and officials in charge of regulations including legislations related to electricity metering are encouraged to attend the seminar. All participants are required to participate in the seminar actively by preparing a detailed report of the economy about **20 minutes**.

Registration:

Fill the “**Registration Form**” and send it to the APLMF secretariat by **February 16, 2007**.

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, Indonesia, Malaysia, Mexico, Papua New Guinea, Philippines, Peru, Russian Federation, Thailand and Viet Nam**. APLMF travel support would be complementary prepared for the non-APEC full-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 seminar.

Visa assistance:

If you need visa to enter PR China, please fill the **bottom part of the Registration Form** and send it to the APLMF secretariat by **February 16**. On your request, the host in PR China will send an official letter of invitation for visa application.

Venue and Accommodation:

Yu Yang Hotel

No. 18 Xinyuanxili Middle Street, Chaoyang District, Beijing, PR China

Tel: +86-10-64669988, Fax: +86-10-64666672, <http://www.yuyanghotel.net/>

Accommodation for the participants will be prepared at the Yu Yang Hotel with the rate RMB 510 (USD65) / night. Please send the **Hotel Reservation Form by February 28** to the host to reserve a room.

Access Information:

Yu Yang hotel is about 20 km from the Beijing Capital International Airport. You can easily reach the hotel by taxi in about 20 minutes for approximately USD10. Some taxi drivers understand English. Another way is to take an airport bus Line 3 going to the Beijing railway station. The first bus stop is the Yu Yang Hotel. It takes about 20 minutes and RMB16. At the exit of the airport, you can find the signs to taxi and bus station. The currency in China is Renminbi (RMB) also called as Chinese Yuan (CNY). Recent exchange rate is USD1=RMB7.74. Only RMB is available in taxi, bus and most of the shops.

Contact Persons for the Seminar:

1. APLMF Secretariat (registration, travel support and lectures by JEMIC)

Dr. Tsuyoshi Matsumoto and Ms. Ayako Murata

NMIJ/AIST Tsukuba Central 3-9, 1-1-1 Umezono, Tsukuba, Ibaraki 305-8563, Japan

Tel: +81-298-61-4362, Fax: +81-298-61-4393, E-mail: e.sec@aplmf.org, sec@aplmf.org

2. Host in PR China (visa assistance, accommodation and venue)

Mr. HAN Jianping and Mrs. XIE Hongyan

Dept. of International Cooperation,

General Administration of Quality Supervision, Inspection and Quarantine

NO. 9 Madiandonglu, Haidian District, Beijing, the People's Republic of China

Tel: +86-10-82262171, Fax: +86-010-82260215,

E-mail: hanjp@aqsiq.gov.cn & xiehy@aqsiq.gov.cn

Program

<u>Day 1 - Monday, 19 March</u>	
09:30 - 10:00	<i>Registration</i>
10:00 - 10:30	Opening Ceremony · Welcome Address by Mrs. Kong Xiaokang, Deputy Director-General, Department of International Cooperation, AQSIQ · Opening Address by Dr. Tsuyoshi Matsumoto, APLMF Executive Secretary · Opening Address by Mr. Takao Oki, Director, Technical Research Laboratory, Japan Electric Meters Inspection Corporation (JEMIC) · Take a Group Photo
10:30 - 11:00	<i>Coffee Break</i>
11:00 - 12:30	Overview of the Measurement System and Current Situation about Electricity Meters in Each Economy Presented by the Participants ^{*1}
12:30 - 14:00	<i>Lunch Break</i>
14:00 - 15:20	Roll Call
	Continue the Presentation ^{*1}
15:20 - 15:50	<i>Coffee Break</i>
15:50 - 17:00	Continue the Presentation ^{*1}
18:30	<i>Leave Yu Yang hotel lobby for the dinner (5- minutes walk)</i>
19:00 - 21:00	<i>Welcome dinner hosted by AQSIQ^{*7} at the Golden Continent Restaurant at No.111 Xinyuanli zhongjie, Chaoyang Disrtict, Beijing (Tel:010-64663661)</i>
<u>Day 2 - Tuesday, 20 March</u>	
09:00 - 10:30	Introduction to the Seminar ^{*2} · Outline of Electricity Meters: Category / Classification ^{*4}
10:30 - 11:00	<i>Coffee Break</i>
11:00 - 11:20	· Outline of Electricity Meters: Category / Classification (cont.) ^{*4}
11:20 - 12:20	· Developments for Electricity Meters ^{*5}
12:20 - 14:00	<i>Lunch Break</i>
14:00 - 15:05	· Legislation ^{*2} · Type Approval: Procedure / Test / Statistics ^{*3}
15:05 - 15:35	<i>Coffee Break</i>
15:35 - 17:00	· Verification: Procedure / Test / Sealing / Statistics ^{*2} · Verification Standards ^{*2}

<u>Day 3 - Wednesday, 21 March</u>	
09:00	<i>Leave the hotel lobby for the tour(one hour from Yu yang Hotel by bus)</i>
10:00 - 11:30	Technical Tour ^{*6-7} to the State Power Banner (Beijing) Electric Equipment Co. Ltd. at Longcheng Gardon, Huilongguan-town, Changping District, Beijing (Tel: 010-80793054) welcomed by Mr. Li Ye.
11:30 - 12:20	<i>Lunch Break hosted by the State Power Banner Electric Equipment Co. Ltd.</i>
13:00 - 14:20	<i>Tour to the Tian'an Men Square^{*7}</i>
15:00 - 17:20	Technical Tour ^{*6-7} to the National Institute of Metrology (NIM) at No.18 Beisanhuan Donglu, Chaoyang District, Beijing (Tel: 010-64211631). Hands-on training was instructed by Ms. Lijuan Liu.
17:20	<i>Leave NIM for dinner (30-45 minutes by bus)</i>
18:00 - 20:00	<i>Farewell dinner hosted by APLMF at the Beijing Quanjude roast duck restaurant</i>
<u>Day 4 - Thursday, 22 March</u>	
09:00 - 10:30	Overview of IEC Standards Relative to the Electricity Meters (IEC TC13) ^{*3} · Abstract of TC13 · Standards of TC13
	Current Situation on the Revision of OIML Recommendations ^{*3} · Abstract of The Revision Work of R46 · Contents of the Revision R46 · Relationships of International Standards and Recommendations
10:30 - 11:00	<i>Coffee Break</i>
11:00 - 12:30	Overview of the Primary Standards in Metrology of Electricity Energy in PR China ^{*6}
12:30 - 14:00	<i>Lunch Break</i>
14:00 - 15:00	Discussion on All Presentations ^{*1-6} · Additional questions and answers. · Summary of the reports from the participants and revision of the APLMF survey on electricity meters. · Problems or requests in participation economies on electricity meters in regard to; metrological standards, product standards, domestic regulations, type approval system, verification system, and metering systems. · Future seminars on electricity meters. Are there any new topics to be included? Are there any candidates of speakers to be invited? How the seminar should be improved?
15:00 - 15:30	<i>Coffee Break</i>
15:30 - 16:10	Closing Ceremony · Give Certificates to All Participants by Mr. Liu Xinmin, Deputy Director-General, Department of Metrology, AQSIQ · Closing Address by Mr. Liu Xinmin · Closing Address by Dr. Matsumoto

Additional Comments:

***1 These sessions will be presented by the participants**

A participant from each economy provides a presentation (about 20 minutes) on the measurement system and current situation about electricity meters in his/her economy. Followings are the recommended topics of the presentation:

- 1 What organization(s) regulate the measurement of electricity?
- 2 Are electricity meters required to have type approval? If required, reply the following four inquiries.
 - 2.1 What organization performs type approval?
 - 2.2 How many type approvals do you perform in a year?
 - 2.3 How long is the validity of a type approval?
 - 2.4 When the type approval expired, is the meter tested again?
- 3 Are electricity meters required of verifications? If required, reply the following six inquiries.
 - 3.1 What organization performs verification?
 - 3.2 How many electricity meters are verified in a year?
 - 3.3 How long is the validity of the initial and subsequent verifications?
 - 3.4 When the initial verification expired, are the meters re-verified or discarded?
 - 3.5 How do you decide the length of validity of verification?
 - 3.6 Are the meters verified at the place of service?
- 4 Do you have a national primary measurement standard for electricity meters? If not, where is the standard traceable to?
- 5 What kinds of electricity meters are used? For examples, active meter, reactive meter, VA meter, demand meter, classification of meters, rated value-connection mode, frequency, voltage, current (ex. 1 phase-2 wire, 240V, 10-40A, 50Hz), single-tariff, multi-tariffs, etc.
- 6 Are there any resolution processes for measurement complaint/dispute?

***2-6 These lectures will be given or instructed by Mr. Oki (*2), Mr. Tetsuka (*3), Mr. Hata (*4), Mr. Nagashima (*5) and Dr. Lu (*6).**

***7 These events will be prepared and guided by the host economy.**

Participants List of APEC/APLMF Seminar on Electricity Meters

No.	Category	Economy	Name	Organization
1	Speaker	China, PR	Dr. Lu Zuliang	Director, Division of Electricity and Quantum Metrology, National Institute of Metrology
2	Speaker	Japan	Mr. Kazunori Hata	Verification Management Division, Japan Electric Meters Inspection Corporation (JEMIC)
3	Speaker	Japan	Mr. Masaru Nagashima	General Manager, Meter Design Dept., Azumino Factory, Energy Metering System Div., e-Solution Engineering Group, Fuji Electric Systems Co., Ltd, Japan
4	Speaker	Japan	Mr. Takao Oki	Director, Technical Research Laboratory, Japan Electric Meters Inspection Corporation (JEMIC)
5	Speaker	Japan	Mr. Masatoshi Tetsuka	Verification Management Division, Technical Research Laboratory, Japan Electric Meters Inspection Corporation (JEMIC)
6	Host	PR China	Ms. Ding Zhiyin	General Administration of Quality Supervision, Inspection and Quarantine (AQSIQ)
7	Host	PR China	Mr. Han Jianping	General Administration of Quality Supervision, Inspection and Quarantine (AQSIQ)
8	Host	PR China	Mrs. Kong Xiaokang	General Administration of Quality Supervision, Inspection and Quarantine (AQSIQ)
9	Host	PR China	Mr. Li Jinsi	Beijing Institute of Metrology
10	Host	PR China	Mr. Liu Xinmin	General Administration of Quality Supervision, Inspection and Quarantine (AQSIQ)
11	Host	PR China	Mr. Wang Zi Gang	Beijing Institute of Metrology
12	Host	PR China	Ms. Wu Xiaomin	Chinese Society for Measurement
13	Host	PR China	Mr. Xie Hongyan	General Administration of Quality Supervision, Inspection and Quarantine (AQSIQ)
14	Host	PR China	Mr. Zhang Zhiping	General Administration of Quality Supervision, Inspection and Quarantine (AQSIQ)
15	Host	PR China	Ms. Zhao Yan	General Administration of Quality Supervision, Inspection and Quarantine (AQSIQ)
16	Host	PR China	Ms. Zhu Meina	General Administration of Quality Supervision, Inspection and Quarantine (AQSIQ)
17	Host	PR China	Mr. Li Ye	State Power Banner (Beijing) Electric Equipment Co. Ltd.
18	Host	PR China	Ms. Lijuan Liu	National Institute of Metrology

19	APLMF	Japan	Dr. Tsuyoshi Matsumoto	National Metrology Institute of Japan (NMIJ)
20	Participant	Cambodia	Mr. Yin Vanndech	Department of Metrology, Ministry of Industry, Mines and Energy
21	Participant	Chile	Mr. Francisco Humberto Muñoz García	Superintendencia de Electricidad y Combustibles (SEC)
22	Participant	Indonesia	Mr. Denny Tresna Seswara	Directorate of Metrology
23	Participant	Indonesia	Mr. Haris Sutanto Broto	Directorate of Metrology
24	Participant	Korea, DPR	Mr. Choe Il	Measurement Information Lab., Central Institute of Metrology (CIM)
25	Participant	Korea, DPR	Mr. Kim Kwang Il	Optic Measurement Lab., Central Institute of Metrology (CIM)
26	Participant	Malaysia	Mr. Jumary Jaapar	Krizik (M) Sdn. Bhd.
27	Participant	Malaysia	Mr. Nazri Marzuki	National Metrology Laboratory, SIRIM Berhad
28	Participant	Mongolia	Mr. Nyam-Ochir Delegnyam	Mongolian Agency for Standardization and Metrology
29	Participant	Papua New Guinea	Mr. Joe Magur Panga	PNG National Institute of Standards and Industrial Technology
30	Participant	Peru	Mr. Henry Postigo	National Institute for the Defense of Competition and Protection of intellectual Property (INDECOPI)
31	Participant	Taipei, Chinese	Mr. Yuan Ping Sun	Bureau of Standards, Metrology, and Inspection
32	Participant	Thailand	Mr. Warapong Pakkut	Bureau of Weights & Measures , Department of Internal Trade, Ministry of Commerce
33	Participant	Vietnam	Mr. Thai Thanh Nam	Electronic Watt-hour Meter Workshop, Computer Centre/Power Company No. 3
34	Participant	PR China	Ms. Lai Lei	Shanghai Institute of Measurement and Testing Technology
35	Participant	PR China	Mr. Shi Leibing	Shanghai Institute of Measurement and Testing Technology
36	Participant	PR China	Mr. Chen Bo	National Quality Supervision and Inspection for Electrical instrument
37	Participant	PR China	Mr. Dai Wei	South China National Center of Metrology, Guangdong Institute of Metrology

38	Participant	PR China	Mr. Gu Liang	Liaoning Provincial Institute of Measurement
39	Participant	PR China	Mr. Guo Jingtao	National Testing Center for Electricity Meter, Tianjin Institute of Metrological Supervision and Testing
40	Participant	PR China	Ms. Huang Yan	Director of Electricity Lab., Beijing Institute of Metrology
41	Participant	PR China	Mr. Li Lin	Jiangsu Institute of Metrology
42	Participant	PR China	Ms. Liu Chunmeng	Liaoning Provincial Institute of Measurement
43	Participant	PR China	Mr. Ma Ruisong	Henan Institute of Metrology
44	Participant	PR China	Mr. Shao Yuda	Jiangsu Institute of Metrology
45	Participant	PR China	Ms. Yang Lin	China Electric Power Research Institute
46	Participant	PR China	Mr. Yang You Tao	Director of Technology Department, Beijing Institute of Metrology
47	Participant	PR China	Mr. Zhang Mian	Henan Institute of Metrology
48	Participant	PR China	Mr. Zhang Ren	National Testing Center for Electricity Meter, Tianjin Institute of Metrological Supervision and Testing
49	Participant	PR China	Mr. Zhou Shaoyuan	Zhejiang Institute of Metrology
50	Observer	PR China	Mr. Chen Ji	Hangzhou Hualong Electronic Technology Co., Ltd.
51	Observer	PR China	Mr. Wang Guosheng	Henan Star HI-TECH Co., Ltd.
52	Observer	PR China	Mr. Wang Yanglong	Delixi Group Electrical Equipment Co., Ltd
53	Observer	PR China	Mr. Zhang Xian	Changsha Weisheng Electronics Co., Ltd.
54	Observer	PR China	Mr. Zhang Xiaogui	Shenzhen Clou electronics Co., ltd

* Names are listed in alphabetical order of their last names by the category.



APEC/APLMF Seminars and Training Courses
in Legal Metrology; (CTI-11/2006T)
Seminar on Electricity Meters
19 -22 March, 2007
in Beijing, the People's Republic of China

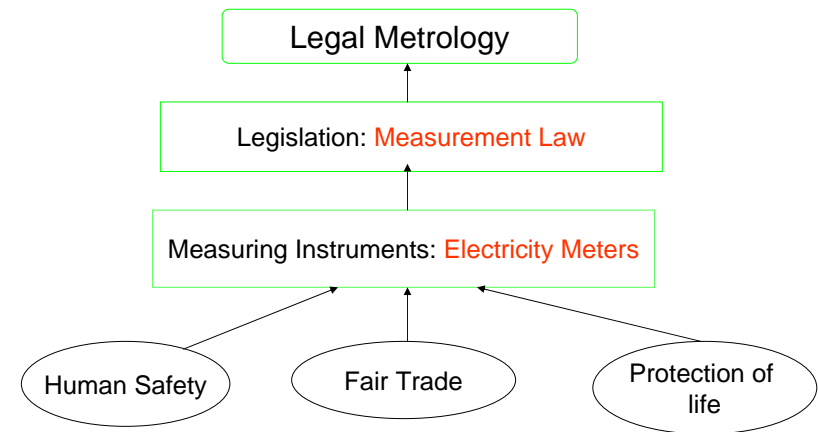


Introduction to the seminar on Electricity Meters

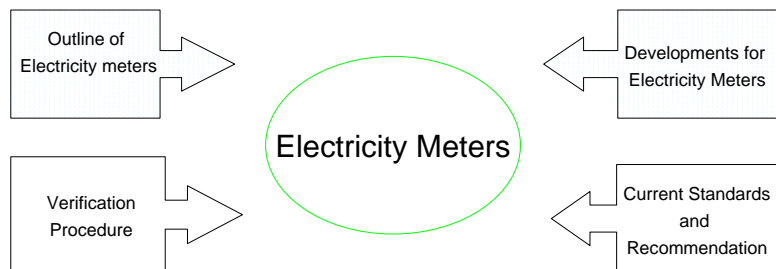
Masaru Nagashima (Fuji Electric Systems Co., Ltd, Japan)
Takao Oki (Japan Electric Meters Inspection Corporation)
Masatoshi Tetsuka (Japan Electric Meters Inspection Corporation)
Kazunori Hata (Japan Electric Meters Inspection Corporation)



Introduction to the seminar (1)



Introduction to the seminar (2)



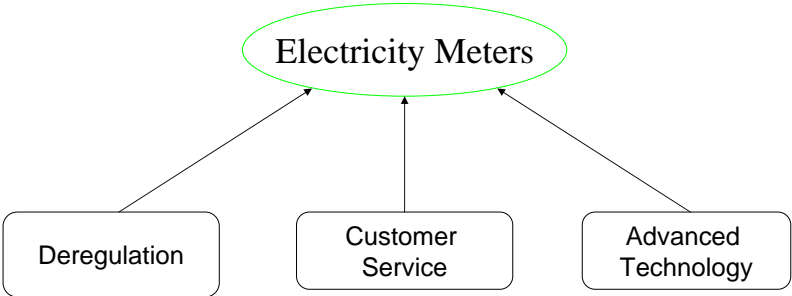
Introduction to the seminar (3)

Outline of Electricity meters



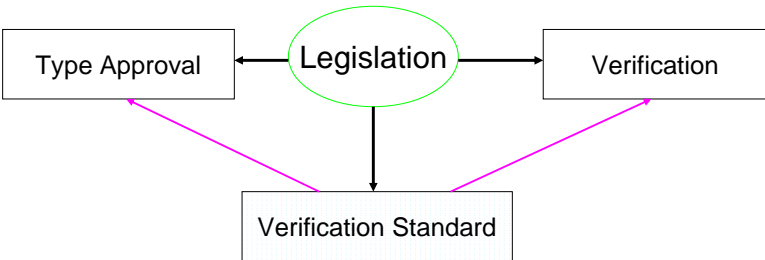
Introduction to the seminar (4)

Developments for Electricity Meters



Introduction to the seminar (5)

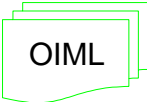
Verification Procedure (Electricity Meters)



Introduction to the seminar (6)

IEC Standards and OIML Recommendation

- Overview of IEC Standards Relative to the Electricity Meters (IEC TC13)
- Current Situation on the Revision of OIML Recommendation



Thank you for your attention

Outline of Electricity Meters



Contents

- The need for electricity meters
- Electricity transmission and distribution methods
- Power and Energy
- Types of electricity meters and precision classification
- Electromechanical induction meters

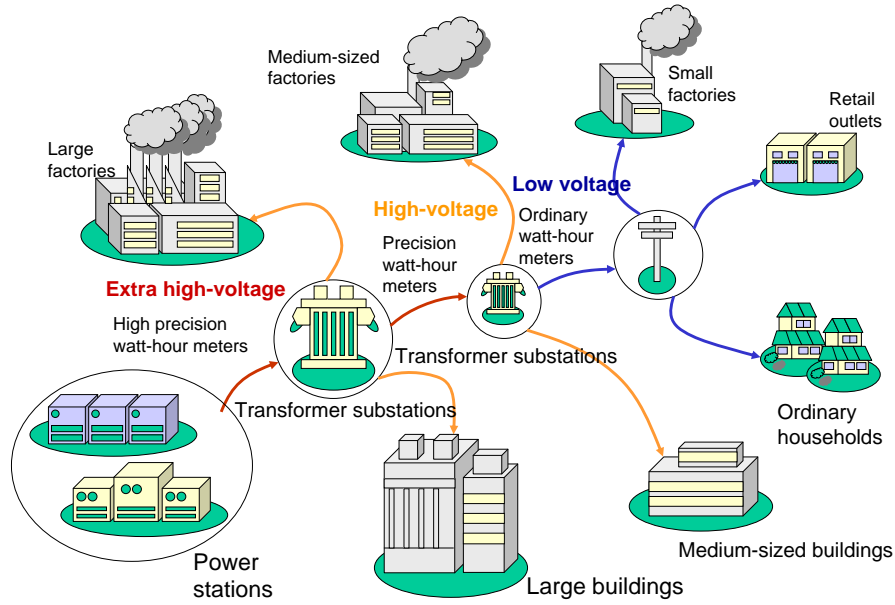
The need for electricity meters



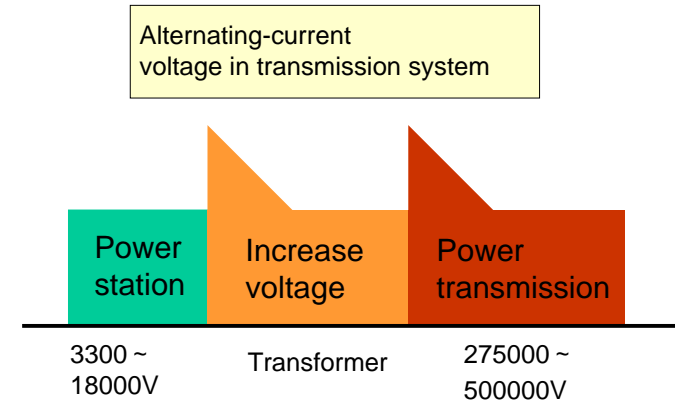
Electricity transmission and distribution methods



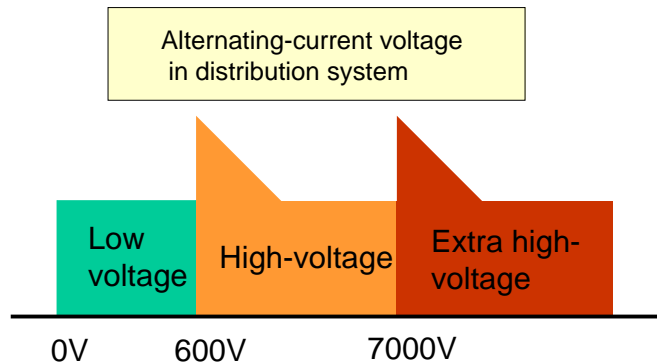
Transmission and Distribution



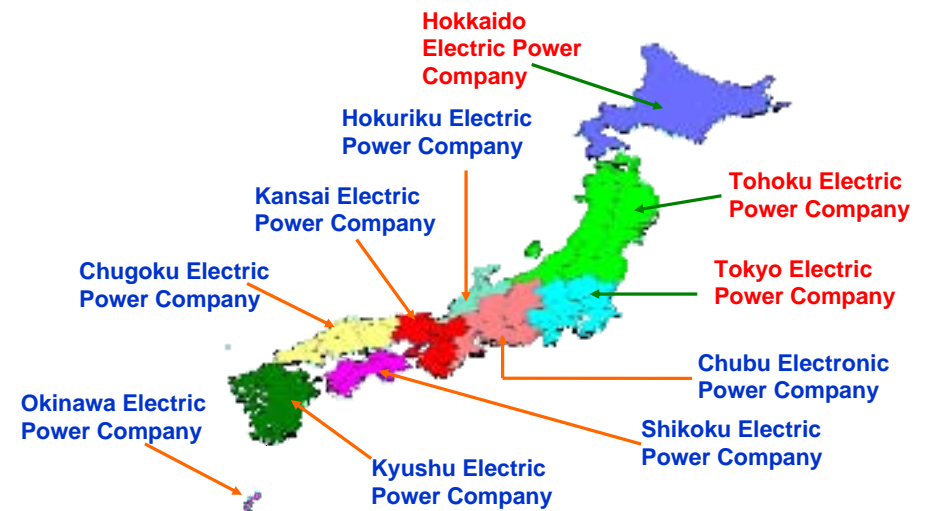
Transmission voltage



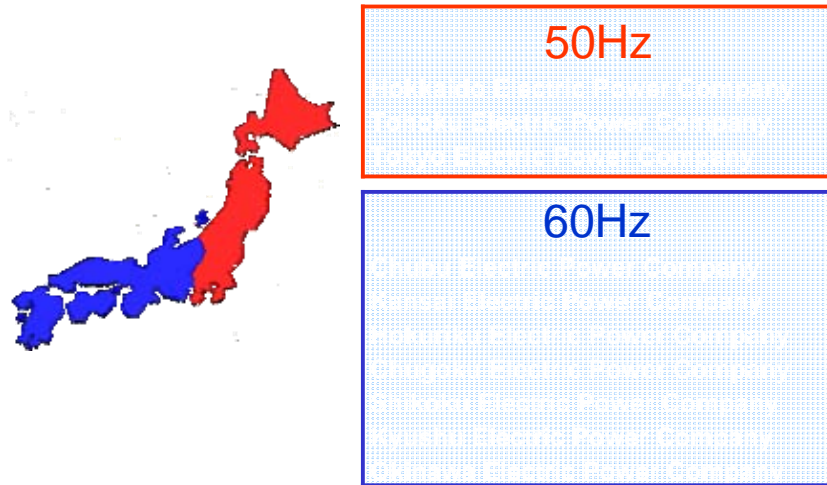
Distribution voltage



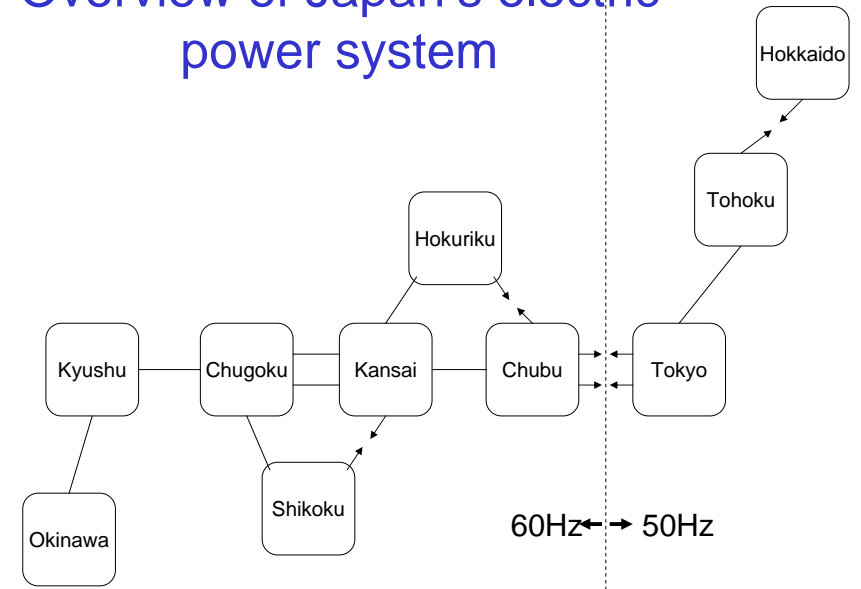
Electric Power Companies in Japan



Power supply Frequency in Japan



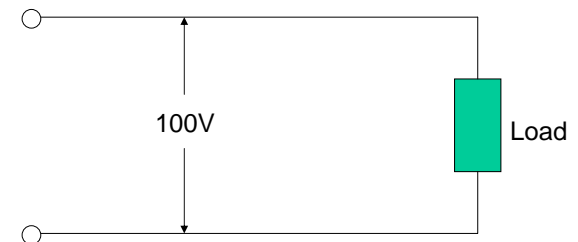
Overview of Japan's electric power system



Distribution methods

Electricity distribution systems (1)

Single-phase two-wire system
 Distribution of electricity at low supply capacity of 100V



Electricity distribution systems (2)

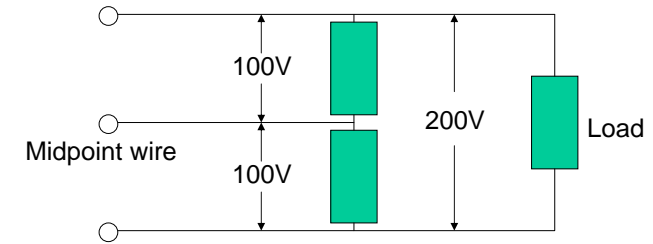
Single-phase three-wire system

This is a "100 volts + 100 volts = 200 volts" power distribution system whereby power cables originate from the midpoint of the single phase 200 volt power transformer and three wires are used to create two 100 volt circuits and one 200 volt circuit.

If the midpoint wire is earthed, then the earth voltage of the other two wires becomes 100 volts, reducing their potential danger for human body.

This system is used in ordinary households where a 200V supply is required, such as where the load is high and a 100V supply is not sufficient.

Electricity distribution systems (2)



Electricity distribution systems (3)

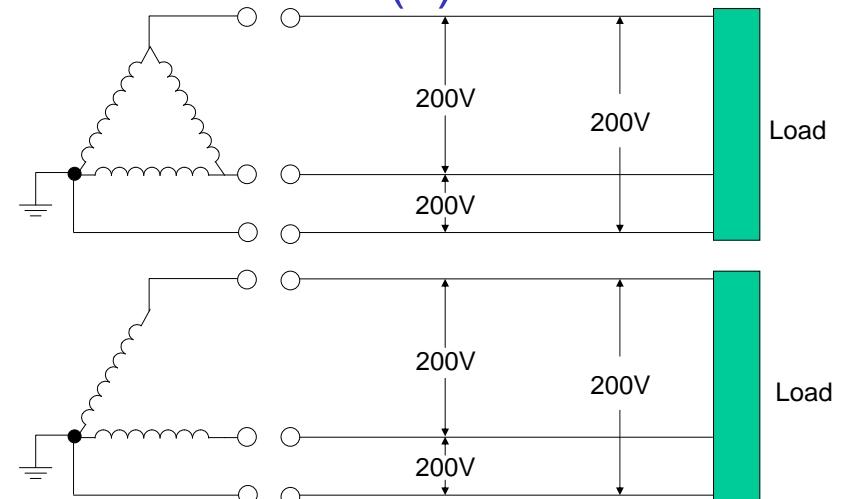
Three-phase three-wire system

These systems are widely used by a range of parties from small factories to major customers. The majority of Japan's power transmission systems are three-phase three-wire systems. (Single-phase power distribution systems use two of these wires.)

Motors are powered with three-phase systems since they produce smoother revolution than single phase systems.

In high-voltage three-phase three wire distribution systems, meters may be combined with transformers

Electricity distribution systems (3)



Electricity distribution systems (4)

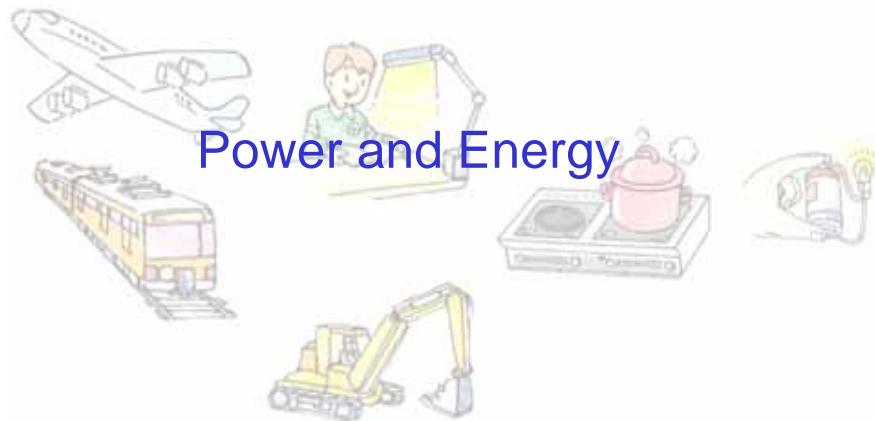
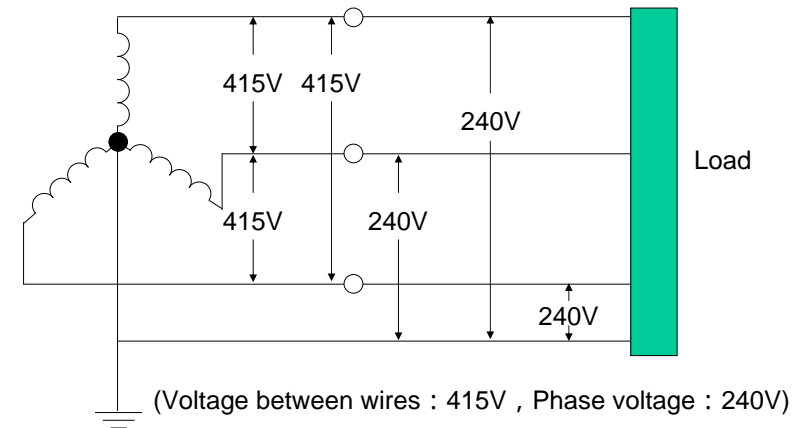
Three phase four wire system

These systems are used to distribute electricity to factories and other customers with a Large-lot load, and therefore are not used as for ordinary Japanese households.

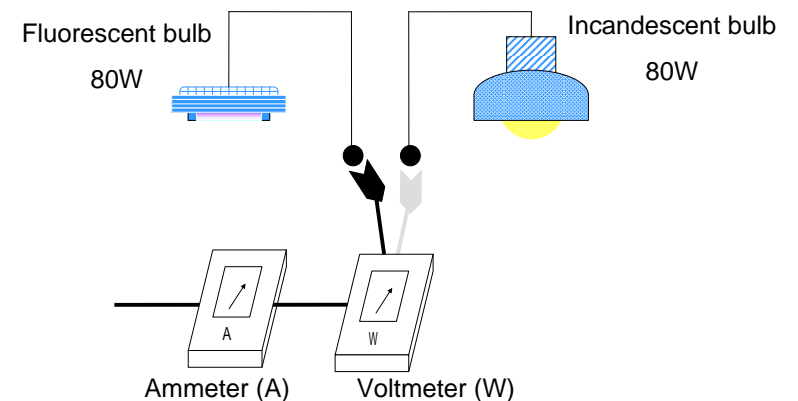
Electricity is input through a three-phase three-wire system, and when the voltage is transformed, a neutral point is connected creating a four wire system.

This system can deal with an increase in the number of customers while remaining economic.

Electricity distribution systems (4)



Example of household electricity consumption and electricity usage (1)



Example of household electricity consumption and electricity usage (2)

- Measure electricity consumption with voltmeter
- Measure current with ammeter

	Current	Power
Incandescent bulb	0.8A	80W
Fluorescent bulb	1.25A	100W

electricity consumption is the same but current differs.

Example of household electricity consumption and electricity usage (3)

Since the household voltage is 100V

Incandescent bulb Power = $100V \times 0.8A = 80W$

Fluorescent bulb Power = $100V \times 1.25A = 125W$

The reading for the fluorescent bulb differs from the measured reading.

This is because it has a low power factor.

Example of household electricity consumption and electricity usage (4)

For alternating-current ,

The basic formula is

$$\text{Power} = \text{Voltage} \times \text{Current} \times \text{Power factor}$$

Example of household electricity consumption and electricity usage (5)

Therefore power factor is:

Incandescent bulb

Fluorescent bulb

$$\text{PF} = \frac{\text{Power}}{\text{voltage} \times \text{current}}$$

$$\text{PF} = \frac{\text{Power}}{\text{voltage} \times \text{current}}$$

$$\text{PF} = \frac{80W}{100V \times 0.8A} = 1$$

$$\text{PF} = \frac{100W}{100V \times 1.25A} = 0.8$$

Example of household electricity consumption and electricity usage (6)

Power factor

	Power factor
Incandescent bulb	1
Fluorescent bulb	0.8

From these results we can see that we can see that "the fluorescent bulb won't achieve for a brightness of 80 watts unless it has a current of 1.25 amps".

In other words, the fluorescent bulb has a lower power factor.

Example of household electricity consumption and electricity usage (7)

The power factor is the proportion of the current that flows to the load (bulb) that performs active work (is emitted as light.)

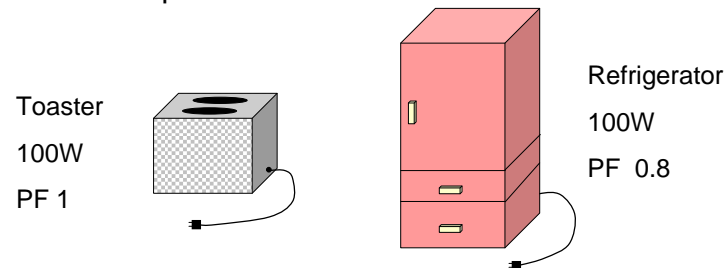
The proportion of the power effective work is

Incandescent bulb	100%
Fluorescent bulb	80%

Example of household electricity consumption and electricity usage (8)

Power factor of household electric appliances

Another example



Example of household electricity consumption and electricity usage (9)

Both appliances use the same power but have a different power factor.

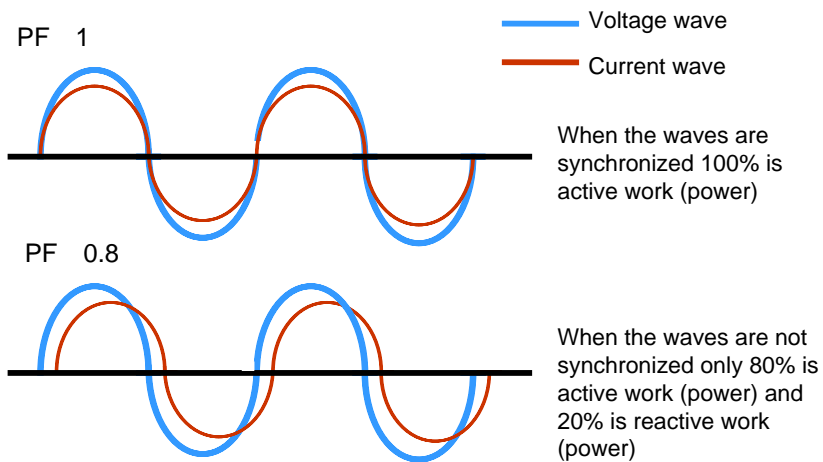
We can find the current from the basic formula

$$\text{Toaster current} = \frac{100\text{W}}{100\text{V} \times \text{PF } 1} = 1\text{A}$$

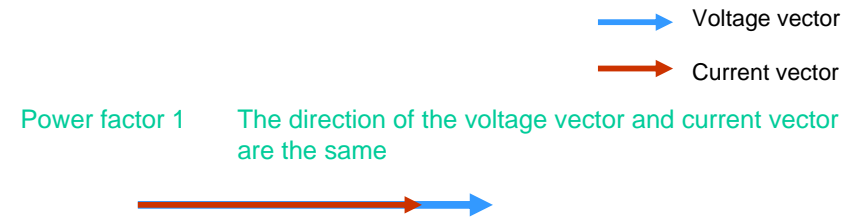
$$\text{Refrigerator current} = \frac{100\text{W}}{100\text{V} \times \text{PF } 0.8} = 1.25\text{A}$$

The volume of the currents are different.

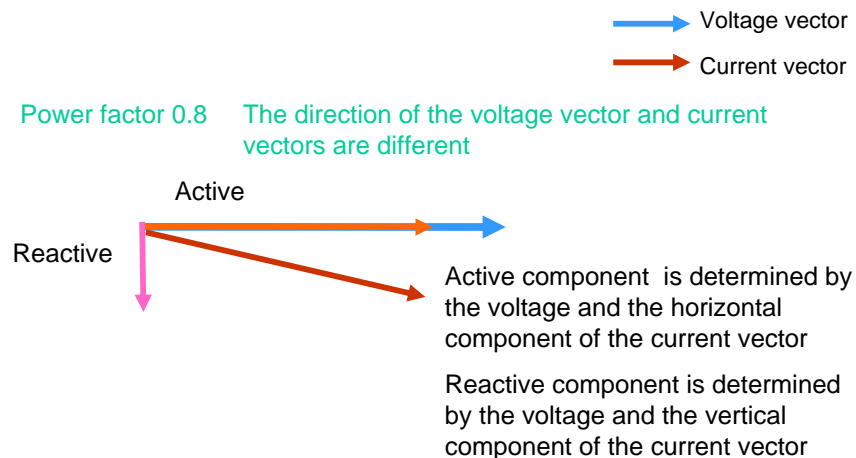
Example of household electricity consumption and electricity usage (10)



Example of household electricity consumption and electricity usage (11)



Example of household electricity consumption and electricity usage (12)



Example of household electricity consumption and electricity usage (13)

Active and Reactive components of power

- Active power = Voltage x Active current component
= $V \times I \cos$
- Reactive power = Voltage x Reactive current component
= $V \times I \sin$

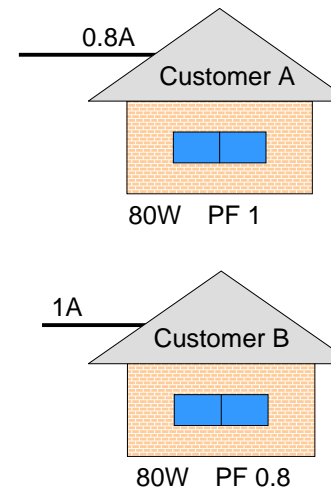
Example of household electricity consumption and electricity usage (14)

Energy

$$\text{Energy} = \text{Power} \times \text{Time}$$

- Active energy = Active power \times Time
 $= V \times I \cos \phi \times t$
- Reactive energy = Reactive power \times Time
 $= V \times I \sin \phi \times t$

Example of household electricity consumption and electricity usage (15)



Reasons for measuring the reactive power

Even if the current is the same, electricity consumption varies depending on the power factor.

Example of household electricity consumption and electricity usage (16)

Electricity tariffs:

Suppose 1kWh = ¥10, and electricity is used for one hour.

Both customer A and customer B will be charged ¥ 0.8, but customer B will require equipment that can generate a current 0.2A larger than for customer A.

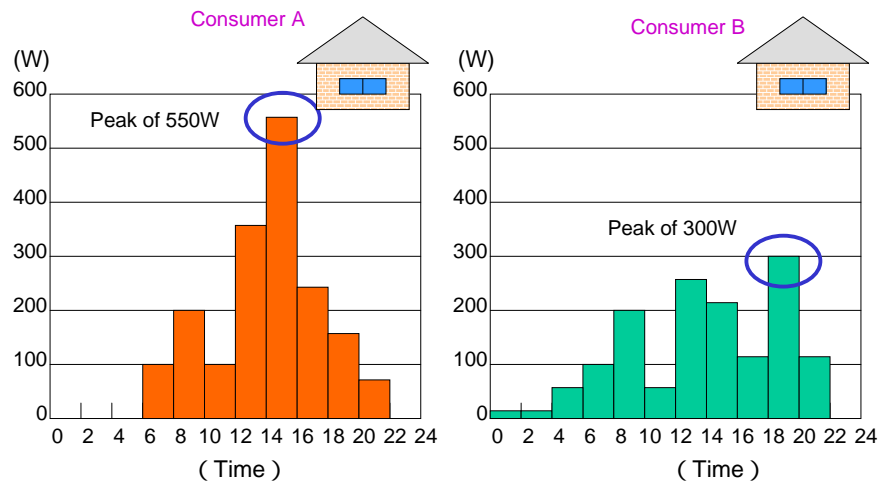
Therefore, to work out the power factor we have to measure reactive power.

Example of household electricity consumption and electricity usage (17)

Power factor

$$\text{Power factor} = \frac{\text{Active power}}{\sqrt{(\text{Active power})^2 + (\text{Reactive power})^2}}$$

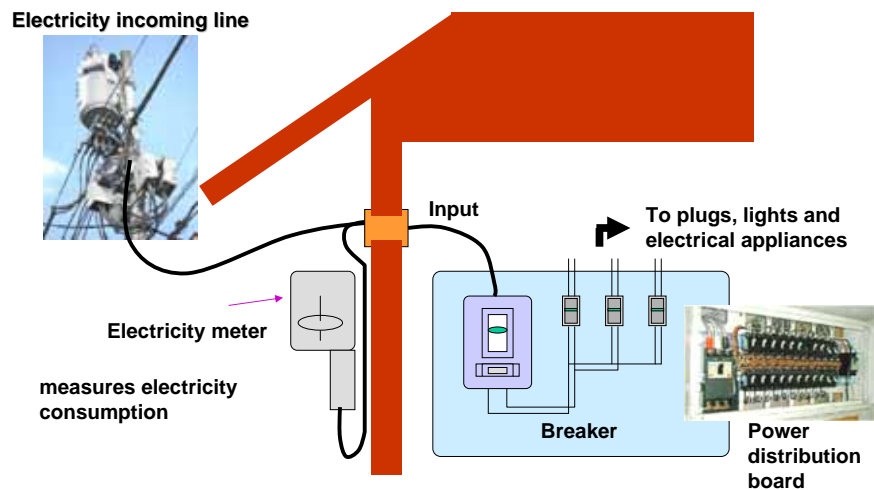
Example of household electricity consumption and electricity usage (18)



Types of electricity meters and precision classification



Supplying electricity to ordinary houses (1)



Supplying electricity to ordinary houses (2)

The electricity output from transformer substations is supplied to ordinary households where it is used for lighting and to power various electrical appliances, through drop wires. Electricity usage is measured in terms of electrical energy used. The amount of the electrical energy used, which determines the monthly electricity tariff, plays a very important role in the transactions between consumers and power companies.

Supplying electricity to ordinary houses (3)

There are various types of electric meter that vary in structure, usage, installation environment and the range of energy amounts they can measure.

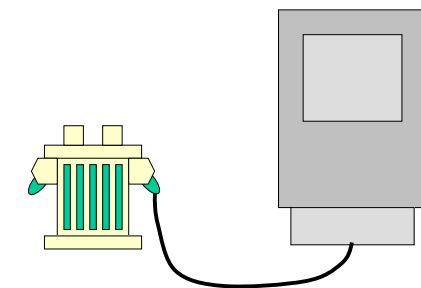
Direct connection type meters and Transformer operated Meter (1)

Direct Connection Type meters → Watt-hour meters used alone

Transformer Operated Meters → Watt-hour meters use in combination with transformers.

Transformers Transformers are voltage transformers that convert high-voltages into low voltages or current transformers that transform large currents into small currents.

Direct connection type meters and Transformer operated Meter (2)



Transformer

Meter

Direct connection type meters and Transformer operated Meter (3)

(Example) Calculating energy usage

(In case of meter with multiplier)

- Voltage ratio (primary voltage / secondary voltage)
- Current ratio (primary current / secondary current)

This product is then multiplied by the previous reading on the meter to give the actual energy consumption.

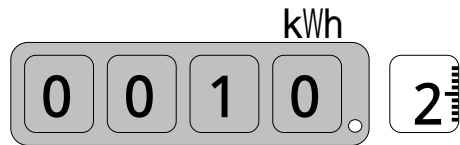
Direct connection type meters and Transformer operated Meter (4)

If primary voltage = 6600V , secondary voltage = 110V ,
primary current = 10A , and secondary current = 5A,

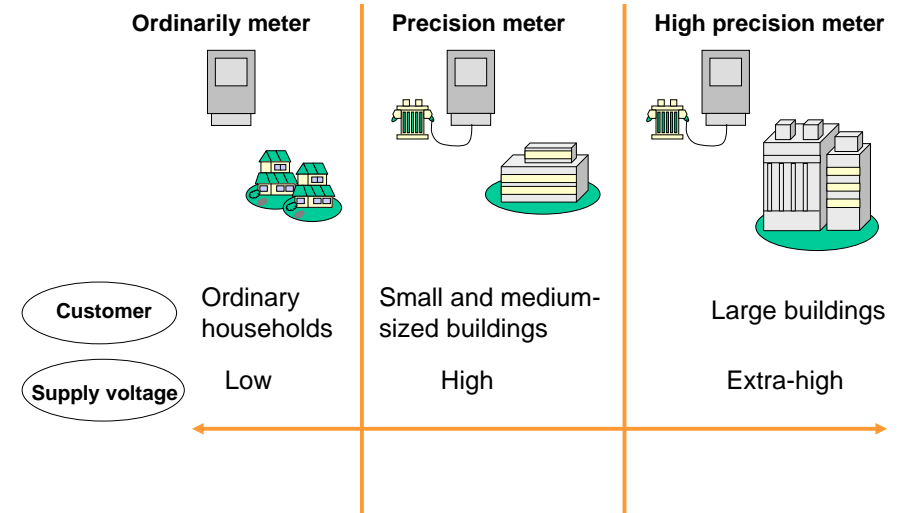
then

$$10.2 \times (6600 / 110) \times (10 / 5) = 1224\text{kWh}$$

The amount of electricity used in this example is 1224 kilowatt-hours.



Classification (1)



Classification (2)

Types of electricity meters and precision classification

Meter type	Error (%)
· Ordinary watt-hour meter (ordinary class)	± 2.0
· Precision watt-hour meter (precision class)	± 1.0
· High precision watt-hour meter (Hi-precision class)	± 0.5
· Var-hour meter	± 2.5
· Maximum demand meter	± 3.0

Types of meter

There are some kinds according to contractual coverage.
Moreover, it may be used combining two or more meters.

Meter type	Usage
· High precision watt-hour meter	· Contracts over 10,000kW
· Precision watt-hour meter	· Contracts over 500kW
· Ordinary watt-hour meter	· Contracts under 500kW
· Var-hour meter	· Calculating power factor
· Maximum demand meter	· maximum power demand

Fundamental principles (1)

The fundamental principles of these meters were discovered in 1885 by the Italian scientist Ferraris, and as such they are sometimes called Ferraris meters.

Electromechanical induction meters

Fundamental structure of
electromechanical induction meters



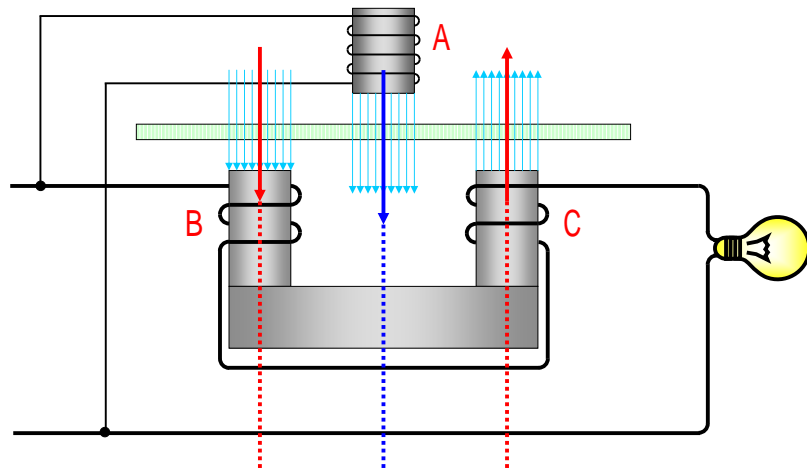
Fundamental principles (2)

This meter is based on the principle that moving a magnet close to the periphery of an aluminum rotating disc causes the disc to rotate in the same direction as the magnet movement, due to the interaction of the magnetic field with the current (eddy current) generated by the disc.

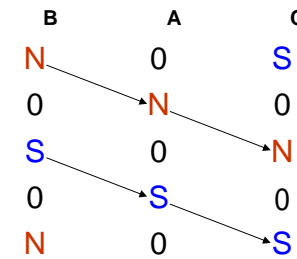
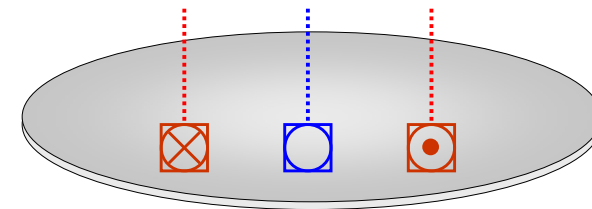
Fundamental principles (3)



Fundamental principles (4)



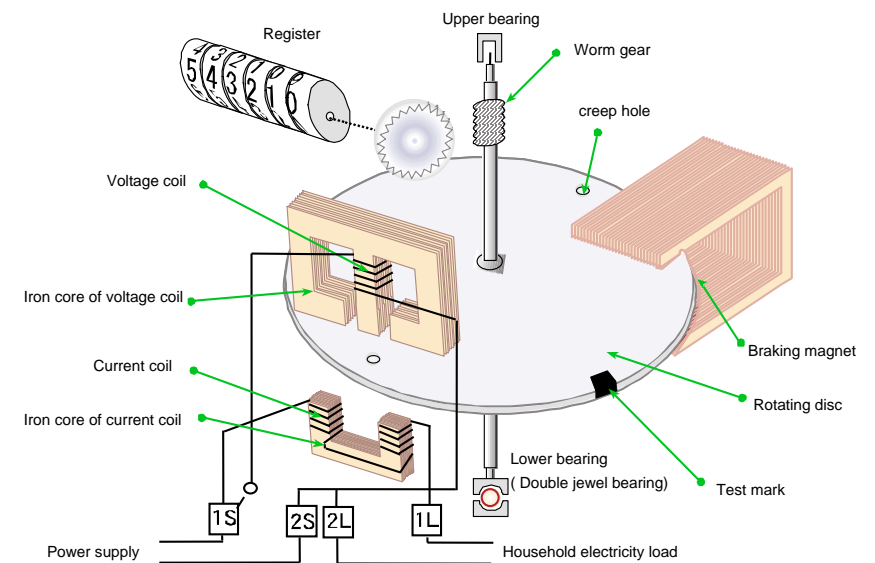
Fundamental principles (5)



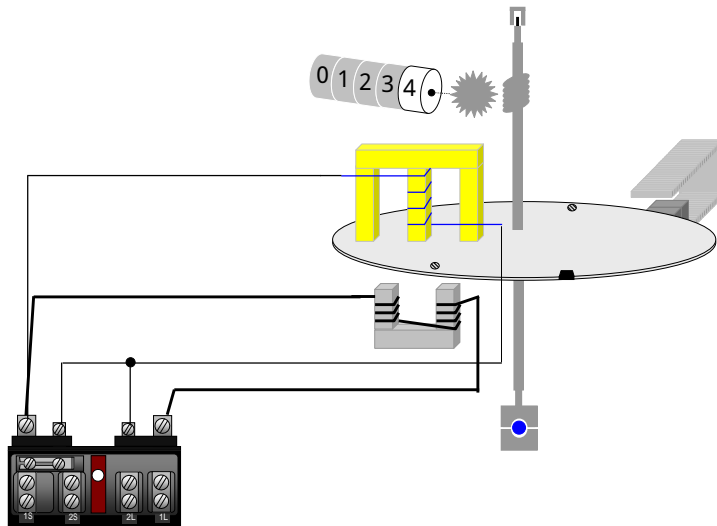
Fundamental structure of electromechanical induction meters

- The voltage coil, current coil and iron core
- Rotating disc and its bearings
- Braking magnet
- Adjusting devices
- Compensating devices
- Register

Structural



Structural (voltage coil)

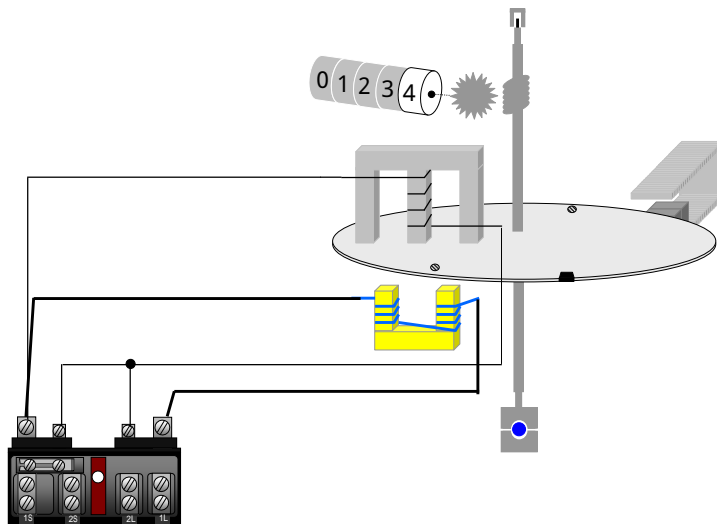


The voltage coil, current coil and iron core (1)

(1) Voltage coil

- The magnetic field lines produced by the voltage coil produce torque in the disc.
- The voltage coil wires are wound around more times than those in the current coil.

Structural (current coil)

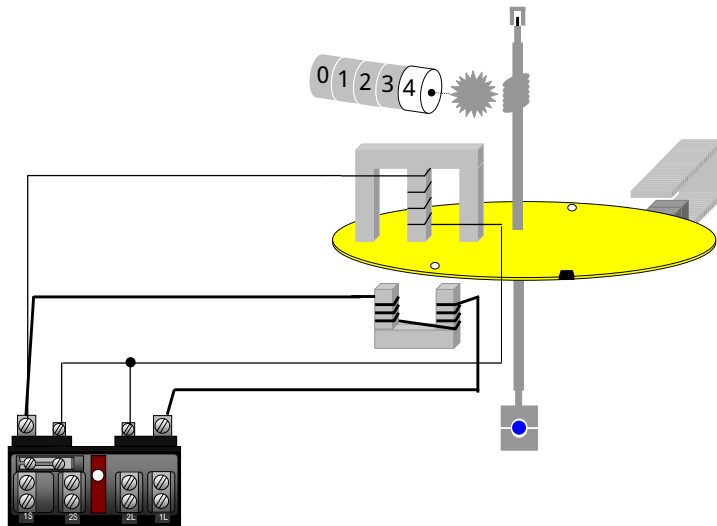


The voltage coil, current coil and iron core (2)

(2) Current coil

- The current coil is the coil for transmitting the load current.

Structural (rotating disc)

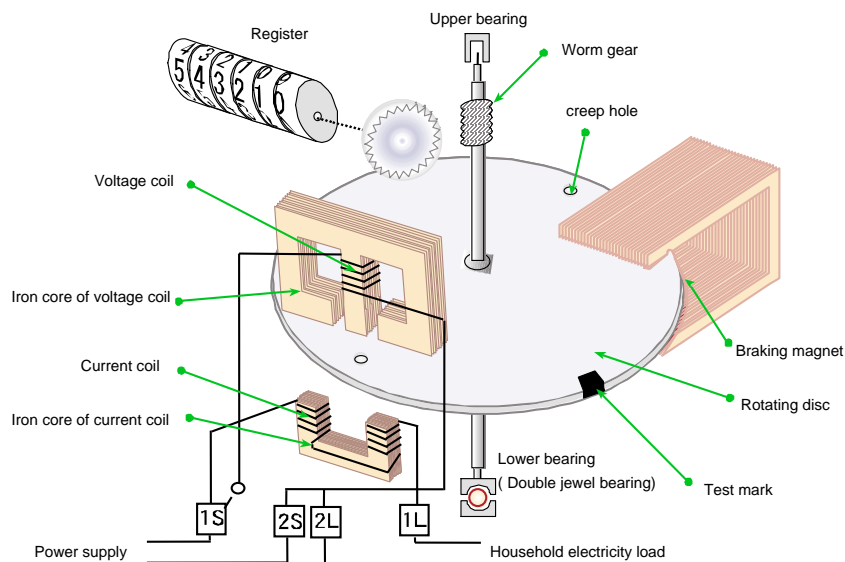


Rotating disc and its bearings (1)

(1) Rotating disc

- The disc is made of aluminum, which is 99.98% percent pure as the aluminum's properties affect meter performance
- It is attached to a duralumin or brass axle using a diecast made from a compound composed principally of lead, and it revolves with the upper and lower bearings as its support point.
- The disc also includes a worm for transmitting the revolutions to the register and holes to prevent creeping.

Structural

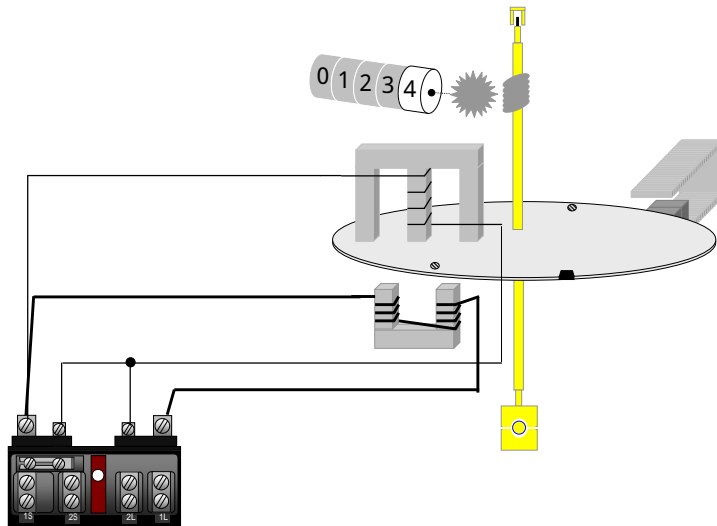


Rotating disc and its bearings (2)

- The disc also includes a worm for transmitting the revolutions to the register and holes to prevent creeping.

The electromechanical induction meters rotating disc has two creep holes to ensure that the disc does not revolve when no power is being consumed. This arrangement works on the principle that if the creep holes come beneath the drive magnetic pole, the eddy current in the disc alternates, and is pulled towards the electromagnet.

Structural (bearing)

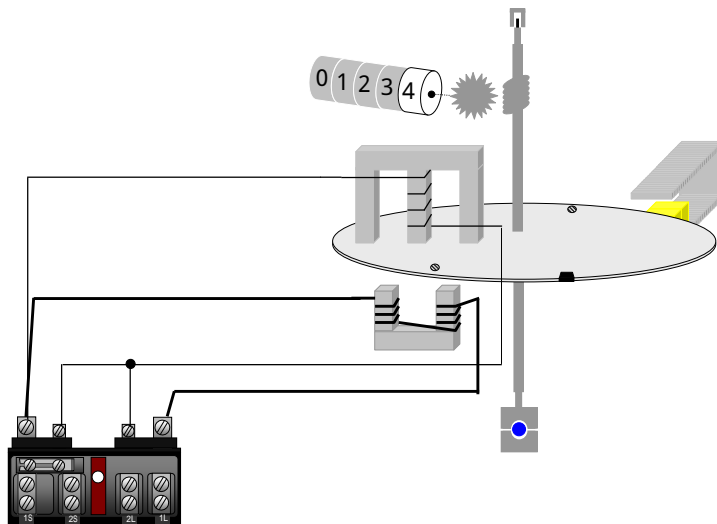


Rotating disc and its bearings (3)

(2) Bearings

- The upper bearing is a steel needle fixed into the meters supporting structure. It is inserted into the hole on the end of the disc axle and prevents the upper part of the disc from vibrating.
- The lower bearing consists of a steel ball sandwiched in between jewel bearings such as sapphire or ruby bearings.

Structural (braking magnet)



Braking magnet

- The braking magnet is used to make sure the disc revolutions are proportional to the load.
- It should have strong remnant magnetization and high coercivity.

Adjustment devices

The register indicates the volume of power consumed in accordance with the revolutions of the disc, which rotates in proportion to the power consumption.

There are two adjustment devices; dial register and cyclometer counter.

Adjusting devices

- The adjusting devices adjust the speed of disc rotation to precisely reflect the amount of power consumption.
- There are the following types of adjusting devices:
 - (1) The heavy-load adjusting device
 - (2) The light-load adjusting device
 - (3) The phase adjusting device

Compensating devices (1)

- The compensating devices maintain the meter's load, voltage, power factor and temperature within an acceptable range.

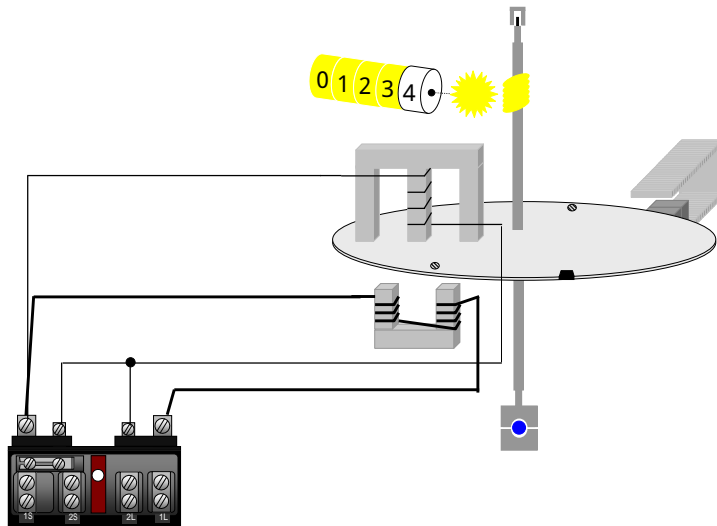
Therefore, compensating devices differ from adjusting devices

Compensating devices (2)

There are the following types of compensating devices

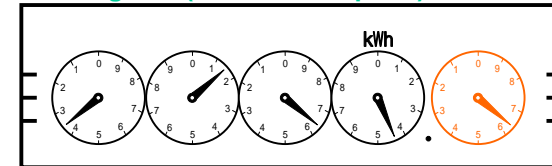
- (1) The heavy-load compensating device
- (2) The light-load compensating device
- (3) The phase compensating device
- (4) The voltage characteristic compensating device
- (5) The temperature compensating device

Structural (register)

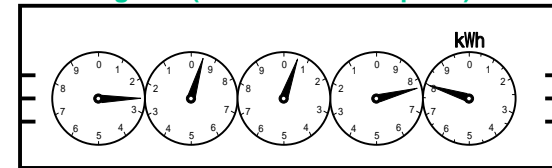


Example register display (1)

Dial register (with decimal point)

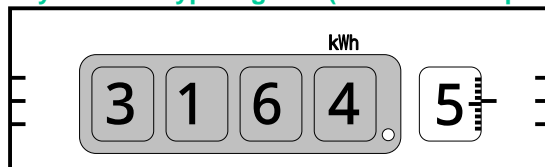


Dial register (without decimal point)

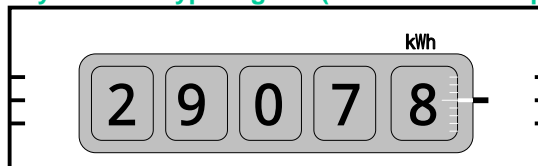


Example register display (2)

Cyclometer type register (with decimal point)



Cyclometer type register (without decimal point)



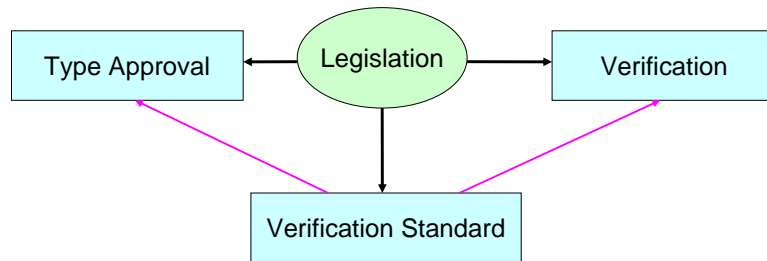
Conclusion

**Question?
&
Comment**

Thank you for your attention



Legislation



Contents

1. Measurement Law
2. Cabinet Order on Enforcement of Measurement Law
3. Regulation for Verification and Inspection of Specified Measuring Instruments
4. Regulation on Inspection of Verification Standard
5. Type Approval and Verification Body

Measurement Law

1. The Measurement Law obligates us to do accurate measurement to secure proper administration of measurement as stipulated by its objectives.
2. The Measurement Law, enforced in November 1st, 1993, forms the backbone of the measurement regime.

Cabinet Order on Enforcement of Measurement Law (1)

Administration of proper Measurement

1. Ministry of Economy Trade and Industry (METI)
2. Local Government
3. JEMIC



Cabinet Order on Enforcement of Measurement Law (2)

Specified measuring instruments

1. Specified measuring instruments shall mean Measuring instruments used in transaction or certification or supplied chiefly for the life of general consumers.
2. Those instruments are described by cabinet order as being necessary to establish the standard with respect to the construction or the instrumental error for the purpose of securing performance of proper measurements

Cabinet Order on Enforcement of Measurement Law (3)

Classification of specified measuring instruments

Taxi meter	Weighing instrument
Thermometer	Hide planimeter
Volume meter	Current meter
Density hydrometer	Pressure gauge
Flow meter	Calorimeter
<u>Maximum demand meter</u>	<u>Watt-hour meter</u>
<u>Var-hour meter</u>	Vibration level meter
Illuminometer	Noise level meter
Instruments for measuring concentration	Relative density hydrometer

Cabinet Order on Enforcement of Measurement Law (4)

Verification period for specified measuring instruments

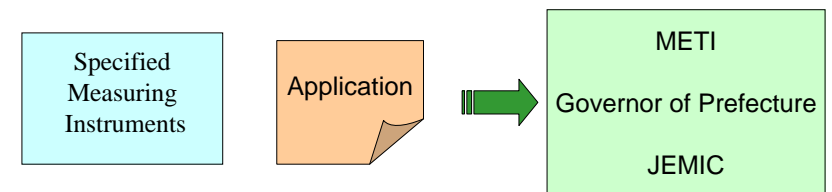
Taxi meter : 1year

Water meter : 8 years

Gas meter : 10 years

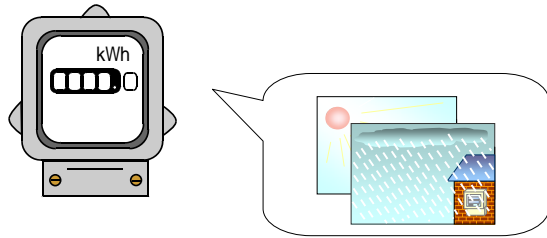
Regulation for Verification and Inspection of Specified Measuring Instruments (1)

Application for type approval and verification



Regulation for Verification and Inspection of Specified Measuring Instruments (2)

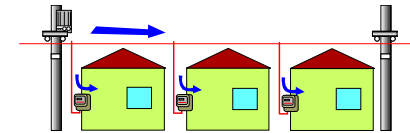
Requirements for type approval and verification
Technical Standards for Structure



Regulation for Verification and Inspection of Specified Measuring Instruments (3)

Requirements for specified measuring instruments in service

Specified measuring instruments such as electricity meters, also must comply with performance test as starting test, test of no-load condition and Maximum permissible errors in service.



Regulation on inspection of Verification Standards (1)

JEMIC has been requested to perform the inspection of verification standard by the specified standard

1. Application for inspection
2. Requirements for verification standards
3. Construction
4. Method of inspection

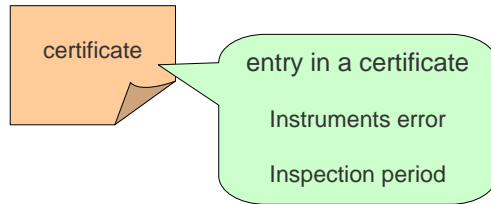
Regulation on inspection of Verification Standards (2)

Inspection Mark

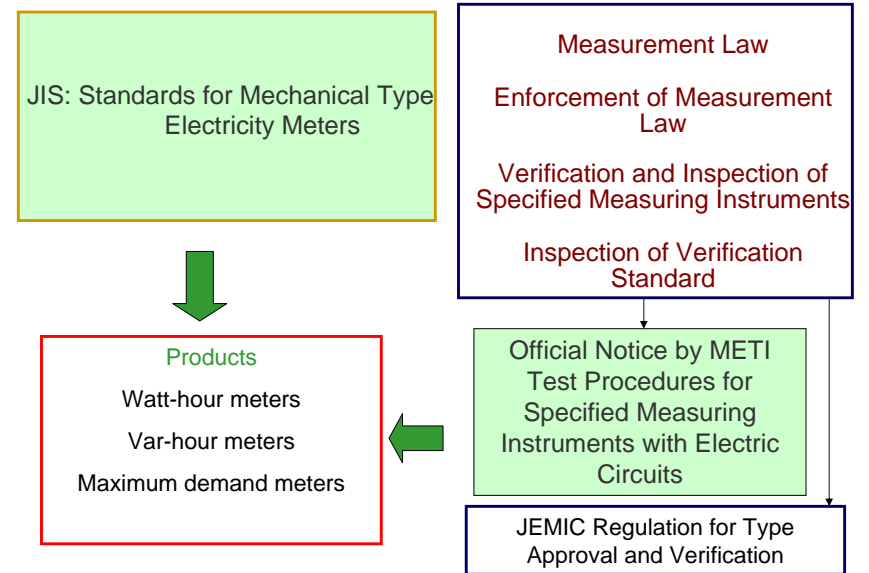


Regulation on inspection of Verification Standards (3)

Certificate of inspection of verification standards



Documentary Standards for Electricity Meters

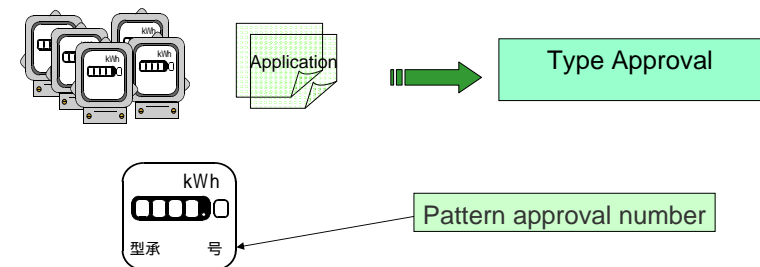


Type Approval and Verification body

The Japan Electric Meters Inspection Corporation (JEMIC) provide type approval and verification for the electricity meters used for tariff or certification purposes.

Type Approval

1. It is practically impossible to conduct all electrical performance tests for every mass-produced electricity meters due to the huge cost and time involved.
2. Therefore, these tests are conducted on samples of newly developed electricity meters and those passing the test are given a type approval number.



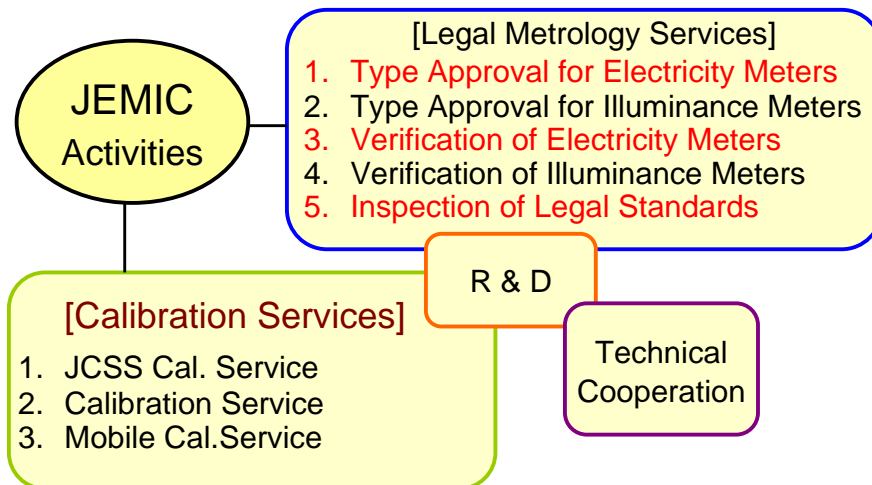
What is JEMIC ? (1)

1. In Japan the verification act of the electricity meter started at ETL(now AIST NMIJ) in 1912.
2. Then, the demand of verification increased with development of industry, and the more efficient and low cost system for verification is desired.
3. In such a reason, **JEMIC was launched** as a semi- government organization in 1964 **based on the JEMIC's law**.

What is JEMIC ? (2)

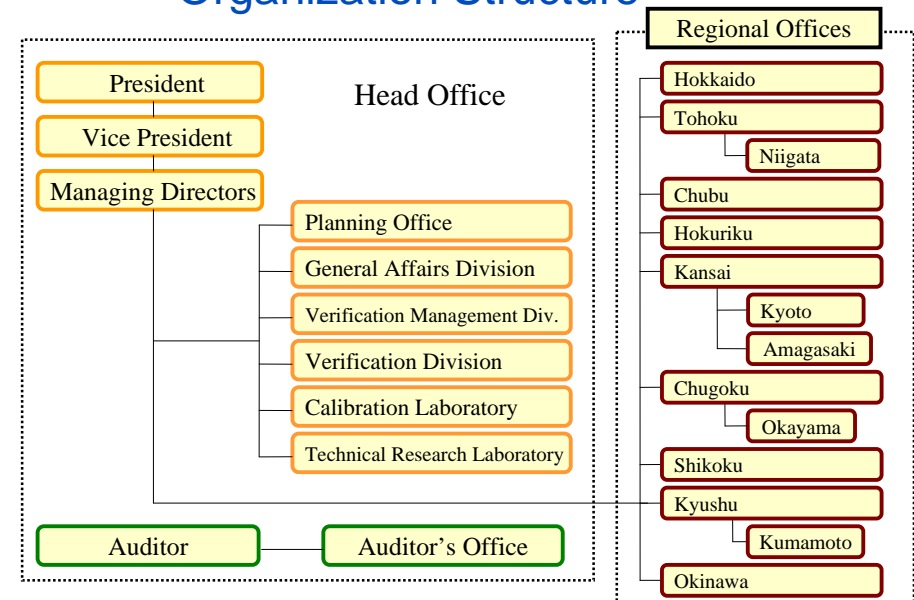
4. Simultaneously, JEMIC took over the verification activity which was being undertaken in ETL, the Japan Electric Association, and Tokyo metropolitan government.
5. Since then JEMIC has carried out the verification of electricity meters for 40 years.

What does JEMIC do?

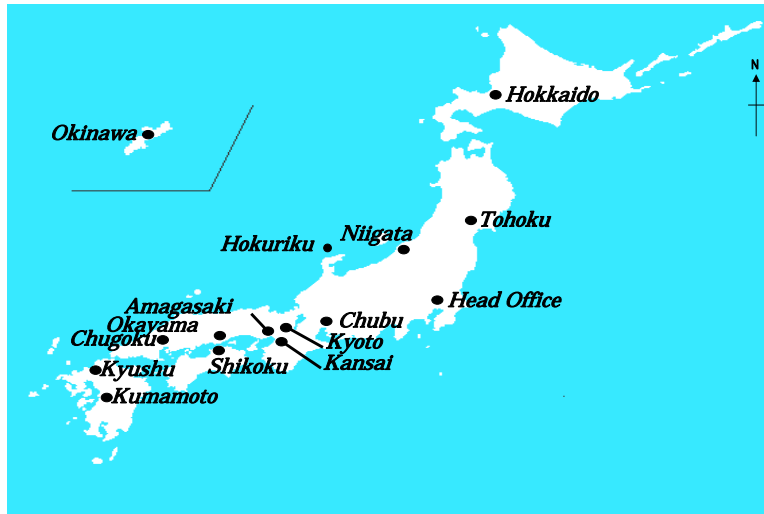


JCSS: The calibrations using the primary standards of the accredited calibration laboratories are carried out for the general industries

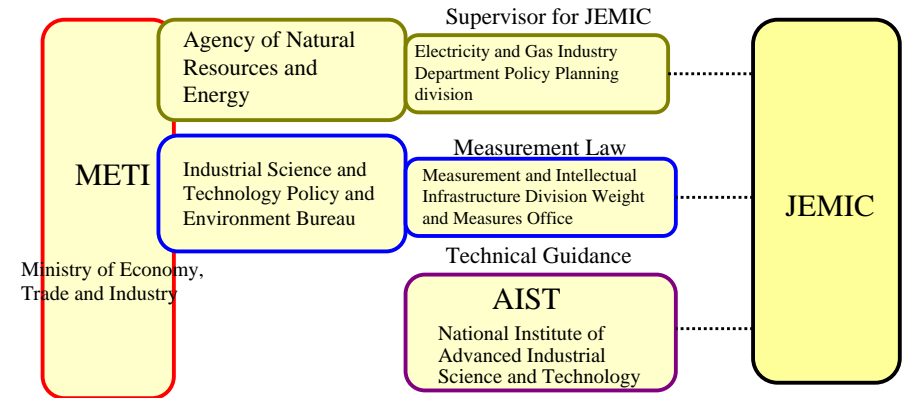
Organization Structure



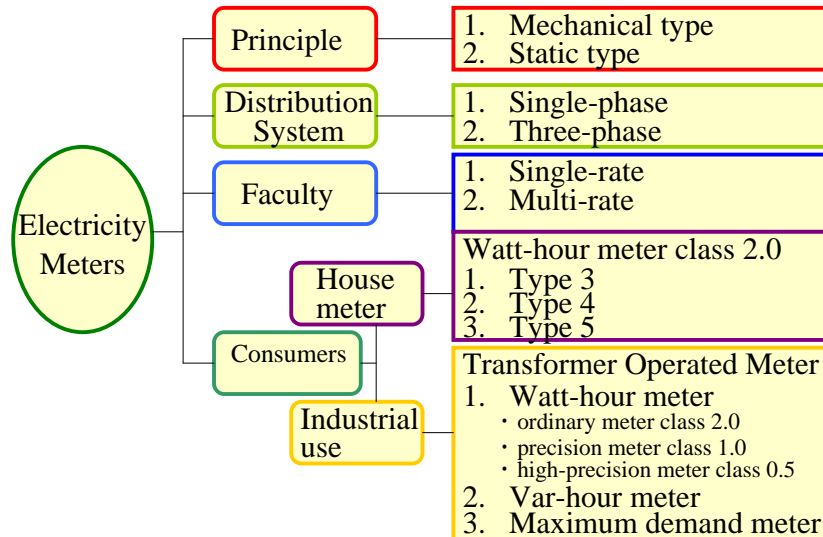
Location of Lab.s



Relationship Between JEMIC and METI



Classifications of the Electricity Meters in Japan



Summary of Legislation

1. Legal basis
The measuring instruments used for tariff purposes (specified measuring instruments) are regulated by the relevant regulations based on the Measurement Law of Japan.
2. National regulatory organization
Ministry of Economy Trade and Industry(METI)
3. Type approval and Verification body for Electricity meters
Japan Electric Meters Inspection Corporation (JEMIC)

Thank you for your Attention



Type Approval of Electricity Meters



Type approval

Purpose

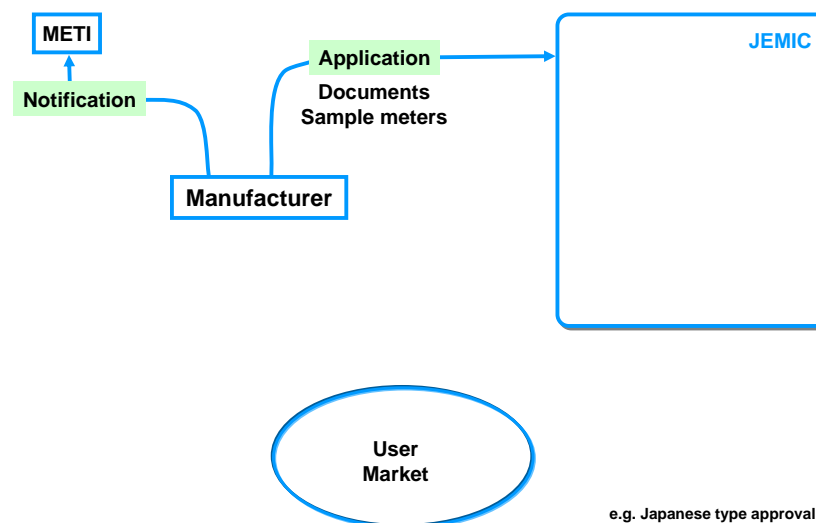
- To determine if a meter type is suitable for trade measurement
- To reduce the amount of testing required during verification
 - To find difficulty doing verification to individual meter
 - To need huge cost of verification and to take long time

Type approval

Process

- 1 Notification to National Authority
- 2 Application to testing laboratory
- 3 Type approval tests by testing laboratory
 - Determination
- 4 Manufacturer start production
- 5 Verification for individual meter
- 6 Installation to consumers

Type approval



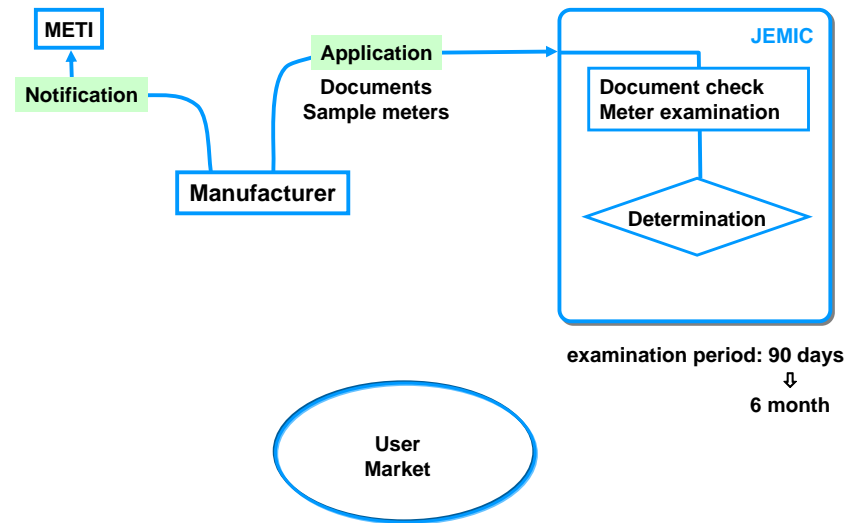
e.g. Japanese type approval flow

Type approval

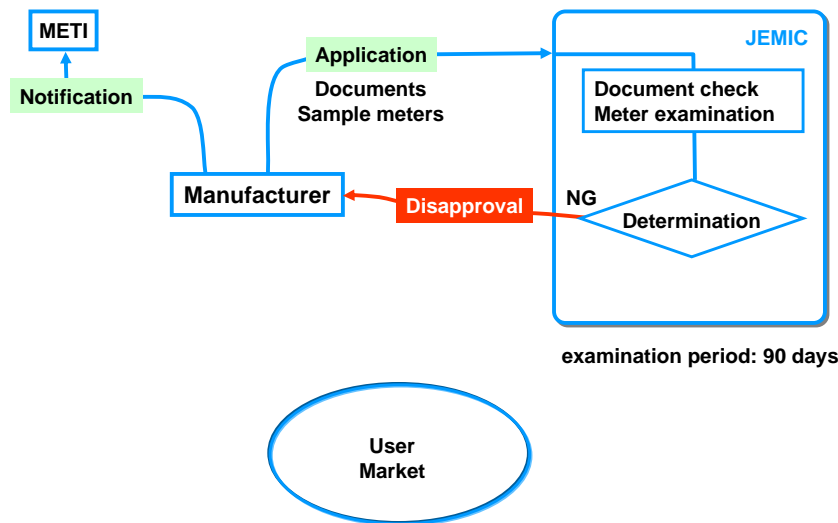
Application category

- New Type
 - To apply newly-developed meters
 - To carry out all tests
- Modification-type
 - To apply changing a part of the meter already approved
 - To carry out a part of tests

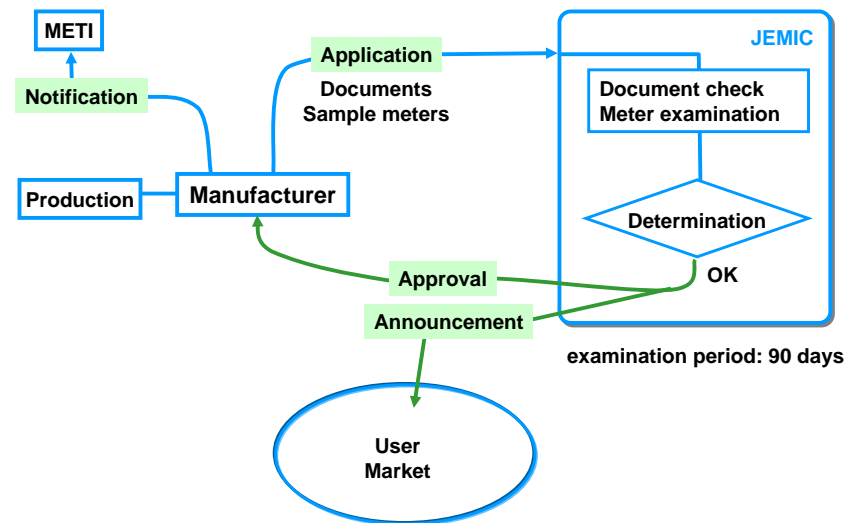
Type approval



Type approval

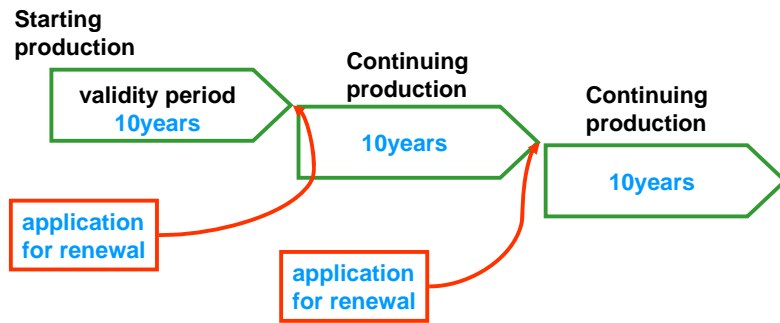


Type approval



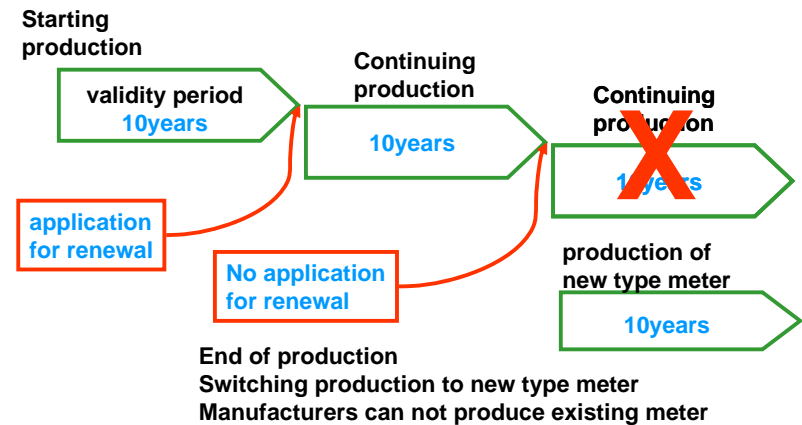
Type approval

Validity period of type approval



Type approval

Validity period of type approval

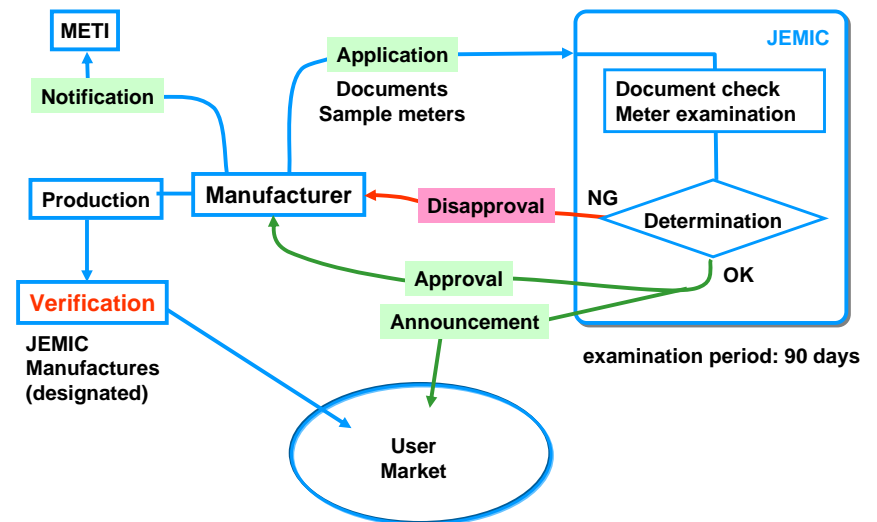


Type approval

Validity period of type approval

- To dispose of a approved meter using old technology
- To give opportunity introducing new technology
- To respond to the changing socially requirements
 - New devices
 - Accuracy improvement of measurement
 - Expansion of the measurement range
 - New tariff system
 - Environmental protection, Energy reducing consumption
 - New requirements - technical,mechanical,etc

Type approval



Type approval

Application

- Documents
 - Application form, Instruction manual
 - Appearance diagram, Rated value & range, circuit diagram, Software flowchart, Manufacturing process chart, Functional description, Sealing device, Communication diagram, use environment, Installation, etc
- Sample meters for tests
 - 5 peaces (as required)

Type tests

- Appearance&Mechanism check
- Accuracy tests
- Insulation tests
- Influence tests of disturbances
 - ◊ Mechanical Influence
 - ◊ EMC
 - ◊ Climatic Influence
- Durability test

Type tests

Appearance, Structure, Devices

- name plate
 - type name
 - name of manufacturer
 - year of product
 - classification
 - rated value - phase-wire, frequency, voltage, current, meter constant
- Structure
 - register
 - sealing devices
 - test pulse output devices(static meter)
 - test index mark(mechanical meter)

Type tests

Accuracy (basic performance)

- Frequency
 - 105% & 95% of I_{max}
- Voltage
 - 110% & 90% of I_{max}
- Current
 - I_{min} to I_{max}

Type tests

- Temperature
 - -10 to +50 deg C
- Self-Heating
 - I_{max}, 2 hours
- Starting → I_{start}
- No-load → no any current

Type tests

Insulation tests

- Insulation Resistance Test
 - DC500V 5Mohm
- A.C. Voltage Test
 - 2000V 1minuite
- Impulse Voltage Test
 - 6000V, 1.2/50 μ s

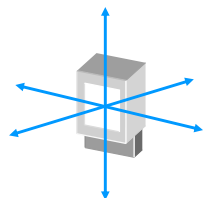


Type tests

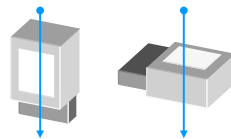
Influence of Disturbances

■ Mechanical performances

- Vibrations → 16.7Hz, 4mm
- Shocks → 500m/s²



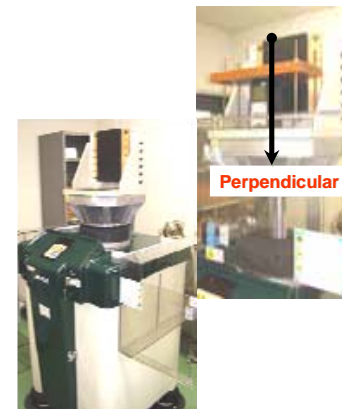
direction of vibrations



direction of shock

Type tests

Shock test

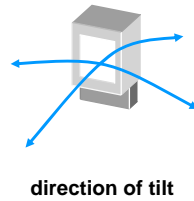


Vibration test



Type tests

- Tilt
→ 3 degree



- Grow-wire
→ 960 deg C
- Spring hammer
→ 0.2 J



Glow-wire test equipment

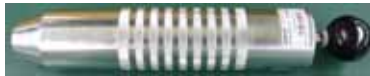
Type tests

Grow-wire (IEC60695-2)



Type tests

Spring hammer (IEC 60068-2-75)



Type tests

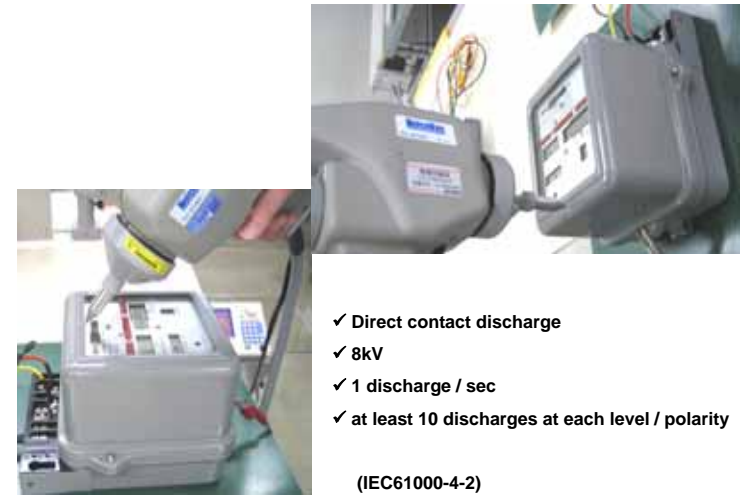
- Short-time Overcurrent
→ $I_{max} \times 20, 0.5s$

Type tests

■ EMC performances

- Electrostatic discharges(ESD)
- RF field
- Fast transient burst
- Voltage dips and short interruptions
- Magnetizing field
- Harmonics

Electrostatic discharges(ESD)



- ✓ Direct contact discharge
- ✓ 8kV
- ✓ 1 discharge / sec
- ✓ at least 10 discharges at each level / polarity

(IEC61000-4-2)

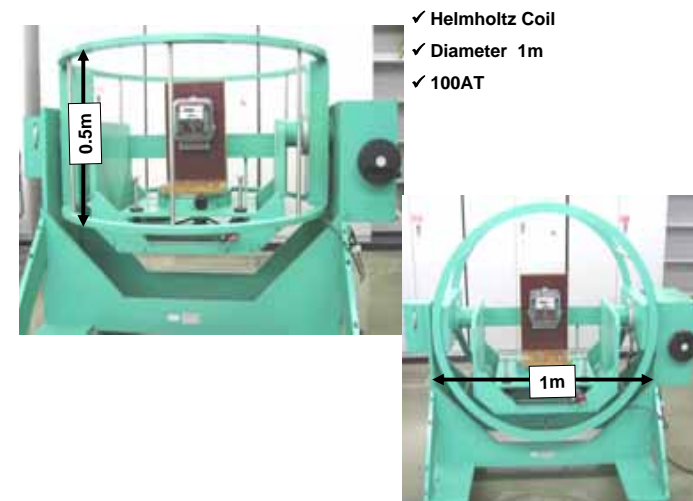
RF field

- ✓ Anechoic chamber
- ✓ 10V/m
- ✓ Biconical antenna (80-200MHz)
- ✓ Logperiodic antenna (200M-1GHz)

(IEC61000-4-3)



Magnetizing field



- ✓ Helmholtz Coil
- ✓ Diameter 1m
- ✓ 100AT

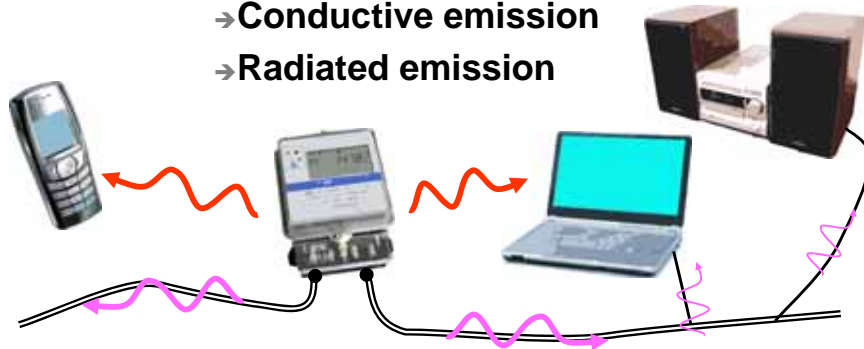
EMC

EMC (Electromagnetic compatibility)

■ EMI (Electromagnetic interference)

• Emission

- Conductive emission
- Radiated emission



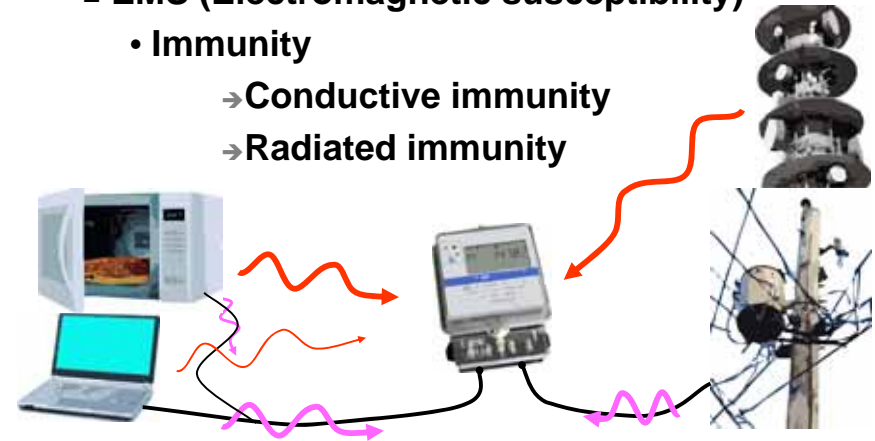
EMC

EMC

■ EMS (Electromagnetic susceptibility)

• Immunity

- Conductive immunity
- Radiated immunity



Type tests

■ Climatic performance

- Solar radiation
- Water
- Higher & Lower temperature
- Humidity
- Heat cycle
- Salt mist



Solar radiation



- ✓ SUNSHINE WEATHER METER
- ✓ Carbon-arc lights



Salt mist

- ✓ Salt mist spray test chamber
- ✓ 5% salt concentration



Type tests

■ Durability performance

- Durability
 - I_{max}, 1000 hours

→ To relate Verification validity period

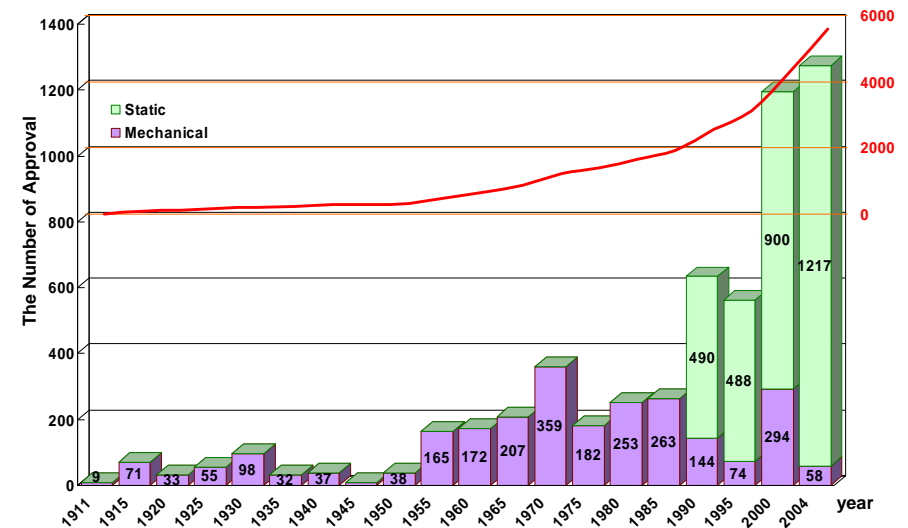


Type approval

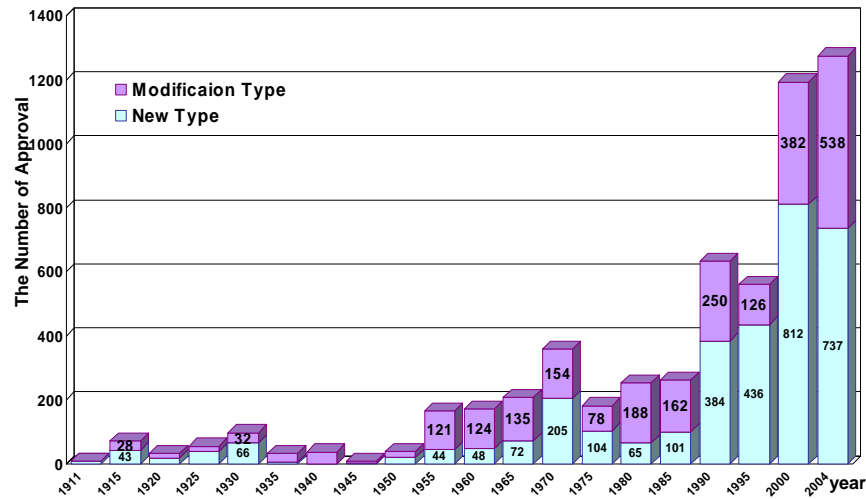
Conclusion

- New type, Modification type
- Application
 - ◊ Documents, Sample meters
- Tests
 - ◊ Accuracy(basic characteristics)
 - ◊ Influence performances
 - Mechanical, Electrical, EMC, Climatic tests

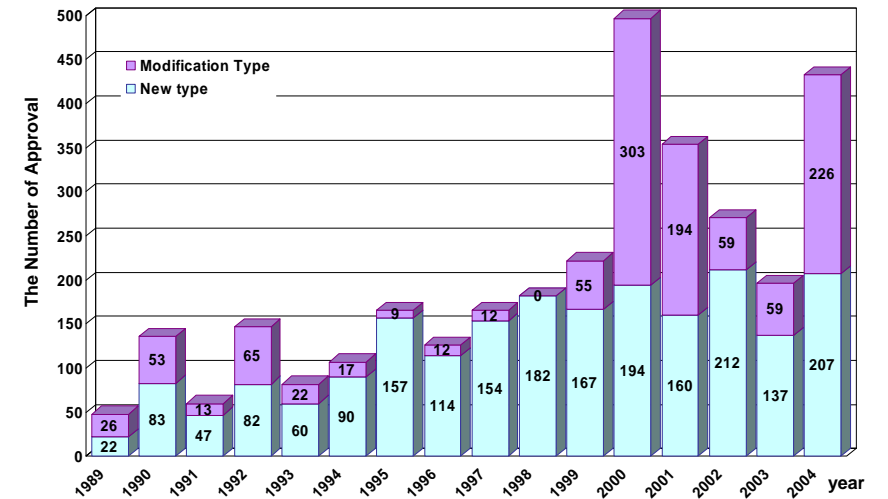
Statistics



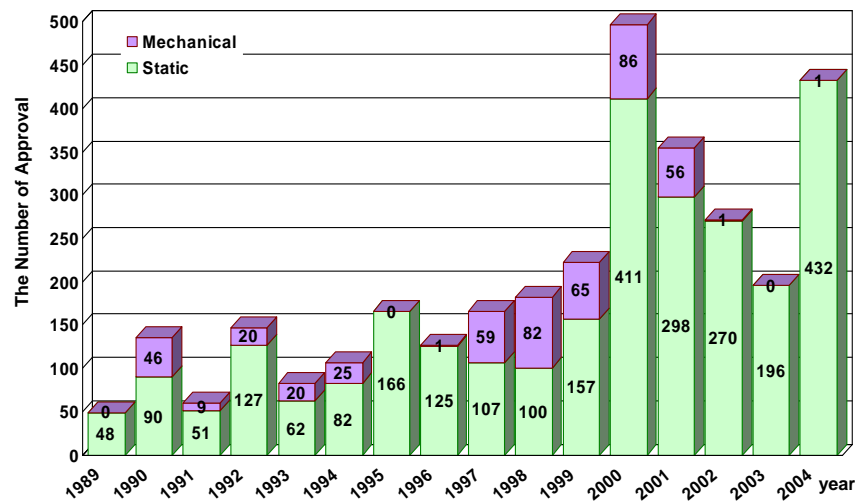
Statistics



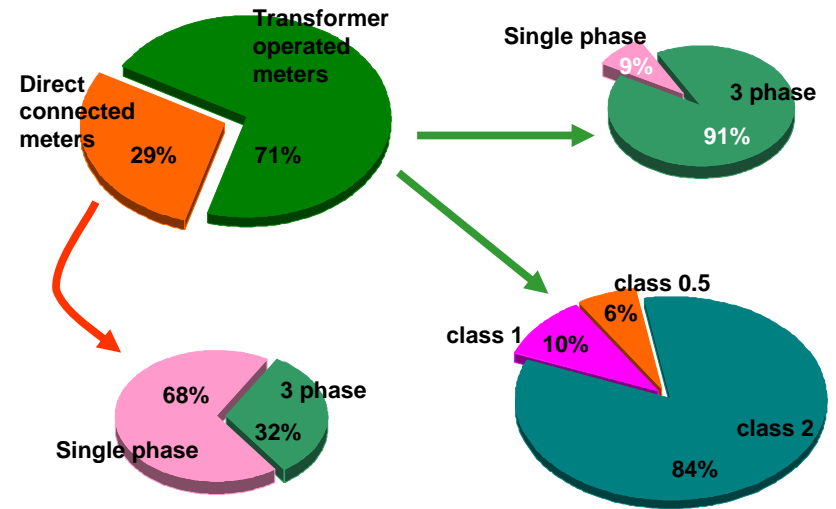
Statistics



Statistics



Statistics



Type approval

Comments ?

Questions ?



Verification



Slide 1

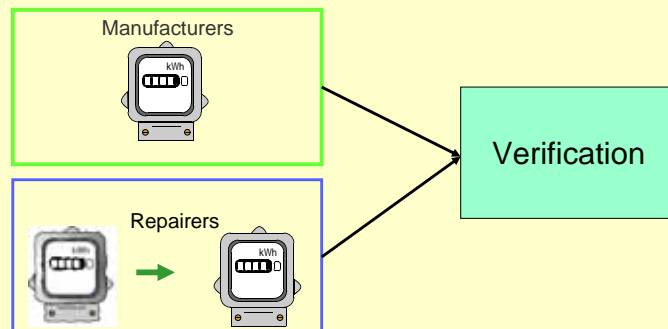
Contents

1. Verification body
2. Verification procedure
3. Testing System for electricity meters
5. Inspection of Instrument Transformers
6. Statistics

Slide 2

Verification body (JEMIC)

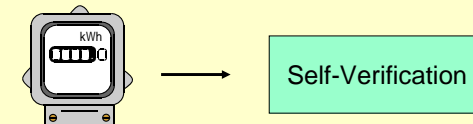
1. Under the **ministerial ordinance**, JEMIC carries out verification tests on each meter submitted for verification.
2. The tests specified in the ordinance are the **same** for both **new and repaired meters**.



Slide 3

Verification body (designated manufacturer 1)

1. In 1992, the new Measurement Law came into force in JAPAN.
2. The Major change is the introduction of self-verification system for electricity meters by the designated manufacturers of meters which has the same effect as the national verification.
3. The self-verification of electricity meters was introduced on October 31, 1998 after the grace period of six years.



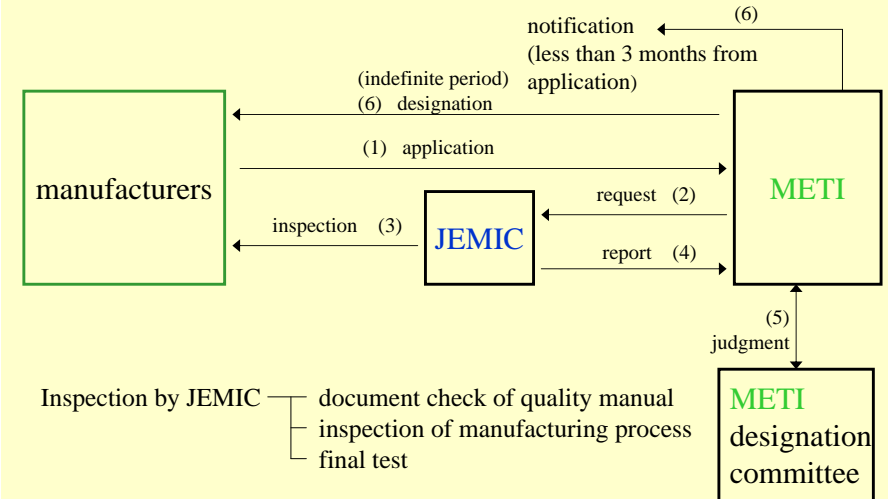
Slide 4

Verification body (designated manufacturer 2)

4. Before manufacturers can certify meters they have to meet certain conditions imposed by the ministerial ordinance of the Measurement Law.
5. One of conditions imposed by the ordinance requires manufacturers to have a Quality Assurance System that meets closely the requirement of ISO9001.
6. Manufacturers have to nominate a representative who takes responsibility for the quality assurance of production and certification of meters.

Slide 5

Designation Procedure for Manufacturers in Japan



Slide 6

Verification Procedure (1)

Tests for type approved meters

Meters tested for verification shall comply with the following requirements:

1. Insulation requirement
2. Starting current requirement
3. No-load requirement
4. Error test

Slide 7

Verification Procedure (2)

Test Conditions

1. Temperature: $23^{\circ}\text{C} \pm 5^{\circ}\text{C}$.
($23^{\circ}\text{C} \pm 2^{\circ}\text{C}$ for high precision watt-hour meters)
2. Voltage: rated voltage $\pm 0.3\%$
3. Frequency: rated frequency $\pm 0.5\%$
4. Voltage and Current waveforms: Distortion Factor
 - Mechanical Type $< 3\%$
 - Static Type $< 2\%$
($< 1\%$ for high precision watt-hour meters)

Slide 8

Verification Procedure (3)

Verification Mark and Sealing

(1)

1. The verification mark shall be affixed to the meters which have passed the verification.



2. JEMIC has devised new sealing system, consisting of an ABS plastic cap loaded with a stainless steel spring.
3. The system permits a simple sealing process.

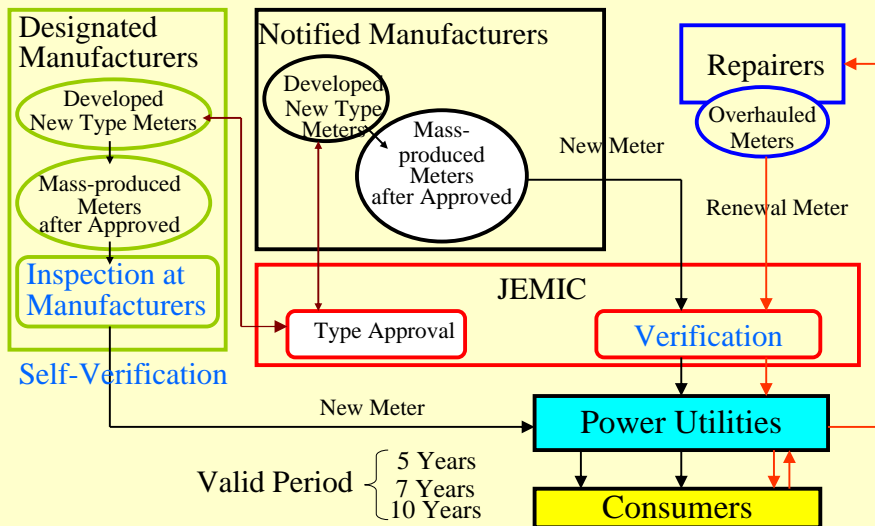
Slide 9

Verification Mark and Sealing (2)



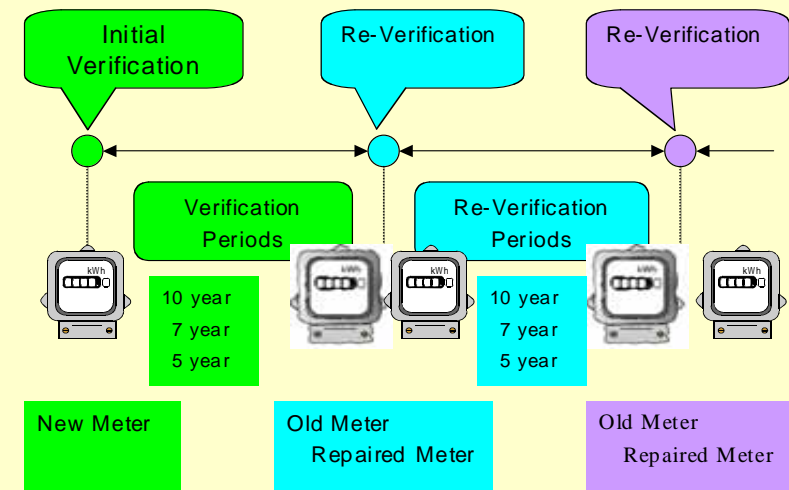
Slide 10

Legal Electricity Meters Verification Scheme in Japan



Slide 11

Verification · Re-Verification



Slide 12

Verification System for Electricity Meters in Japan (1)

1. In Japan, **all the electricity meters** used for electric dealings are **examined**.
2. The number of the examination items performed in order to test the performance of the electricity meter **exceeds 30 items**.
3. In the daily examination, a **huge amount of time and expense** are required to examine all of these examination items.

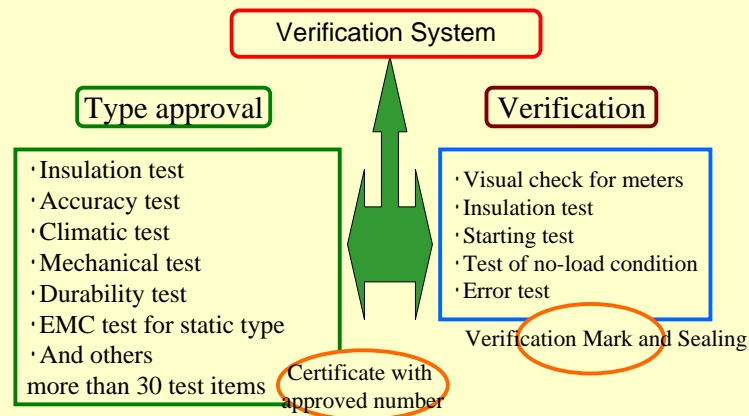
Slide 13

Verification System for Electricity Meters in Japan (2)

4. The examination system is **divided into the type approval and the daily examination** in order to carry out the verification system **more efficiently and economically**. That is, the **sampled meter** is submitted to JEMIC. The examination of **all items** is performed about these meters.
5. The sampled meter which passed all examinations receives **type recognition**.
6. As for the meter of the same type as the meter which received type recognition, many of examination items are **omitted**.

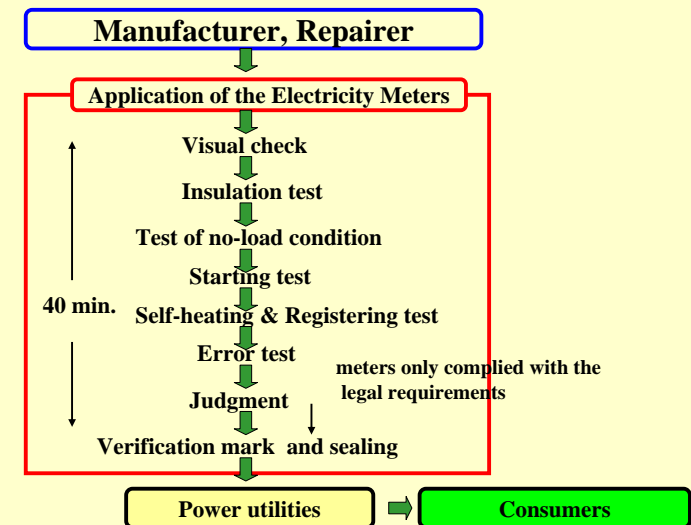
Slide 14

Verification System for Electricity Meters in Japan (3)



Slide 15

The daily Verification process



Slide 16

Time Limit to Perform Verification

Periods prescribed by the Regulation are as follows:

1. Type approved direct-connected meter (Domestic meter): 20 days
2. Type approved transformer operated meter: 20 days
3. Type approved transformer operated meter and instrument transformer: 30 days
4. Inspection of instrument transformer carried out at consumer's premises: 50 days

Slide 17

Automatic Testing System for Electricity Meters (1)

The automatic watt-hour meter testing system consists of 4 meter benches, a power source unit and P.C.

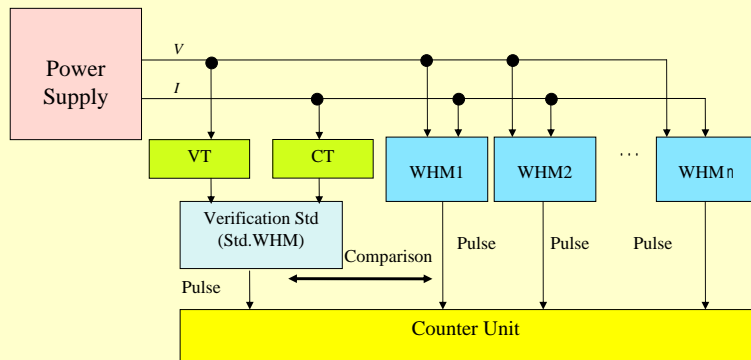
A group of 20 watt-hour meters undergoes the registering test after the no load test and starting current test.

The result of error tests are printed out.



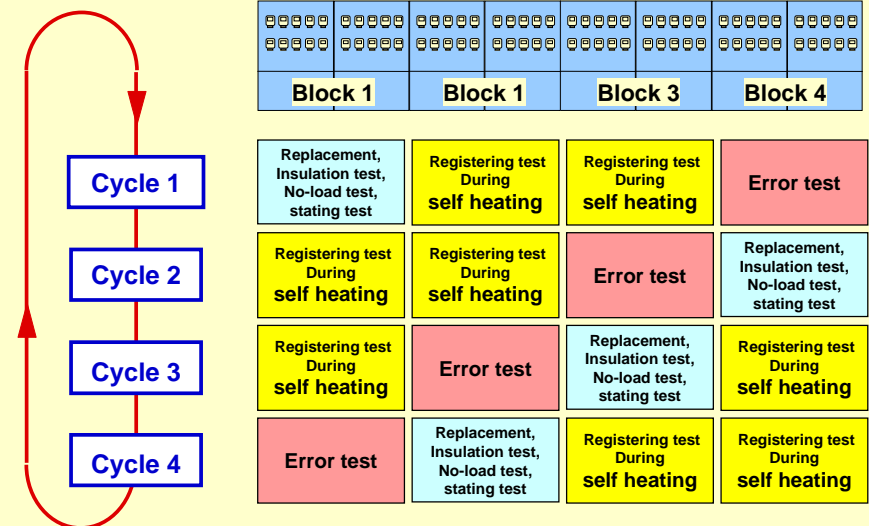
Slide 18

Automatic Testing System for Electricity Meters (2)



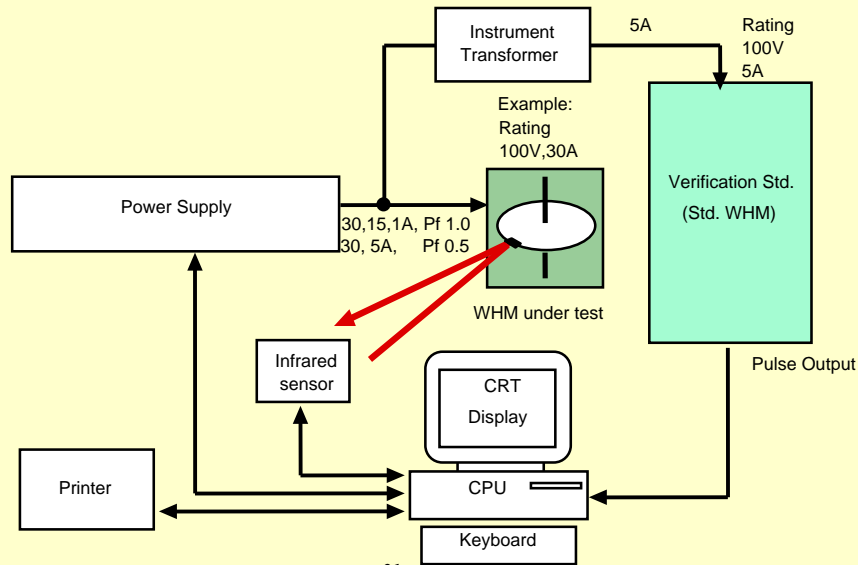
Slide 19

Cyclic Operation of the Automatic Testing Equipment



Slide 20

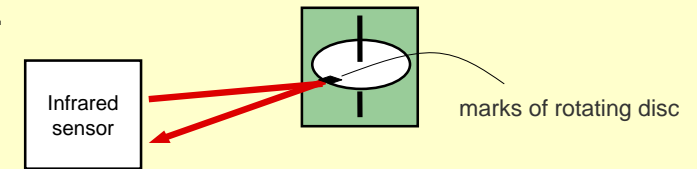
A Test Method (1)



Slide 21

A Test Method (2)

The revolutions of the rotating disc of the meters being tested are detected by an infrared sensor and are compared with the out put pulse of the standard watt-hour meter.



Slide 22

IRS Apparatus

Mark detection (Electromechanical meters)

Photo detection (Static meters)



Slide 23

Calculation of the error of electricity meter

The error of electricity meter used for test is calculated according to the following formula:

$$= (R / T - 1) \times 100 (\%)$$

: The error of electricity meter used for test (%)

R: The quantity registered by the meter used for test

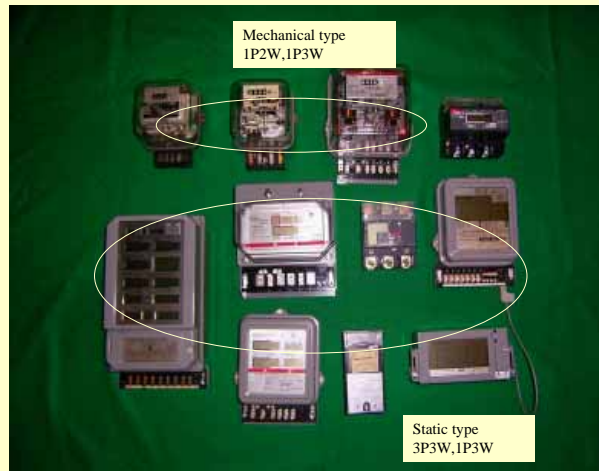
T: The true value of the quantity indicated by the verification standard

e_s : The error of verification standard (%)

e_i : Resultant error of instrument transformer (%)

Slide 24

Different types of electricity meters



Slide 25

Inspection of Instrument Transformers (1)

Instrument Transformers used with electricity meters shall comply with the legal requirements for inspection.



Slide 26

Inspection of Instrument Transformers (2)

Instrument transformers are classified into three:

1. A current transformer (CT) that transfers current of a large-current to small current (usually 5A) in Japan.
2. A voltage transformer (VT) which steps down high voltage to low voltage (usually 110V) in Japan.
3. Transformer (VCT) which contains both a current transformer and a voltage transformer and is mainly used for measuring electric power.

Slide 27

Combined errors of Instrument Transformers and Transformer Operated Meters

1. The combined errors shall comply with the maximum permissible errors for inspection.
2. Combined error = error of transformer operated meter + error of instrument transformer



Slide 28

Matching number

If the combined errors comply with the legal requirements for inspection, the matching number shall be attached to the meters and instrument transformers to ensure that combination of them is not changed in-service.



6600V 20A



Slide 29

Inspection of Instrument Transformers

Standard High Voltage Transformer



Slide 30

Maximum Permissible Errors for Verification

1. Domestic meters (Direct-connected watt-hour meters)

	Maximum Permissible Errors	Power Factor	Test Current
Type 2	2.0%	1	5%In, 50%In, 100%In
	2.5%	0.5 inductive	20%In, 100%In
Type 3	2.0%	1	3.3%In, 50%In, 100%In
	2.5%	0.5 inductive	20%In, 100%In
Type 4	2.0%	1	2.5%In, 50%In, 100%In
	2.5%	0.5 inductive	20%In, 100%In
Type 5	2.0%	1	2%In, 50%In, 100%In
	2.5%	0.5 inductive	20%In, 100%In

Slide 31

2. Transformer operated meters

	Maximum Permissible errors	Power factor	Test current
Ordinary watt-hour meters	2.0% (2.0%)	1	5%In, 50%In, 100%In
	2.5% (2.5%)	0.5 inductive	20%In, 100%In
Precision watt-hour meters	1.0% (1.2%)	1	20%In, 50%In, 100%In
	1.5% (1.8%)		5%In
	1.0% (1.3%)	0.5 inductive	20%In, 50%In, 100%In
	1.5% (2.0%)		5%In
High precision watt-hour meters	0.5% (0.6%)	1	20%In, 50%In, 100%In
	0.8% (1.0%)		5%In
	0.5% (0.7%)	0.5 inductive	20%In, 50%In, 100%In
	0.8% (1.1%)		5%In
Var-hour meters	2.5% (2.5%)	0	100%In
		0.866 inductive	20%In, 50%In, 100%In
Maximum demand meters	3.0% (3.0%)	1	10%In, 50%In, 100%In
		0.5 inductive	100%In

Note (1) In: Rated current

(2) (): Maximum Permissible errors for a meter error + an instrument transformer error

Slide 32

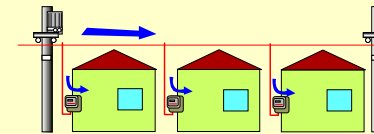
3. Maximum Permissible Errors for Meters in-service and Verification period

Electricity meters	Maximum permissible errors in-service	Verification period (in years)
Domestic Watt-hour meter 100%In to 20%In, pf 1 Rated current: 30, 120, 200 , 250A Rated current: 20, 60 A	+/-3.0%	10 7 (20, 60A)
Precision watt-hour meter 100%In to 10%In, pf 1 5%In, pf 1 Rated current: 5 A	+/-1.7% +/-2.5%	5(mechanical Type) 7(static Type)
High precision watt-hour meter 100%In to 10%In, pf 1 5%In, pf 1 Rated current: 5 A	+/-0.9% +/-1.4%	5(mechanical Type) 7(static Type)
Var-hour meter 50%In, pf 0.866 Rated current: 5 A	+/-4.0%	5(mechanical Type) 7(static Type)
Maximum demand meter 50%In, pf 1 Rated current: 5 A	+/-4.0%	5(mechanical Type) 7(static Type)

Slide 33

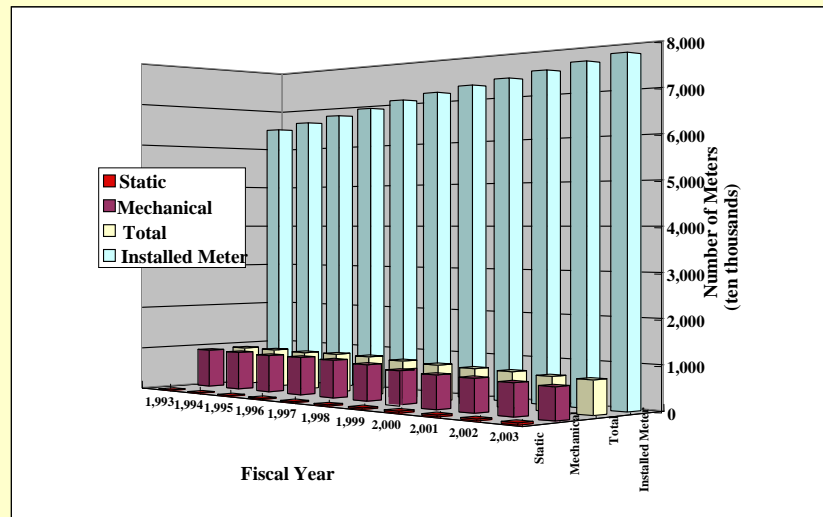
Number of Electricity Meters in-service (at 2005/4)

1. Direct-connected meter
Domestic meter: 75,737,134pcs
2. Transformer operated meter
Industrial use meter: 3,794,558pcs



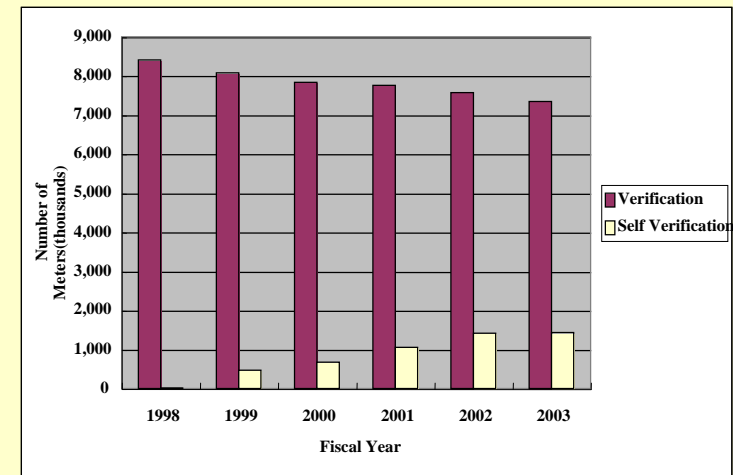
Slide 34

Number of Electricity meters in service and Number of Meters Verified



Slide 35

Number of Meters Verified by JEMIC or Designated Manufactures



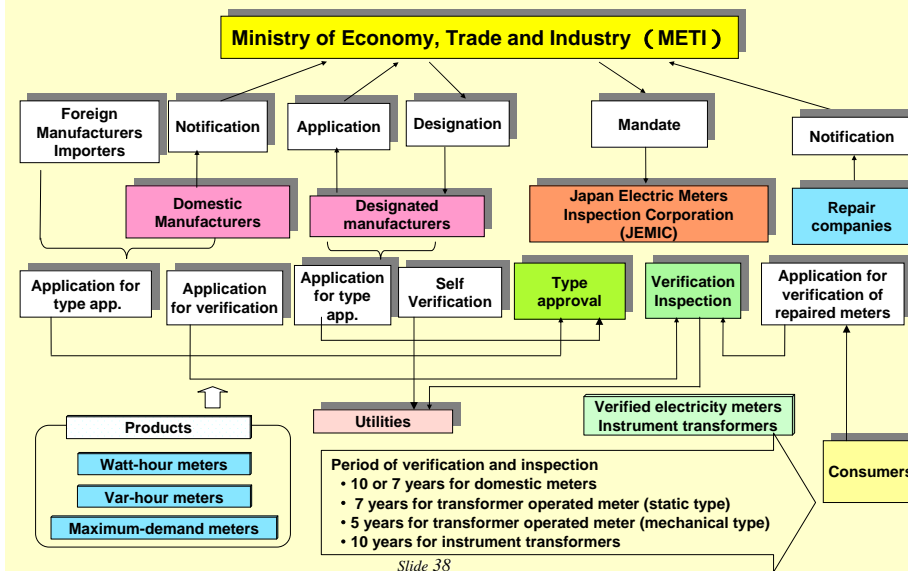
Slide 36

Verification Fees (Cabinet Order)

1. Type approved direct-connected meter: (4US\$)
 Initial verification of 1p3w 30A meter; 446 yen
 Subsequent verification of 1p3w 30A meter; 480 yen
2. Type approved transformer operated meter:
 Initial verification of 3p3w ordinary watt-hour meter; 2,464 yen
 Subsequent verification of 3p3w ordinary watt-hour meter; 2,650 yen
3. Instrument transformer:
 Voltage transformer 3p3w 6.6kV ; 4,600 yen
 Current transformer 3p3w 50A : 3,300 yen

Slide 37

Scheme of Legal Metrology for Electricity Meters



Slide 38

Summery of Verification

1. Initial verification is performed by JEMIC or designated manufactures. (at this moment 10 manufactures)
2. Subsequent verification is performed by JEMIC.
3. Meters tested for verification shall comply with the maximum permissible error and technical requirements.

Slide 39

Thank you for your Attention



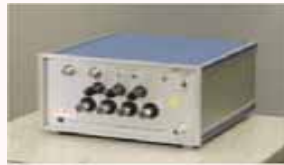
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APEC/APLMF Seminars and Training Courses
in Legal Metrology; (CTI-11/2006T)
Seminar on Electricity Meters
19 -22 March, 2007
in Beijing, the People's Republic of China



Verification Standards



Slide 1

Contents

1. Inspection of Verification Standards
2. Traceability system of power and energy standards (Verification Standards)
3. Introduction of National Standard for power and energy
(A Digital System for Calibrating Active/Reactive Power and Energy Meters)

Slide 2

Importance of verification standards

Energy Saving

- Kyoto protocol(carbon reduction treaty)
- EU Action Plan for Energy Efficiency

Energy Measurement

- Confirmation of energy saving reduction of carbon-dioxide
- Accurate measuring instrument(verification standard)
- Traceability ensuring of reliability of measurement results

Slide 3

Electricity Consumption (2003)

USA: 4050 Billion kWh
China: 1910 Billion kWh
Japan: 1040 Billion kWh
Russia: 910 Billion kWh

1040 Billion kWh 130 Billion US \$

Impact of 1% measurement error ?



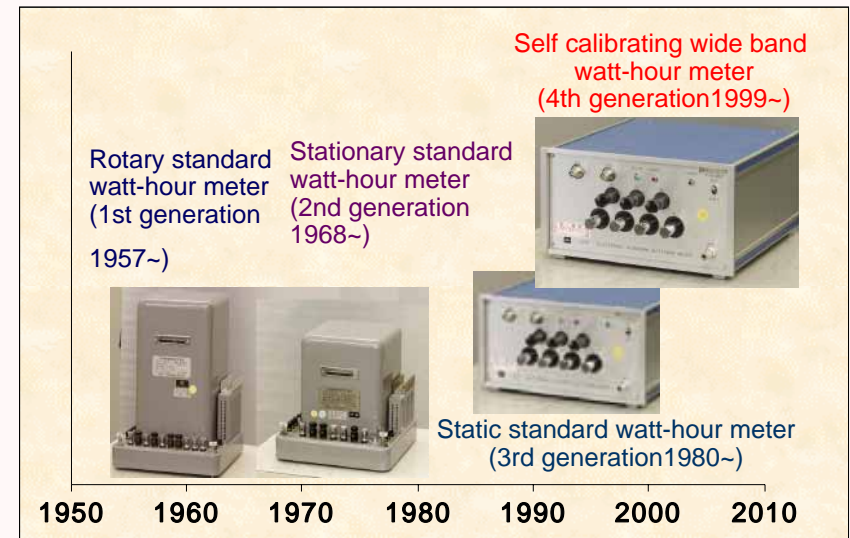
Slide 4

Inspection of Verification Standards (1)

1. The use of standard of specific accuracy is essential to ensure and maintain the reliability of verification.
2. The measurement law demands that not only verification organizations for electricity meters but also business which manufacturers and repairers such meters be equipped with verification standards(legal standards).
3. The legal standards such as standard watt-hour meters are inspected by JEMIC.

Slide 5

Standard Watt-Hour Meters



Inspection of Verification Standards (2)

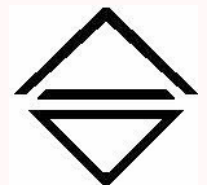
1. The JEMIC carries out calibration of power and energy standard for industry and inspection of tariff and certification electricity meters.
2. Power and Energy measurement system which is designated as Primary Measurement Standard was developed by JEMIC.
3. The JEMIC maintains such Primary Measurement Standard as power and energy standard.

Slide 7

Inspection Mark of Verification Standards

- | | |
|--------------------------|-------|
| 1. Term of Validity; | 1Year |
| 2. Instruments Error; | |
| High Precision Standards | 0.2% |
| Precision Standards | 0.5% |

A measuring instrument which has passed the inspection of verification standards shall be affixed with an inspection mark of verification standards.



Slide 8

Traceability system of power and energy standards (Verification Standards) (1)

1. JEMIC establishes power and energy standards and supplies these standards to industries.
2. The scope and uncertainty of calibration service by JEMIC as an accredited calibration laboratory are shown as next page.
3. Power and Energy measurement system which is designated as Primary Measurement Standard was developed by JEMIC.

Slide 9

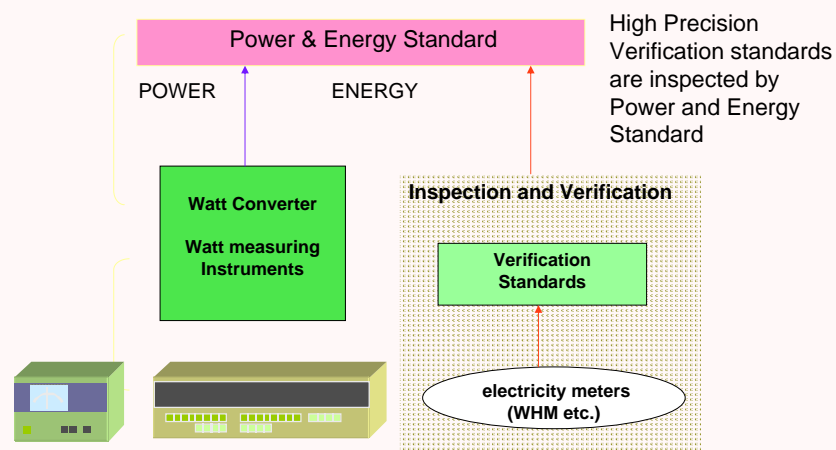
Calibration scope and uncertainty by using Primary Standard

	Scope of the Calibration Service		Best Uncertainty
			(k= 2)
Power	Watt Converter	<110V, <50A, 45 - 65Hz	50ppm
	Power Measuring Instrument	<110V, <50A, 45 - 65Hz	48ppm
Energy	Watt-hour Meter	<110V, <50A, 45 - 65Hz	50ppm

Best Uncertainty : 100V, 5A, 50Hz,60Hz, 1Phse 2-Wire

Slide 10

Traceability system of power and energy standards (Verification Standards) (2)



Slide 11

A View of Electric Energy Measurement



Slide 12

Introduction of National Standard for power and energy

A DIGITAL SYSTEM FOR CALIBRATING ACTIVE/REACTIVE POWER AND ENERGY METERS

Voltage : 100V

Current : 5A

Frequency : 50, 60Hz

Simple approaches for power/energy measurement with digital technique.



Slide 13

System Overview

Basic Principle

Active power (P) and reactive power (Q) can be calculated from voltage (U), current (I) and phase angle (ϕ).

$$P = UI\cos\phi$$

$$Q = UI\sin\phi$$

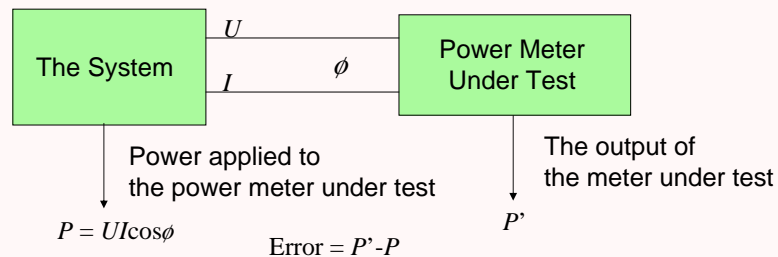
Slide 14

The power calibration system

generates U and I with phase angle ϕ ,

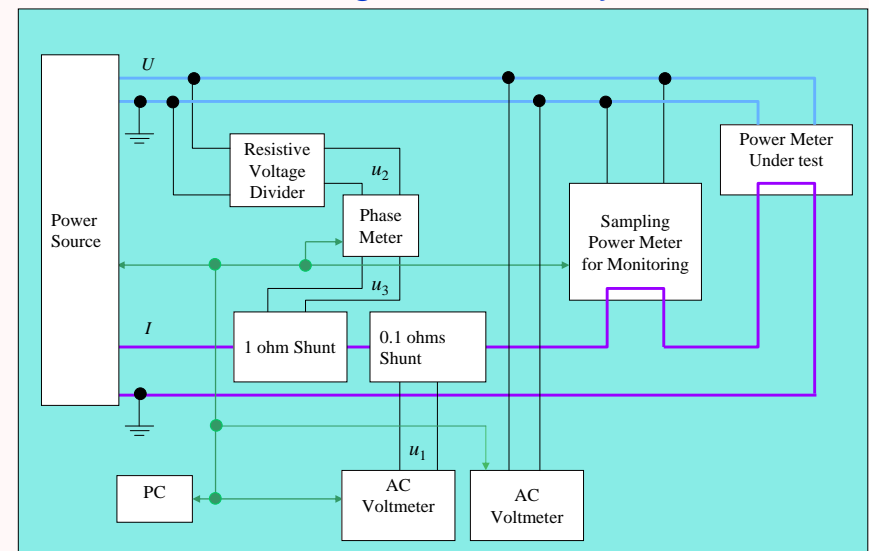
measures U , I and ϕ individually,

calculates P and Q from the measurement results of U , I and ϕ according to the "basic principle".



Slide 15

Block Diagram of the System



Slide 16

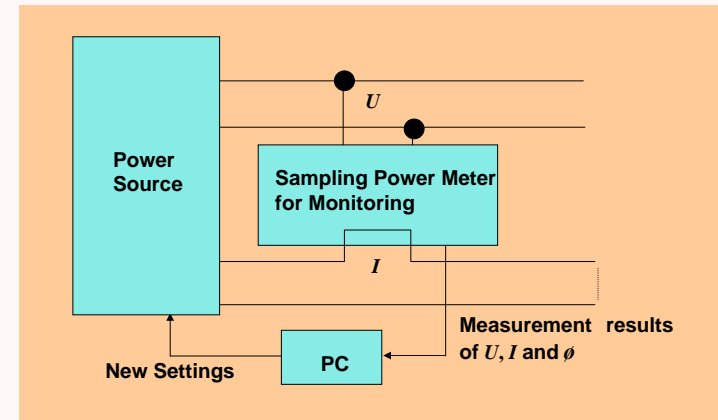
JEMIC

A view of Primary Standard for power and energy



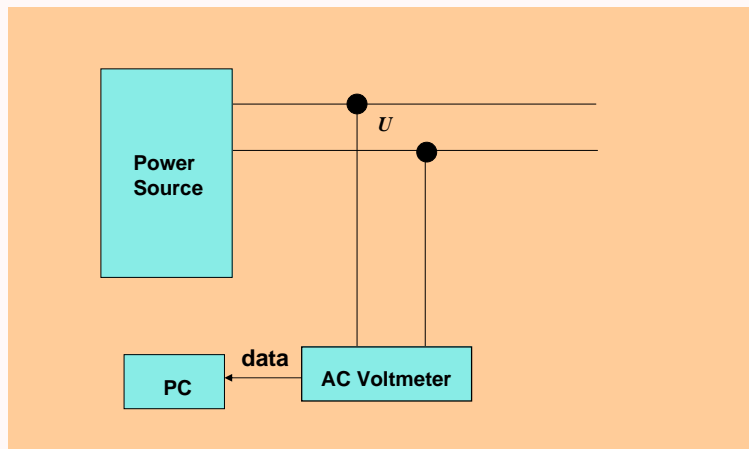
Slide 17

Monitoring the power source with the sampling power meter



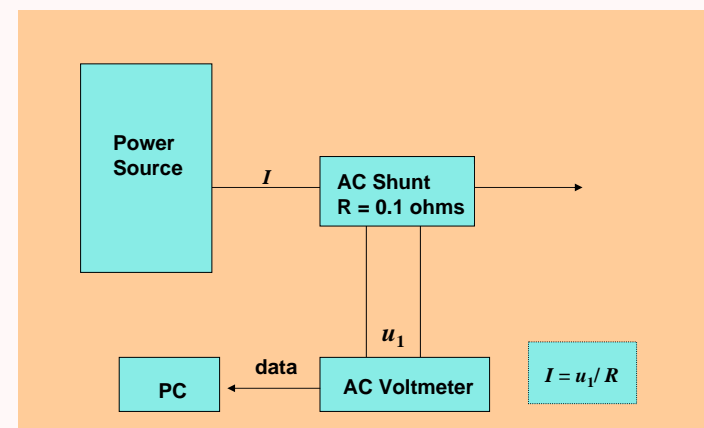
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Voltage measurement



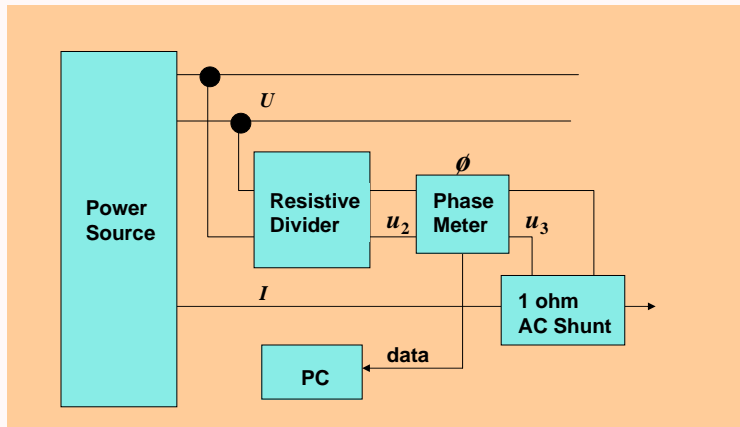
Slide 19

Current measurement



Slide 20

Phase angle measurement



Slide 21

Active power (P) and reactive power (Q)

Active power (P) and reactive power (Q) can be calculated from the measurement results of U, I and ϕ .

Active power

$$P = UI\cos\phi = Uu_1\cos\phi / R$$

Reactive power

$$Q = UI\sin\phi = Uu_1\sin\phi / R$$

Slide 22

Performance (1)

Uncertainty of power measurement

Power factor 1

- Uncertainty of **voltage** measurement 14 $\mu\text{V/V}$
- Uncertainty of **current** measurement 14 $\mu\text{A/A}$
- Total 20 $\mu\text{W/VA}$

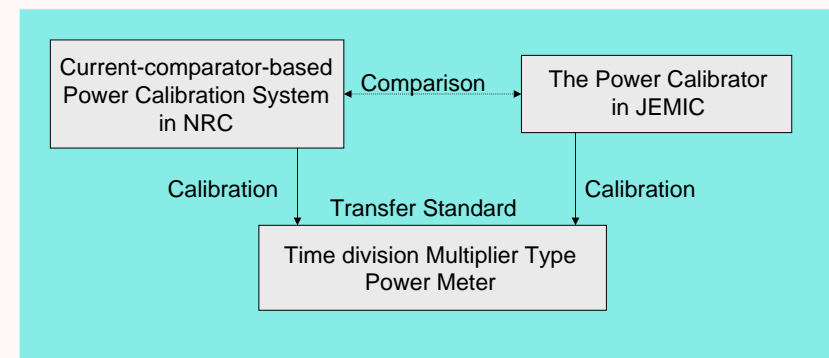
Power factor 0

- Uncertainty of **phase** measurement 11 μrad
- Total 11 $\mu\text{W/VA}$

Slide 23

Performance (2)

Comparison between JEMIC's and NRC's system

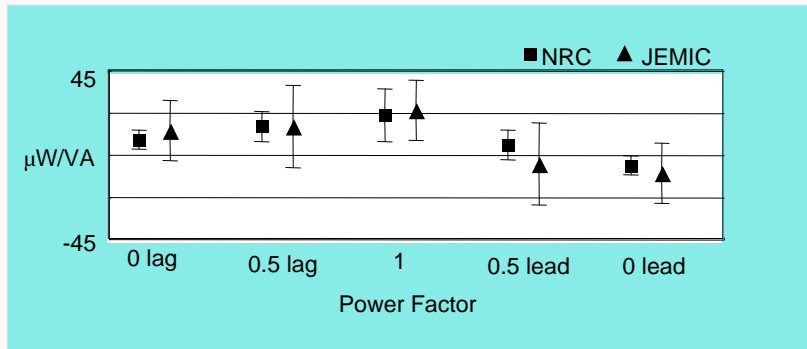


Slide 24

Performance (3)

Comparison between JEMIC's and NRC's system

The error of the transfer standard
measured with JEMIC's and NRC's system
at 120V, 5A, 60Hz



Slide 25

Features of Power and Energy System

1. Theoretically simple
2. Simple design
3. Easy to operate
4. Sufficiently practical for calibrating precision power/energy meters

Slide 26

New approach

Power and Energy Measurement
under Sinusoidal and Non-sinusoidal
Waveform Conditions

Slide 27

Power and Energy Measurement under Non-Sinusoidal Waveform Conditions

Back Ground

Increase of non-sinusoidal voltage
and current caused by nonlinear
loads



Needs to measure electrical
quantities under non-sinusoidal
conditions



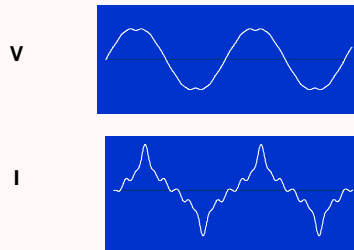
Slide 28

Power and Energy Measurement under Non-Sinusoidal Waveform Conditions

The next study

Wider bandwidth

Non-sinusoidal power standard



Slide 29

Summary of Verification Standards

1. The verification equipments must be traceable to national standards and be inspected by JEMIC.
2. Traceable to the primary standards on energy measurements are essential to maintain a fair trade.
3. A fair trade is to contribute for consumer confidence.

Slide 30

Thank you for your Attention



Slide 31



APEC/APLMF Seminars and Training Courses
in Legal Metrology; (CTI-11/2006T)
Seminar on Electricity Meters
19-22 March, 2007
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Overview of International Standards relate to Electricity Meters

-International Standards of IEC TC13-



IEC

International Electrotechnical Commission

Foundation June 1906
Central Office Geneva, Switzerland
Members 73countries
TCs&SCs 113TCs, 66SCs
TC:Technical Committee, SC:Sub Committee

IEC

TC 1	Terminology	TC 32	Fuses
TC 2	Rotating machinery	SC 32A	High-voltage fuses
TC 3	Information structures, documentation and graphical symbols	SC 32B	Low-voltage fuses
TC 4	Hydraulic turbines	SC 32C	Miniature fuses
TC 5	Steam Turbines (IN STAND BY)	TC 33	Power capacitors
TC 7	Overhead electrical conductors	TC 55	Winding wires
TC 8	Systems aspects for electrical energy supply	TC 56	Dependability
TC 9	Electrical equipment and systems for railways	TC 57	Power systems management and associated information exchange
TC 13	Electrical energy measurement, tariff- and load control	TC 59	Performance of household and similar electrical appliances
TC 14	Power transformers	TC 64	Electrical installations and protection against electric shock

IEC

TC 66	Safety of measuring, control and laboratory equipment	TC 104	Environmental conditions, classification and methods of test
TC 68	Magnetic alloys and steels	TC 105	Fuel cell technologies
TC 69	Electric road vehicles and electric industrial trucks	TC 106	Methods for the assessment of electric, magnetic and electromagnetic fields associated with human exposure
TC 70	Degrees of protection provided by enclosures	TC 107	Process management for avionics
TC 72	Automatic controls for household use	TC 108	Safety of electronic equipment within the field of audio/video, information technology and communication technology
TC 73	Short-circuit currents	TC 109	Insulation co-ordination for low-voltage equipment
TC 76	Optical radiation safety and laser equipment	TC 110	Flat panel display devices
TC 77	Electromagnetic compatibility	TC 111	Environmental standardization for electrical and electronic products and systems
TC 87	Ultrasonics	TC 112	Evaluation and qualification of electrical insulating materials and systems
TC 88	Wind turbines	TC 113	Nanotechnology standardization for electrical and electronics products and systems

IEC

Mission

IEC is the leading global organization that prepares and publishes international standards for all electrical, electronic and related technologies. These serve as a basis for national standardization and as references when drafting international tenders and contracts.

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IEC

Objectives

- meet the requirements of the global market efficiently
- ensure primacy and maximum world-wide use of its standards and conformity assessment schemes
- assess and improve the quality of products and services covered by its standards
- establish the conditions for the interoperability of complex systems
- increase the efficiency of industrial processes
- contribute to the improvement of human health and safety
- contribute to the protection of the environment

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IEC TC13

Electrical energy measurement, tariff- and load control

Scope

to prepare international standards for equipment for electrical energy measurement, tariff- and load control, customer information, payment, local and/or remote data exchange.

The standards may include requirements and test methods to cover mechanical, environmental, electrical, safety, **metrology**, dependability aspects, as well as functional requirements and data models.

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IEC TC13

Membership:

AUSTRALIA, AUSTRIA, BELGIUM, BRAZIL, BULGARIA, CHINA, COLOMBIA, CROATIA, CZECH REPUBLIC, DENMARK, FINLAND, FRANCE, GERMANY, GREECE, HUNGARY, INDIA, INDONESIA, IRELAND, ISRAEL, ITALY, JAPAN, KOREA, NETHERLANDS, NEW ZEALAND, NORWAY, POLAND, PORTUGAL, ROMANIA, RUSSIAN FEDERATION, SERBIA, SLOVAKIA, SLOVENIA, SOUTH AFRICA, SPAIN, SWEDEN, SWITZERLAND, TURKEY, UKRAINE, UNITED KINGDOM, UNITED STATES OF AMERICA

40 countries

Participant :28

Observer:12



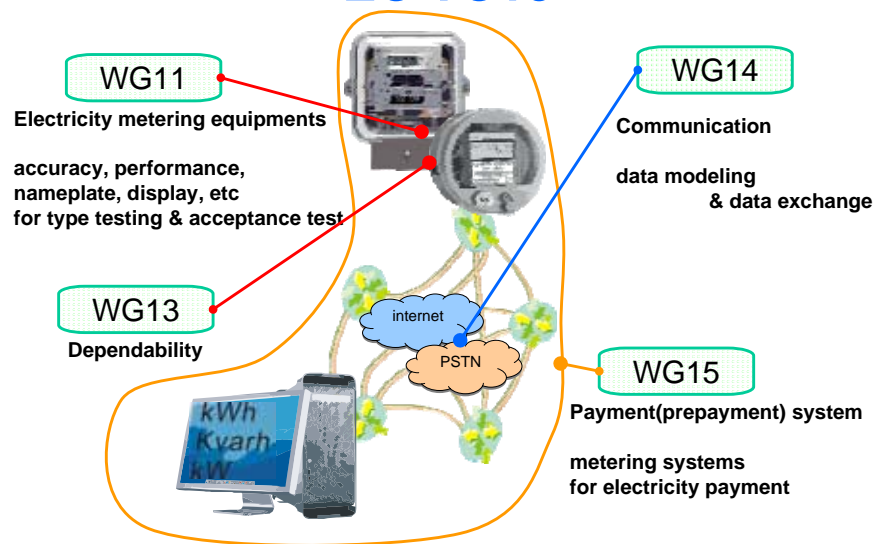
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IEC TC13

Working groups and project teams

- WG 11: Electricity metering equipment**
 - WG 13: Dependability of electricity metering equipment**
 - WG 14: Data exchange for meter reading, tariff and load control**
 - WG 15: Electricity metering - Payment systems**
- PT62053-24:varh meter CI 0.5 & 1**
PT62055-41:STS

IEC TC13



IEC TC13 WG11 Documents

Type test

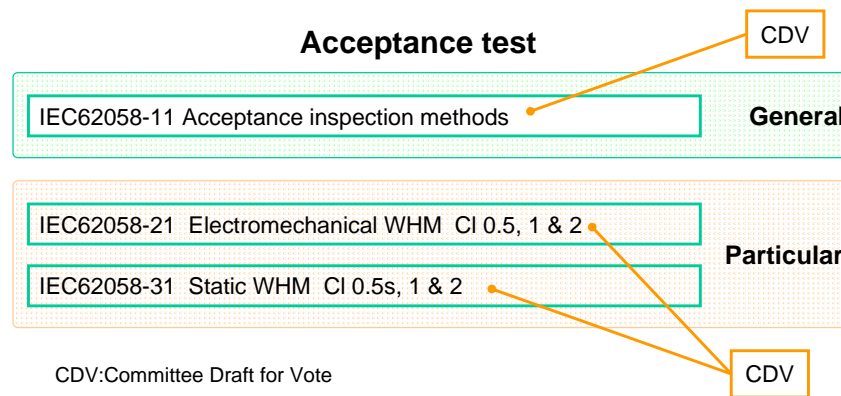
General	IEC62052-11 Metering equipment	IEC62053-31 Pulse output devices	IEC62053-52 Symbols	IEC620523-61 Power consumption & voltage requirements
	IEC62053-21 WHM cl 1 & 2	IEC62053-22 WHM cl 0.2s & 0.5s	Particular	PT
	IEC62053-23 VHM cl 2 & 3	IEC62053-24 VHM cl 0.5 & 1		
	IEC62053-11 WHM cl 0.5, 1 & 2	IEC60145 VHM	IEC60211 demand indicators	
	IEC62052-21 Tariff & load control equipment	IEC62054-11 Ripple control receivers	IEC62054-21 Time switches	

Static meters (points to IEC62053-21, IEC62053-22, IEC62053-24)

Electromechanical meters (points to IEC62053-11, IEC60145, IEC60211)

IEC TC13 WG11 Documents

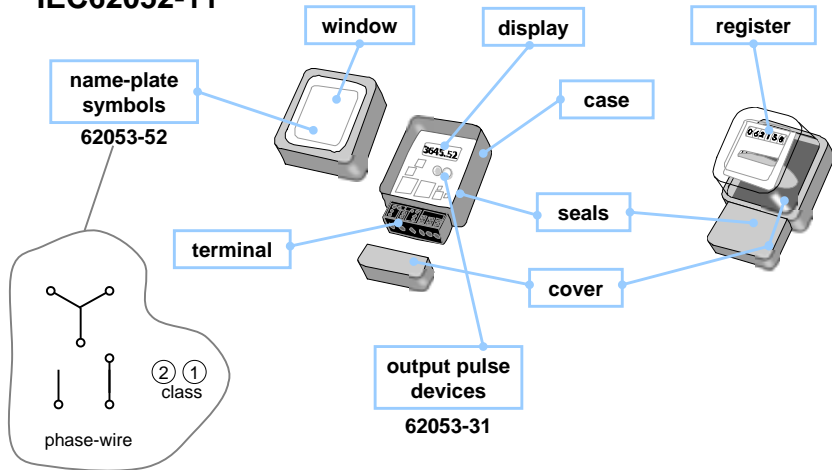
Acceptance test



CDV:Committee Draft for Vote

IEC TC13 WG11 Documents

IEC62052-11



IEC TC13 WG11 Documents

IEC62053-11, -21, -22, -23

kwh, kvarh

Accuracy class
2, 1, 0.5, 0.2

Requirements	Tests
Mechanical aspects Electrical aspects Accuracy Test condition	Current Voltage Frequency Temperature Starting No-load
	Influence of; vibration shock magnetic EMC etc

IEC TC13 WG13 Documents

IEC/TR62059-11 General concepts	General
IEC/TR62059-21 Collection of meter dependability data from the field -41 Reliability prediction	Particular
IEC/TR62059-31 Accelerated reliability testing	FDIS
IEC/TR62059-51 TR Software aspects of reliability	NP

FDIS:Final Draft International Standard
NP:New Work Item Proposal

IEC TC13 WG14 Documents

IEC/TR 62051-1 Terms related to data exchange with metering equipment using DLMS/COSEM
IEC 62056-21 Direct local data exchange
IEC 62056-31 Use of local area networks on twisted pair with carrier signalling
IEC/TS 62056 -41 Data exchange using wide area networks: PSTN with LINK+ protocol
IEC 62056 -42 Physical layer services and procedures for connection-oriented asynchronous data exchange
-46 Data link layer using HDLC protocol
-47 COSEM transport layers for IPv4 networks

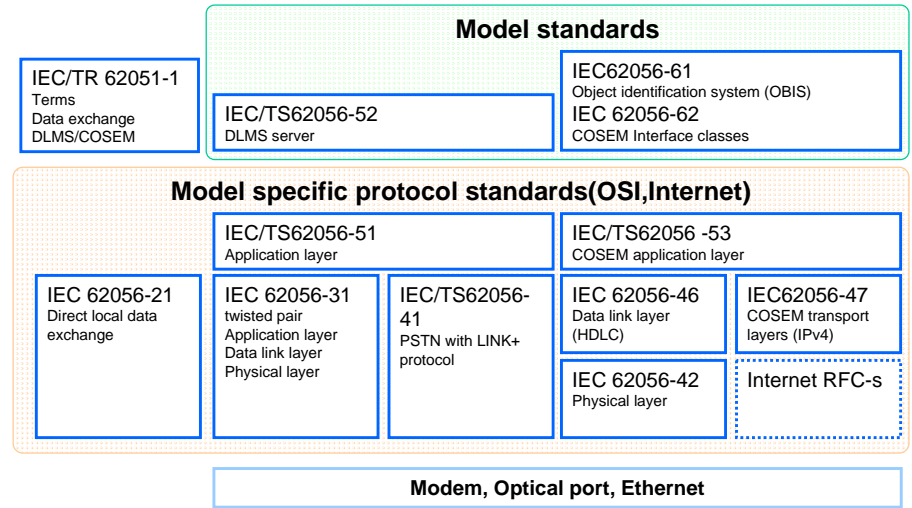
IEC TC13 WG14 Documents

- IEC/TR 62056 -51 Application layer protocols
 - 52 Communication protocols management DLMS server
 - IEC -53 COSEM application layer
-
- IEC 62056 -61 Object identification system (OBIS)
 - 62 Interface classes



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IEC TC13 WG14 Documents



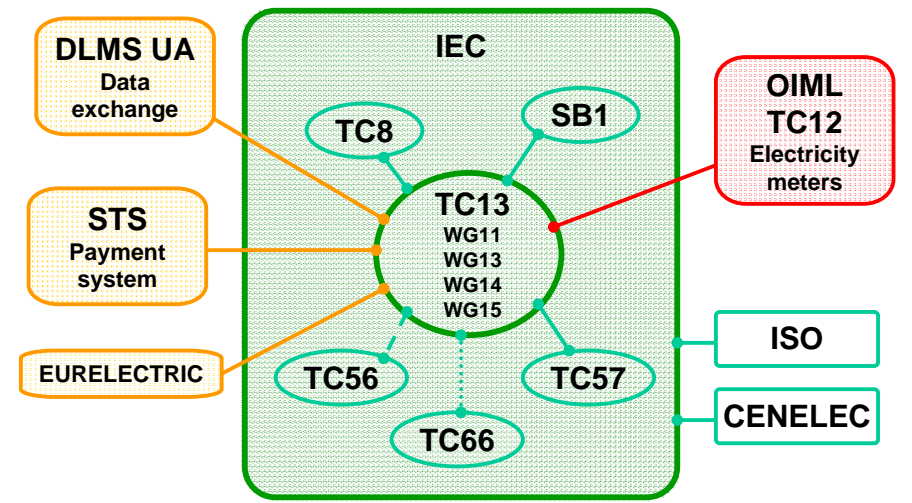
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IEC TC13 WG15 Documents

- IEC/TR 62055-21 Framework for standardization
 - IEC 62055-31 Static payment meters for active energy Cl1 & 2
 - IEC/PAS 62055-41 Standard Transfer Specification(STS) PT
-
- IEC 62055-41 STS - Application Layer Protocol for one-way token carrier systems FDIS
 - IEC 62055-51 STS - Physical Layer Protocol for one-way numeric and magnetic card token carriers
 - IEC 62055-52 STS - Physical layer protocol for a two-way virtual token carrier for direct local connection CDV

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Liaison(relationship)



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Liaison(relationship)

OIML:International Organization of Legal Metrology
IEC TC8:System aspects of electrical energy supply
IEC TC56:Dependability (informal)
IEC TC57:Power system control and associated and communications
IEC TC66:Safety of measuring, control and laboratory equipment (informal)
DLMS UA:DLMS User Association
STS:STS association
ISO:International Standardization Organization
CENELIC:European Committee for Electrotechnical Standardization
EURELECTRIC:Union of the Electricity Industry

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On-going and Future work

WG11 - Acceptance inspection IEC62058-11,-21,-31
- varh meter CI 0.5 & 1 IEC62053-24
- Safety aspects ←

WG13 - Dependability IEC62059-31,-51
- Software aspects of reliability ←

WG14 - Dependability IEC62056-46
- MCR IEC62056-21,-41,-51,-52

WG15 - STS IEC62055-51,-52
- PT 62055-41

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IEC TC13

Meeting

- 1990 Beijing (with IEC 54 General Meeting)
- 1993 Sydney (with IEC 57 General Meeting)
- 1995 Durban (with IEC 58 General Meeting)
- 1998 Helsinki
- 2001 Winterthur
- 2005 Cape Town (with IEC 69 General Meeting)
- 2007 , 8? France? , China?

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International Standards

Comments ?

Questions ?



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Current situation of the Revision of OIML Recommendation

-R46 Electricity meters-



OIML TC12

- OIML TC12
“Instruments for measuring electrical quantities”

member

AUSTRALIA, AUSTRIA, BELGIUM, BRAZIL, BULGARIA,
CANADA, CHINA, CUBA, CZECH REPUBLIC, DENMARK,
EGYPT, FINLAND, FRANCE, GERMANY, HUNGARY,
INDONESIA, IRELAND, ISRAEL, JAPAN, KOREA(R.),
NETHERLANDS, NORWAY, POLAND, ROMANIA,
RUSSIAN FEDERATION, SERBIA, SLOVAKIA, SLOVENIA,
SOUTH AFRICA, SWEDEN, SWITZERLAND,
UNITED KINGDOM, UNITED STATES

33 countries

P-member:23

O-member:10

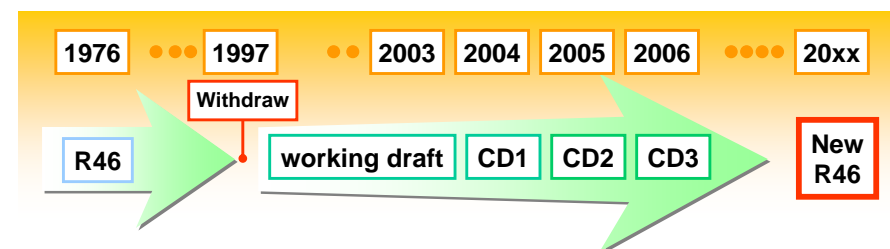
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OIML TC12

- R46(1976)
“Active Electrical Energy Meters
for Direct Connection (class 2)”
- Revision Committee Draft CD3(2006)
“Electricity Meters”

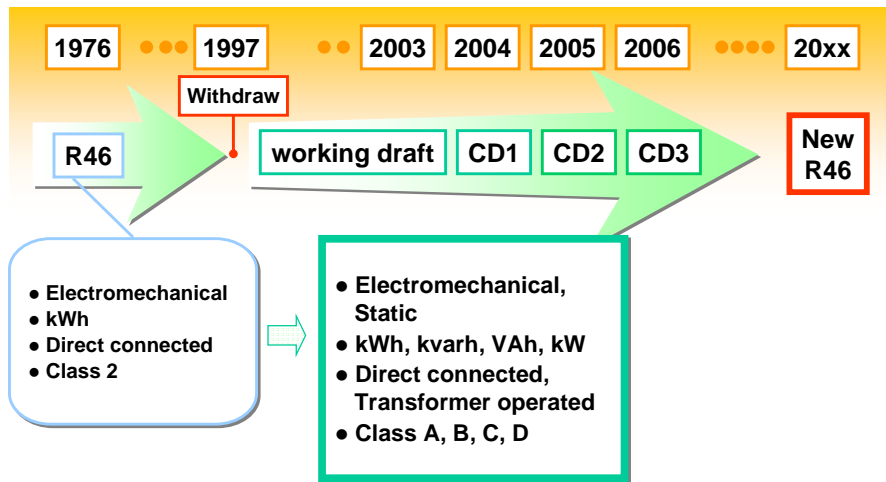
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Working Progress



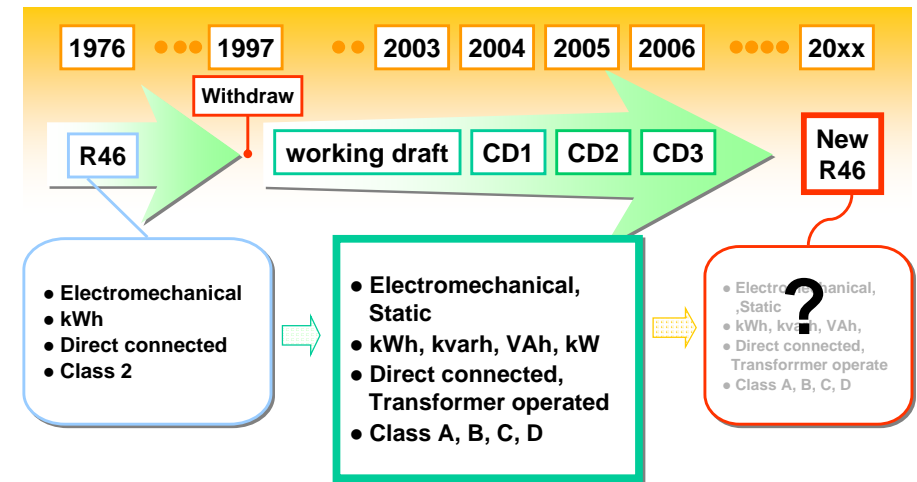
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Working Progress



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Working Progress



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- Terminology
 - Scope
 - Unit
 - Technical requirements
 - Pattern approval
 - Initial verification
 - Examination for conformity with approved pattern
 - Statutory markings
- 8 Chapter**
20 pages

- Scope
 - Bibliography
 - Terminology
 - Metrological Requirements
 - Type approval
 - Test program
 - Test procedures for type approval
 - Examination for conformity with type approval
 - Initial Verification and subsequent-verification
- 9 Chapter**
over 40 pages

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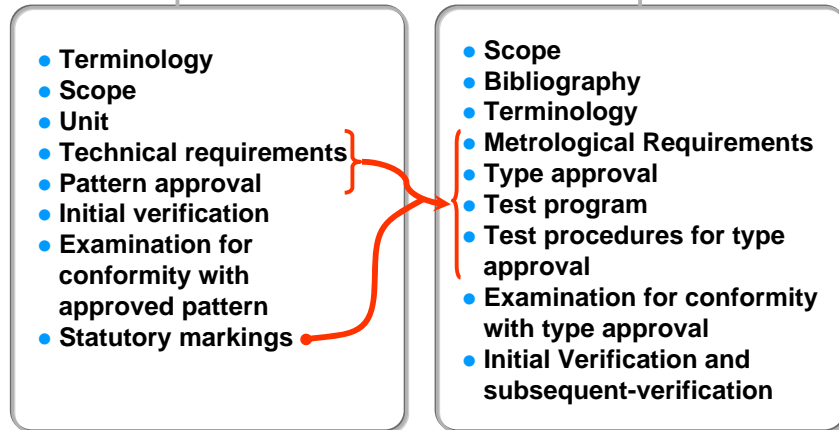
- Terminology
- Scope
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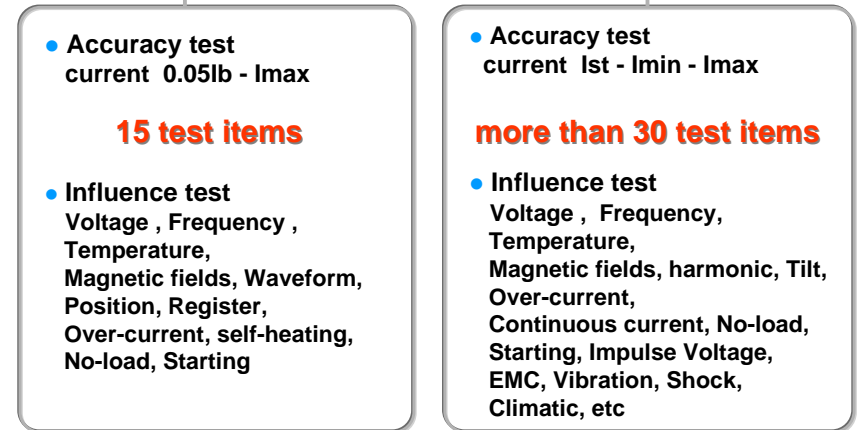
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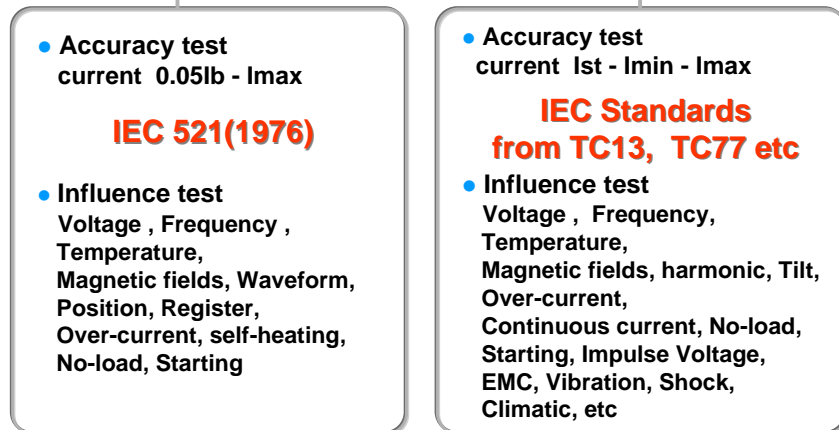
Previous (1976) <<- TESTs ->> Draft (2006)



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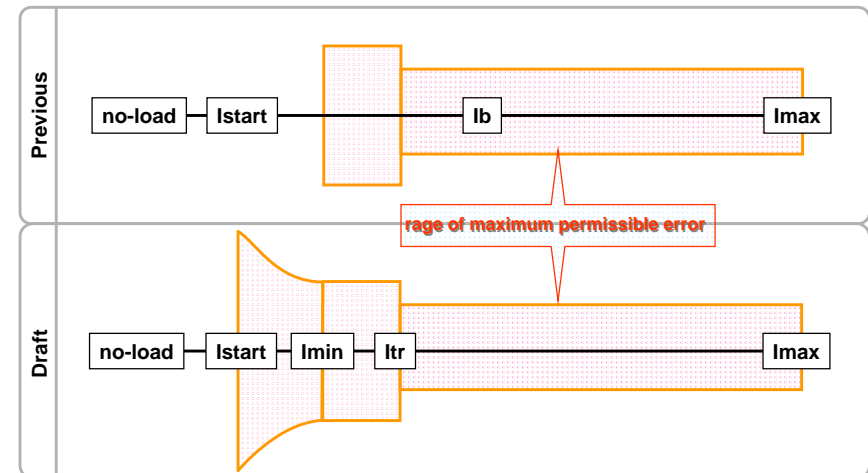
Previous (1976) <<- Tests ->> Draft (2006)



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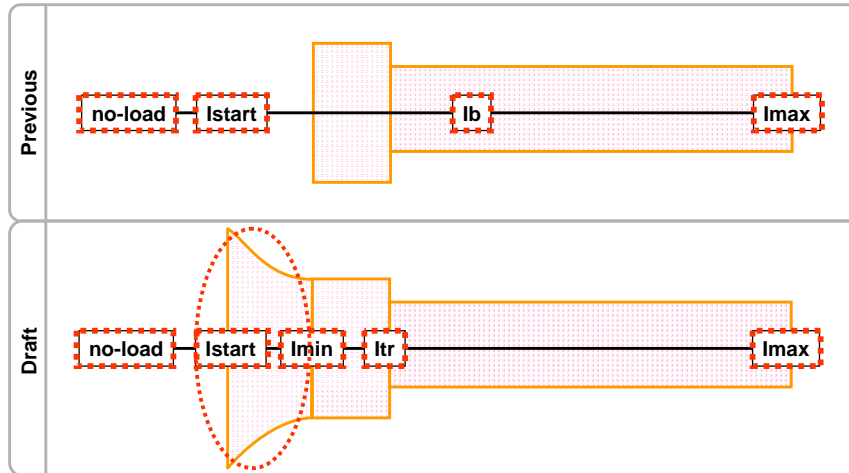
Previous (1976) <<- Current range ->> Draft (2006)



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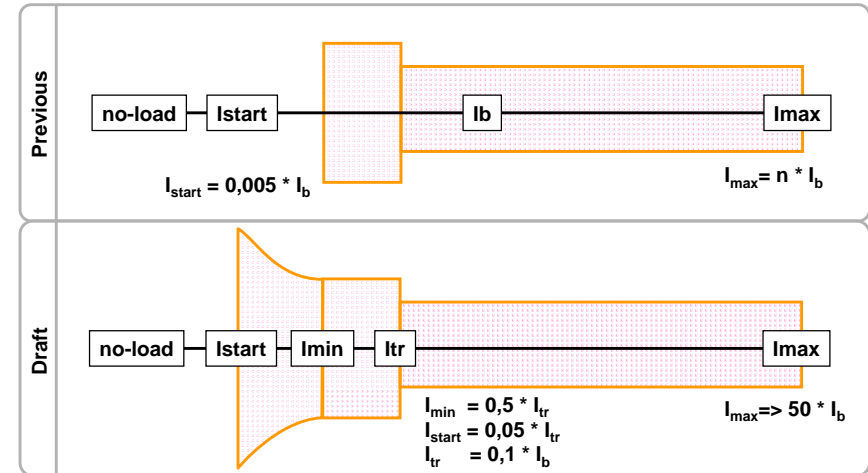
Previous (1976) <<- **Current rage** ->> Draft (2006)



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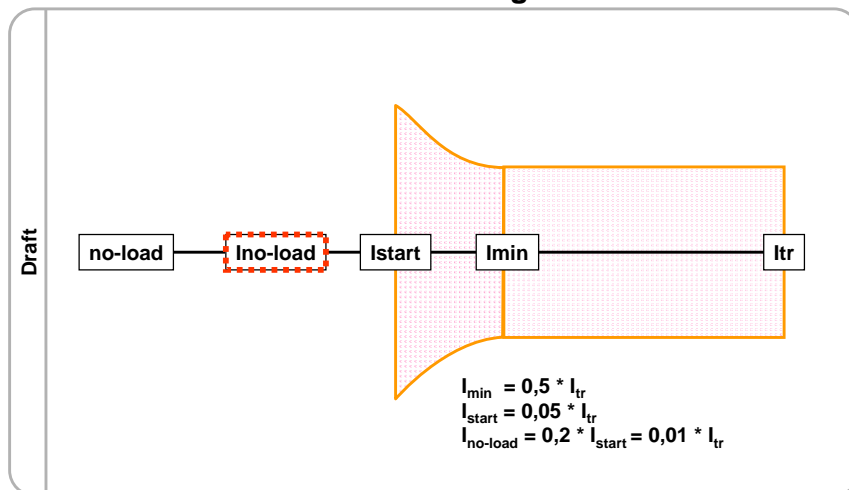
Previous (1976) <<- **Current rage** ->> Draft (2006)



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Minute Current rage area



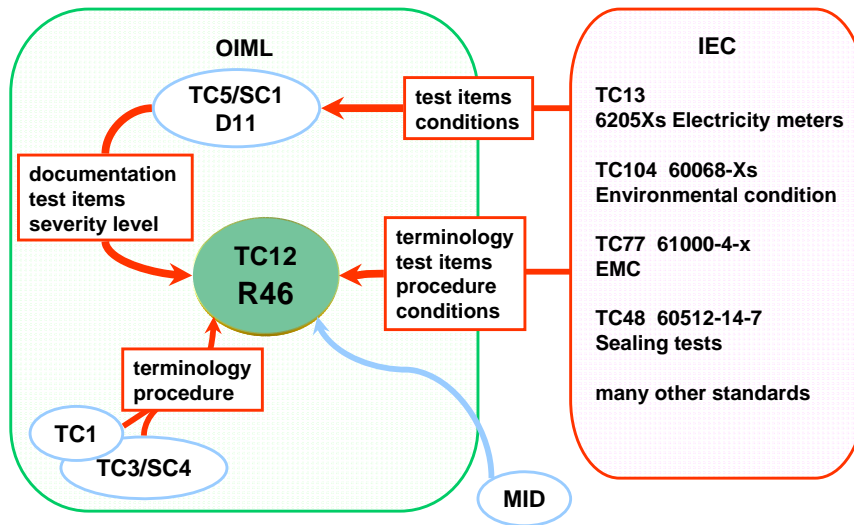
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Terminology

Istart Starting Current	OIML-the lowest value of current at which the meter is declared to register electrical energy at unity power IEC-the lowest value of the current at which the meter starts and continues to register
Imin minimum current	The lowest value of current at which the mpe requirement is constant with regard to current variations
Itr transitional current	The declared value of current at which the meter purports to lie within the smallest mpe corresponding to the class index of the meter
Ib basic current	Value of current in accordance with which the relevant performance of a direct connected meter are fixed
Imax maximum current	The highest declared value of current at which the meter purports to meet the accuracy requirements of recommendation(standard)

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Relationship



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Conclusion

- OIML TC12
"Instruments for measuring electrical quantities"
 - Committee Draft 3rd edition(2006)
"Electricity Meters"
 - Electric & Mechanical Meters
Classification - A, B, C, D
Test items - EMC, climatic, harmonics, etc
New item - software aspects
- ? var-hour meter, Demand meter

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OIML Recommendation

Comments ?

Questions ?

Measuring Instruments Directives (MID)

(informative article)

- Annex MI-003 Electricity meters -



MID

- EU regional directive
- New approach for measuring instruments
- To prescribe the performance requirements
- To cover a number of measuring instrument types, including water, gas and **electricity meters**, petrol pumps , automatic weighing instruments and taximeters

Page_2

MID

Contents

- Introduction
- Scope / General requirements
- Essential requirement ←
Annex 1
- Conformity assessment Module
Annex A - H1
- Instruments Specific Annexes ←
Annexes MI-001 - MI-010

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MID

Annex 1, Essential Requirements

- Definitions
- Allowable Errors
 - MPE, Operating conditions, Climatic, Mechanical, Electromagnetic Environments, Influence quantities
- Reproducibility, Repeatability, Discrimination, Sensitivity, Durability, Suitability
- Protection against corruption
- Information, Indication of result, Processing of data, Designed to evaluation

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MID

Instrument	Annex	OIML Recommendation
Water meters	MI-001	R49
Gas meters	MI-002	R6,R31,R32,R137
Electricity meters	MI-003	R46
Heat meters	MI-004	R75
Liquid meters	MI-005	R81,R105,R117,R119
Automatic weighing	MI-006	R50,R51,R61,R106,R107,R134
Taxi meters	MI-007	R21
Material measure	MI-008	R29
Dimensional	MI-009	R66,R129,R136
Exhaust gas	MI-010	R70,R99

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MID

Annex MI-003 "ACTIVE ELECTRICAL ENERGY METERS"

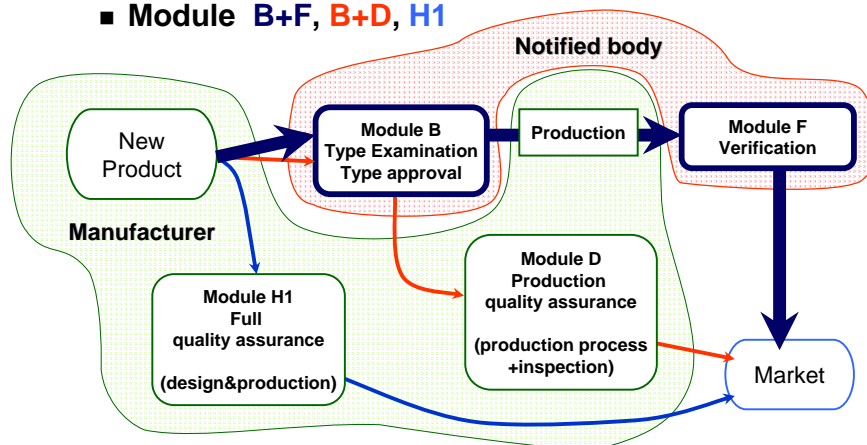
- Definitions
- Specific requirements
 - ◊ Accuracy, Rated operating conditions
 - ◊ MPE
 - ◊ Permissible effect of disturbances
 - ◊ Suitability
 - ◊ Units
 - ◊ Putting into use
- CONFORMITY ASSESSMENT
 - ◊ B + F , B + D , H1

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Modules & Procedures

Electricity Meters

- Module **B+F, B+D, H1**

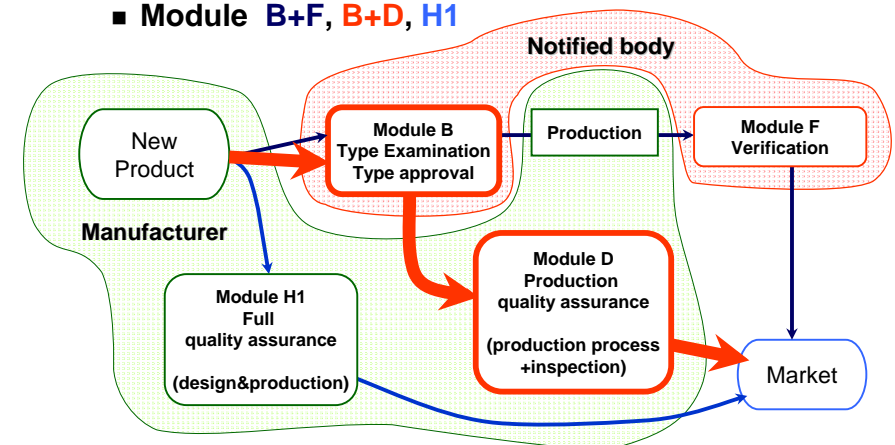


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Modules & Procedures

Electricity Meters

- Module **B+F, B+D, H1**

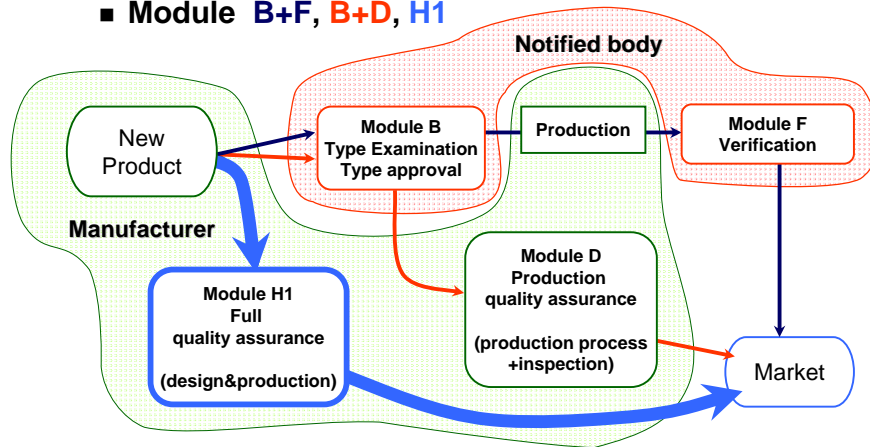


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Modules & Procedures

Electricity Meters

- Module B+F, B+D, H1



Conformity Assessment in Europe

(informative article)

- Modules -



Conformity Assessment

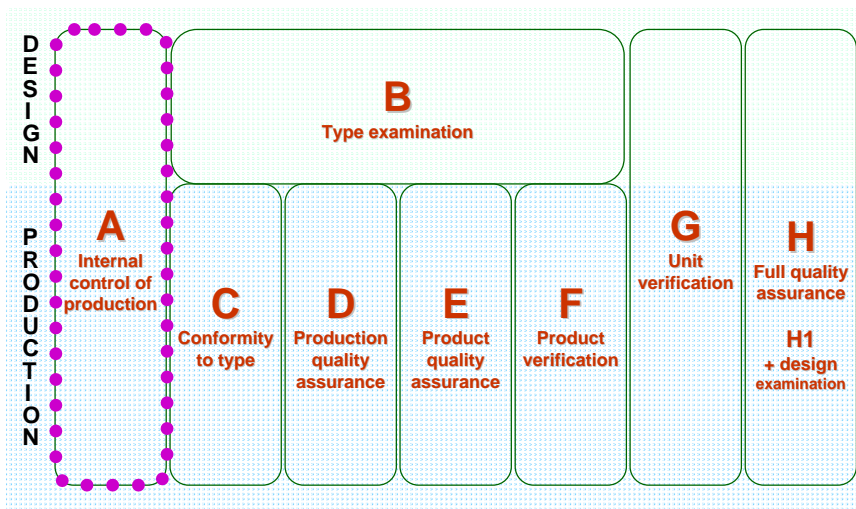
“Guide to the implementation of directives based on the New Approach and the Global Approach” (Blue Guide)

- Introduction/Scope
- Responsibilities
- Compliance with directives
- Procedure
- Notified bodies
- CE marking
- Market surveillance



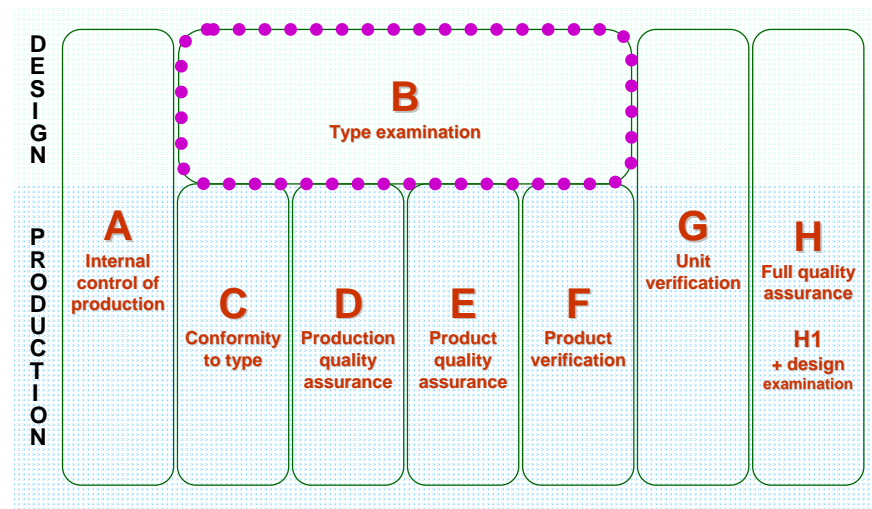
Page_2

Modules



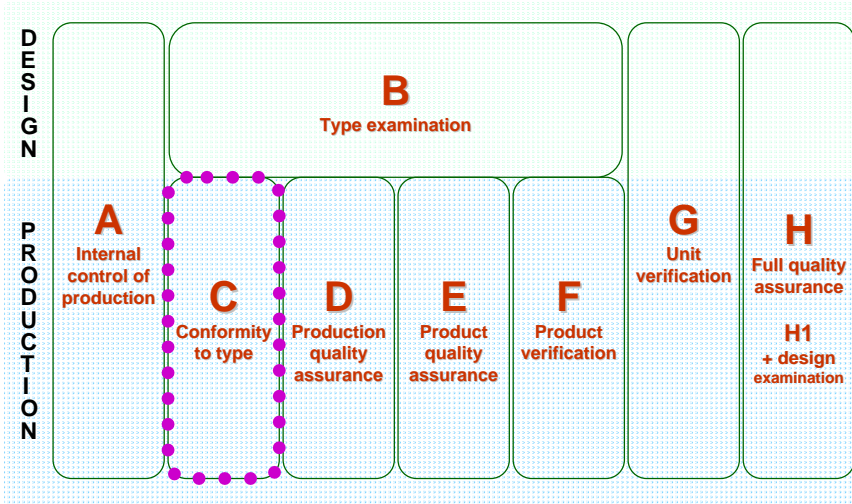
Page_3

Modules

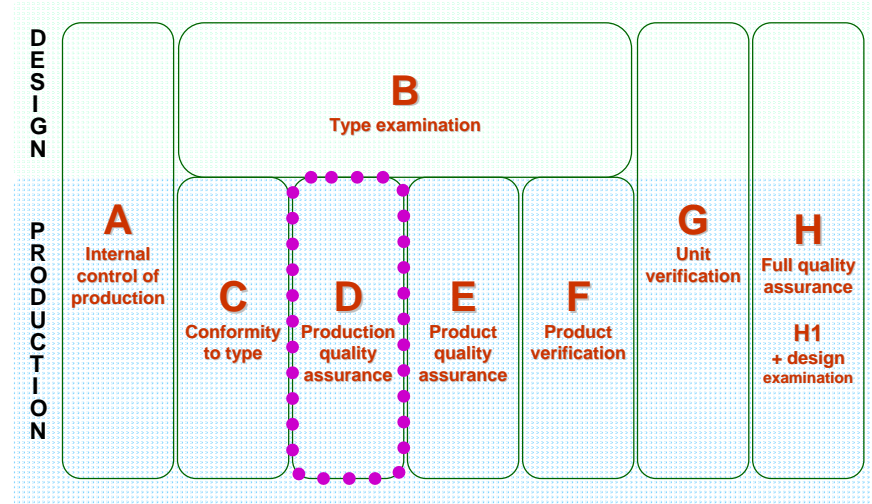


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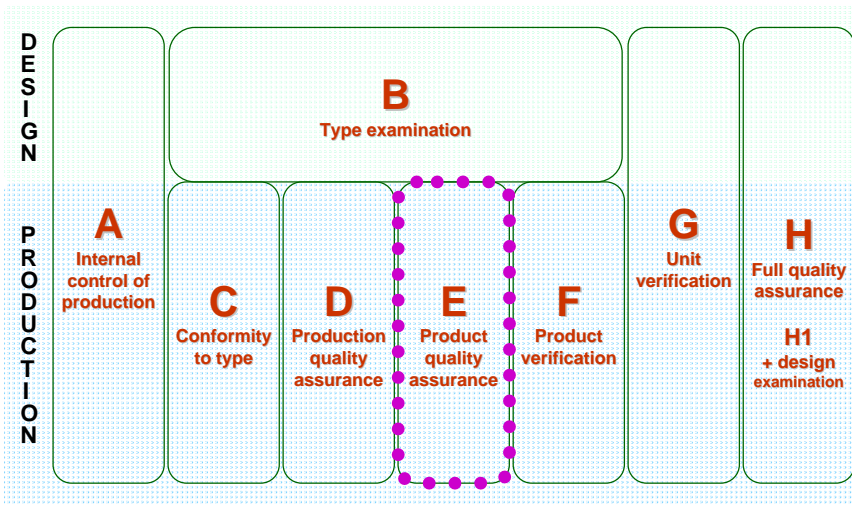
Modules



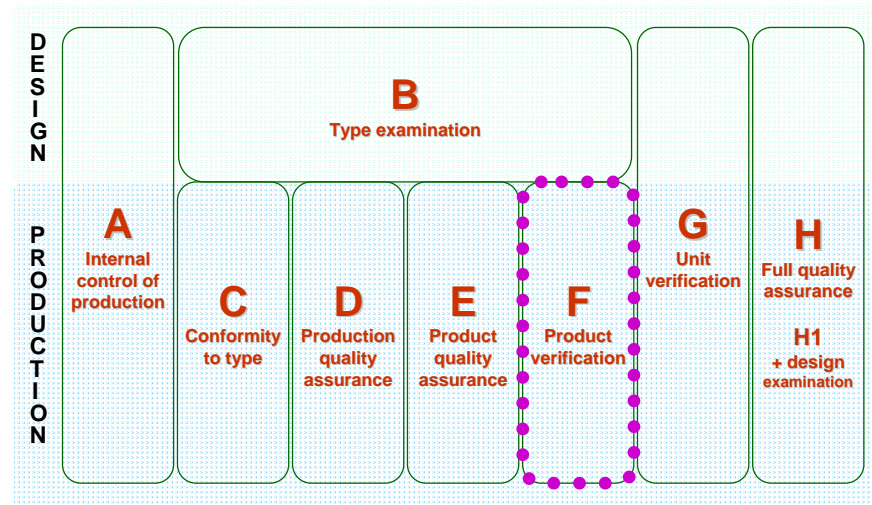
Modules



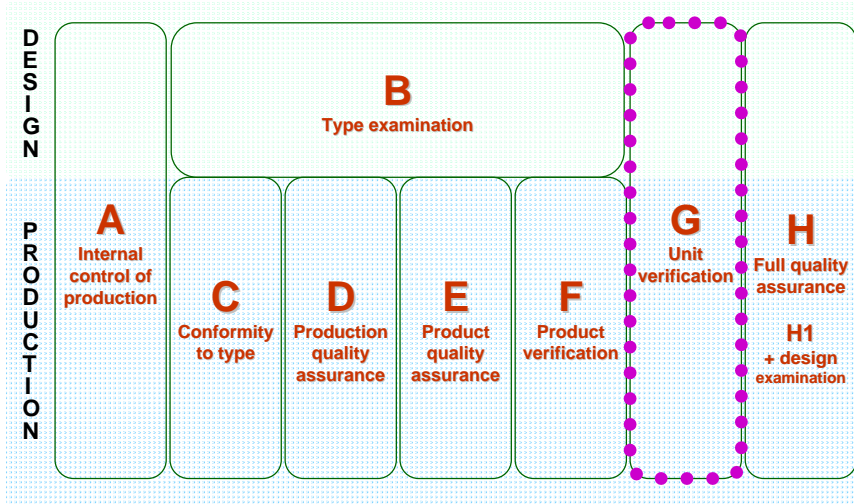
Modules



Modules

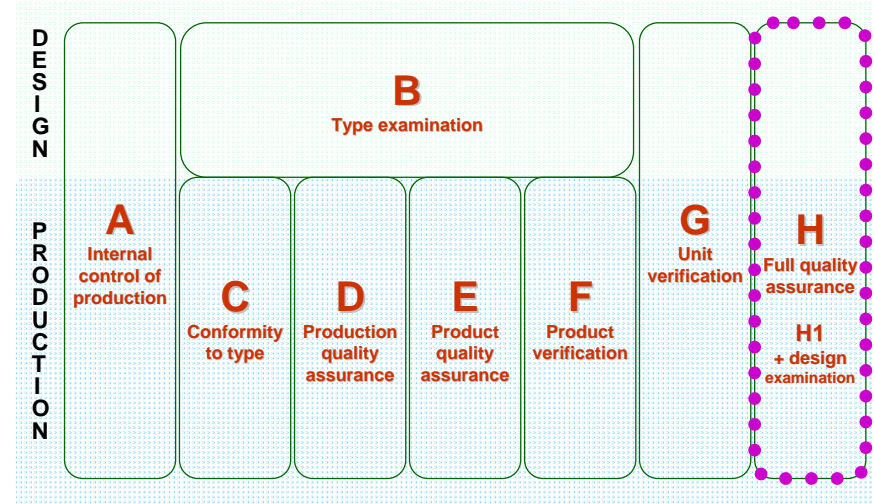


Modules



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Modules



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Modules

A Internal control of production	Covers internal design and production control. This module does not require a notified body to take action.
B EC type-examination	Covers the design phase, and must be followed up by a module providing for assessment in the production phase. The EC type-examination certificate is issued by a notified body.
C Conformity to type	Covers the production phase and follows module B. Provides for conformity with the type as described in the EC type-examination certificate issued according to module B. This module does not require a notified body to take action.
D Production quality assurance	Covers the production phase and follows module B. Derives from quality assurance standard EN ISO 9002, with the intervention of a notified body responsible for approving and controlling the quality system for production, final product inspection and testing set up by the manufacturer.

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Modules

E Product quality assurance	Covers the production phase and follows module B. Derives from quality assurance standard EN ISO 9003, with the intervention of a notified body responsible for approving and controlling the quality system for final product inspection and testing set up by the manufacturer.
F Product verification	Covers the production phase and follows module B. A notified body controls conformity to the type as described in the EC type-examination certificate issued according to module B, and issues a certificate of conformity.
G Unit verification	Covers the design and production phases. Each individual product is examined by a notified body, which issues a certificate of conformity.
H Full quality assurance	Covers the design and production phases. Derives from quality assurance standard EN ISO 9001, with the intervention of a notified body responsible for approving and controlling the quality system for design, manufacture, final product inspection and testing set up by the manufacturer.

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Developments for Electricity Meters in Japan

20 March, 2007

Masaru Nagashima (Fuji Electric Systems Co., Ltd., Japan)

1. Start in real electronization age of meters
2. Introduction situation of electronic meters
3. Progress of electronic meter introduction
 - (1) Contract demand 500kW or more
 - (2) Contract demand from less than 500kW to 50kW
 - (3) Contract demand less than 50KW

1. Start in real electronization age of meters (necessity of electronic electricity meter)

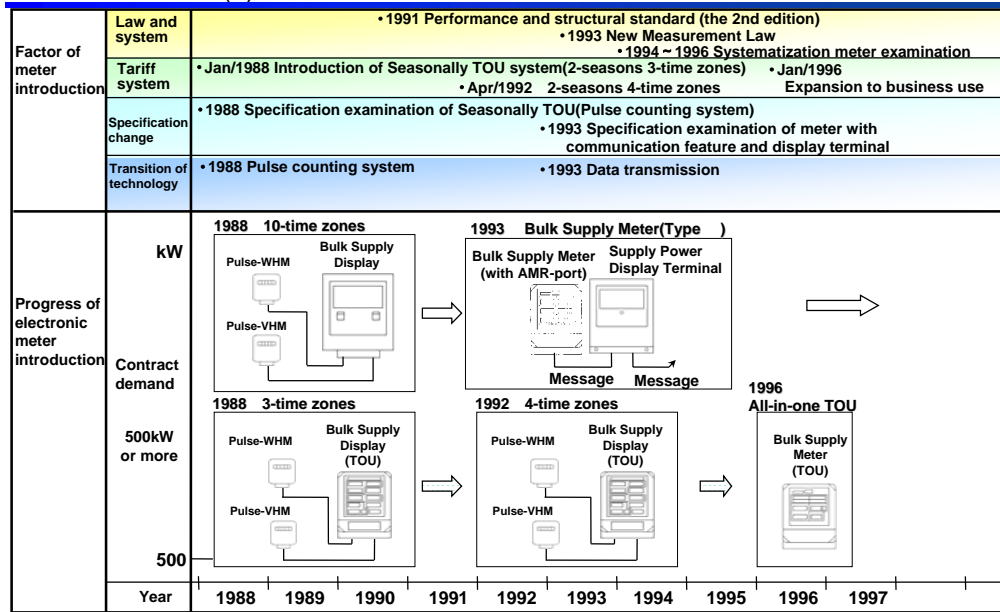
1. Development of electronic technology and substitution for electronics product
2. Expectation that there is no error change by wear-out because there is no moving part
3. Expectation for small size and lightness
4. Expectation for multi-function and compound all-in-one design
5. Expectation for reduction in costs

2. Introduction situation of electronic meters

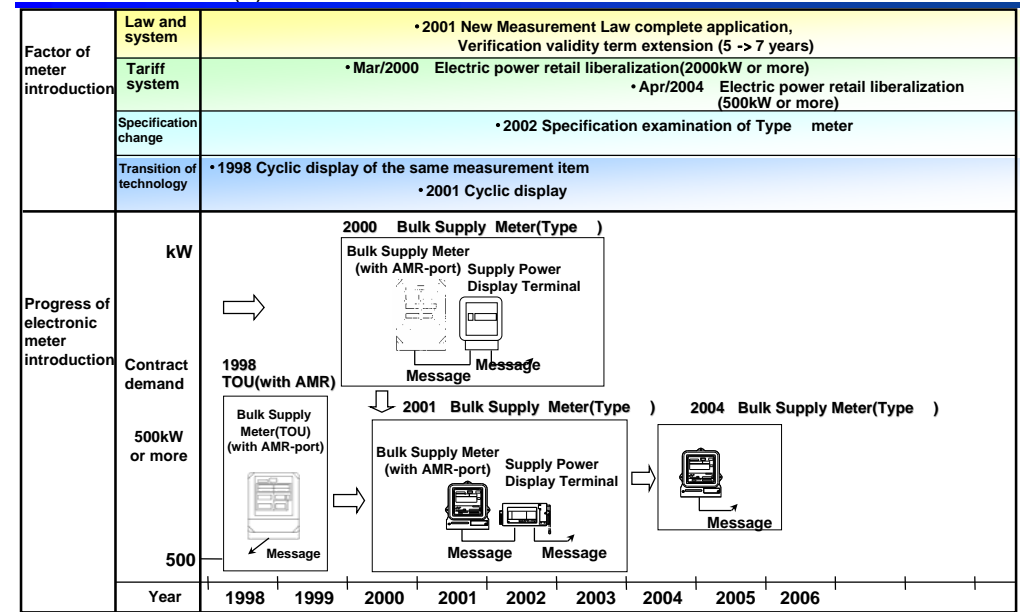
	Main customer	Electric power liberalization enforcement	Meter	AMR-port of meter	Meter-reading method	AMR execution trend
Large	Large-scale factory, Department store, Office building, Hotel, and University, etc.	March, 2000 Simultaneous this amount surveillance	Class:0.5 Compound meter + Display terminal	Having	Employee meter-reading / Consignment meter-reading member	Introduction completion / Introducing
High voltage	Medium scale factory, Supermarket, Small and medium-sized building, etc.	April, 2004	Class:1.0 Compound meter + Display terminal	Having / None	Consignment meter-reading member	Partial introduction
Low voltage	Small-scale factory, Supermarket, Small and medium-sized building, etc.	April, 2005	Compound meter	None / Having	Consignment meter-reading member	<General> None
	Back-street factory, Convenience store, and Ordinary family, etc.	April, 2007 Beginning of examination	Induction type meter / Multi time zone electronic meter	None / Having	Consignment meter-reading member	<Difficult meter-reading> Partial introduction

Note) The example of general of the electric power company in Japan is shown.

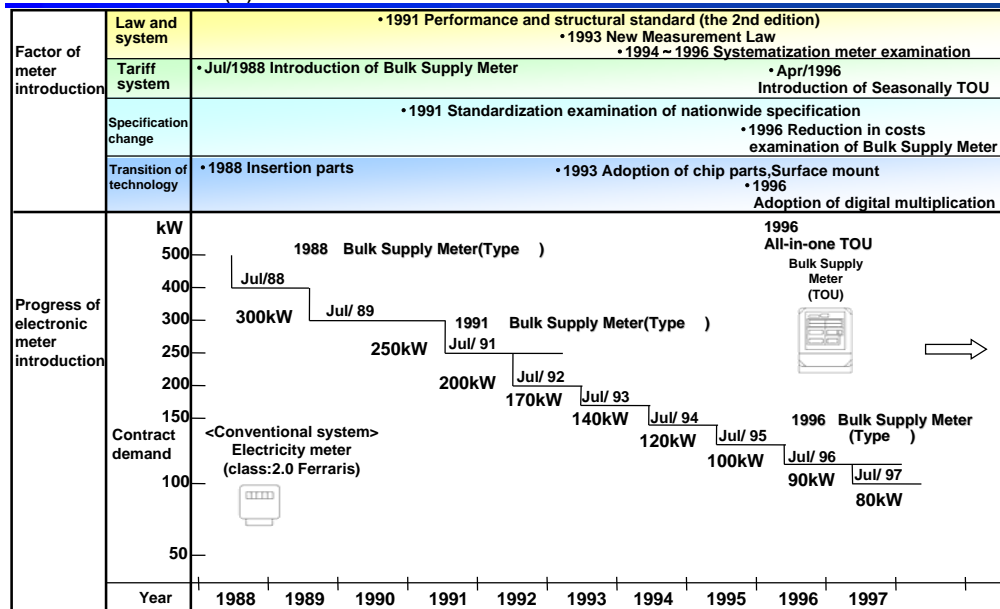
3. Progress of electronic meter introduction (1) Contract demand 500kW or more No.1



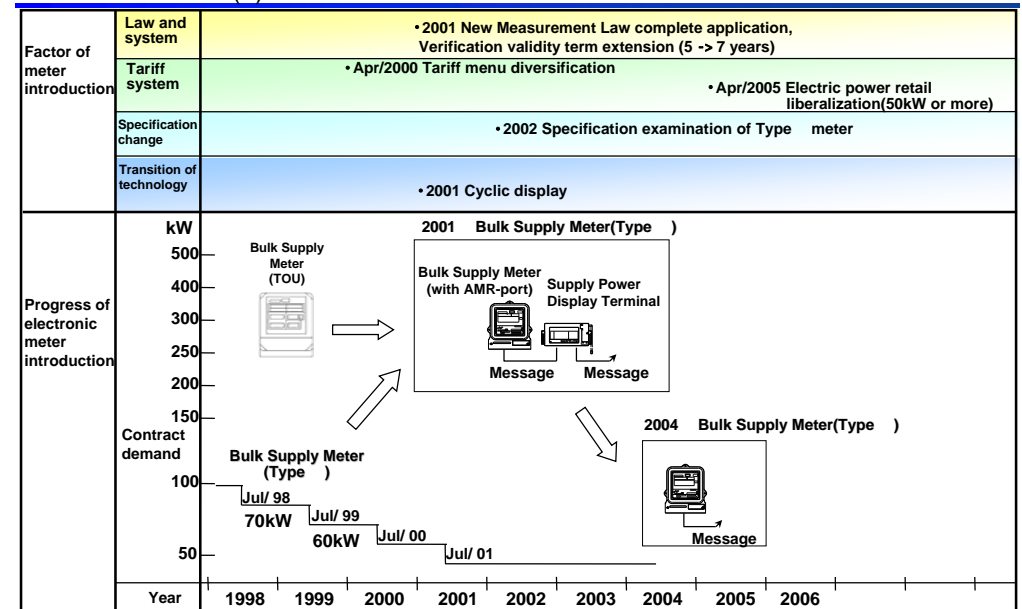
3. Progress of electronic meter introduction (1) Contract demand 500kW or more No.2



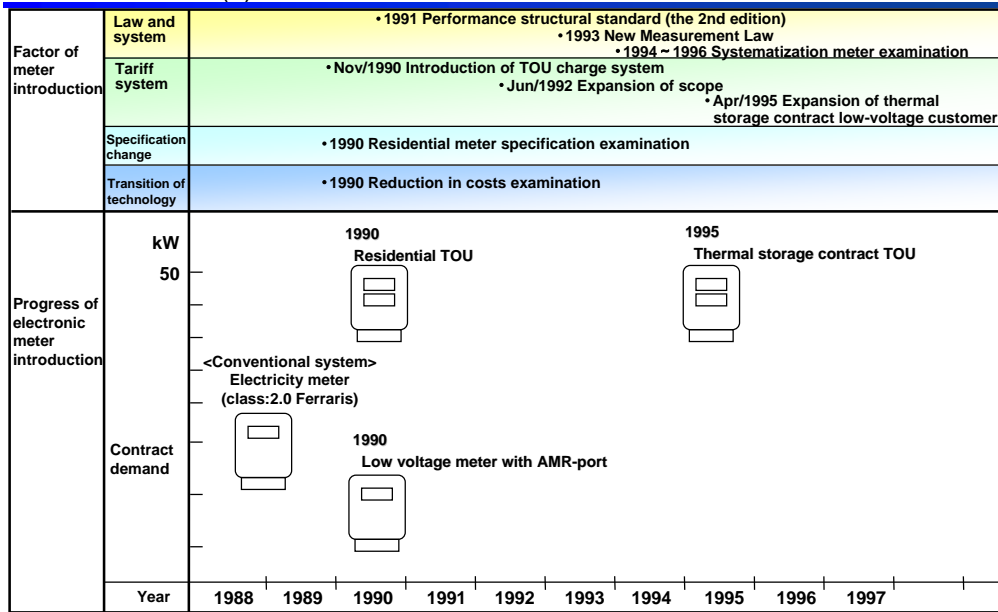
3. Progress of electronic meter introduction (2) Contract demand from less than 500kW to 50kW No.1



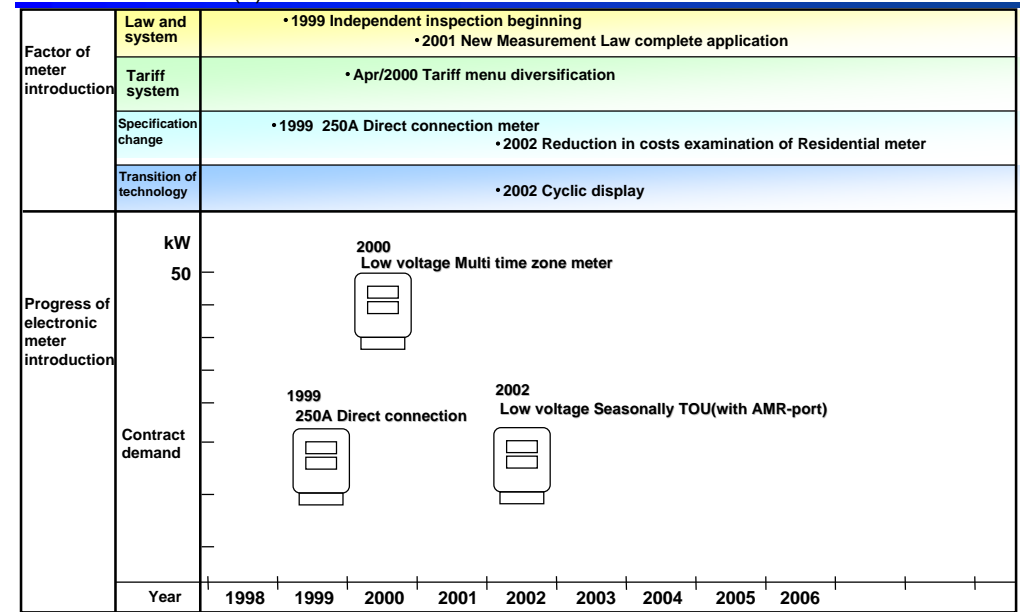
3. Progress of electronic meter introduction (2) Contract demand from less than 500kW to 50kW No.2



3. Progress of electronic meter introduction (3) Contract demand less than 50kW No.1



3. Progress of electronic meter introduction (3) Contract demand less than 50kW No.2



Overview of the Primary Standards in Metrology of Electricity Energy in PR China

Lu Zuliang

National Institute of Metrology

(luzl@nim.ac.cn)

2007.03.22

Content

1, Introduction

1.1 Production of Power and Meters

1.2 Technical Documents

1.3 Dissemination Relation

2, Primary Standards

2.1 Single-Phase

2.2 Three-Phase

2.3 Harmonic Power

2.4 General Considering for Energy Standard System

3, Our Comments for IR46 Revising

1, Introduction

1.1 Production of Power and Meters

Production Amount of Electrical Power in China is over 2.5×10^{12} kWh/year
The Error of 1% means a Fund Error of 10^{10} RMB Yuan

Production Amount of Electrical Meters in China is about 8×10^7 /year
In which about 50% are Electronic Meters and the other are Mechanic Meters.

The Meters with amount of about 9×10^6 /year are exported to American, Europe and other areas of world

More than 600 Manufactories of Electrical Meters in China

1.2 Technical Documents

National Standards

GB/T 15283-1994 0.5, 1和2级交流有功电度表 (idt IEC521-88)

GB/T 15282-1994 无功电度表

GB/T 17215-2002 1和2级交流静止式有功电能表 (eqv IEC1036-2000)

GB/T 17883-1999 0.2S级和0.5S级静止式交流有功电度表 (eqv IEC60687-1992)

GB/T 17882-1999 2级和3级静止式交流无功电度表 (eqv IEC61268-1995)

National Verification Regulations

JJG307-2006 机电式交流电能表

JJG596-1999 电子式电能表

JJG597-1989 交流电能表检定装置

1.2 Technical Documents (Reference)

National Standards

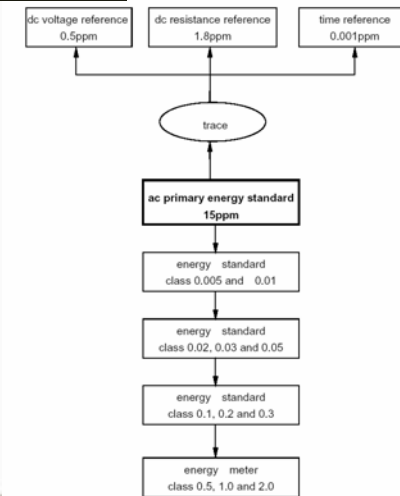
Reference to IEC standards or directly to adopt as IEC standards

National Verification Regulations

Reference to IR46-1980 (OIML TC12)

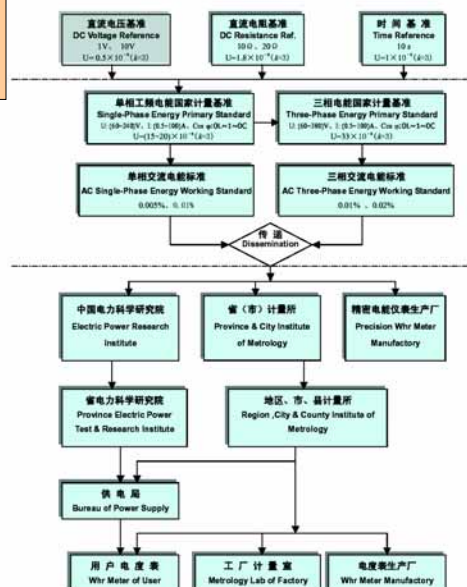
Fig. 2 Dissemination system in China

1.3 Dissemination Relation-in Class



1.3 Dissemination Relation-in Organization

工频电能计量检定系统表
The National Hierarchy Scheme of Energy at Industrial Frequency



2, Primary Standards

2.1 Single-Phase

- It was built up in 1990
- The Quantities of Voltage, Resistance and Time are traced directly to the national standards
- Thermoelectric Converting Principle
- Uncertainty $15 \mu\text{W}/\text{W}$ or $\mu\text{J}/\text{J}$ ($k=3$)
- Participated in Key Comparison CCEM.EM-K5

2.1 Single-Phase

Principle

- Electromagnetic Induction
- Thermoelectric Converting (adopted by NIM)
- Time-Divide
- Sampling-Computation
- Hall Effect

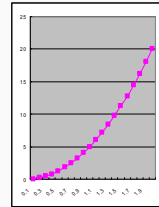
$$w = \int u i dt$$

where W is energy, u is voltage, i is current and t is time.

How to realize the multiplication operation for the power in a specified time interval?

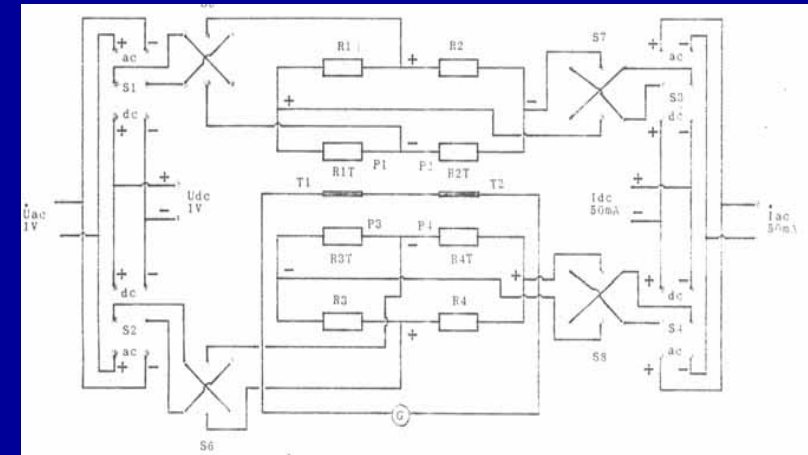
Square-Characteristic of Thermocouple

$$u_{th} \sim i^2$$



$$(i_1 + i_2)^2 - (i_1 - i_2)^2 = 4 i_1 i_2$$

The Double-Bridge Power/Energy Comparator



$$X = (A+B)^2 + (A-B)^2 = 4AB \quad x = (a+b)^2 - (a-b)^2 = 4ab$$

$$X - x = 4AB - 4ab \quad U_T = P_{DC} - P_{AC}$$

Principle of the Primary Standard in China

A double-bridge power/energy comparator based on the multi-junction thermocouple has been developed in NIM and adopted in the primary standard of energy. When an AC power and a more or less equated dc power is applied in the bridge, an emf will output, which is proportional to the difference between ac and dc power.

Therefore the ac power is equal the sum:

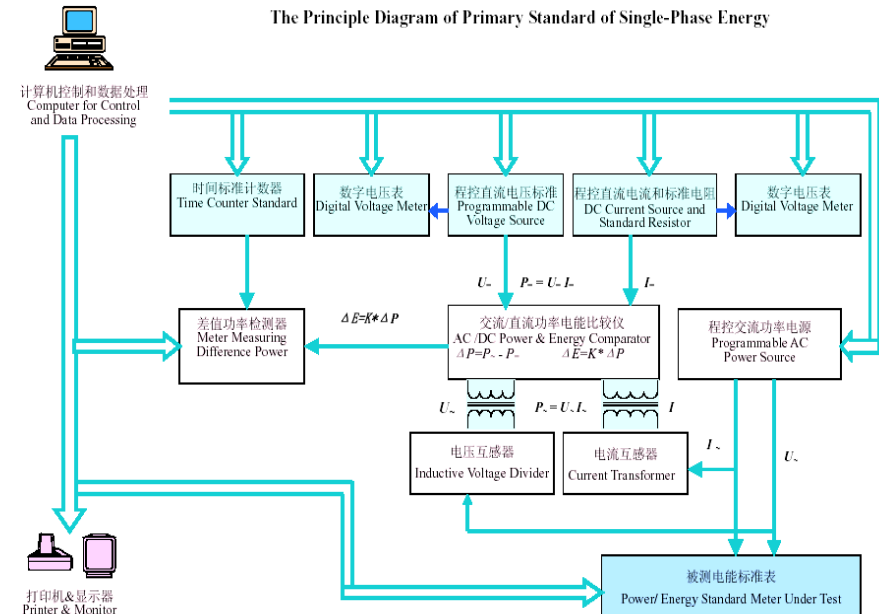
dc power + the part related to the emf.

To obtain the ac energy, an accumulation is taken for dc power and emf in a specified time interval.

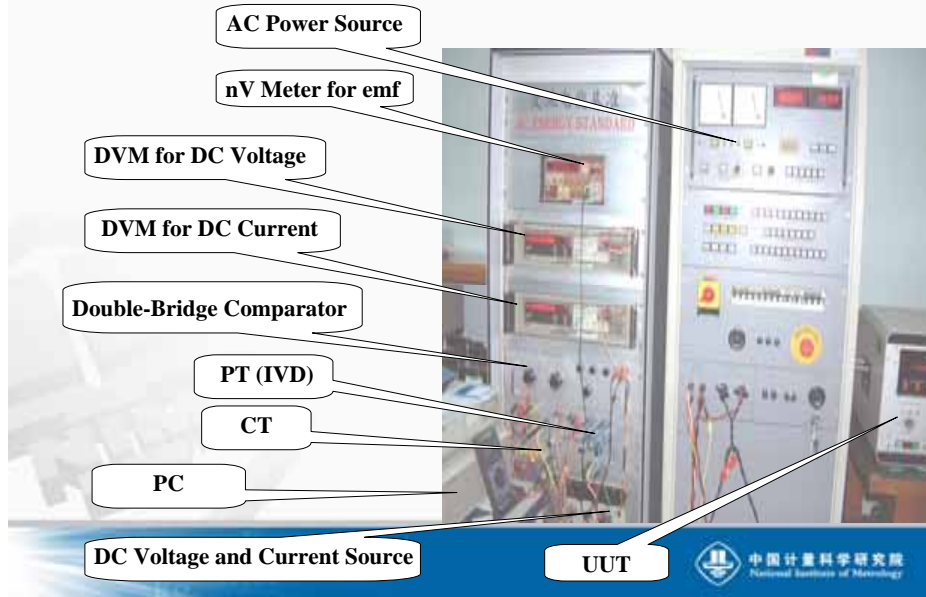
The primary standard traces to the reference standards of voltage, resistance and time maintained in NIM

单相工频电能国家计量基准原理框图

The Principle Diagram of Primary Standard of Single-Phase Energy



Structure of the Primary Standard: Single-Phase



Range and Uncertainty

Frequency: 45 Hz to 65 Hz
 Voltage: 60 V to 480 V
 Current: 0.5 A, 1 A, 2 A, 5 A, 10 A directly
 20 A, 50 A, 100 A with a Current Transformer
 Power Factor: 0 lead to 1.0 to 0 lag
 Uncertainty: 15 μ W/W or μ J/J ($k=3$)

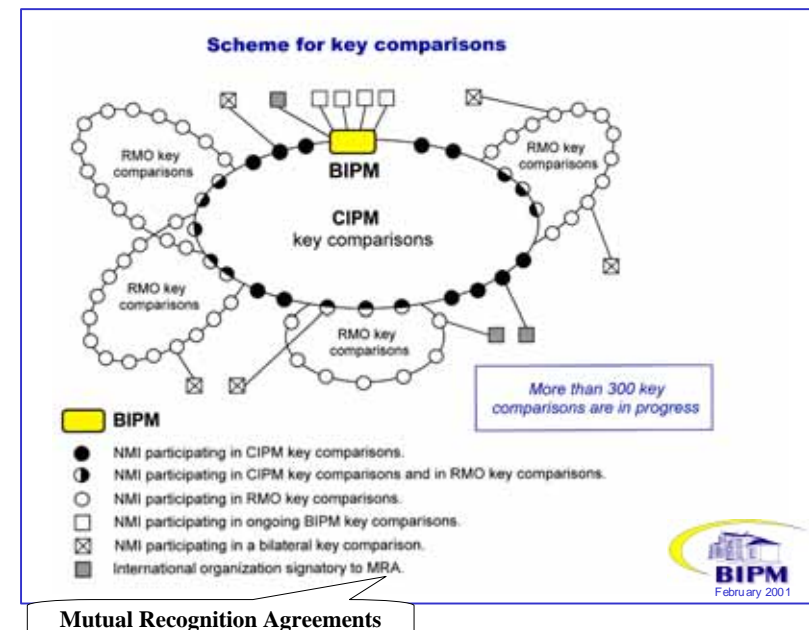
- The dc power is traced to dc voltage and resistance, which have very well uncertainties
- The multi-junction thermocouple has very little ac/dc transfer error
- The difference between ac and dc power is very little.

The CMC can be found in <http://kcdb.bipm.fr/BIPM-KCDB/AppendixC/search.asp?MET=EM>.

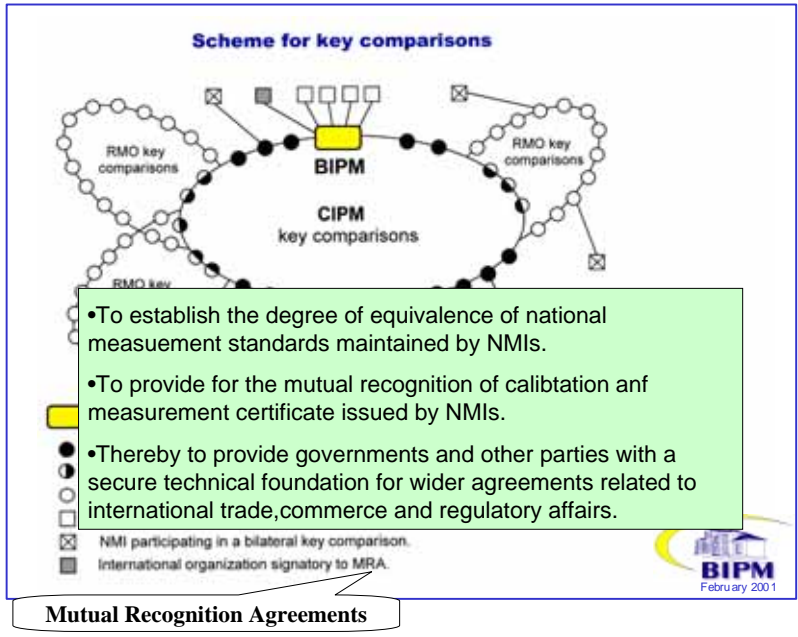
To Participate the Key Comparison organized by CCEM

- CCEM-K5 Comparison of 50/60 Hz Power
- The National Institute of Standards and Technology (NIST) was selected as the *Pilot Laboratory*
- 15 NMIs from five metrology regions participated the comparison
- Rotek MSB-001, based on a time-division-multiplication scheme was selected as the *Traveling Standard*
- **Test Points:** 120 V, 5 A, 53 Hz, at 1.0, 0.5 (lead and lag) and 0.0 (lead and lag) power factors

NIM, China participated this Comparison with the Primary Standard of Single-Phase Energy



Mutual Recognition Agreements

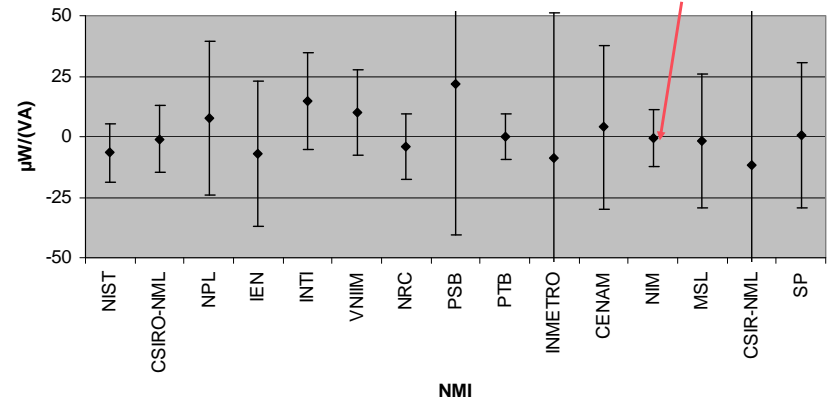


Mutual Recognition Agreements

Differences and Combined Standard Uncertainties in $\mu W/(VA)$

i	NMI	Differences									
		1.0 pf		0.5Lead		0.5Lag		0.0Lead		0.0Lag	
1	NIST	-7	12	1	12	1	12	0	9	3	9
2	CSIRO-NML	-1	14	-1	16	3	16	9	15	-2	15
3	NPL	8	32	-12	26	19	26	-28	29	14	28
4	IEN	-7	30	-10	30	2	30	-14	31	0	32
5	INTI	15	20	9	34	4	34	6	39	7	38
6	VNIM	10	18	-15	28	-25	28	9	25	-11	24
7	NRC	-4	14	5	12	-3	12	7	12	-11	11
8	PSB	22	62	-3	62	13	62	-18	62	-4	62
9	PTB	0	10	-7	10	12	10	-4	12	7	11
10	INMETRO	-9	60	15	60	-26	60	4	60	-13	60
11	CENAM	4	34	-2	34	2	34	-16	54	9	54
12	NIM	-1	12	13	12	-14	12	3	13	-7	13
13	MSL	-2	28	5	30	-16	30	-1	33	-4	32
14	CSIR-NML	-12	80	-14	80	3	80	-26	80	7	80
15	SP	1	30	-8	22	1	22	-9	19	17	19

**Figure 6. Deviation from Reference Value
120 V, 5 A, PF 1.0 (k=2)**



Planned APMP Comparison

Follow-up of the 9th APMP TCEM Meeting in New Delhi

5. APMP.EM-K5 : AC Power; 120 V, 5 A, 53 Hz;

Power factor 1.0, 0.5 Lead, 0.5 Lag, 0.0 Lead and 0.0 Lag

Pilot : NIM

Contact: Dr. Zuliang LU, luzl@nim.ac.cn

It is now in Preparation Phase: Support Group, Technical Protocol , Pilot Study, Invitation of Participants

All Members of APMP could Participate this Comparison, Their Results would be Published in BIPM Website: KCDB

The Comparison will start from this year as planning

2, Primary Standards

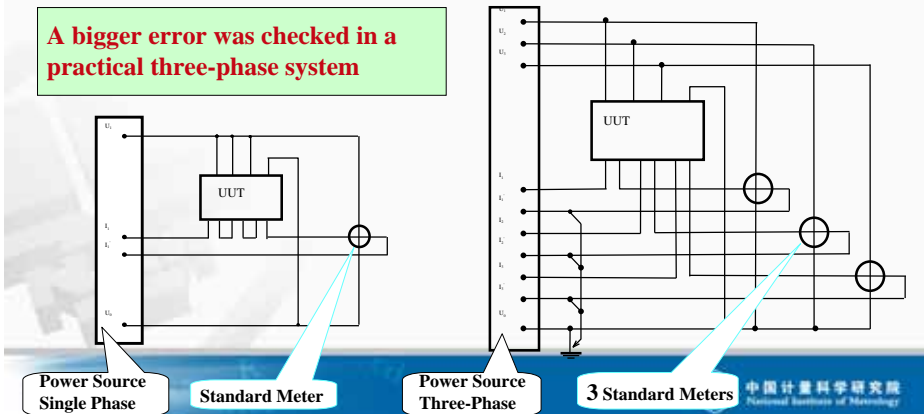
2.2 Three-Phase

- It was built up in 2000
- The 3 single-phase power converters (type C1-1) are adopted and traceable to the primary single-phase standard
- Main Matter existed in Three-Phase: “mutual influence among phases” or “phase effect” was studied and overcome
- Uncertainty $33 \mu\text{W}/\text{W}$ or $\mu\text{J}/\text{J}$ ($k=3$)

Principle: Main Matter existed in Three-Phase:
“mutual influence among phases”

An error up to 0.02% was found on a commercial meter of class 0.02. The meter manufactured by a company in a developed country, it is passed as the Certificate offered by National Institute of the country, but with a method “single-phase standard” and “series-parallel system”.

A bigger error was checked in a practical three-phase system



Structure of the Primary Standard: Three-Phase

Power Source

3 DVMs HP3458A

3 Standard Meters C1-1

UUT

PC

3 PT and 3 CT



Range and Uncertainty

Frequency: 45Hz to 65 Hz

Voltage: 60 V to 380 V

Current: 0.5 A to 100

Power Factor: 0 lead to 1.0 to 0 lag

Uncertainty: $33 \mu\text{W}/\text{W}$ or $\mu\text{J}/\text{J}$ ($k=3$)

Connect Model

3 Phase 4 Wire

3 Phase 3 Wire with 3 elements

3 Phase 3 Wire with 2 elements

The CMC can be found in

<http://kcdb.bipm.fr/BIPM-KCDB/AppendixC/search.asp?MET=EM>.

Energy Comparison in China

Organizer: AQSIQ

Participants: 7 metrology institutes of the big regions
(south, northeast, east et al.)
+ 3 important provinces (Zhejiang, Jiangsu and Tianjing)

Pilot Laboratory: NIM

Traveling Standard: A three-phase standard meter type COM3000 (0.01%)

Time: 2003-09 to 2004-12

Test Points:

The 6 points are asked:

a) 3-phase 4 wire, 100V 5A $\cos\phi=1.0, 0.5L$ and $0.8C$.

b) Single-phase, 100V 5A $\cos\phi=1.0, 0.5L$ and $0.5C$.

The 2 points are option: 3-phase 3 wire (V connecting), 100V 5A $\cos\phi=1.0, 0.5L$.

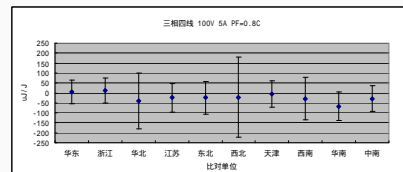
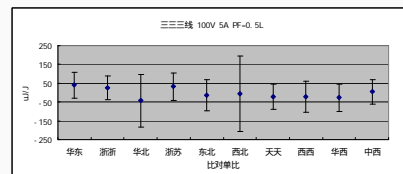
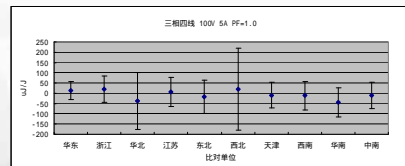


Traveling Standard, COM3000,
25kg

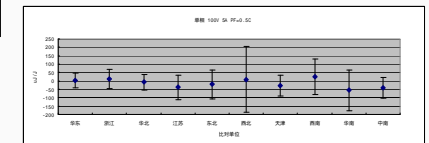
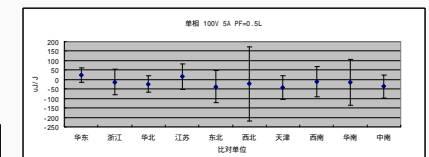
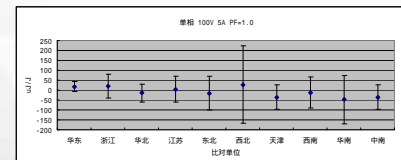
Aluminum Package, 45kg
incl. COM3000



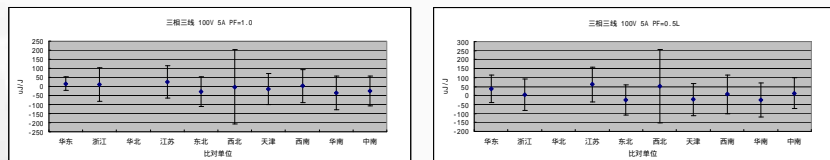
Comparison Results 3-phase 4 wire 100V 5A



Comparison Results Single-phase 100V 5A



Comparison Results 3-phase 3 wire 100V 5A



Comparison Conclusion

The Uncertainties Claimed from All Participants are reasonable with more or less Surplus.

The Implement Scheme referenced as International Comparison CCEM.EM-K5, and started after the later had been published

The Situation and Results of the Comparison in China was exchanged in CPEM2004

2.3 Harmonic Power

It is completed in the end of 2006

To Meet the Need of Traceability of Harmonic Analysis Instruments

The Type Approval of the Electricity Meter (IEC1036)

The Harmonic Current Test in EMC of Appliances

To Measure and Monitor the Harmonic Components in the Power Net

It traces to dc Voltage, dc Resistance, ac Voltage, ac Current, and Frequency Standards

Uncertainties: Up to 60th harmonics, Reference to the Fundamental, $k=2$

Voltage 30 $\mu\text{V/V}$, Current 32 $\mu\text{A/A}$, Power 40 $\mu\text{W/VA}$

Principle

•Sampling of the Non-sinusoidal Signals with DVMs

•DFT to Determine the Amplitudes and Phase Differences of Voltage and Current

•Non-Integer-Period Sampling Theory and Algorithm Developed by NIM, the synchronization between sampling rate and signal frequency is not been strictly required

•For a numeric estimation of uncertainty a “character signal” is assumed

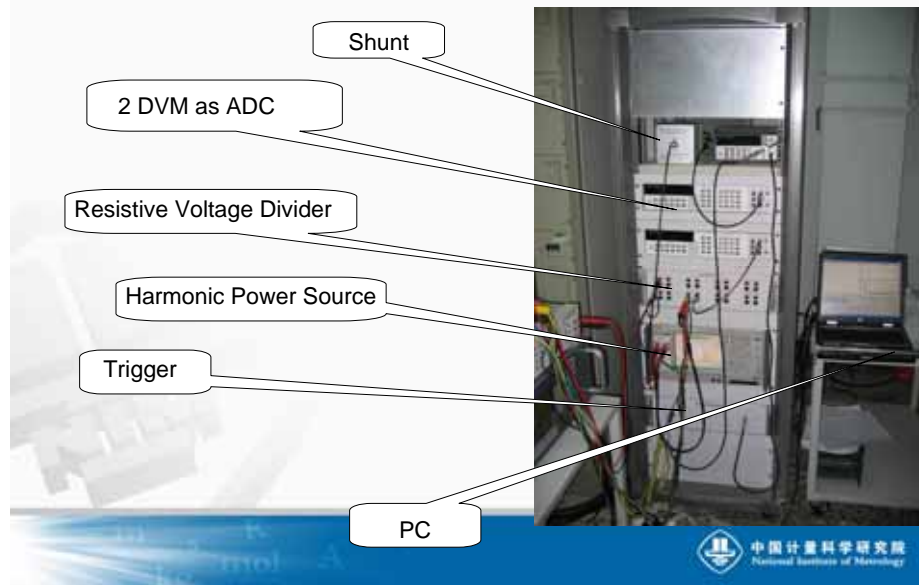
•To validate the uncertainties, some tests are taken, such as orthogonality test described by NRC, and comparison with power standard etc.

2 DVMs type of HP3458A are applied as ADC to sample

RVD developed to Extend the Range of Voltage up to 500 V

Shunt offered by SP to Extend the Range of Current to 20 A, CT up to 50 A

Structure: Harmonic Power



Range and Uncertainties: Harmonic Power

Range:

Non-sinusoidal Condition

Fundamental Frequency: 45 Hz to 65 Hz

Harmonic Order: up to 60th

Voltage: 60 V to 500 V

Current: 0.5 A to 50 A

Power Factor : 0 (lead) to 1.0 to 0 (lag)

Uncertainties ($k=2$)

Voltage: 30 μ V/V referenced to fundamental voltage

Current: 32 μ A/A referenced to fundamental current

Power: 40 μ W/VA referenced to fundamental apparent power

2.4 General Considering for Energy Standard System

To decide the Class of MPE (or Uncertainty) and Range

0.005% or 0.01%?

600 V ?

20 A or 50 A or 100 A?

According to the UUT (Calibrated Meters)

To select the Equipments

Standard Meter: Class of MPE and Range

Power Source: Range, Output Power, Stability, Adjust and Control

Range Extending Device: PT; CT (IVD, RVD; Shunt)

Working Standard: (directly serve for UUT, monitor of the system's stability, or the intermediate check)

Reference:

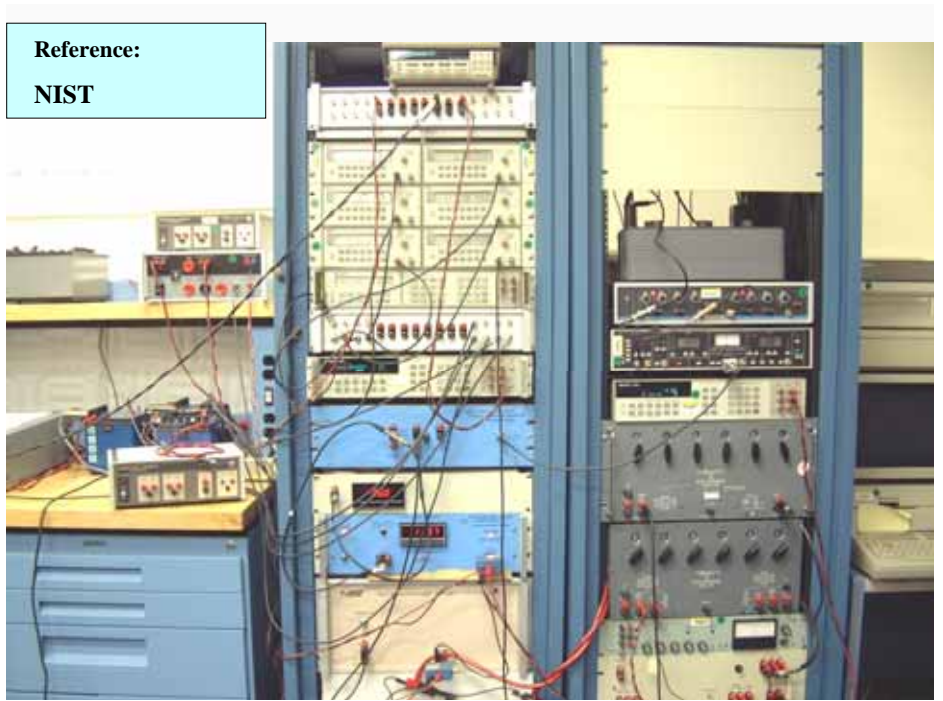
PTB: Single-Phase



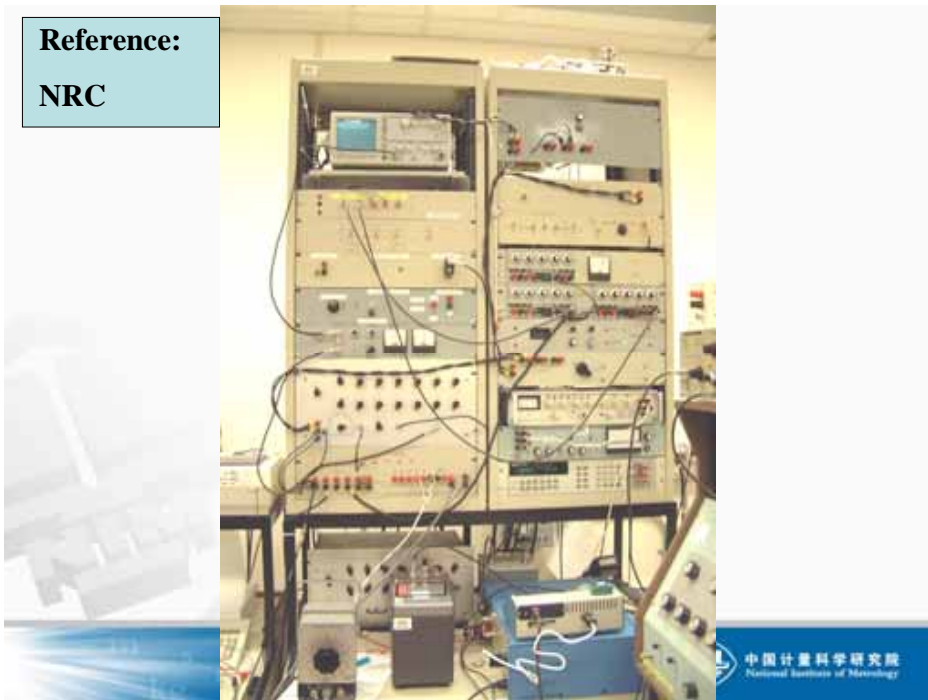
Reference:
PTB: Three-Phase



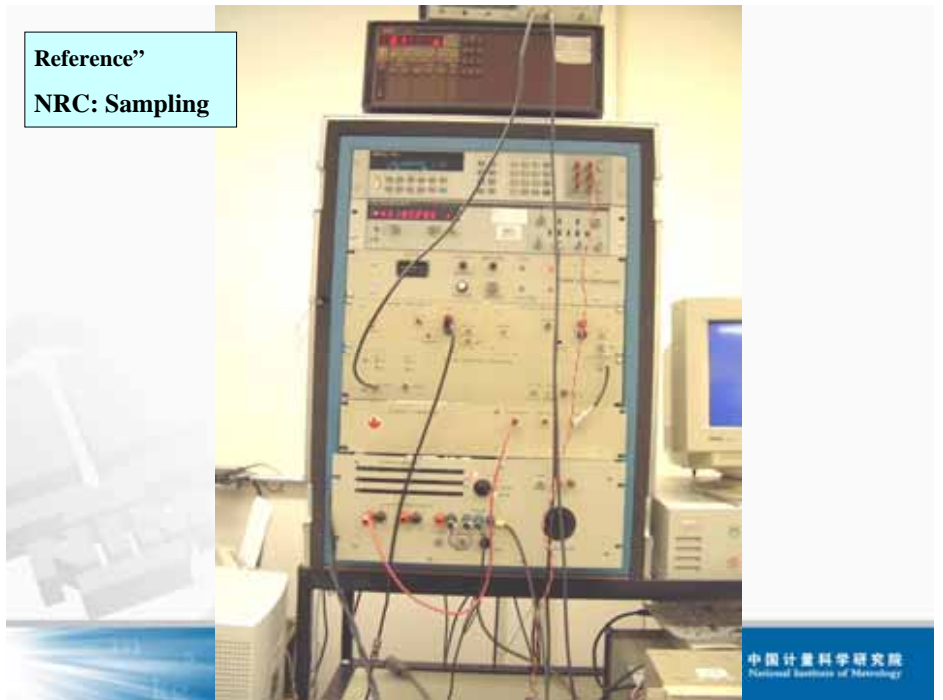
Reference:
NIST



Reference:
NRC



Reference'
NRC: Sampling



3, Our Comments for IR46 Revising

Original Version

INTERNATIONAL RECOMMENDATION No 46

ACTIVE ELECTRICAL ENERGY METERS for DIRECT CONNECTION (Class 2)

Fifth International Conference of Legal
Metrology – October 1976
First edition 1978 (French version) – 1980
(English version)

It is harmonic with IEC Standard



Why to Revise?

- Measurements of Electrical Energy on Deregulated Market
- Consumers can freely buy electrical power to any one or several power plants, Consumers can also change their purchase from a plant to another plant.
- Some countries in North America and Europe start to try.
- In the condition, higher requirement for measurement of electrical power is put

•In Europe, a new technical file: Measuring Instrument Directive, MID is enforced, in which MI-003 is for electrical meter

TC12 IR46 WG Meeting

The Secretariat of the WG is in SP, Sweden

In Boras, Sweden, 2002-09-19 to 20

In Maastricht, the Netherlands, 2003-03-27 to 28

In Copenhagen, Denmark, 2004-03-30 to 31

In Boras, Sweden, 2005-01-24 to 27

In Canada, 2005-09-21 to 24

Main Problem existed:

IEC Standards are referenced incompletely. The Draftsman try to reference to the MID

Therefore, the mechanical meters manufactured as IEC standards will not meet the new file of IR46

Our Standpoint

How to produce our STANDPOINT?

- Some experts meetings were held in China before every WG Meeting or decision of important matters (vote)
- The experts are from 3 fields: Metrology, Utilities, Manufacturer (incl. the foreign capital)
- The Authority directed the process
- To understand that it is reasonable for the advanced countries to put higher requirements.
- MID is applicable in Europe, which is an important reference for us. In the future it might be referenced or applied by us.
- In the present situation in China, the mechanic meters are still needed. The manufacturer state that they are able to produce the meter according the revised IR46 but with higher cost which will not be accepted by users in current situation.
- The mechanic meters shall be included in the new IR46, at least the class A in the former file shall be held.

Vote for CD3 file

In 2005 March the CD3 of the revised IR 46 was sent to members of OIML for their vote and possible comments with the deadline of 30 June 2006.

- A test activity was organized under support of the Authority from March 2006 to May
- To research the practical capability at present in design and manufacture of the electromechanical meters in China
- the test methods according to CD3.
- 90 meters including single-phase and three-phase, with 30 types sampled from 9 manufactories were tested.
- 5 qualified units, National Electrical Meters Test Centers, are pointed to test.

The Aim is

- To put a more effective and more practical proposal.
- To check the difference between the new IR46 and practical capability according to IEC standards

中国计量科学研究院
National Institute of Metrology

Our comments focus in a few points only:

- 1, Load balance at point of I_{max} only;
- 2, Harmonics in voltage and current (in Table 4 and Clause 7.2.7.6);
- 3, Sub-harmonics in The AC current (in Table 5 and Clause 7.3.1.4);
- 4, Harmonics in the AC current circuit (in Table 5 and Clause 7.3.1.5);
- 5, Continuous (DC) magnetic induction of external origin (in Table 5 and Clause 7.3.1.7);

中国计量科学研究院
National Institute of Metrology

Thank you very much for your attention!

中国计量科学研究院
National Institute of Metrology

Presentation

On Electricity Meters in Cambodia

Current Situation of Electricity in Cambodia

- The Royal Government of Cambodia has Electricity Law, that promulgated by Royal KRAM No., NS/RKM/0201/03 on February, 2001.
- In this law, Ministry of Industry, Mines and Energy (MIME) shall be responsible for setting and administrating the policies, strategies and planning in the power sector.

Current Situation of Electricity in Cambodia

- Electricity Authority of Cambodia (EAC) is the legal public entity, being granted the rights by the Royal Government of Cambodia to be an autonomous agency to regulate the electricity power services and govern the regulation between the delivery, receiving and use of Electricity.
- Electricity of Cambodia (EDC) is a public company of State under administration of MIME and Ministry of Economic and Finance, which produces and distributes the Electric Power around country.

Organization performs the measurement of Electricity

- Electricity Authority of Cambodia (EAC) shall ensure the provision of services and use of electricity and be performed efficiently, qualitatively, sustainably and in a transparent manner.
- EAC shall require each licenses to ensure and certify that metering equipment and meter testing facilities to comply with all applicable standards. Any metering equipment and meter testing facility may be inspected by Authority from time to time.

Organization performs Type Approval

- The metrology law has drafted by Department of Metrology (DOM) and MIME and now submitted to the council of Minister office for adoption.
- In the Article of drafted law for use in trade and purpose shall be:
 - subject to pattern approval
 - subject to initial verification in accordance with requirement.
 - subject in service of verification,
 - subject to verify after repair or modification

Organization performs Type Approval

- In the Article of drafted law is also specified on:
 - weighing or measuring equipment for use in the field of public health.
 - weighing or measuring equipment for use in the field of postal service.
 - weighing or measuring equipment for use in the field of Electricity, Gas and Water.
- DOM has not measurement standards equipment and regulatory control for Pattern approval and verification such instruments.
- Under UNIDO project in Second phase for Market Access and Trade Facilitation, supports for MEKONG DELTA Country to assist and establish new measurement Standard facilities for verification of Electricity Meters and Water Meters in the near future.

Kinds of Electricity Meters in Cambodia

- Active Power
- Reactive Power
- Single tariff and Multiple tariff.

Future Purpose

- When the metrology law will be passed by National Assembly, Department of Metrology has power to control and verify Standard Equipments in Electricity Authority of Cambodia (EAC) (Working Standards) in order to resolute the complaints between the suppliers and user.

Thank you for your attention

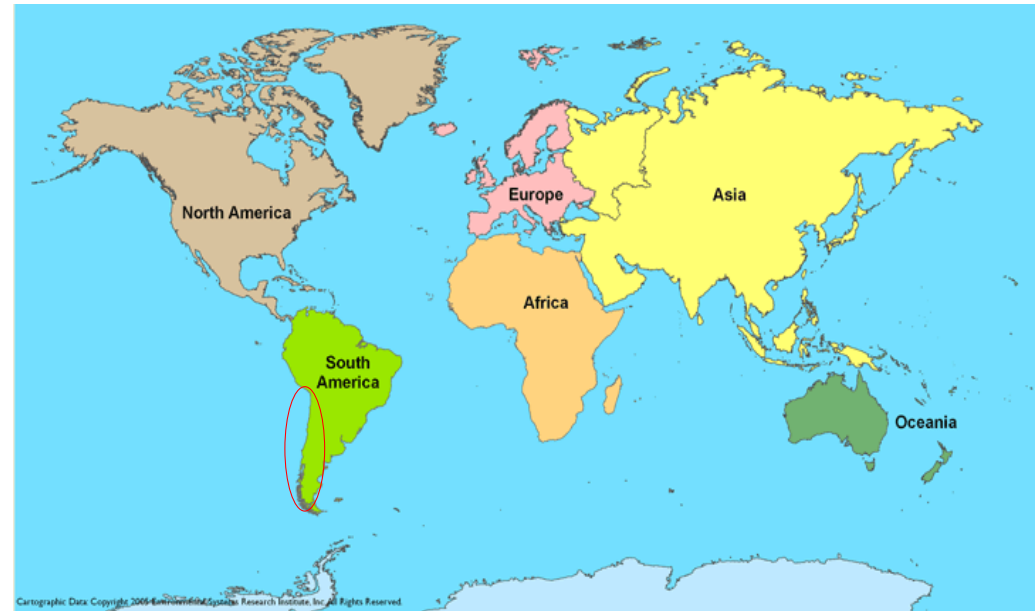
Electricity Meters - Chile

Francisco Muñoz G
Superintendencia de Electricidad y Combustibles (SEC)

APEC/APLMF Seminars and Training Courses in Legal Metrology
Seminar on Electricity Meters (CTI-11/2006T)
 19-22 March, 2007



Where is Chile located?



Where is Chile located?



This is Chile



Chilean Energy Regulatory bodies

- Chile has two regulatory bodies
 - The National Commission of Energy (CNE)
 - Principally it is a regulatory body
 - www.cne.cl
 - The Superintendence of Electricity and Fuels (SEC)
 - Principally it is a controller body
 - www.sec.cl



In Chile

- The electricity meters are required to have type approval
- This type approval is performed by the Certification Bodies
- These Certification Bodies are authorized by SEC
- As a result, before installing, the meters have to be verified, calibrated, sealed and certified by a Certification Body



In Chile

- The Certification Bodies perform around 200.000 meters approval in a year
- The maintenance tariff was calculated with a re-verification interval for customer owned meters of 4 years



In Chile

- The electricity meters are required to have verifications
- This verification is performed by the Verification Bodies
- These Verification Bodies are authorized by SEC



In Chile

- The validity of the verification is 4 years to initial and subsequent verifications
- The length of validity of verification is decided by a decree
- The meters are verified at the place of service or in a laboratory



In Chile

- Maintenance and rent tariffs are very similar in present value, but the rent is a per month tariff
- The tariff decree indicates that the interval will be 4 years until SEC determines a different interval
- SEC determined 10 years. The Government National Controller dictated that SEC cannot do this until a new tariff process is held. SEC appealed



In Chile

- The utilities companies have the responsibility of doing maintenance to the meters
- The utilities companies can charge the maintenance cost, only after the service has been done
- There are about 5.000.000 electricity customers and meters in Chile



In Chile

- The utilities companies own about half of these meters, and rent them to the customers (the tariff includes maintenance)
- The customers that own the meters have to pay the "maintenance" (re-verification)
- Both prices are set by a tariff fixing process, led by CNE
- The Verification Bodies are independent companies owned by the utilities companies (subsidiaries)



In Chile

- The kinds of electricity meters used are
 - Active and Reactive
 - VA and Demand
 - 1, 2 and 3 phases
 - Single-tariff and Multi-tariffs



In Chile

- If exist a measurement complaint, the customers ask for a re-verification, the utility company has to do so by an authorized Verification Body
- If the meter is OK: the re-verification is paid by the customer, otherwise paid by the company



Thank you for your attention



Electricity Meters - Chile

Francisco Muñoz G
Superintendence of Electricity and Fuels (SEC)
fmunoz@sec.cl

APEC/APLMF Seminars and Training Courses in Legal Metrology
Seminar on Electricity Meters (CTI-11/2006T)
19-22 March, 2007



Legal management for Utility Electricity Meters In China



SIMT

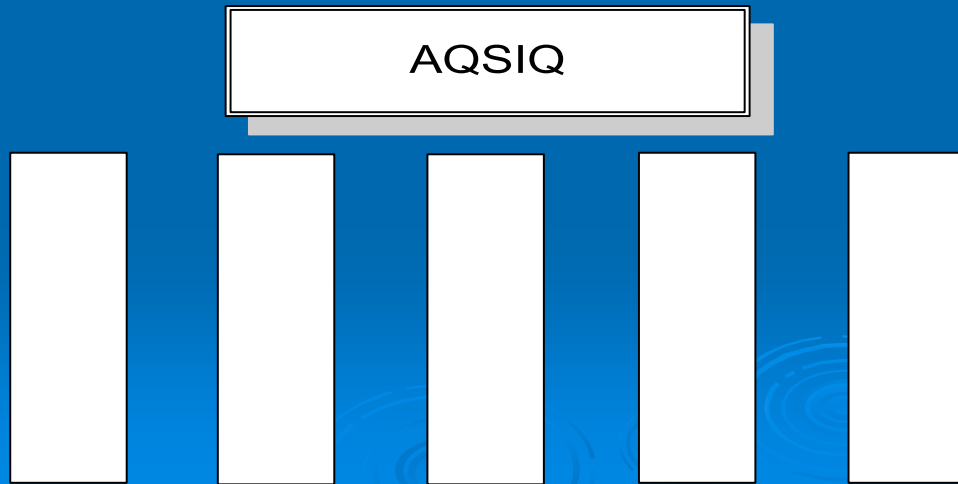
1. Legal metrology & management
2. Pattern approval
3. Initial Verification
4. Metrology Dispute
5. Example

Legal Metrology & Management

General Administration of quality supervision, inspection and Quarantine of the P. R. China (AQSIQ) to be responsible for the management of electricity meters

Utility electricity meter is listed by AQSIQ as a significant management of measuring instruments

- The provincial bureau of quality and technical supervision (PBQTS) be responsible for the management of electricity meters and accepts the pattern approval application



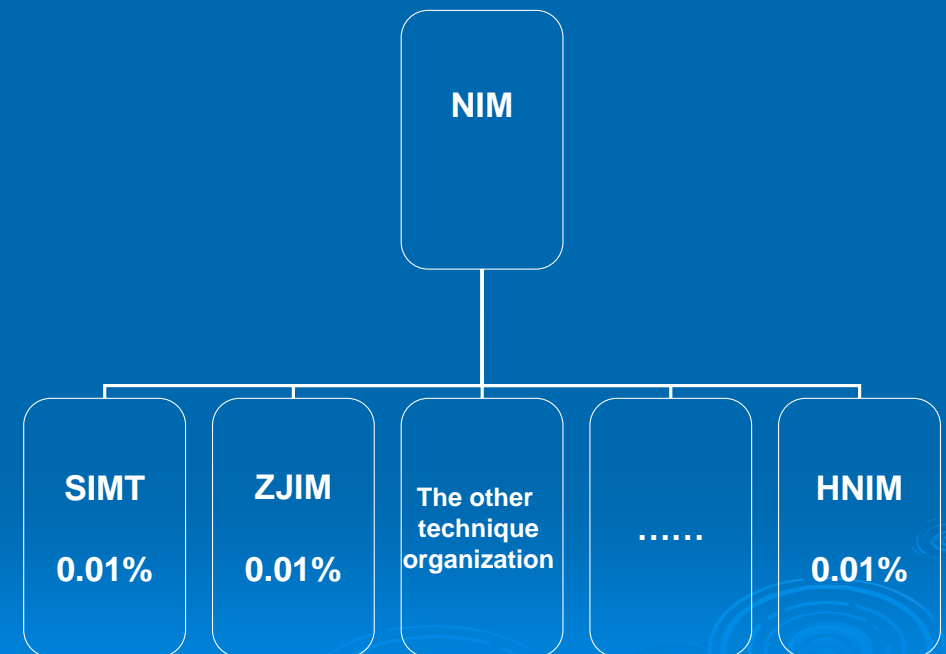
The technique organization established by AQSIQ

National Institute of Metrology
P.R.China
(NIM)

National primary standard of Electrical Energy

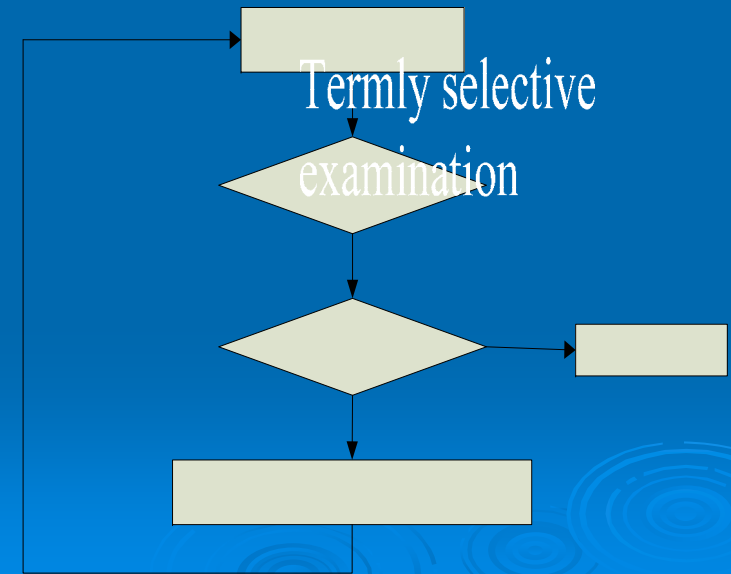
- national primary standard of single-phase Electrical Energy
Uncertainty: 0.0015%
- national primary standard of three-phases Electrical Energy
Uncertainty: 0.0033%

Zhejiang Provincial bureau of



Pattern Approval

Pattern approval Procedure



Pattern approval of electricity meters

- The pattern approval certificate has no term of validity
- The license of manufacturing measurement instruments (CMC) is generally valid in 3 years, but doesn't need a pattern approval again.
- The local metrology administrative department is in charge of supervision after the enterprises acquire the CMC

Initial Verification

The initial verification of electricity meters

- carried out by the technique organization authorized by the metrology administrative department of the government.
- The subsequent verification period
 - ✓The single-phase meters for active energy of magnetic force bearings and double precious stone bearings should not be suitably rotated over 15 years, while others not over 10 years.
 - ✓the electronic type electricity meters can not be over 5 years

The initial verification of electricity meters

- When expiring for the very first time verification, the electricity meters can be reverificated or discarded and replaced the new one .
- The rotating period of the electricity meters is stipulated in the rules of national metrology verification regulation according to the actual using circumstance and design life span of electricity meters.
- The initial verification of electricity meters are all carried out in the laboratory

The use of utility electricity meters

Mechanical electronic single phase electricity meters

220V 5(20)A、 10(40) single rate



Electronic single phase electricity meters

220V 5(20)A、 10(40) single rate



Single phase multi-rates electricity meters

220V 5(20)A、 10(40) multi-rates

Single phase pre-paid electricity meters

220V 5(20)A、 10(40) single rate



Metrology Dispute

Metrology dispute

- When the measuring result of electricity meters meets dispute, the customer can:
 - 1) Apply to the initial verification technique organization for re-verification
 - 2) Issue the complaint to the local metrology administrative department, which will be arbitrated by legal metrology service appointed by the local administrative department

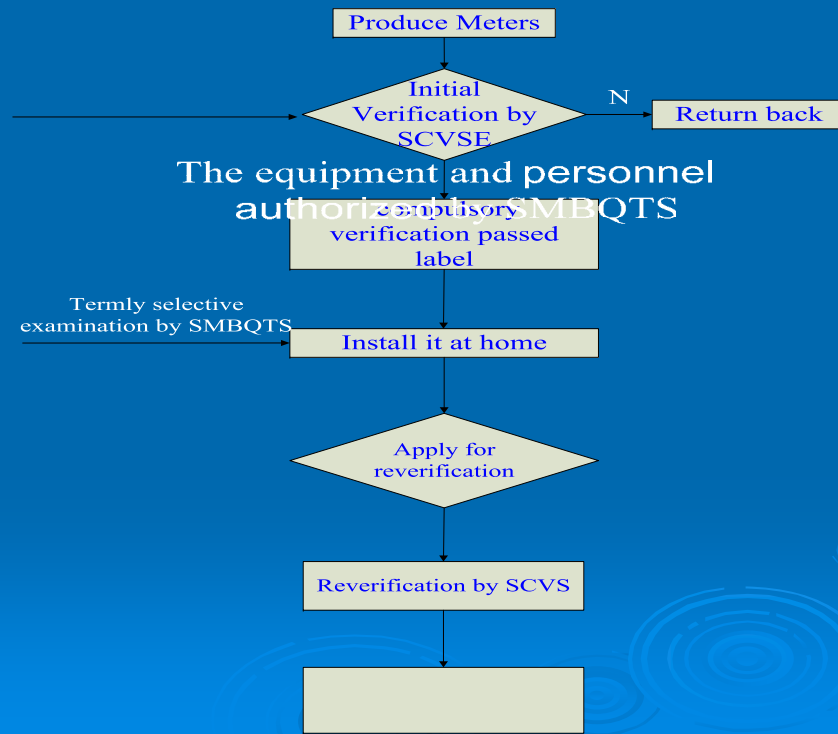
example

Legal management of utility electricity meters in Shanghai

- **AQSIQ** is the highest metrology administrative department in the nation.
- **SMBQTS** Shanghai municipal bureau of quality and technical supervision is the concrete executor of the policy set by the AQSIQ and make the correspond procedure according to the local actual circumstance.
- **SIMT** is a technical institute established by SMBQTS in the region of shanghai. It maintains the highest-level standards in shanghai and East of China, and is one of the technical organization authorized by AQSIQ to carry out electricity meters pattern evaluation

Legal management of utility electricity meters in Shanghai

- **SCVSE** Shanghai compulsive verification station of electricity meters is an branch of electrical power company, which is authorized by SMBQTS to carry out initial verification of electricity meters, whose equipments and personnel are all value transmitted and trained by **SIMT**.
- When the measuring result of electricity meters meets dispute, the customer can request the verification again to SCVSE or complain to SMBQTS and **SIMT** will arbitrate the complaint.



The technique organization of the pattern evaluation

- The technique organization should be authorized by AQSIQ .
- *SIMT*, an authorized organization by AQSIQ, gains accreditation of CNAS(China National Accreditation Service for conforming Assessment) and CQC(China Quality Certification Center).



pattern experimental abilities of *SIMT* accredited by CNAS and CQC

- IEC 62052-11 Electricity metering equipment (AC)-General requirements, tests and test conditions- Part11: Metering equipment
- IEC 62053-11 Electromechanical meters for active energy (class 0.5,1 and 2)
- IEC 62053-21 Static meters for active energy (class 1 and 2)
- IEC 62053-22 Static meters for active energy (class 0.2S and 0.5S)
- IEC 62053-23 Static meters for reactive energy (class 2 and 3)

pattern experimental abilities of *SIMT* accredited by CNAS and CQC

- GB/T 17215-2002 Alternating current static watt-hour meters for active energy (class 1 and 2) (IEC 61036-2000 , IDT)
- GB/T 18460.3-2001 Pre-payment electricity meters
- GB/T 15283-1994 Class 0.5、 1 and 2 Alternating current watt-hour meters (IEC 521-1988 , IDT)
- GB/T 15282-1994 Reactive energy meters
- GB/T17883-1999 Alternating current static active energy meters (class 0.2s and 0.5s)
- GB/T17882-1999 Alternating current static var-hour meters for reactive energy (class 2 and 3)
- GB/T15284-2002 Particular requirements for multi-rate electricity meters
- JB/T5467.1-2002 Electricity metering equipment (AC)-General requirements ,tests

equipments and test items carried out in *SIMT*

- Verification equipment for electricity power standard
- Uncertainty: 0.01%
- The main electricity power standard:
- C1 - 2 accuracy 0.005%



Accuracy requirements and Influence quantities



Accuracy requirements and Influence quantities



Climatic conditions and Mechanical requirements



Electromagnetic compatibility(EMC)



Electromagnetic compatibility(EMC)



Electrical requirements



Shanghai Compulsive Verification Station of Electricity Meters

- A technique organization carrying out the initial verification of electricity meters in Shanghai



The Utility electricity meters mainly used in Shanghai

- Before 1994 Mechanical electronic single phase electricity meters are mainly used. 220V 5(10)A
- 1994-1998 Modified mechanical electronic single phase electricity meters are mainly used, which are improved in the respects of life span and quality. 220V 5(20)A
- 1998-2001 The mechanical electronic single phase electricity meters of magnetic force bearings are widely used, which are further advanced in design life span. 220V 5(30)A, 10(40)A
- 2001- Electronic single phase multi-rate electricity meters are widely used. 220V 5(30)A, 10(40)A, 15(60)A
- The number of electricity meters used in the net currently is more than 6,200,000 in region of Shanghai



Site-Examination





APEC/APLMEF Seminars and Training Courses in Legal Metrology
Seminar on Electricity Meters (CTI-11/2006T)
19-22 March, 2007

Overview of the Measurement System and Current
Situation about Electricity Meters

Speaker: Zhang Mian

Henan Institute of Metrology (HNIM)
Electric energy and Power laboratory



Brief introduction of Henan Institute of Metrology



- Henan Institute of Metrology is a provincial legal metrological verification institute set up by the Henan Provincial Government according to the laws, and a social benefit type public institution for scientific research, with notary status as the third party.

Organization Structure of HNIM

- Administrative Department
 - Department of Administration and Finance
 - Department of Customer Service
 - Department of Development and Planning
 - Department of Quality Management
 - Department of Marketing
 - Department of Condition Support

Organization Structure of HNIM

- Professional Divisions
 - Electric energy and Power Laboratory**
 - Electromagnetic Compatibility, Safety and Environmental conditions Laboratory
 - Electromagnetic Laboratory
 - Length and Optics Laboratory
 - Thermal Laboratory
 - Mechanics Laboratory
 - Mass Weighting Laboratory
 - Dynamic Weighting Verification Laboratory
 - Radio, Frequency and Communication technology Laboratory
 - Liquid Flow and Capacity Laboratory
 - Gas Flow and Pressure Laboratory
 - Chemical and Environmental Protection Laboratory
 - Medicine and Ionizing Radiation Laboratory
 - Motor Vehicle Testing technology Laboratory

Responsibility and Authorization

- The institute has established 158 items of public measuring standards in 10 major sorts, including 71 items of provincial top standards, 87 items of substandard. It is able to imperatively verify the measuring instruments of 74 kinds in 39 items, and to carry out the verification, calibration and testing for the society.
- Its certificate of authorization No. is (G)F(2002)No.01031, which is entitled by the General Administration of Quality Supervision, Inspection and Quarantine.

Responsibility and Authorization

- In 2000, the institute passed the examination and approval of China National Accreditation Board for Laboratories, the certificate No is L0175 .
- The institute also has the authorization of the General Administration of Quality Supervision, Inspection and Quarantine to carry on 207 items of verification /calibration, and 51 items of testing ; carry on design appraisalment of electric meter, weighting equipment, water meter and gas meter .
- Its certificate of authorization No. is (G)F(2002)No.01031, which is entitled by the General Administration of Quality Supervision, Inspection and Quarantine .

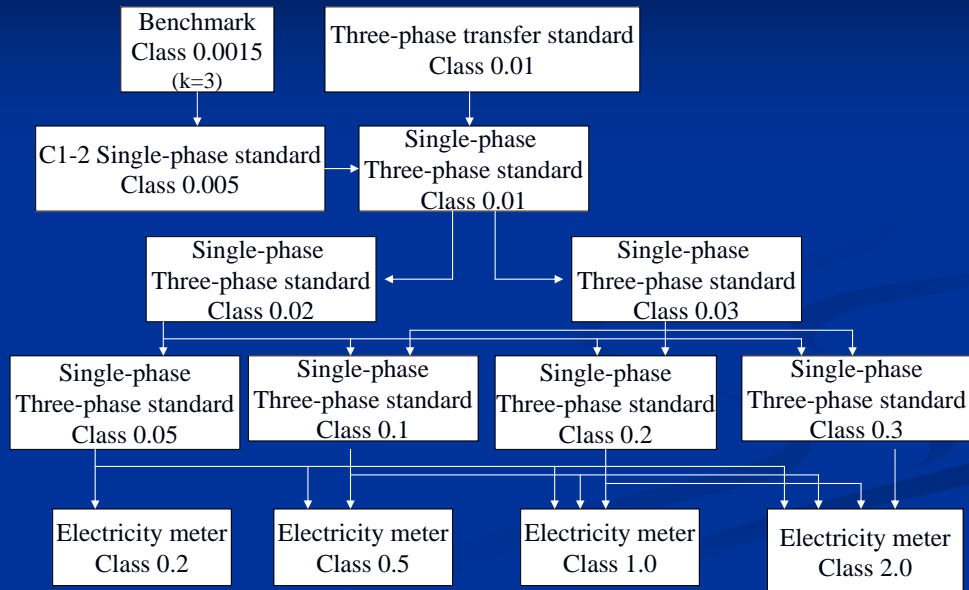
Certificate



Introduction of Electric energy and Power Laboratory of HNIM

- With the quick development of nearly 30 years, the Electric energy and Power Laboratory has become one of the highest level laboratories in the lead position in China . And its measurement instruments are advanced, possessing the international level .
- The laboratory has excellent disseminating ability of the quantity value in electric energy testing field, which has 8 class 0.01 or 0.02 electric energy measuring standard totally.

Verification System of electricity meters



Electric energy and Power Laboratory



ZERA ED7186 Class 0.03 three-phase electric energy standard device

Foresight ----- Put into use in 1986

Electric energy and Power Laboratory



ZERA IML03-3 Class 0.01 single-phase electric energy standard device

Put into use in 1995

Electric energy and Power Laboratory



NST-3500 Class 0.03 three-phase electric energy standard device

Put into use in 2000

Electric energy and Power Laboratory



EMH KOM200.3 Class 0.02 three-phase electric energy standard device

Put into use in 2002

Electric energy and Power Laboratory



ZERA KOM3003 Class 0.01 three-phase electric energy standard device

Put into use in 2003

Electric energy and Power Laboratory



YES-10000 Class 0.01 three-phase electric energy standard device

Introduction of the YES-10000

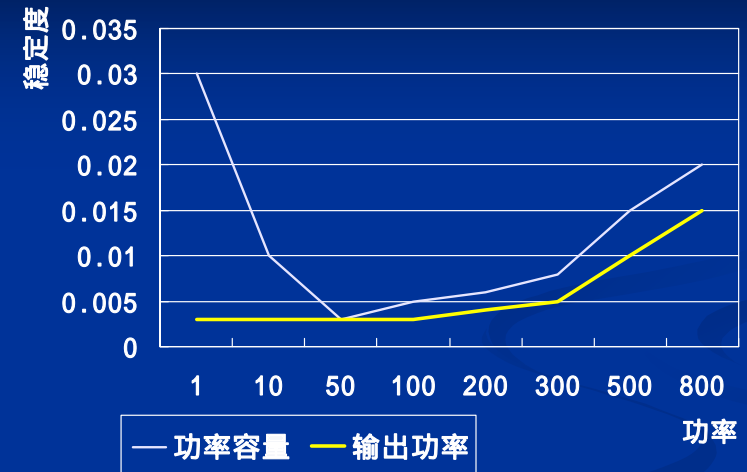
- The class 0.01 three-phase electric energy standard device **YES-10000** was designed by Henan Institute of Metrology independently .
- The project of YES-10000 started in 2003 and was finished in 2005 .
- YES-10000 has passed the examination and approval of National Institute of Metrology in 2006, which make HNIM be the first accredited institute in china for the authorization of class 0.01 three-phase electric energy standard device.

Introduction of the YES-10000

Feature

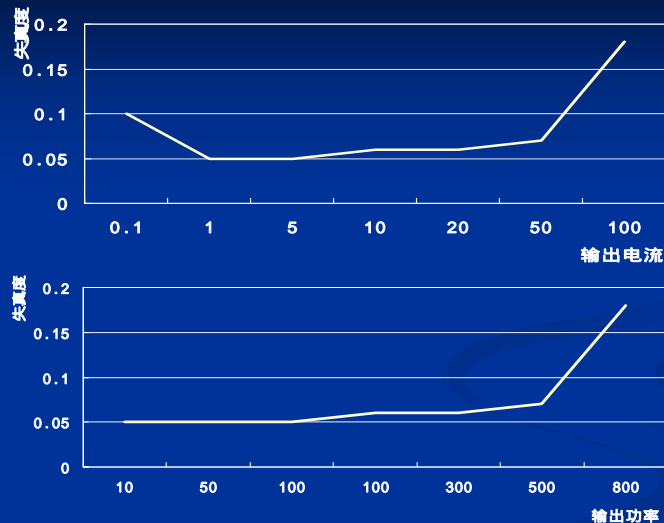
- Multi-standard working model
- Multi-wiring model for autotest
- Multi-calculating model for testing
- Multi-meter constant and range for autotest

Introduction of the YES-10000



The relationship between the Power and Stability

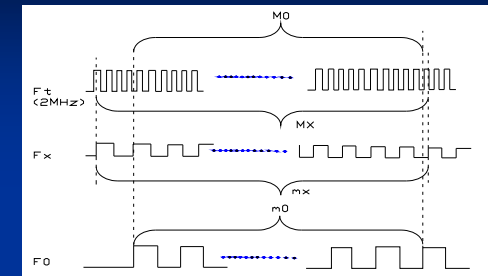
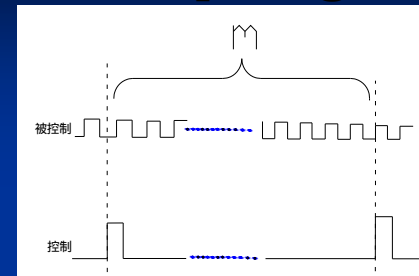
Introduction of the YES-10000



The relationship between the Power and Distortion

Introduction of the YES-10000

Exploring for error calculate model



$$\Delta = \frac{\pm 1}{m} = \frac{\pm 1}{f \cdot t}$$

$$e = \frac{P_x - P_0}{P_0} = \frac{\frac{m_x f}{M_x C_x}}{\frac{m_0 f}{M_0 C_0}} - 1 = \frac{m_x \cdot m_0 c_0}{m_0 \cdot M_x C_x} - 1$$

$$= \frac{m_x c_0}{m_0 c_x} \cdot \frac{M_0}{M_x} - 1$$

$$\Delta = \frac{\pm 1}{M_0} + \frac{\pm 1}{M_x} \text{ 当 } 1S \text{ 时 } \Delta \leq 0.0001 \%$$

Introduction of Electric energy and Power Laboratory

- The Electric energy and Power Laboratory is one of the labs which first acquiring the authorization for design appraisalment .
- The Electric energy and Power Laboratory, equipping with over 80 international advanced instruments and equipments, such as harmonic standard, multi-functional standard, GTEM Room, Shield Room,etc is able to carry out performance tests according to clients' requirements based on International(IEC), National(GB), Professional and Enterprise Standard for electric energy measurements.

Introduction of Electric energy and Power Laboratory

Excellent Group

Abundant Experience

- 2 committee members of National Electromagnetic Technology Committee
- 1 committee member of National Metrology Technical Committee
- 6 senior engineers, 12 senior engineers
- Several excellent middle age/young expert of electricity metering
- Participants for drafting 8 national or local metrological verification regulations such as JJG 597-2005 Verification Equipment for AC Electrical meters
- Undertake the National Production Quality Supervision and Examination of electricity meter both in 2005 and 2006

Introduction of Electric energy and Power Laboratory

Superior Environment

- The institute attaches importance to the environment conditions of carrying out the verification, calibration and testing . The offices and laboratories of the institute cover area over 13000m², with the fixed assets of more than 30 million Yuan .
- The constant area of the Electric energy and Power Laboratory covers area of 300m², besides 500m² for the Electromagnetic Compatibility, Safety and Environmental Conditions test .

Type evaluation

- Since acquired the authorization for design appraisalment first in 2000, the Henan Institute of Metrology has finished the tasks 500 batches design appraisalment of 6 provinces, which make it possess a proficient professional testing group with abundant experience .
- Impartial behavior, Scientific method and strict attitude, Provide report accurately and in time, for all of these, The Henan Institute of Metrology has won high praise by enterprises and metrological department.

Henan Province

important electricity meter manufacturing bases

- Henan is in a specific position in national electricity metering market, And it is also notably one of the most important electricity meter manufacturing bases in China. Jinque electricity meter is recognized as the national named brand by the AQSIQ, Sida is the first electric energy measuring instrument enterprise which invest and manufacture abroad .
- Henan is also the main production and research base for electric energy standard device and occupied over 60% market share. Sida is the only listed electric energy standard manufacturer.
- Meanwhile, Henan is considered the manufacturing base of electric energy instrument attachment production and competent in other related field such as transfer, net meter, electric energy metering chest, auto data exchange for reading system, etc.

Current Situation about the Electricity Meter

- Along with the new techniques' emerging, the structure of electric meter has been changed significantly. Subsequently, electric metering research and production technique have been advanced into a higher level as well as the quality. New types of electric meter have been produced with new functions. Now there are more than 600 electric meter manufacturers nationwide with over a hundred products of hundreds of types .
- As the result of the competition and improved technology, the technique of electricity metering production and quality is improved as well. But there are also undesirable appearances in the electric metering market, for example, some operator lack of quality awareness, using low price to disorder the market with shoddy production ; Some areas don't execute national type evaluation policy strictly to protect local manufacturers and issue the certificate wantonly.
- So in recent years, the government has strengthened the supervision on the electric meter quality which force the manufacturers pay more attention on the quality and keep the overall quality of the electric metering products rising and maintaining in a high level . Market demands and competition also have encouraged the quality improvement and enterprises ' development . This gives the electric metering industry a prospective outlook in the future along with continuing innovation and importing technology.

Contact us

Electric energy and Power laboratory of
Henan Institute of Metrology

Address : No21, Huayuan Road, Zhengzhou, 450008, China

Website : <http://www.hnim.com.cn>

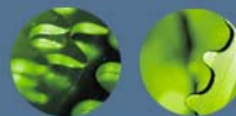
Tel: 0086-371-65773925

Fax : 0086-371-65773900

Email : liuwei@haqi.gov.cn

hajly@hnim.com.cn

Thank you for your attention!



Indonesia



Land areas : 1,922,570 km²
Populations : 219.2 million
Capital City : Jakarta (JKT)

DOM Location : Bandung (BDG)
Approx. 250 km from Jakarta



Overview of the Electricity Meters in Indonesia

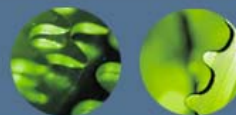
by
Denny Tresna Seswara



DIRECTORATE OF METROLOGY
MINISTRY OF TRADE REPUBLIC OF INDONESIA



Seminar on Electricity Meters
19-22 March, 2007 in Beijing, the People's Republic of China



Type of Organization (1)

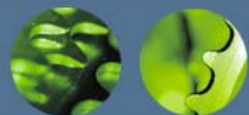
➤ What organization(s) regulate the measurement of electricity ?

Directorate of Metrology (DOM)

DOM belongs to Directorate General of Domestic Trade, the Ministry of Trade Republic of Indonesia.

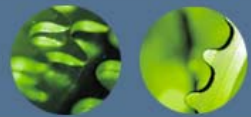


DEPARTEMEN PERDAGANGAN
REPUBLIK INDONESIA



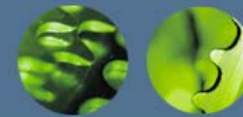
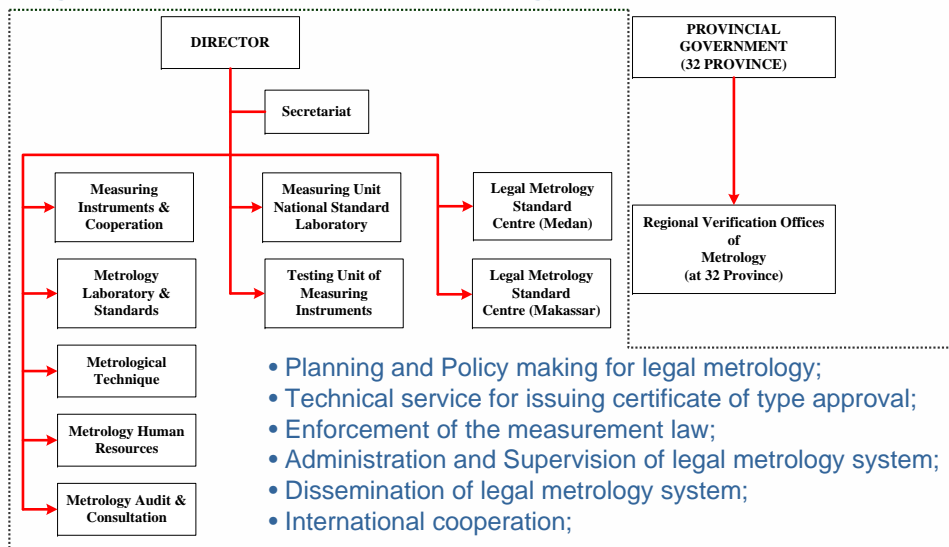
Outline

- Organization
- Legislation
- Type Approval
- Verification & re-verification
- Future Plan



Type of Organization (2)

Organization of Directorate of Metrology (DOM)



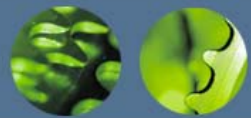
Type of Organization (3)

• RVO (Regional Verification Office)

The purpose of Regional Verification Offices (RVO) at provincial government are to implement the legal metrology in their area. RVO is responsible for verification/re-verification and inspection of measuring instrument.

Before autonomy law in 2001, all RVOs belonged to DOM, and DOM at Bandung had functioned as the headquarters (centralization).

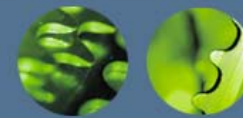
After in 2001, RVOs transferred to the provincial governments (decentralization).



Type of Legislation

The measuring instruments used for trading transaction or tariff purpose are regulated by the following law and regulation :

- **Measurement Law**
Law No.2/1981 concerning legal metrology
- **Government Regulation**
Regulation No.2/1985 concerning verification & re-verification requirements for legally controlled measuring instruments
- **Ministerial Decree**
The ministerial decrees are regulations to implement government regulation for legally controlled measuring instruments
- **Director Decree**
Technical manual concerning type approval testing and verification for legally controlled measuring instruments

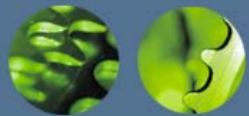


Type Approval (1)

➤ What organization performs type approval?

Directorate of Metrology → Issuing certificate of Type approval
Litbang – PLN* → Type Approval testing

- **Regulation of type approval**
 - a. Ministerial decree concerning imported measuring instrument (2004)
 - b. Ministerial decree “implementation of metrology” (1998) and amendment (1999)
Regulation for private measuring instrument manufacturers
- **Technical manual**
Technical manual of type approval testing and verification in legal metrology, SSTK (special technical standard) ex: SSTK watt-hour meters.



PLN State Company Electric Supply

• What is PLN ?

PLN (Perusahaan Listrik Negara) is the major power company in Indonesia. The supply area covers almost the whole country. PLN was established as governmental enterprise in 1964 the later privatized in 1994.

• What is Litbang PLN

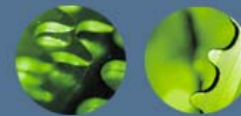
Litbang PLN (Research & Development) is one of all business units in PLN. In 1964 called LMK (Electric Related Institution). In 1994 is changed to be JTK (Services of Electrical Engineering). In 2004 is changed to be Litbang PLN. Main functions are research, development & engineering Services.

• Number of PLN Customers by Type of Customers

(unit: thousand)

Group	2000	2001	2002	2003
Household	26,796,675	27,905,482	28,903,325	29,997,554
Business	1,062,955	1,177,012	1,245,709	1,310,651
Industry	44,337	46,021	46,824	46,818
Social Institution	582,811	608,993	633,114	659,034
Public	108,627	115,369	124,927	137,324
Total	28,595,405	29,852,877	30,953,899	32,151,381

Average annual increase 4%



Type Approval (2)

➤ How many type approvals do you perform in a year?

Average annual 25

Test are conducted on samples/prototype of electricity meters and if the meters passing the test are given certificate including type approval number and label

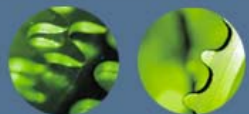
➤ How long is the validity of a type approval?

No validity of type approval

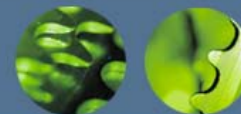
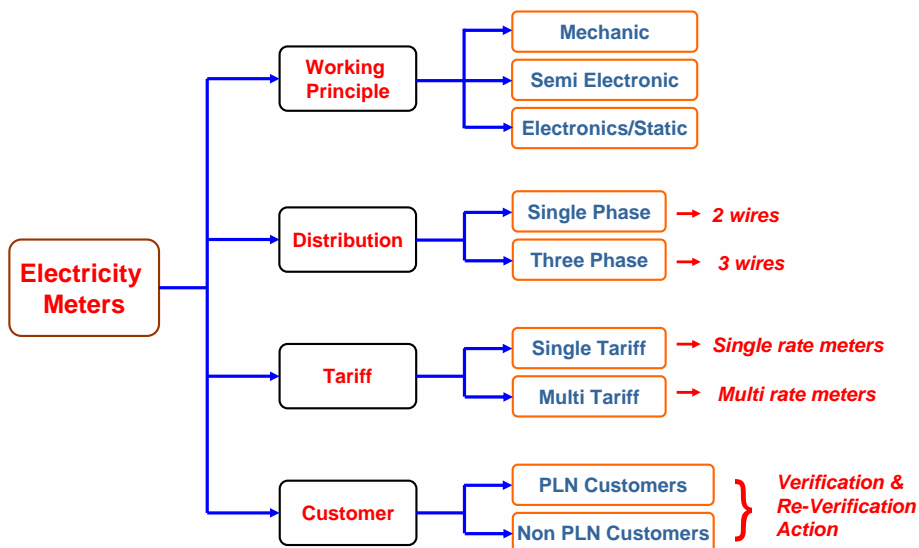
➤ When the type approval expired, is the meter tested again?

No expired of type approval and not tested again

Type approval are conducted on newly type of electricity meters.

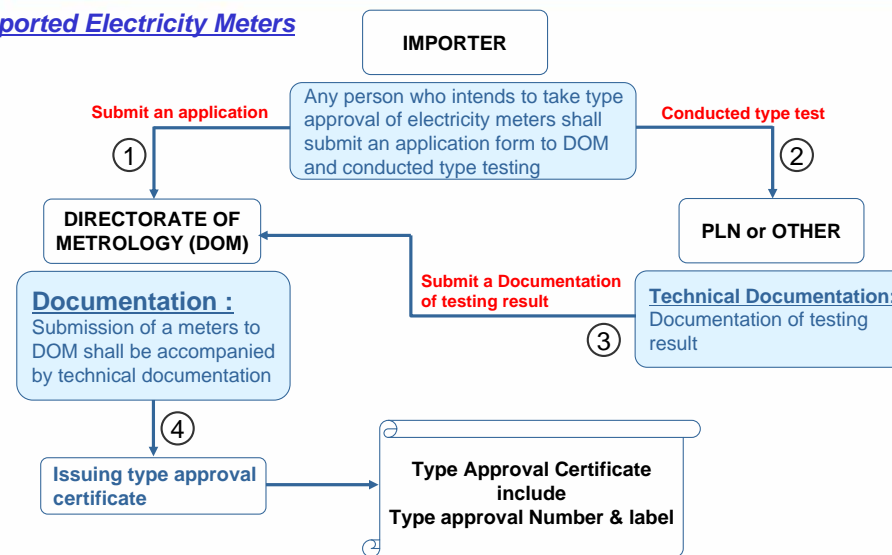


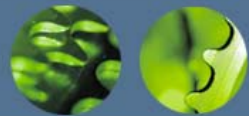
Classification of Electricity Meters in Indonesia



Type Approval Test System of Electricity Meters in Indonesia (1)

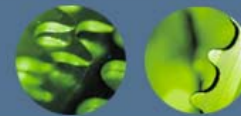
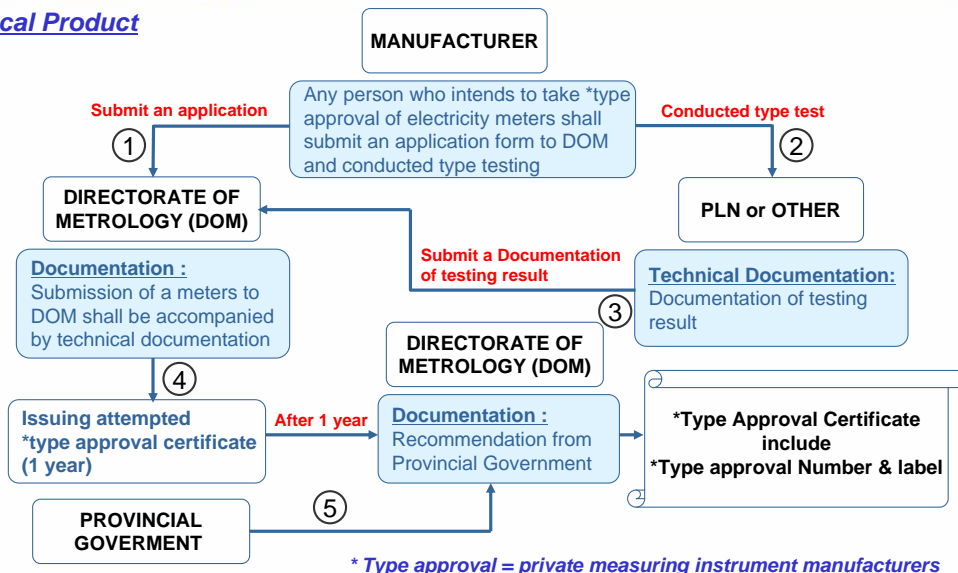
Imported Electricity Meters





*Type Approval Test System of Electricity Meters in Indonesia (2)

Local Product



Type Test of Type Approval

Conducted by Litbang PLN

Visual Test (1)
- Specification
- Technical information
- Display / Register

Insulation Test (2)
- Impulse voltage
- AC voltage

Accuracy Test (3)
- Meter Constant
- Starting
- Basic current
- No load
- Variation of current

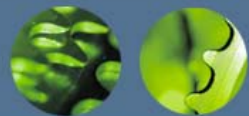
Electrical Req. Test (4)
- Power consumption
- Influence of supply voltage
- Influence of short time over currents
- Influence of self heating
- Influence of heating

EMC Test (5)
- Radio interference
- Fast transient burst
- Immunity electro-magnetic Field
- Immunity of electro-static discharge

Climatic Test (6)
- Dry heat
- Cold
- Damp heat cyclic

Mechanic Test (7)
- Vibration
- Shock
- Spring hammer test
- Protection dust & water
- Resistance of heat & fire

Reference Test :
- IEC 62052-11 : 2003-02
- IEC 62053-21 : 2003-01



Verification & Re-verification (1)

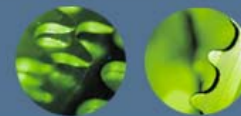
➤ Are electricity meters required of verifications ? **Yes**

➤ What Organization performs verification ?

- Directorate of Metrology (DOM) & RVOs;
- PLN → using their facilities

- **Non PLN customers** (W-H meters owner aren't PLN) are performed verification by DOM.
Ex : W-H meters are implemented in Apartment.
Each of apartment owners are paying electric invoice to the apartment management.
- **PLN customers** (W-H meters owner are PLN) are performed verification by RVOs at the area of regional PLN office.
Ex : W-H meters at PLN Jakarta are verified by RVO Jakarta.

Legislation



Verification & Re-verification (2)

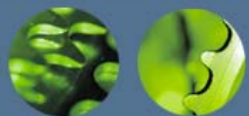
➤ What Organization performs re-verification ?

- RVOs
- PLN → using their facilities
- In principle, RVOs is responsible to re-verification of W-H meters, but they often use PLN facilities. Such use of PLN facilities is allowed under agreement at below.

Legislation :

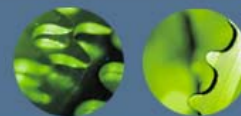
Joint ministerial decree of Ministry of Trade and Ministry of Energy concerning Verification of watt-hour meters (1988).

Back



Verification & Re-verification (3)

- How many electricity meters are verified in a year ?
Estimation → 1 millions
- How long is the validity of the initial and subsequent verifications?
- 10 years
- When the initial verification expired, are the meters re-verified or discarded?
re-verification
- Are the meters verified at the place of service?
Not, at the verification laboratory



Verification & Re-verification (4)

- How do you decide the length of validity of verification?

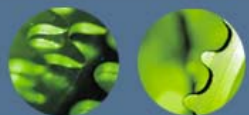
Legislation :

Ministerial decree concerning verification mark (2004)

In the decree, the length of validity of verification for W-H meters is 10 years.

Reason :

Estimation → W-H meters still have correcting value for measure energy.



Verification & Re-verification (5)

Electricity meters tested shall comply with the following requirements :

separated

Mechanic & Static:

- Physical requirement
- No load requirement
- Starting requirement
- Accuracy requirement
- Constanta requirement

Legislation

SSTK (special technical standard)
for Mechanic & static watt-hour meter

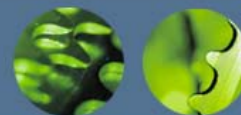
Under Development

Static :

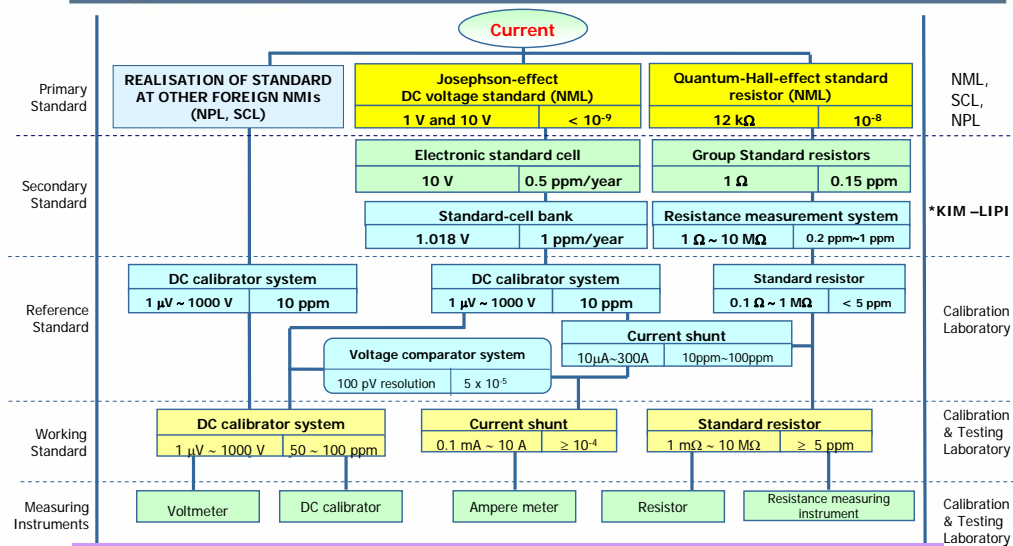
- Physical requirement
- Dielectric requirement
- No load requirement
- Starting requirement
- Accuracy requirement
- Constanta requirement

Legislation

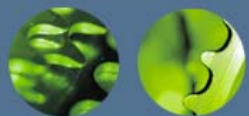
SSTK (special technical standard)
For Static watt-hour meter



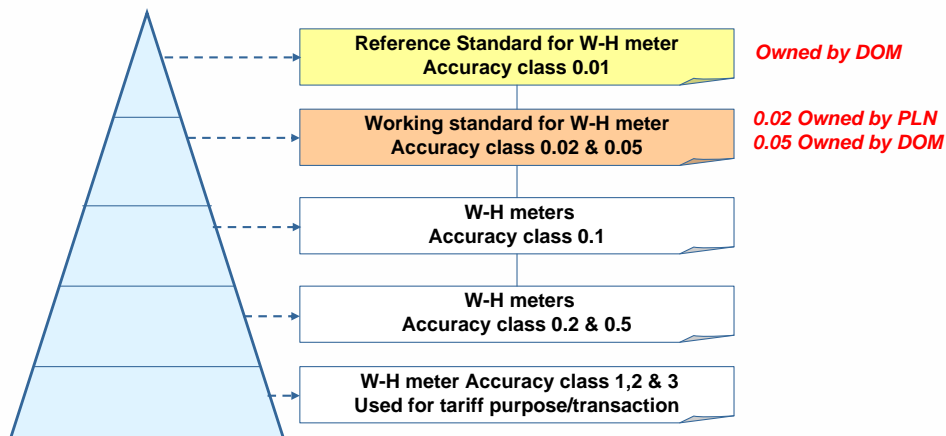
Do you have a national primary measurement standard for electricity meters? If not, where is the standard traceable to? **No**



Traceability Diagram of Electricity Measurement in Indonesia



Measurement Standard for Watt-Hour Meters



Electricity reference standard made by Radian (RD-30) is used reference instruments (0.01). Multi-meters made by Schlumberger (SM7050) are used reference instruments (0.05) for verification of Electricity meters.



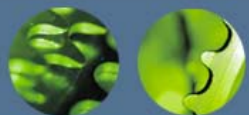
Future Plan

➤ Are they any resolution processes for measurement complaint/dispute ? **Yes**

- RVOs has been attached verification and re-verification using PLN facilities and type approval testing has been conducted by PLN.

To minimize lacking fairness of watt-hour meter because PLN is provider of electricity, our institution makes planning as following below :

- Build facilities and equipment : Watt-hour verification (RVOs) and type approval testing facility (DOM)
- Human resources : build knowledge and skill of watt-hour verification and type approval testing (DOM & RVOs)
- Develop Standard of Procedure (SOP) of verification and type approval testing of W-H meters are informed to RVOs.



THANK YOU



Terima Kasih

OVERVIEW OF the Electricity Meters in Indonesia

by
Denny Tresna Seswara
Sub Directorate/Division of Metrological Technique

I. ORGANIZATION OF DIRECTORATE OF METROLOGY (DOM)

Directorate of Metrology (DOM) was built in 1928 at Bandung and responsible for legal metrology in Indonesia. DOM belongs to the Ministry of Trade, Directorate General of Domestic Trade.

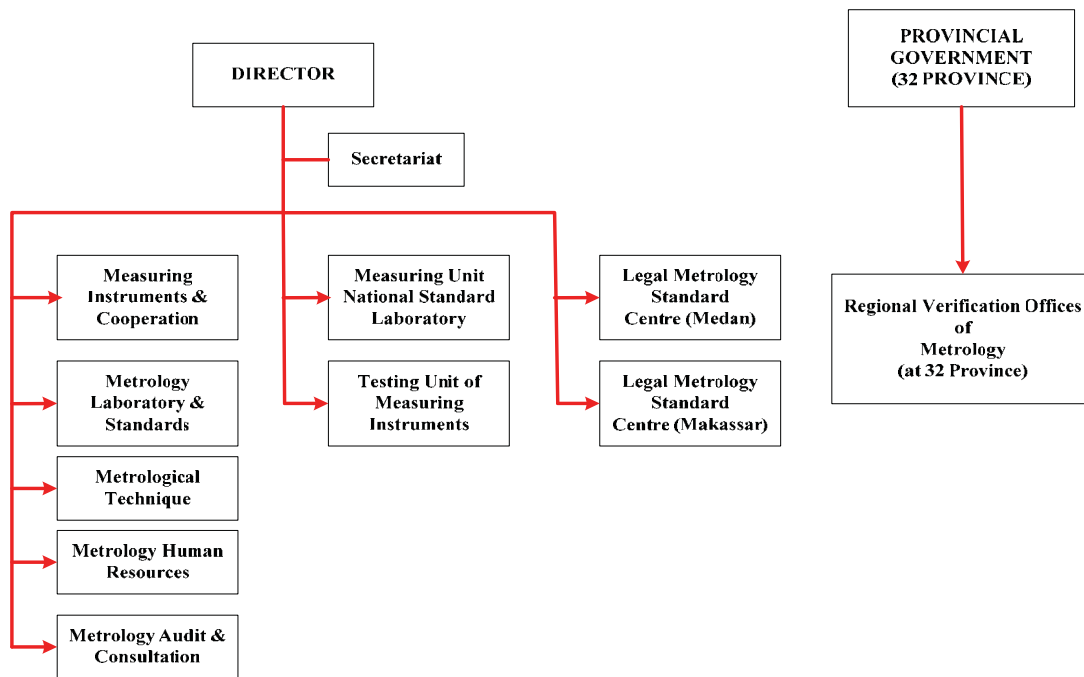


Figure 1. Organization of DOM

The organization of DOM is shown in Figure 1. There are five sub directorates/divisions, secretariat, two Units and two Legal Metrology Standard centers in DOM organization. The sub directorates are consists of Measuring Instrument & cooperation, Metrology Laboratory & standard, Metrology Technology, Metrology Human Resources and Metrology Audit & Consultation. Main functions of sub directorates are:

- ❖ Planning and Policy making for legal metrology;
- ❖ Technical service for issuing certificate of type approval;
- ❖ Enforcement of the measurement law;
- ❖ Administration and Supervision of legal metrology system;
- ❖ Dissemination of legal metrology system;
- ❖ International cooperation;

The units of DOM are consists Measuring Unit National Standard Laboratory and Testing Unit of Measuring Instruments. Main functions of Unit are:

- ❖ Technical services for measuring instruments, including maintenance of primary standard of mass, calibration of secondary standards, type approval test and verification/re-verification
- ❖ Technical services administration

DOM has been already for establishing Legal Metrology Standard (LMS) centers at Medan and Makassar. LMS center at Medan has territory in Sumatera Island, Java Island and Kalimantan Island. The other Islands are covered by LMS Makassar (Sulawesi Island, Bali Island, Papua Island, etc). Main function of LMS will be:

- ❖ Conducting calibration of secondary standard that Regional Verification Offices (RVO) have, giving technical assistance to RVO and giving short-term training for RVO and industrial sector within the territory.

Regional Verification Offices (RVO) at provincial government are responsible for verification/re-verification and inspection of measuring instrument. The purpose of Regional Verification Offices (RVO) at provincial government is to implement the legal metrology in their area.

RVO is responsible for verification/re-verification and inspection of measuring instrument.

Before autonomy law in 2001, all RVOs belonged to DOM, and DOM at Bandung had functioned as the headquarters (centralization).

After in 2001, RVOs transferred to the provincial governments (decentralization).

II. TYPE OF LEGISLATION

Hierarchy of legislation system in Indonesia as below:

- 1945 Constitution (UUD 1945)
- MPR Resolution
- Law
- Government regulation substituting a law
- Government regulation
- Presidential Decree
- Ministerial Decree
- Regional Regulation

The measuring instruments used for trading transaction or tariff purpose are regulated by the following law and regulation:

- **Measurement Law**
Law No.2/1981 concerning legal metrology
- **Government Regulation**
Regulation No.2/1985 concerning verification & re-verification requirements for legally controlled measuring instruments (called UTTP).
- **Ministerial Decree**
The ministerial decrees are regulations to implement government regulation for legally controlled measuring instruments
- **Director Decree**
Technical manual concerning type approval testing and verification for legally controlled measuring instruments

III. CLASIFICATION OF ELECTRICITY METERS IN INDONESIA

Frequency of electric in Indonesia is 60 Hz.

Classification of working principle:

- **Mechanic watt hour meters**
Instrument intended to measure active energy by integrating active power with respect to time. To measure active energy used revolution of the rotating disc of the meters. The revolution of the rotating disc is resulted induction of electromagnetic at voltage and current inductor. Displaying of measured active energy is used mechanical register.
- **Semi electronic watt hour meters**
Meter in which current and voltage act on solid-state (electronic) elements to produce an output proportional to watt-hours. Displaying of measured active energy is used mechanical register.
- **Electronic/static watt hour meters**
Meter in which current and voltage act on solid-state (electronic) elements to produce an output proportional to watt-hours. Displaying of measured active energy is used electronic/digital register.

Classification of tariff:

- **Single tariff**
- **Multi tariff → used multi rate meter**
Multi rate meters: Energy meter provided with a number of registers, each becoming operative at specified time intervals corresponding to different tariffs. Specified time intervals of used energy are causing different tariff.
Peak load time: 6 pm – 10 pm
Non Peak load time: 10 pm – 6 pm
In indonesia is used multi tariff.

IV. VERIFICATION AND RE-VERIFICATION

Electricity meters tested shall comply with the following requirements

(SSTK/ special technical standard for mechanic & static W-H meters):

➤ Physical requirement

Meter shall be designed and constructed in such a way as to avoid introducing any danger in normal use and under normal condition, so as to ensure especially:

(Mechanical general requirements)

- Personal safety against electric shock;
- Personal safety against effect of excessive temperature;
- Protection against spread of fire;
- Protection against penetration of solid object, dust and water.

The meter shall have a case which can be sealed. The cover shall not be removable and shall be provide with protective **(case requirements)**.

Every meter shall have name-plate which has the following information as applicable:

- Manufacturer's name and trade mark;
- Designation of type, and have space of approval mark;
- The number of phases and number of wires for which the meter suitable (single phase or 3 phase);
- Serial number, year of production, the reference voltage, basic current (I_b) and rated current (I_n);
- Constanta is expressed the revolution of the rotating disc or pulse with respect to energy or energy with respect to revolution of the rotating disc or pulse.

➤ No load requirement

For this test the current circuit shall be open circuit and the voltage of 110 % of the reference voltage shall applied to the voltage circuits. During this test the output device (revolution of the rotating disc) of the meter shall not emit more than 1 revolution or 1 pulse for static W-H meters.

➤ Starting requirement

For this test the meter shall start and continue register at the revolution of the rotating disc. During this test the output device (revolution of the rotating disc) of the meter shall emit more than 1 revolution or 1 pulse for static W-H meters.

➤ Accuracy requirement

For this test is conducted by comparing energy at the meter under test with energy at the standard, in normal use and under normal condition.

➤ Constanta requirement

This test is conducted to know value of constanta at the meter and compare with information at the data plate.

(SSTK/ special technical standard for static W-H meters) requirement same as STTK at above, but have additional requirement:

➤ Dielectric requirement

This test is conducted to know endurance mechanical device and insulation circuit at the meter from fault in electric system. The test consists of a.c voltage test and impulse voltage test. This test is conducted with the following steps:

- Test vorage r.ms 2 kV shall be substantially sinusoidal, having frequency between 45 Hz until 65 Hz, and applied for 1 min. The power source shall be capable of supplying at least 500 VA.
- During the test, at the meter may not occur electric spark and electric discharge.

V. FUTURE PLAN

IV.1. Development of verification of W-H meters

RVOs has been attached verification and re-verification using PLN facilities. However, it is critized as lacking fairness because PLN, a provider of electricity. Using PLN facilities to verify W-H meters can make PLN perform verification and then the inspector (RVOs) only perform marking and seal on the passing meters.

Development of verification of W-H meters is to build up organizations involving verification of W-H meters as well as to construct effective verification system of W-H meters.

- Build facilities and equipment: Watt-hour verification facility (RVOs)
- Human resources: build knowledge and skill of watt-hour verification (DOM & RVOs)
- Develop Standard of Procedure (SOP) of verification a of W-H meters are informed to RVOs.

IV.2. Development of type approval testing of W-H meters

Type approval testing consists of structural test which consists of several mechanical, electrical and electronic tests and accuracy test. However, at the present in Indonesia (DOM) only accuracy tests are conducted for type approval testing of legally measuring instrument (called: UTTP), except W – H meters conducted by Litbang – PLN (Research & Development of state company electric supply). Type approval testing conducted by PLN is criticized as lacking fairness because PLN, a provider of electricity.

Plan to develop type approval testing of W-H meters as following below:

- Develop testing procedures referring to OIML recommendations for type approval testing (IR R46 Active electrical energy meters for direct connection of class 2) and also referring to IEC
- Build facilities and equipment: Watt-hour type approval testing facility
- Human resources: build knowledge and skill of watt-hour type approval testing especially structural test (The tests include the surge test, EMC test, durability test, vibration test, climatic test, etc.)

Overview of the Electrical power measurement in DPR Korea

Central Institute of Metrology (CIM)
under State Administration
for Quality Management (SAQM)
March. 2007

Electrical energy is the main power in DPR Korea

- Engraving the hydroelectric power plant on National emblem.
- Source of electrical energy is
 - large , medium and small scale hydroelectric power plant.
 - large scale thermal power plant.
 - wind power, solar energy, tidal power and so on.

Regulation on Electricity Measurement

- The State Administration for Quality Management (SAQM) is responsible for the legal metrology management in DPR Korea.
- The state regulation office of electric power measurement in DPRK is the metrology division, SAQM.
- The metrology verification office of every province regulates the factories, enterprises and users.

Type Approval

- Type approval of electricity meter in the DPR Korea is performed by the SAQM.
- Process of type approval
 - Apply for type approval to SAQM.
 - the case which want to product the electricity measurement means newly
 - the case which want to re-product the electricity measurement means expired
 - Entrust the testing for type approval of electricity meter to the CIM.
 - confirm the meter has been accepted as a state standard.
 - confirm the meter has been passed in the design examination.
 - examine the metrological parameters of meter
 - examine manufacture and technical conditions for continual production of electricity meters

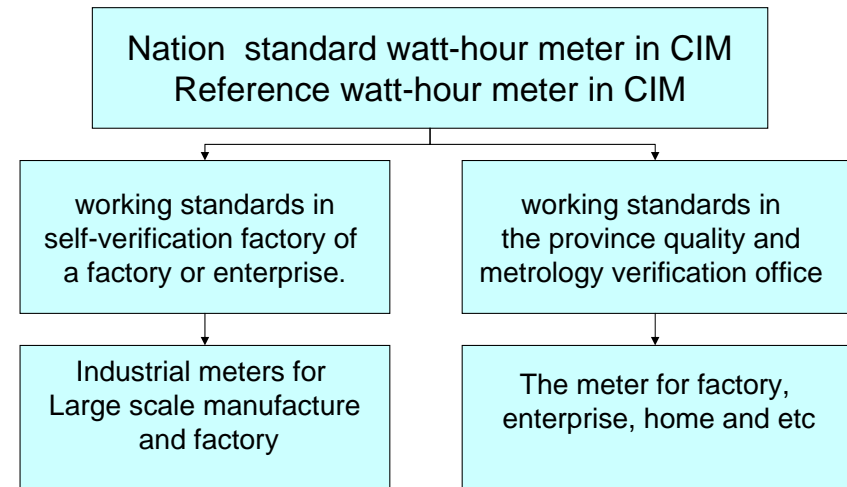
Type Approval (cont)

SAQM approves the type of the electricity meter

- The SAQM performs tense type approval in a year.
- The validity of type approval
 - initial validity is usually 1~2 years.
 - the validity is prolonged to 3~5 years according to the performance of electricity meter during the validity after the first testing.
 - requires the higher technical conditions than the first on the meter.

Verification

The verification system of electricity meter



Verification (cont)

- The State demands that all the measuring instruments should be registered in the state metrology verification offices and subjected to periodical metrology verification.
- A validity of verification is determined according to the conditions of use and environment, importance, the present technical status and so on of measuring instrument.
 - The national standard of electricity meter in CIM is regularly compared with that in other countries
 - The reference standards in CIM are verified by the national standards every year.
 - The validities of meters of province metrological offices and self-verification factories are 1 year.

Verification (cont)

- When the validity expired,
 - the re-verification is performed on the meter
 - if the meter does not satisfy metrological parameters, it is rejected.
- There are the verification and repairing services in every city and country in DPR Korea, and they verify and repair all the electricity meters in their regions.

Electricity meters being used.

- Static watt-hour meter and induction type watt-hour meter are mainly used. The most of static watt-hour meters are used for fee-computation.
- There are many precision electrical measuring instruments to measure electric parameters (voltage, current, electrical energy, power factor, frequency and so on) in CIM and province quality metrology verification offices and their performances are improved constantly.

The resolution process for measurement compliant/dispute

- CIM is solving the major measurement compliant/dispute on the supply and consumption of electric power on the basis of the “**LAW OF THE DPR KOREA ON METROLOGY**”.

**Thank you for your
attention.**



APEC/APLMF Seminars and training courses in legal metrology


Seminar on electricity meters
(CTI-11/2006T)
Yu Yang Hotel, Beijing,
The People's Republic of China

19th – 22nd March , 2007

Overview of the measurement system and current situation about electricity meters in Malaysia

Introduction

Electricity utility

-  Tenaga Nasional Berhad
-  SESCO
-  SESB

These are the main utility in Malaysia that utilises electricity meter as a mean of measurement of energy consumption and consumer billing purposes.

There are others, smaller distribution companies, such as NUR Distribution Sdn. Bhd.

For the purpose of this presentation, TNB will be in the spotlight.



Electricity utility - area of responsibility



Peninsula Malaysia


Sarawak

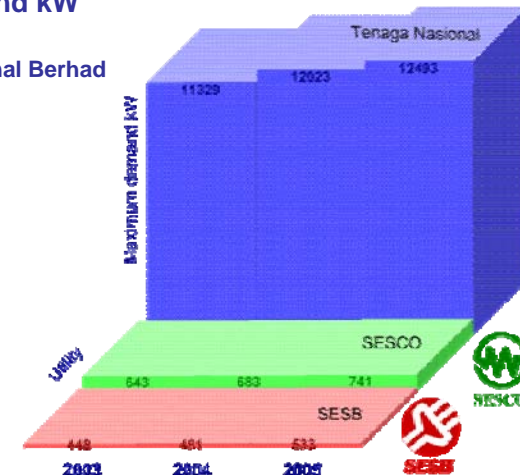
Sabah



Illustration of size

Maximum demand kW

-  Tenaga Nasional Berhad
-  SESCO
-  SESB





Source : EC 2006 annual report

'Chain of command'



Regulation



Regulation of the measurement of electricity is done collectively by :

Agency (Keyword)	Roles
 QUALITY	<ul style="list-style-type: none"> To undertake the statutory role in national standardisation Carrying out the activities of standardisation and accreditation for organization and companies Accredited laboratories are accredited by Department of Standard Malaysia (DSM) There are 5 accredited laboratories in electricity meters calibration and traceable to NML through calibration services
 RULE	<ul style="list-style-type: none"> Among the roles is to be technical, service, performance and economic regulation of the electricity and piped gas supply industries. The commission also responsible to regulate electricity measurement

Source : Sirim Berhad

Regulation

Regulation of the measurement of electricity is done collectively by :

Agency (Keyword)	Roles
 National metrology laboratory	<ul style="list-style-type: none"> NML is the keeper of Malaysia's Primary Physical Standards of Measurement under Weights and Measures Act 1972. The main role is the establishment, maintenance and dissemination of national measurement standards. Dissemination of national measurement standards to various government agencies is thorough calibration services provided by NML. All measurements used in trade transactions and other fields of legal metrology are traceable to NML. In electrical field, legal metrology activity involved of calibration of smoke meter, radar gun, lux meter, stop watches and also pattern approval of parking meter.
 Verification	<ul style="list-style-type: none"> TNB is government link company and the main power utility in Malaysia Formerly known as the National Electric Board in 1965, it was privatize on September 1990. Core activities are in electric energy generation, transmission and distribution. Under distribution division, the electricity meters are test, verify and inspect.

Source : Sirim Berhad

Meter approval

- Electricity meter approval is based on utility requirement :-
- Compliance to critical and mandatory technical specification
 - Type test approval from recognized laboratory
 - Field trial of six months or more
- Electricity meter standard
- BS5685 Specification for single phase and polyphase wh meters
 - IEC62052-11 Metering equipment
 - IEC62053-11 Electromechanical meters for active energy (Class 0.5, 1 and 2)
 - IEC62053-21 Static meters for active energy (Class 1 and 2)
 - IEC62053-22 Static meters for active energy (Class 0.2 and 0.5)
 - IEC62053-23 Static meters for reactive energy (Class 2 and 3)

Meter type test approval report – test requirement

Insulation

- a) Impulse voltage test
- b) AC voltage test

Accuracy requirement

- a) Meter constant
- b) Starting conditions
- c) Running with no load
- d) Influence quantities (Current, voltage, freq, waveform, magnet etc)
- e) Accuracy test in the presence of harmonic

Electrical requirement

- a) Influence of supply voltage – interruptions and dips
- b) Influence of short time over current
- c) Influence of self heating

Meter type test approval report – test requirement

Electromagnetic compatibility

- a) Radio interference measurement
- b) Fast transient burst test
- c) Immunity to electromagnetic HF fields
- d) Immunity to electrostatic discharges

Mechanical requirement

- a) Vibration
- b) Shock
- c) Spring hammer
- d) Penetration of dust and water
- e) Resistance to heat and fire

Type test laboratory

Any recognised laboratory, such as (many others not included)

- | | |
|---------------------------------|-----------------------|
| a) OFFER measurement laboratory | Birmingham, UK |
| b) Parkside Laboratories Ltd | New Zealand |
| c) TUV Product Service Ltd | Hampshire, UK |
| d) PTB | Braunschweig, Germany |
| e) YMPL | Udaipur, India |
| f) BIS laboratory | Guwahati, India |

Validity

No time limit (One off practice, based on specific model)

Monitoring

Utility will request for new type test to be carried out for verification purposes

Electricity metering system

1 phase whole current kWh 10-100A Class 2

3 phase whole current kWh/kVarh 10-100A Class 2

3 phase LVCT kWh/kVarh x/5A Class 2

3 phase MV/HV kWh/kVarh x/5A, x/1A class 0.5, 0.2, 0.1

By comparison, TNB utilises simple measurement method of 1 element metering – for single phase, and 3 element metering for three phase.

Even though, there are still 2 element metering around (Old installation with 2 CTs and PTs), mostly in MV/HV installation, teps have been taken to rectify this issue.

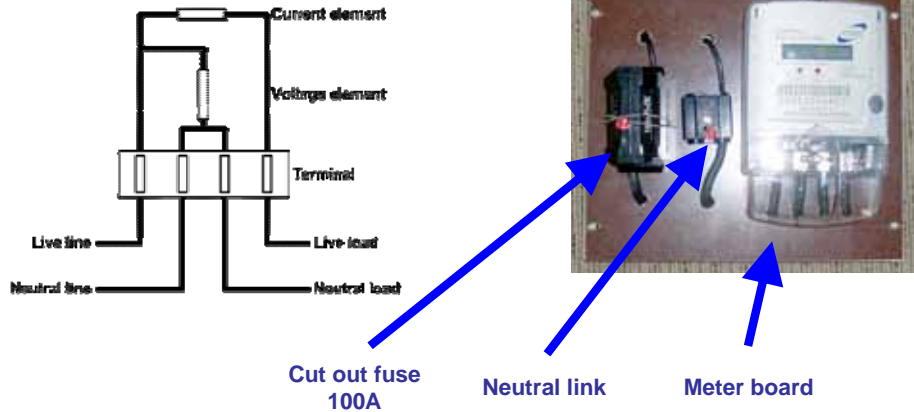
TNB has embarked on 100% installation of electronic meters program since 2004 for the whole range of metering scheme.

It is expected, electromechanical meters will be phased out by 2014.



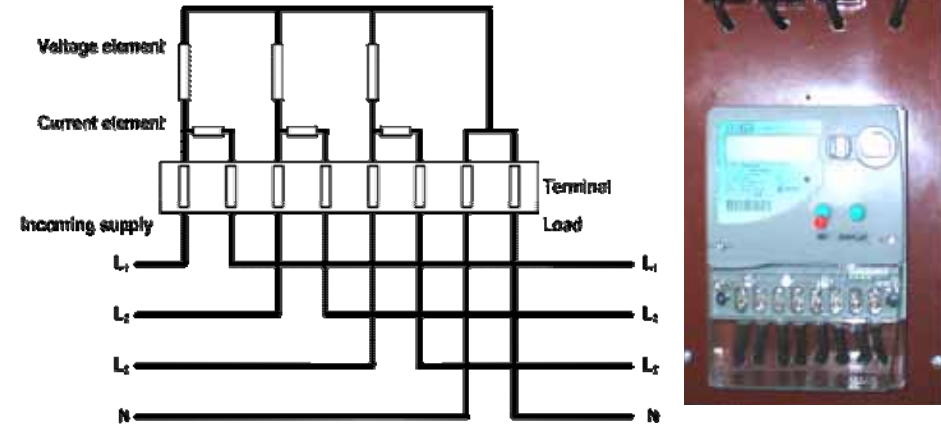
Electricity metering system

1 phase whole current kWh 10-100A Class 2



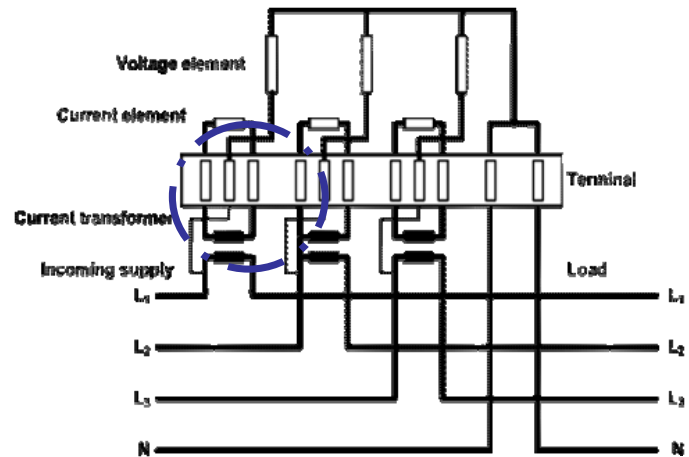
Electricity metering system

3 phase whole current kWh/kVarh 10-100A Class 2



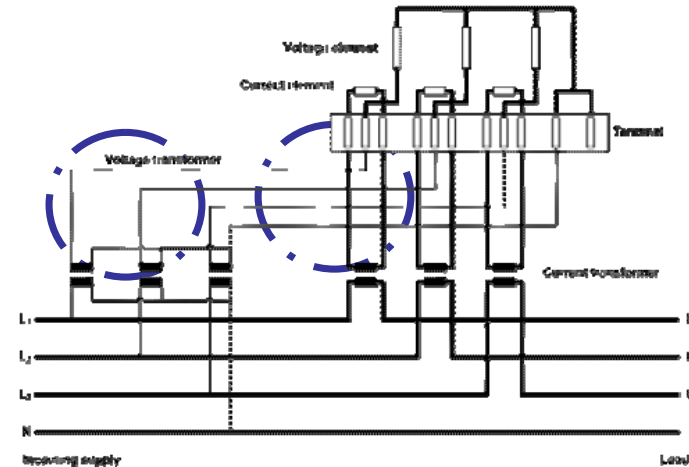
Electricity metering system

3 phase LVCT kWh/kVarh x/5A Class 2



Electricity metering system

3 phase MV/HV kWh/kVarh x/5A, x/1A class 0.5, 0.2, 0.1



Electricity meters

3 phase MV HV 10,000

3 phase LVCT 50,000

3 phase WC 600,000

1 phase WC 5 million



Verification process

Accuracy requirement

- Meter constant
- Starting conditions
- Running with no load
- Accuracy test (per phase and import export if applicable)

Testing coverage

All meter allocated for customer billing will be tested 100% by TNB or accredited ISO/IEC17025 laboratory



Verification process

Electricity meters verification

- Electricity meters verifications is performed by utility (TNB) and meter manufacturers accredited under SAMM laboratory scheme – also performed on site verification
- In a year, about 450,000 meters are verified
- The validity of verifications is about 15 years depend on meter utilization and accuracy class
- The length of validity of verifications is based on sample testing, analytical study and scheduled on site verification report
- For low voltage consumers (single phase/three phase), no specific verifications interval.
- Verification is done when have differences in bill's statistic or complain by the consumers.
- For medium and high voltage consumer where used of electricity meters with transformer, the verification interval is once a year.
- After the initial verification expired the meters will be discarded

Inter-laboratory comparison

Inter-laboratory arrangement

- Use of pilot meter
- Test carry out at both of the participating laboratory
- Standardized test point
- Compare result

Proficiency test

- Arranged by Department of standard Malaysia
- Test artifact provided by SIRIM
- Determining best measurement value
- Laboratory staff proficiency



Acceptance test

Lot acceptance test

- Witness by utility representative
- Sampling as per IEC standard
- Rejection is as per batch
- More comprehensive test sequence

Routine test

- Witness by utility representative
- 100% test of all the batch
- Rejection is as per unit
- Simpler test sequence



Traceability of reference standard

Sequence

- Public laboratory
- Utility laboratory (optional)
- Sirim (optional, but recommended)



Reference standard



Traceability of reference standard

Power and energy standard

- Power/Energy Laboratory, National Metrology Laboratory (NML), SIRIM Berhad is responsible organisation in maintaining national primary standard for electricity meters.
- The power standard is single phase watt converter which is capable to measure power up to 6 kW with uncertainty of $\pm 0.01\%$ at unity power factor
- The energy standard is 3 phase wathour standard which is capable to measure energy at 1.2 kW with uncertainty of $\pm 0.02\%$ at unity power factor



General outlook

Pointers

- Electromechanical test laboratory has been phased out
- Electronic laboratory has taken over
- Electronic meters have more features
- Test sequence must reflect this change
- Test will include direction (import/export)
- Test will include revenue protection measures
- Metrology laboratory must keep up with change



Old



New

Near future

Present development

- a) Utility is very concerned about revenue protection
- b) Many deterrent features introduced
- c) Punitive steps handled by meters
- d) Meter sealed off after testing (Glued/ultra sonic welding)
- e) Laboratory must cope once these meters come back from field
- f) Revenue protection measures
- g) Metrology laboratory must keep up with change



Electronic test bench with Common Mode Rejector unit to enable testing of three phase meters even with voltage link closed

Field testing

Pointers

- a) Utility conduct 100% field verification for HV customer
- b) Other consumers, random exercise
- c) Stress on revenue protection
- d) Test conducted on site
- e) Meter loading is actual
- f) Comparison testing method

Resolution process for complaint/dispute

- a) The first level resolution of complaint or dispute by consumers is based on the power utility ISO system
- b) The upper level such involved huge amount of money and regulations, the resolution process for this complaint/dispute is through Energy Commission



Thank you

APEC/APLMF Seminars and Training Courses in Legal Metrology (CTLM)

Seminar on Electricity Meters

19-22 March, 2007

Yu Yang hotel, Beijing, in China



MONGOLIAN AGENCY FOR
STANDARDIZATION AND METROLOGY

Delegnyam Nyam-Ochir

RESEARCHER OF ELECTRICAL STANDARD LABORATORY

E-mail: masm@mongol.net, Tel: +976-51-263647, Fax +976-11-458032

MAP OF MONGOLIA



Capital: Ulaanbaatar

Location: Northern Asia, between China and Russia



HISTORY OF MONGOLIA



- Mongolia was inhabited 500,000 years ago.
- First state was established by Hunnu tribes in 209 B.C.
- Great Mongol Empire under Chinggis Khan was established in 1206.
- Conquest by Manchu Empire during XVIII-XIX centuries
- Restoration of Mongolian sovereignty in 1911.
- Creation of People's Republic of Mongolia in 1924 (under communism)
- Establishment of democracy in 1990



Quick facts about Mongolia

- Population: 2,8 mil. (with low density of 1,5 persons per sq.km)
- More than 10 ethnic groups, (75%-Khalkha, 7%-Kazakhs and others)
- Language: Mongolian
- Religion: More than 90%-Tibetan Buddhist Lamaism, 6%-Muslim
- Climate: Extreme continental, 4 distinct seasons (-45C in January; +25C in July)



MONGOLIAN AGENCY FOR STANDARDIZATION AND METROLOGY



MONGOLIAN AGENCY FOR STANDARDIZATION AND METROLOGY

The main functions are:

- Standardization
- Certification
- Establishment of national measurement standards
- Legal metrology
- Accreditation
- State supervision of standardization, quality and metrology
- Training and consulting
- International cooperation

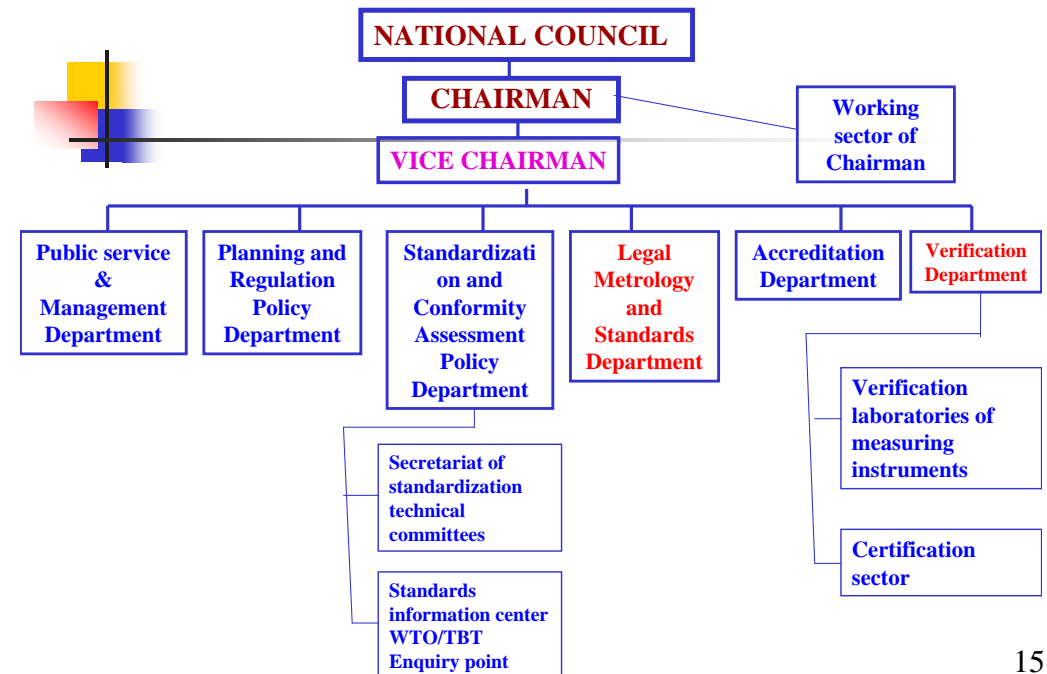
MASM

Mongolian Agency for Standardization and Metrology is a Government regulatory agency responsible for coordinating and managing the standardization, metrology, testing and quality sector throughout the country. MASM reports to the Deputy Prime Minister of Mongolia.

Mission

To contribute to the social and economic development of Mongolia in conjunction with the development strategic tendency by applying standardization, quality and metrology.

MASM chart



Legal Metrology and Standards Department

Pattern approval of measuring instruments

Standards Laboratories

Licenses for metrological service

Mechanical standard laboratory

Electrical standard laboratory

Physical & Density standard laboratory

Time & Frequency standard laboratory

Temperature & Pressure standard laboratory

Certified reference material's

Mass

Volume

Length

DC voltage

DC resistance

AC voltage

Energy and power

MAIN FUNCTIONS OF LEGAL METROLOGY & STANDARDS DEPARTMENT

- Development of national measurement standard system
- Development and registration of certified reference materials
- Maintenance and improvement of accuracy of measurement standards
- Traceability of measurement standards
- Pattern approval of measuring instruments
- Calibration of measurement standards or measuring instruments
- Licensing for manufacture, repair, installation and sale of measuring instruments
- Training
- Others

ELECTRICAL STANDARD LABORATORY

Electrical standard laboratory was established in 1989. Since its establishment, the laboratory has developed and maintained the following national electrical standards:

1. DC voltage (approved in 1999)
2. DC resistance (approved in 2002)
3. AC voltage (approved in 2003)
4. Energy and power (approved in 2003)



Range: (1 to 10) V
Accuracy: 6×10^{-7}

ELECTRICAL STANDARD LABORATORY



Range: $(10^{-3} \text{ to } 10^5) \Omega$
Accuracy: $1 \times 10^{-7} - 7 \times 10^{-7}$



Range: $(10^{-3} \text{ to } 10^3) \text{ V}$
Accuracy: 1×10^{-6}

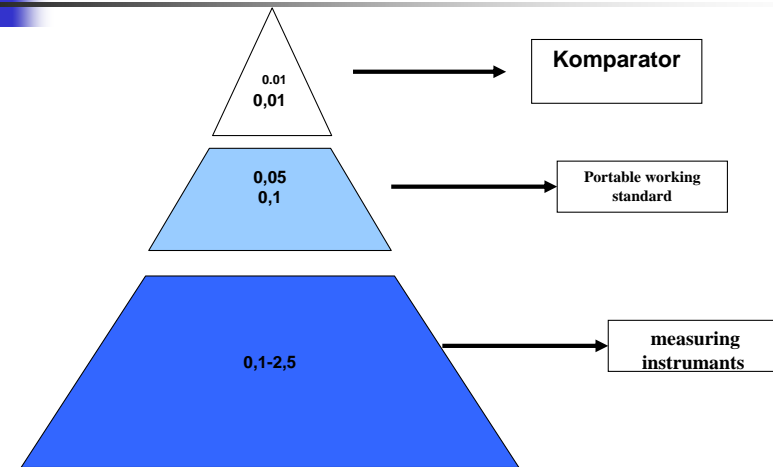
Energy and power standard



Range:
Voltage: (0.1 to 300) V
Current: (0.01 to 120) A
Accuracy: 1×10^{-4}

Standard is calibrate at KRISS every year.

Accuracy scheme of energy and power standard



Type approval

- Type approval of electricity meter
 - We perform about 20 type approval in year.
 - Validity of type approval is 3 years.
 - When the type approval expired, we test again belong to meters employment. If there is not complain/dispute, we don't need test again.

Verification

Verification Department performs verification of electricity meters.

- Here verified about 100000 electricity meters in year.
- Validity of the initial and subsequent verifications is 3 year for mechanical meter and 8 year for electronic meters.
- When the initial verification expired, meters are re-verified.
- MASM regulate length of validity of verification, ascribe design of electricity meter.
- Electricity meters are verified in electrical verification laboratory of Verification Department.




Following kinds of electricity meters used in Mongolia.

Single-tariff/multi-tariff and mechanical or electronic active meter, reactive meter and VA meter of accuracy class 0.2S, 0.5S, 0.2, 0.5, 1.0 and 2.0 .

1 phase-2wire 220V, 5/60/A, 50Hz

3 phase-4wire 220x3/380V, 5/100/A, 50Hz

3 phase-3wire 3x100V, 1.5/5/A, 50Hz



If there is any measurement complaint/dispute, we resolve under MNS standard.

- MNS 5660 : 2006
- MNS 5090 : 2005
- MNS 2816 : 2003



Summary

The participation in the seminar will benefit to understand current legislation and procedures on type approval and verification of electricity meter.



*Thank you for
your attention*

APEC/APLMF Seminars and Training Courses in Legal Metrology (CTI-11/2006T)

Seminar on Electricity Meters

19-22 March, 2007
Yu Yang Hotel, Beijing, the
People's Republic of China

Introduction

- Name: Mr. Joe Panga
- Position: Metrologist
- Division: Metrology
- Organization: PNG NISIT

PNG NISIT

- Papua New Guinea National Institute of Standards and Industrial Technology is the National Standards Body.
- The Metrology Division in the institute is in charge of Physical and Legal Metrology.

MSL Responsibilities

- Our responsibilities are covered under the NISIT Act, 1993.
 - ☞ Part (vi) Units and standards of measurement
 - ☞ Sections 33 -Application of this part
 - ☞ Section 34 -Papua New Guinea legal units of measurements
 - ☞ Section 35 –Contracts
 - ☞ Section 36- Conversion factors

Responsibilities Cont'd

- ☞ Section 37- Standards of measurements
- ☞ Section 38- Verification of standards of measurement
- ☞ Section 39- Measurements to be ascertained in accordance with appropriate standards of measurement.
- ☞ Section 40- Verification of Means of measurement

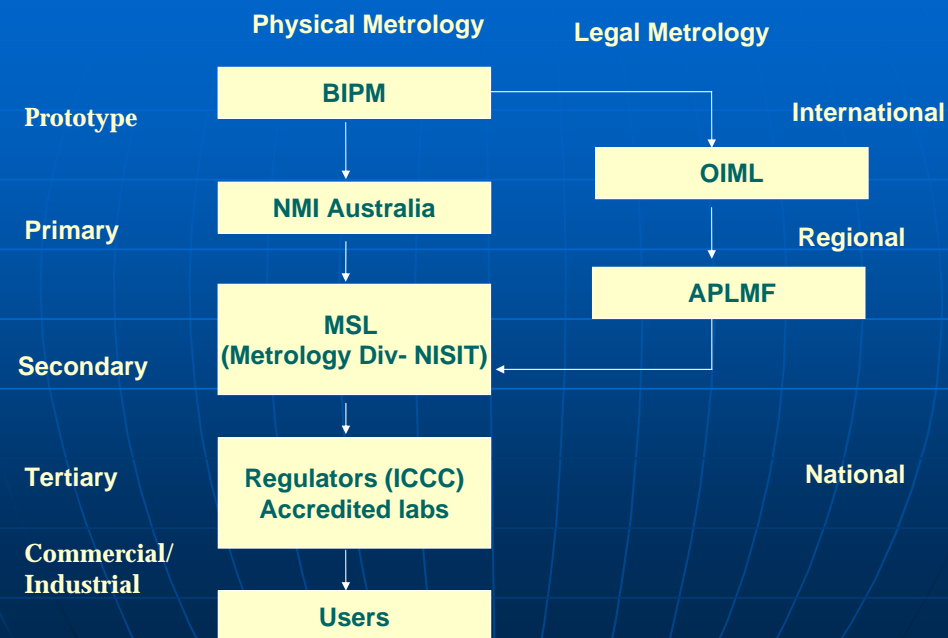
Other Metrological Acts that exist

- Trade Measurement Act of PNG
- Packaging Act
- Bread Act
- PANGTEL Act
- PNG Power Act

MSL Services

- Calibration and Verification
- Mass
- Weighing devices
- Capacity provers
- Dispensers
- Temperature sensors
- Pressure and torque
- Length

Traceability of Measurement



Electricity Meters

What organization(s) regulate the measurement of electricity in PNG?

- **PNG Power**

Service delivery and Regulatory functions, i.e., testing, inspection, verification.

- **ICCC**

Consumer rights and protection

Electricity Meters cont'd

- **NISIT**

For standards and conformance

What are the legal units of measurement for the sale of electricity?

Kilowatt-hour

Electricity Meters cont'd

Do electricity meters require type approval?

Yes they do.

What organization performs approval of types testing?

PNG Power

Electricity Meters cont'd

How many type approvals do you perform in a year?

PNG Power does the approvals on new meters before installation only.

How long is the validity of a type approval?

No expiry date is given. Only called for test if the meter is faulty or damaged.

Electricity Meters cont'd

What organization performs verification?

PNG Power.

How many electricity meters are verified in a year?

Only recalled for verification if meters are at very old age/ upon customer request.

Electricity Meters cont'd

How long is the validity of the initial and subsequent verifications?

Do not have any program in place for verification of meters.

When the initial verification expired, are the meters re-verified or discarded?

The meter is not verified until it is faulty, it is called for test, if repairable, repaired, verified against sub-standards and stocked for installation.

Electricity Meters cont'd

Are meters verified at place of service?

Yes.

Do you have a national primary measurement standard for electricity meters?

No. PNG Power only has sub-standards traceable to their supplier, Enerjex (accredited electrical laboratory, Australia).

Electricity Meters cont'd

What kinds of electricity meters are used?

- 1 phase-2wire, (240V, 10-80A, 50Hz)
- Both Electromechanical and electronic meters are in use.

Are there any resolution processes for measurement complaint/dispute?

Yes. PNG Power, ICCC and NISIT are consulted depending on the nature of the complaint.

Way forward

- ✓ **Electrical Laboratory**
- ✓ **Establish electrical standards in the country.**

END

SEMINAR ON ELECTRICITY METERS BEIJING, PR CHINA

ECONOMY: PERU

ORGANIZATION: INDECOPI -
NATIONAL METROLOGY SERVICE (SNM)

TRAINEE: Henry Postigo L.

LOCATION



PERU IS PART OF
LATIN AMERICA.
IT IS LOCATED IN
THE OCCIDENTAL
PART OF SOUTH
AMERICA

Peru is the land of the INCAS Empire



INFORMATION

- Country (long form) Republic of Peru
- Capital Lima
- Total Area 1 285 215 square kilometers
- Population 28 000 000 (aprox.)
- Languages Spanish (official), Quechua (official), Aymara
- Religions Christians (Catholic and others) 99 %
- Government Type Constitutional Republic
- Currency 1 Nuevo Sol (S/.) = 0,30 US\$
- Industry mining of metals, petroleum, fishing, textiles, clothing, food processing, cement, steel, metal fabrication
- Agriculture coffee, cotton, sugarcane, rice, wheat, potatoes, coca; poultry, beef, dairy products
- Peru has the biggest biodiversity of the world
- Natural Resources copper, silver, gold, petroleum, wood, fish and others

INTRODUCTION



INDECOPI

- What is your position and responsibility in your economy?

I am head of Electricity laboratory in the National Metrology Service – INDECOPI. My responsibility is to keep measurement standards and transmit traceability to the industry. Also establish standards methods in coordination with normalization area of INDECOPI. Then, these methods are used by laboratories or fiscalization offices.

Measurement system and Current situation about electricity meters

- 1 What organization(s) regulate the measurement of electricity?
The Supervising Organism of the Investment in Energy and Mining - OSINERGMIN, is in charge of the regulation, supervision and control.
- 2 Are electricity meters required to have type approval?
Yes.
2.1 What organization performs type approval?
INDECOPI through the National Metrology Service - SNM

Measurement system and Current situation about electricity meters

- 2.2 How many type approvals do you perform in a year?

We perform type approval only of electromechanical meters.

In the picture we can appreciate the quantity of type approved per year.

Measurement system and Current situation about electricity meters

Type approvals			
YEAR	QUANTITY	YEAR	QUANTITY
1988	4	1998	4
1989	1	1999	12
1992	2	2000	6
1993	1	2001	8
1994	1	2002	6
1995	4	2003	3
1996	10	2004	4
1997	4	2005	1

Measurement system and Current situation about electricity meters

2.3 How long is the validity of a type approval?

Until 1994 the Certificate of Type Approval had a validity of 10 years; later on the indication of time of validity was eliminated.

Measurement system and Current situation about electricity meters

3 Are electricity meters required of verifications?

Yes.

The type approval and the initial verification are mandatory. It is established in the Resolution of the Technical and Commercial Regulations Commission N° 046-97/Indecopi-CRT.

OSINERGMIN is the organism in charge to take the corresponding actions for its fulfillment.

Measurement system and Current situation about electricity meters

OSINERGMIN established a reverification intervale of 10 years. It initiated the verification of the park of meters in 2006 like part of their supervising function. It has considered to conclude the verification in 2015 (annual 10%). The meters are verified at the place of service with accredited companies.

Measurement system and Current situation about electricity meters

4 Do you have a national primary measurement standard for electricity meters?

· Yes.

We have two standard meters class 0,02, with traceability to NIST – EE. UU.

Measurement system and Current situation about electricity meters



Measurement system and Current situation about electricity meters

5 What kinds of electricity meters are used?
Active meter, reactive meter, demand meter, single-tariff, multi-tariff, multifunción. Single phase (1 and 2 wire), three phase (3 and 4 wire), 220 V, 60 Hz, 2,5 A to 20 A of nominal current.

Measurement system and Current situation about electricity meters

6 Are there any resolution processes for measurement complaint/dispute?

Yes.

We have the Ministerial Resolution N° 496-2005-MEM/DM: Standard DGE “Verification of the measurement system of electrical energy”.

Thank you!

Henry PostigoL.
INDECOPI - PERU
hpostigo@indecopi.gob.pe

APEC/APLMF Seminars and Training Courses in Legal Metrology



Current Situation of Electricity Meters in Chinese Taipei

Yuan-Ping Sun

Bureau of Standards, Metrology and Inspection, MOEA

March 19, 2007

Introduction



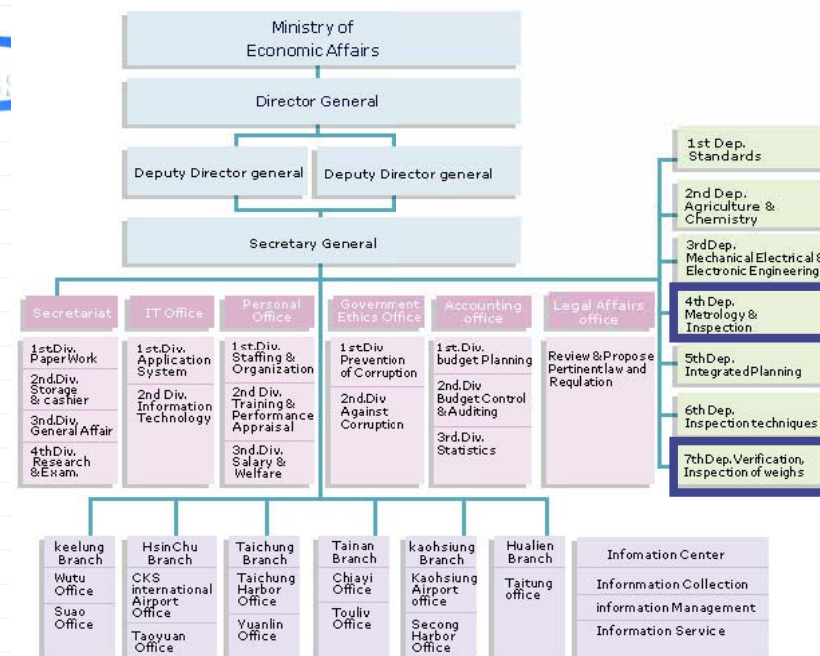
- ◆ The Bureau of Standards, Metrology and Inspection (BSMI) under the Ministry of Economic Affairs is the regulatory authority for legal metrology.
- ◆ With a view to maintaining an effective national metrology system and to facilitating trade, the BSMI has been working towards promoting the use of international system of units, harmonizing national technical requirements for weights and measuring instruments with international requirements, and implementing a sound verification/inspection scheme in line with international practices.

Introduction

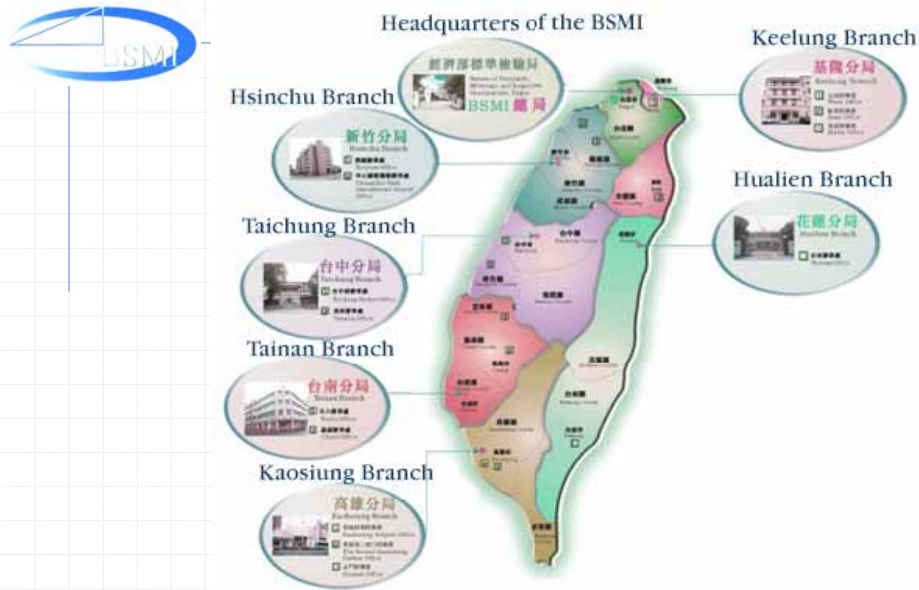


- ◆ The Ministry of Economic Affairs (MOEA) regulates metrological control of measuring instruments.
- ◆ Bureau of Standards, Metrology and Inspection (BSMI) verifies measuring instruments before they are sold or used.
- ◆ BSMI inspects measuring instruments when they are in use.

Organization Chart



Locations of BSMI offices



Laws on Legal Measuring Instruments

- ◆ The Weights and Measures Act
- ◆ Enforcement Rules of Weights and Measures Act The Business Operation Licensing and Administration
- ◆ Regulations of Measuring Instrument Enterprises Regulations Governing Type Approval of Measuring Instruments
- ◆ Regulations Governing Verification and Inspection of Measuring Instruments
- ◆ Regulations Governing Commissioned Metrological Activities
- ◆ Regulations Governing Self-verification Conducted by Measuring Instrument Enterprises

Categories of Legal Measuring Instruments Subject to Verification (Regulations Governing Verification and Inspection of Measuring Instruments)

- ◆ 1. Taximeters;
- ◆ 2. Weighing instruments;
- ◆ 3. Mercury clinical thermometers.
- ◆ 4. Volumeters (including liquid dosage meters, diaphragm gas meters, water meters, oil meters, liquefied petroleum gas flow meters) ;
- ◆ 5. Milk hydrometers;
- ◆ 6. Electricity meters;

Categories of Legal Measuring Instruments Subject to Verification (Regulations Governing Verification and Inspection of Measuring Instruments)

- ◆ 7. Radar speedometers;
- ◆ 8. Sound level meters;
- ◆ 9. Concentration meters (including breathe alcohol testers and analyzers, rice moisture meters, vehicle exhausts emissions analyzers);
- ◆ 10. Illuminance meters;
- ◆ 11. Liquid column pressure gauges (including sphygmomanometers) ;

Organization of verification of Electricity Meters



The BSMI entrust well-equipped, independent, and impartial testing institutions to carry out the verification.

- ◆ BSMI entrusts TERTEC (Taiwan Electric Research & Testing Center), a non-profit professional institute, to carry out the verification of electricity meters.
- ◆ All electricity meters are verified at the TERTEC's testing laboratory.
- ◆ Laboratory tests ensure that electricity meters comply with **“Technical Specification for Verification and Inspection of Electricity Meters.”**

Management of Electricity Meters



- ◆ At present, the electricity meters are subject to verification and inspection.
- ◆ Electricity meters are not subject to type approval, but we are going to set up the technical specification for type approval of electricity meters.

Management of verification



- ◆ All new and repaired electricity meters are required to be verified.
- ◆ When the initial verification expired, the meters shall be re-verified.
- ◆ There are more than one million electricity meters to be verified annually.

The validity of verification



- ◆ Diamond bearing watt-hour meter is valid for 7 years.
- ◆ Non-bearing (electronic) meter is valid for 8 years.
- ◆ Surge proof with transformer or with a demanding meter is valid for 8 years.
- ◆ Surge proof (magnet bearing watt-hour meter) without transformer or without demanding meter is valid for 16 years.
- ◆ Single-phase socket is valid for 20 years.



National primary measurement standard

- ◆ NML (National Measurement Laboratory) has established national measurement standards in the fields of electricity to provide traceability of electrical standards for domestic industry.
- ◆ It has established standards including DC/AC voltages, DC/AC currents, AC power and impedance.



Complaint/dispute resolution process

- ◆ Users can apply for meters identification.
- ◆ Staff of BSMI, users and staff of power company attend the meeting for meters identification.
- ◆ TERTEC provides the identification results to both power company and users.



Types of Electricity Meters

- ◆ Residential : Watt-hour meters, 1 phase - 3 wire, 110V/220V, 30A, 60Hz.
- ◆ Commercial and industrial: demand meters , 3 phase – 3 wire/ 3 phase – 4 wire, 110V/220V, 30A, 60Hz.



Website

BSMI (Bureau of Standards, Metrology and Inspection)

<http://www.bsmi.gov.tw>

TERTEC (Taiwan Electric Research & Testing Center) <http://www.tertec.org.tw>

NML (National Measurement Laboratory)

<http://www.nml.org.tw/>

The End



Electricity Meters

**IN
THAILAND**

By: Warapong Pakkut
Bureau of Weights & Measures

Organization

- * In Thailand there is no organization that are responsible for the measurement of electricity directly

Organization

- * Metropolitan Electricity Authority
- * Provincial Electricity Authority



- * Metropolitan Electricity Authority



* Provincial Electricity Authority

Verification

Import : All meters have to be verified and standard are referring to the reference of country origin. Such as import meters from USA, their meters will be verified by ANSI standard.

Domestic : Reference base on IEC standard and verification by random

In service

* Each organization have to provide data for electricity meters before setting such as: place, date, type, etc. After 20 years of installation, the meter will be checked and replaced by new meter. (For Metropolitan Electricity Authority 20 year and Provincial Electricity Authority 15 year)

Verification interval

Has not Verification interval.

Unit

- * Legal unit of measure is kilowatt per hour.

Type Approval

Manufacturer have to send type test include his bid. Verification base on IEC521-1976.

Measurement complaint

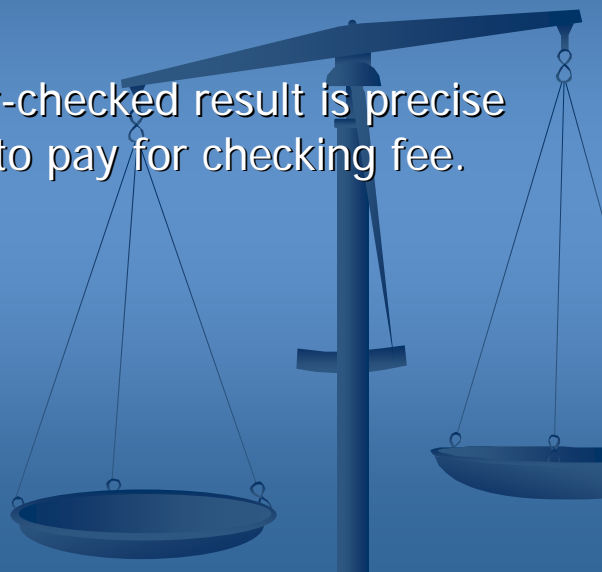
Both organizations find measurement complaint approximately 0.4% year.

Measurement complaint

However measurement complaint that occur will be proceed as follow, the doubted meter will be checked at laboratory meanwhile the officer replace a new meter at user's place.

Measurement complaint

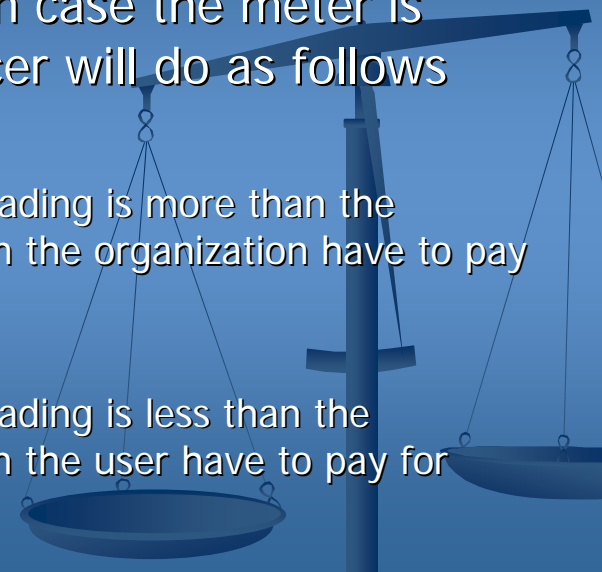
If the meter-checked result is precise the user has to pay for checking fee.



Measurement complaint

* Other fees in case the meter is imprecise officer will do as follows

- The meter reading is more than the standard then the organization have to pay for surplus.
- The meter reading is less than the standard then the user have to pay for surplus.



**THANK YOU
FOR
YOUR ATTENTION**





**DIRECTORATE FOR STANDARDS AND
QUALITY (STAMEQ)
VIETNAM METROLOGY INSTITUTE (VMI)**

YOU ARE WELCOME



2



**DIRECTORATE FOR STANDARDS AND
QUALITY (STAMEQ)
VIETNAM METROLOGY INSTITUTE**

Training Courses in Legal Metrology

Training Course on Electricity

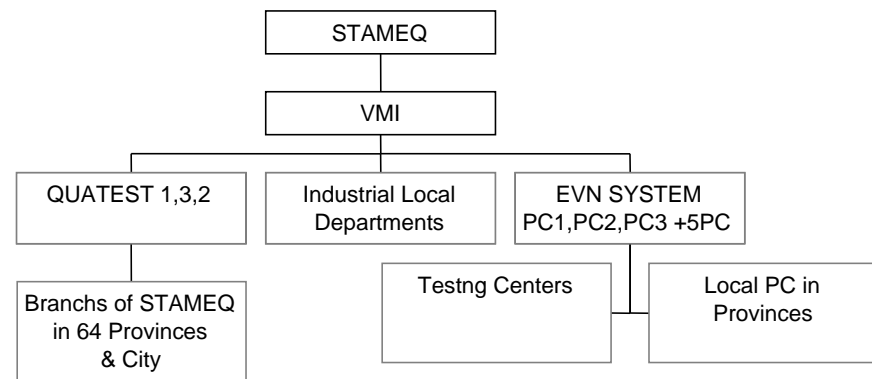
**overview of the measurement
system about electricity
meters in Vietnam**

March 29-3, 2007.

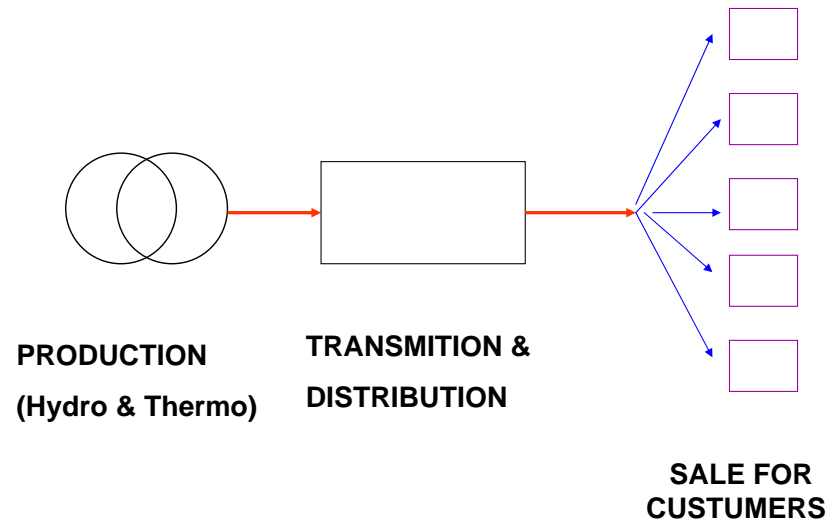


- 64 provinces & city
- 3 regions:
- North (24 provinces + 2 city)
- Middle (23 provinces +1 city)
- South (12 provinces + 3 city)

ADMINISTRASION METROLOGICAL SYSTEM IN VIETNAM



**ELECTRICITY DISTRIBUTION SYSTEM
IN VIETNAM
(All system belonging to EVN)**



**STATISTIC OF Electricity Meters
FOR THE SALE OF ELECTRICITY (12-2006)**

NN	organizations	Inductive 1 phase	Inductive 3 phase	Electronics	Summary
1	EVN	12,677,452	185,176	166,855	13,029,482
2	PC 1 (24 local PC)	1,727,970	68,948	17,454	1,814,372
3	PC 2 (12 Local PC)	2,135,869	18,866	18,207	2,172,942
4	PC 3 (23 Local PC)	2,106,407	35,015	13,657	2,155,078
5	HANOI PC	2,828,108	15,451	9,966	2,853,524
6	HAIPHONG PC	1,130,124	36,0458	8,949	1,175,117
7	HOCHIMINH PC	2,424,949	6,958	13,797	2,445,704
8	DONGNAI PC	79,115	1,976	2,149	283,240
9	NINHBINH PC	44,911	1,918	176	47,005

organizations regulate the measurement of electricity

- 64 Authorized Stations
(Branches of STAMEQ in 64 Provinces & City)
- 61 Authorized Laboratories
(belong to PC_s of the EVN System)
- 02 Authorized Laboratories
(belong to local Industrial Departments)

**LEGAL UNIT OF MEASURE
FOR THE SALE OF ELECTRICITY**

- kWh (Kilowatt-Hour)
- kVArh (Kilo-var-Hour)
- kVAh (Kilova-Hour)

**In Vietnam all the meter using for
purchasing electricity by contract have
to verify**

TYPE APPROVAL

2 types:

- Model Test :- Domestically Produce
(New design of meters)**
- Imported meters**
- Verification test
(Inspection, reverification...)**

REGULATIONS

Vietnamese Standards

- For Inductive Meter**
- TCVN 6572-1999 & DLVN 07-2003)**
- Follow to IEC 62053-21 (IEC 521-1988)**
- For Electronic Meter**
- TCVN 6571-1999 & DLVN 39-2004**
- Follow to IEC 62053-22 (IEC 1036 , IEC 687 IEC 1268)**

TYPICAL ELECTRICAL METERS OF USED

1-Reference (Electronic)

Classification : 0,005-0,01-0,02-0,1-0,2-0,5

Reverification Interval :1 year

2-Consumers (Inductive & Electronic type)

-1 phase (2 wire)

-3 phase (3 elements - 4wire , 2 elements - 3wire)

-3 phi multitariff

Classification : 0,5-1,0-2,0 (Follow to IEC)

Reverification Interval : 1 phase - 5 year

3 phase - 2 years

**who have right to verify and test
OF ELECTRICITY METER**

Authorized Organization :

+Personal have license

+Technical equipments

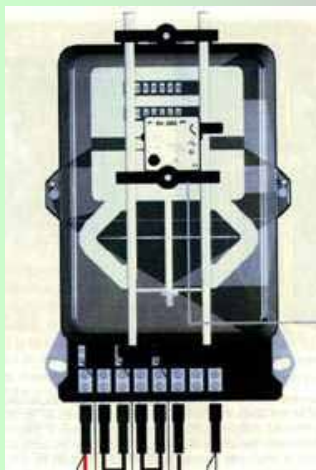
who have right to verify and test OF ELECTRICITY METER



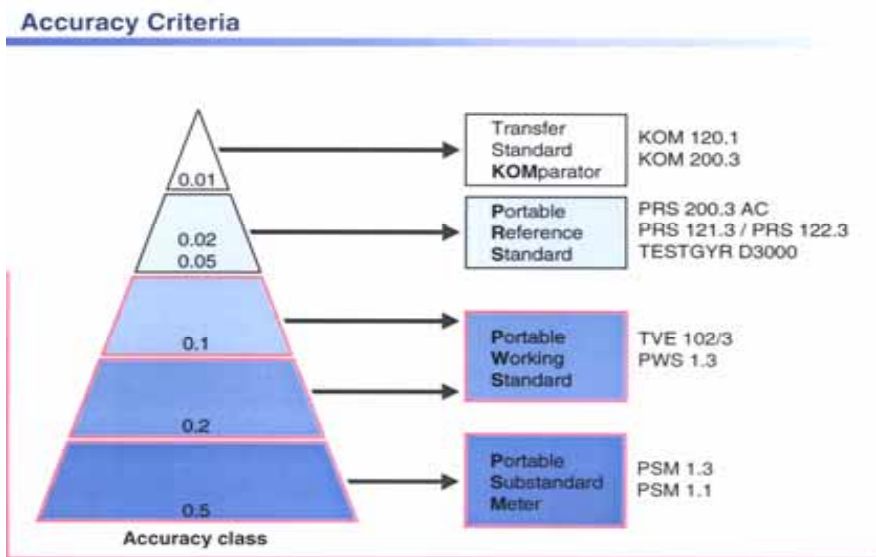
REFERENCES meters



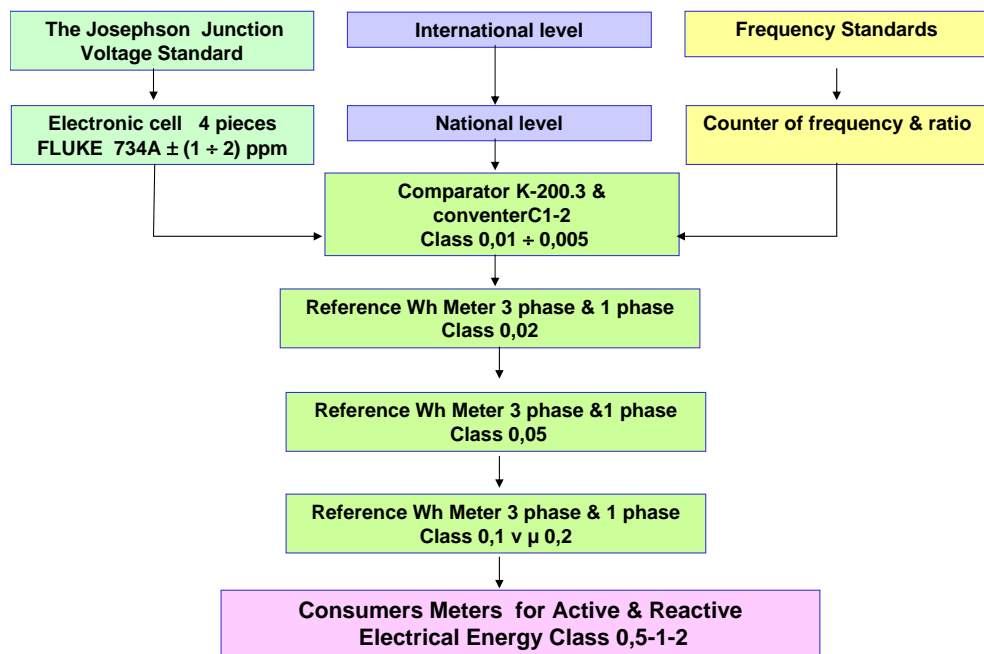
Consumers meters



ACCURACY CLASS OF REFERENCE METERS



Traceability of electricity meters



who have right to verify and test
OF ELECTRICITY METER

Authorized Organization :

+ Technical equipments :

-MTE (Switzerland-Germany)

-China

-.....

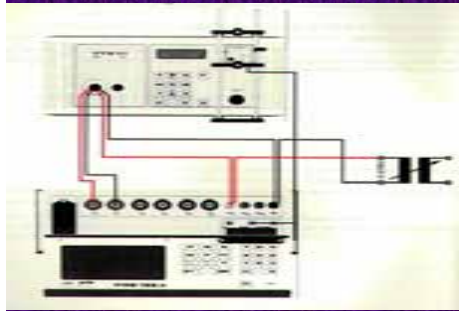
TESTING BAND FOR ELECTRICAL METERS MADE BY VMI



On-site Supply & Reference Watt-hourmeter



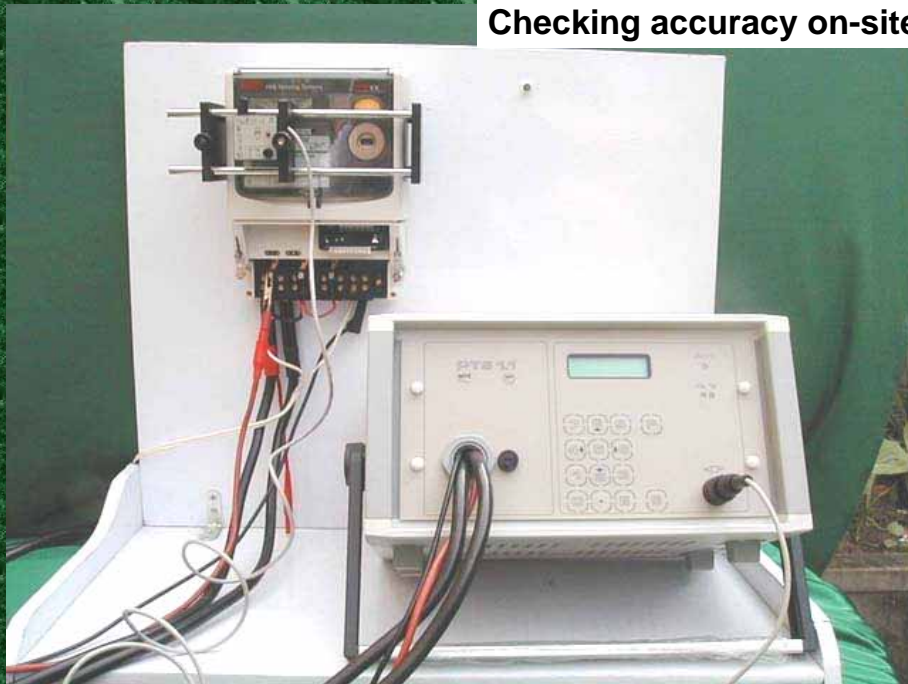
process of checking



Checking accuracy on-site

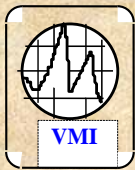


Checking accuracy on-site



Complaint - Dispute Resolution Process

In Vietnam , meters used for the sale of electricity by contracts for purchasing electricity, all are propriety of EVN .When have complaints from customers relating to Energy account Rate. Customer have to request by application to the local PC .Meter is checked to review by group of 3 representatives of organizations :Customer , Local PC& Branch of STAMEQ in local province .
.If meter is faulty, the Energy lost is calculated and is credited to their account and meter is replaced by local PC.
Payment for checking by Whom have done not truth
-For big customers decided by economical Law-court



**DIRECTORATE FOR STANDARDS AND
QUALITY (STAMEQ)**

VIETNAM METROLOGY INSTITUTE (VMI)

Thank You
for your attention

Summary of Reports Submitted from the Participants at the APLMF/APEC Seminar on Electricity Meters held on 19-22 March, 2007 in Beijing, PR China

As of: March 22, 2007

		Cambodia	Chile	PR China	Indonesia	Japan	DPR Korea	Malaysia	Mongolia	Papua New Guinea	Peru	Taipei Chinese	Thailand	Viet Nam
1	What organization(s) regulate the measurement of electricity?	DOM, MIME	CNE	AQSIQ	DOM	METI	SAQM	Energy commission	MASM	PNG Power, ICC, NISIT	OSINERGMIN	MOEA	none	STAMEQ
2	Are electricity meters required to have type approval? If required, reply the following four inquiries.													
2.1	What organization performs type approval?	NO		AQSIQ and provincial	PLN	JEMIC	SAQM	TNB, accredited labs.	MASM	PNG Power	INDECOPI, SNM	none	none	STAMEQ
2.2	How many type approvals do you perform in a year?				25	100~250	about 20	2 at least	20	none	6			
2.3	How long is the validity of a type approval?			no limit	none	10	1~2 (int) 3~5	none	3 yrs.	none	no limit			
2.4	When the type approval expired, is the meter tested again?			No	none	yes	Yes	NO	Yes	none	no			
3	Are electricity meters required of verifications?													
3.1	What organization performs verification?	EAC	SEC	Authorized organization	DOM/RVO	JEMIC/Manufacturer	CIM	TNB, accredited labs.	MASM	PNG Power (on request)	OSINERGMIN	BSMI, TERTEC	MEA, PEA	STAMEQ & other
3.2	How many electricity meters are verified in a year?		200,000		1,000,000	8000000	1,000	450,000	100,000			1,000,000~		1,000,000
3.3	How long is the validity of the initial and subsequent verifications?		4 yrs.	5 yrs (static), 15 (1P2W mechanical), 10(others)	10	10, 7, 5	1 year	1- 15 yrs.	3-8 yrs.		not determined	20, 16, 8, 7		5 yrs (1P), 2yrs(3P).
3.3'	If re-verification is not required, are meters inspected periodically? How long is the interval?												Yes. 20, 15 yrs.	
3.4	When the initial verification expired, are the meters re-verified or discarded?		re-verified	re-verify or discard	re-verified	re-verified	re-verified	re-verify or discard	re-verified		not determined	re-verified		re-verified
3.5	How do you decide the length of validity of verification?		CNE decide	According to the national regulation	DOM		SAQM decide according to importance	based on statistic and survey	MASM		OSINERGMIN	BSMI decide		
3.6	Are the meters verified at the place of service?	Yes	Yes	NO	no	no	Yes	Yes	NO	NO	yes	no	no	No
4	Do you have a national primary measurement standard for electricity meters? If not, where is the standard traceable to?	NO	NO	yes	no traceable to NIST	yes	NO	Yes	Yes	no	NIST (USA)	yes	no	Yes
5	What kinds of electricity meters are used? For examples, active meter, reactive meter, VA meter, demand meter, classification of meters, rated value-connection mode, frequency, voltage, current, single-tariff, multi-tariffs, etc.	1 phase 2 wires, 3 phase 4 wires	1 phase 2 wires, 3 phase 4 wires	1 phase 2 wires, 3 phase 4 wires	1 phase 2 wires, 3 phase 4 wires (220V class 0.2-2)	1P2W, 1P3W (100V 30-250A, 50/60Hz), 3P3W (110V, 5A, 50/60Hz), 3P4W (63.5V, 5A 50/60Hz)	1 phase 2 wires, 3 phase 4 wires	1 phase 2 wires, 3 phase 4 wires, active & reactive meters (class 0.1-2, 110-240V, 10-100A 50Hz)	1 phase 2 wires, 3 phase 4 wires	1P2W(240V, 10-80A, 50Hz) S&EM, 3 phase 4 wires	1P2W, 1P3W, 3P3W/3P4W(220V, 2.5-20A, 60Hz)	1P3W(110V/220V, 30A, 60Hz), 3P3W/3P4W(110V/220V, 30A, 60Hz)	1 phase 2 wires, 3 phase 4 wires	1 phase 2 wires, 3 phase 4 wires
6	Are there any resolution processes for measurement complaint/dispute?	EAC	SEC	AQSIQ and provincial	DOM		CIM	Yes	MASM	Yes, PNG power	Yes	BSMI	MEA, PEA	STAMEQ
7	Reference Product Standards	NO		Original & IEC	Original & IEC	original		IEC, BS	IEC,MNS		National standards similar to IEC	Original	original, ANSI, IEC	original, IEC