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RELATIONSHIP BETWEEN QUALITY CONTROL, STANDARDIZATION AND METROLOGY

and

CONCEPTS OF METROLOGY SERVICES 1/

by

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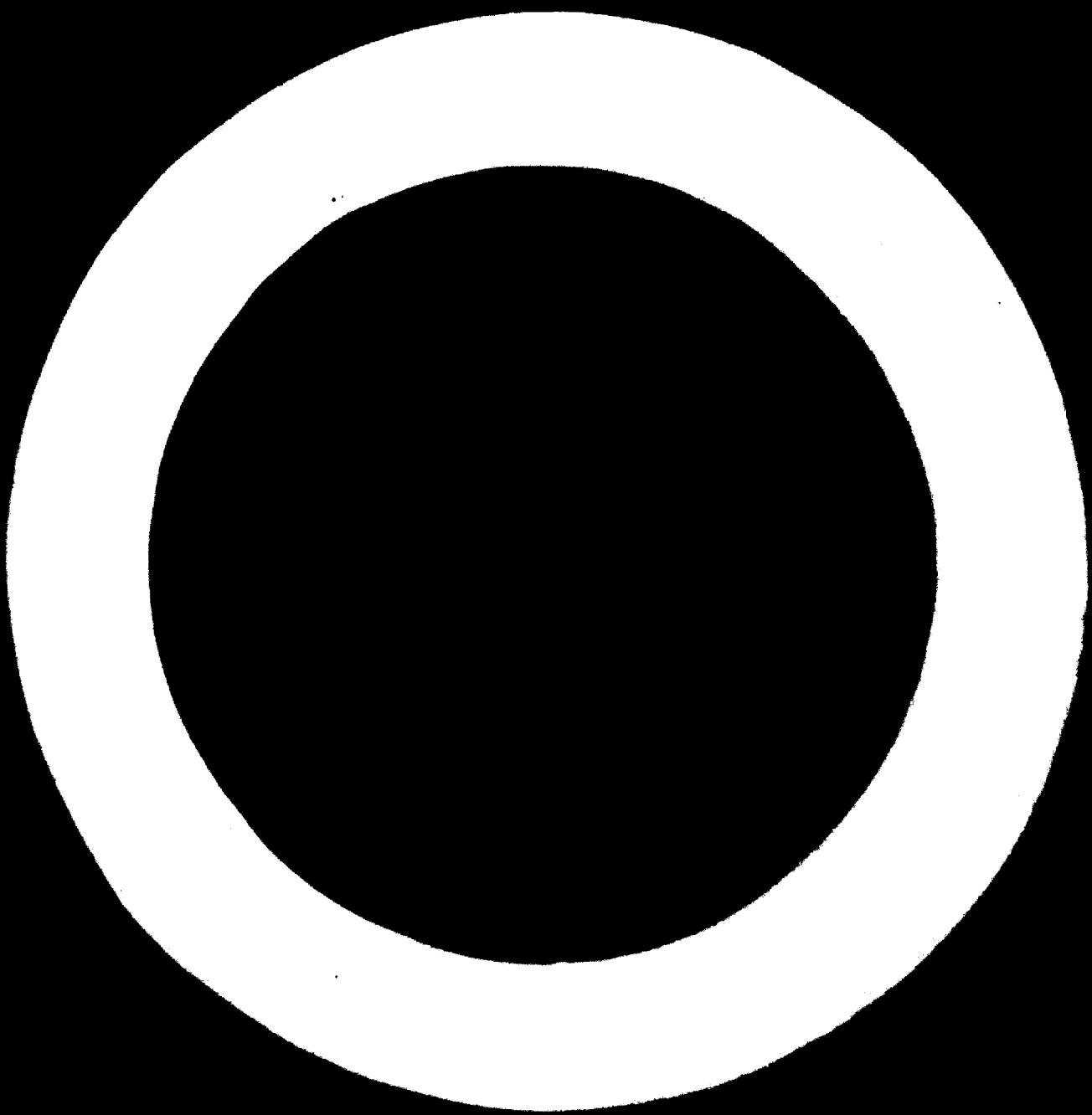
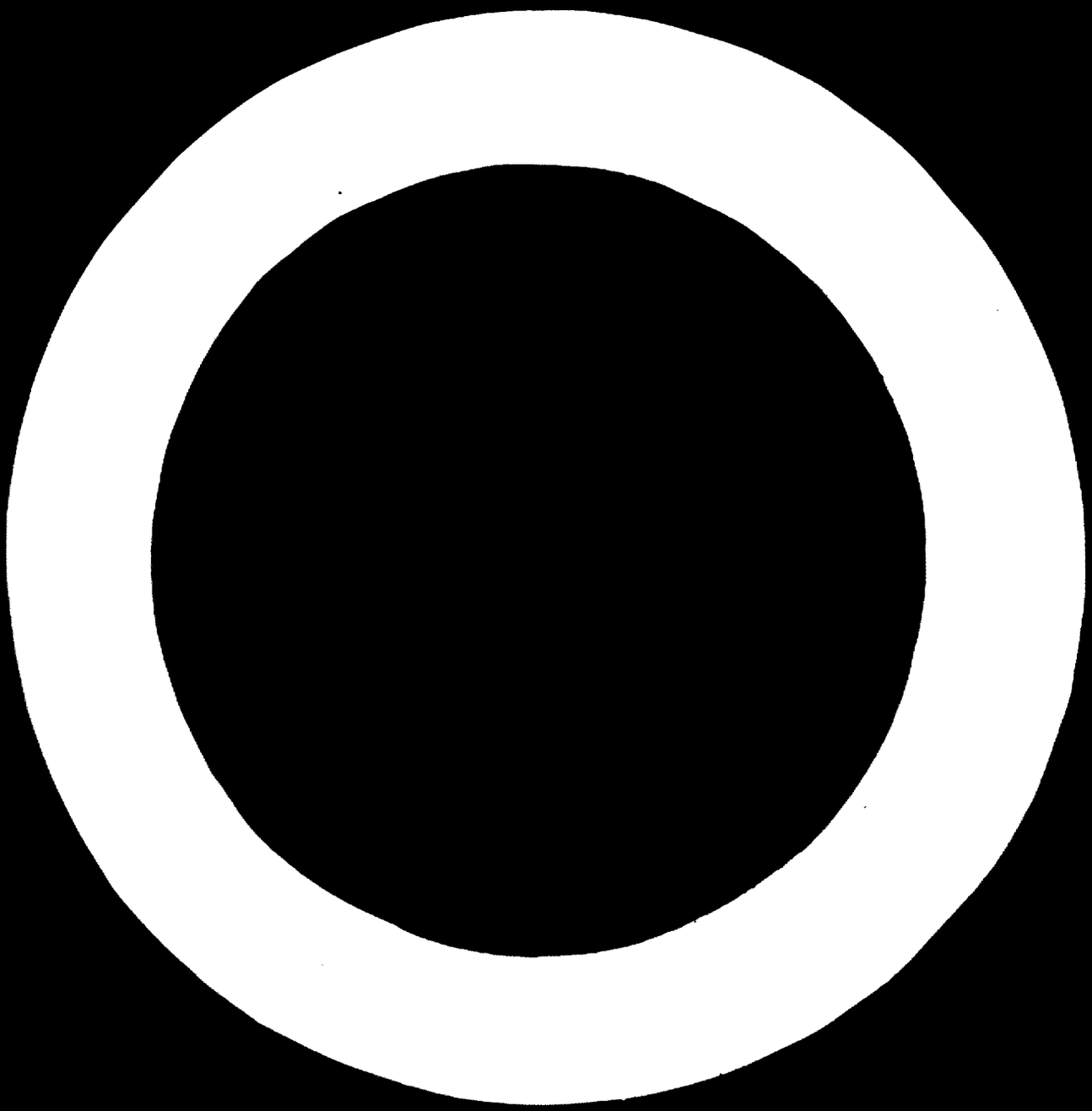




I. RELATIONSHIP BETWEEN QUALITY CONTROL, STANDARDIZATION AND METROLOGY

1. Quality Control in Japanese Industry

The manufacturing industry of balance and indicating scale is a good example to show the role of the quality control. There is a wide difference between the small and the large-scale manufacturers in terms of technical grade and economic scale. Indicating spring scale consists of a small number of component parts and has a fairy simple construction. In very small manufacturer, only a few handicraftsmen machine the parts, assemble them, make adjustments and bring into accomplished final products. On the other hand, in large scale enterprise, parts are worked, tested and assembled with adequate machine tools and properly designed jigs under a thorough quality control system, and consequently final products are easily accomplished without skilled labor required in the former case and still the productivity is kept high. The rejected rates at the verification are 4 % in the former and approximately zero in the latter.

Quality control is not simple but means rich contents, and will show its merit when the necessary controls corresponding to the requirements are satisfied; length control subject to precision of machine tool and accuracy of positioning in machining of the parts, form and shape control in fitting or assembling, machining and assembling conditions like as cutting speed and tightening force of screw, environmental control for temperature, humidity and contamination of atmosphere in working area, assurance of inspections by a national metrology system in the manufacturing process, and a guarantee of durability for the practical use.

2. Co-operation of Government and Industry

What the government did directly for the promotion of quality control is too little to describe here. The only thing the government has done was the help to solve common and fundamental problems in the industrial growth in the course of the national development. Regarding the most fundamental problem in industry, which is the national metrology service including the establishment and custody of the national standards, the National Research Laboratory of Metrology (NRLM) has taken consistent responsibility since three quarters of century. NRLM has also given them scientific and technical guidances in the fields of machining, measurement and process control, though some of which were mutual aid and co-operation. Thus, NRLM has been placed its position at the center of the industries as the only and highest organization in the national metrology. With the background of sufficient metrology services, the work of quality control has been undertaken in the way of private enterprise level, and it still continued resulting a fruitful success.

Among the corporations actively promoting this movement, nationally organized ones are "The Instrumentation Control Association", "Japan Weights and Measures Association" and "Japan Certified Measurers Association", which promote pervasion of the knowledge of metrology to the public and the knowledge of quality control to the enterprises, making the efforts to maintain the proper metrology featuring their characteristics.

3. Standardization in Japan

National standardization has partly been undertaken since old days, but systematized standardization started in 1921 when the Japan Engineering Standards Committee was

founded. The nationally specified standards, Japanese Engineering Standards, were adopted for the purchasing of the governmental properties.

In 1949, the Industrial Standardization Law was enacted, and the Japanese Industrial Standards (JIS) were to be determined by the Minister concerned, through the deliberation of the Japan Industrial Standards Committee. The committee is organized by members selected from manufacturers, user consumers, intellectual persons, and the Standards Division of the Agency of Industrial Science and Technology, the Ministry of International Trade and Industry, as the authorities directly in charge. The Standards Division refer the established JIS to the Japan Standard Association where copies are published and sold to the public users. JIS copies are printed 2,800 thousand in pamphlet type and 100 thousand in handbook type a year. English translation of JIS has been made on 2,200 items by the Japan Standard Association.

The number of JIS amounts up to 7,000, and 200 are added every year. Re-examination is applied to the individual JIS every three years in compliance with the articles of the Law.

4. JIS Mark Indication

Manufacturer can mark the letters "JIS" on the products which meet the requirements of JIS. This is a kind of license system provided that the manufacturer performs a systematic administration on standardization and quality control, and is organized for making assurance of quality. The goods bearing JIS mark show the quality to be authorized in a certain sense.

5. Permeation of JIS into the Industry

JIS system is managed by the Law, but the use of JIS is left to a free selection of industry with some exceptions that JIS are cited and enforced in other laws. In spite of this matter, 1,849 factories in manufacturing and non-manufacturing industries showed a high rate of 96 % in the use of JIS on certain 255 items at the investigation in 1967.

Standardization in an enterprise is a basis for the execution of the quality control, and quality control may stimulate the better standardization. Moreover, the private standards and specifications which are guideline of the standardization in the enterprise may become a source for establishment of national standards. Reversely, the national standards already established affects the private standard. The fact that 54 % of Japanese manufacturing factories possesses complete private standards or specifications in 1969 (38 % in 1959) shows the steady spread of standardization and quality control, and now the fruits are highly evaluated.

6. Utilization of Standardization

In marchandising between the enterprises, a purchaser keeps away possible mistake and hasten the contract by assigning JIS instead of the individual detailed ordering specification. A supplier also can manage a major part of requirement by the production of standardized goods of a small number of sorts without the trouble of the unnecessary stock of miscellaneous sorts, so that the elevation of productivity, reduction of cost and acceleration of the date of delivery can be attained. These are equal to the assurance for the uniformity of quality and specification, and mean that quality control system shows its validity throughout the whole industries, combined with the industrial

metrology raised in its technical level.

Quality control based upon a useful metrology system yields the rise of quality and rationalization, and prepares the acceptability of the standardization. Standardization promotes high productivity and the circulation among separated fields and regions, and inversely stimulates the quality of the quality control system as well as the metrology in the capacity of its foundation. These are the trunk-road which certainly contributes to scientific, industrial and economic development in every countries.

7. International Efforts

Japan Standard Association distributes "JSA Technical Report" and "JIS Year Book" to foreign organizations concerned to circulate the information of standardization, quality control and JIS.

Overseas Technical Co-operation Agency has executed training since 1968 on the "Standardization and Quality Control" for the personnels belonging to the national metrology organisations in the developing countries.

II. CONCEPTS OF METROLOGY SERVICES

1. General Aspect in Japan

The National Research Laboratory of Metrology, formerly known as the Central Inspection Institute of Weights and Measures, was established in 1903, and ever since has been playing an active role in the unification of units and standards of various quantities throughout Japan as a national center of metrology.

Japan had joined the Metric Convention since 1885, and the Laboratory, being in close contact with the International Bureau of Weights and Measures at Sevres and other standard research organizations in many countries, has also contributed to the international unification of units and standards.

Besides taking charge of the custody of the national prototype of Kilogram, the laboratory conducts a broad range of program for the improvement of standards and the advancement of metrology.

Calibrations and tests of working standards and measuring instruments of higher accuracy, inspections of the model measuring devices, and guidance for local governments and industries are also conducted as the laboratory's responsibility in compliance with the Measurement Law which was substituted in 1951 for the former Law of Weights and Measures.

The complete and compulsive use of the Metric System is put into force since 1959, and recommendations of the International Organization of Legal Metrology and the International Organization for Standardization are positively adopted into the Measurement Law and the Japanese Industrial Standards.

2. Legal Metrology

Legal system of metrlogy in Japan is constructed by the Measurement Law as foundation and surrounding ordinances and regulations which concretely prescribe details in accordance with their respective gradations. Enforcement ordinance for the Measurement Law, verification and calibration ordinance and regulation, model measuring device inspection ordinance and regulation, fee and charge ordinance and unit ordinance almost cover the whole system.

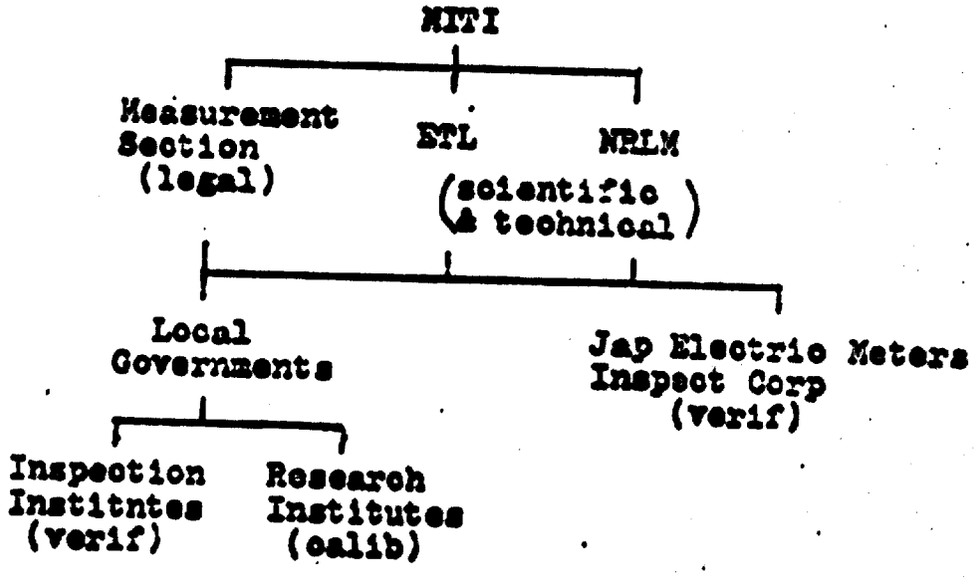
These law and rules aim at a proper metrology, industrial development and cultural progress, and give the government a basis that the measurement in transactions and certifications, and the business of measuring instruments including manufacture, repair and sale, are regulated within a limit. At the same time the government and local governments also owes the obligation to perform verification, model measuring device inspection and etc.

3. Administrative Organization and Functions

Legal administrative system including local governments is shown in the Figure below. NRLM and Electrotechnical Laboratory have responsibility in scientific and industrial metrology and the Measurement Section, MITI, shares in legal metrology with NRLM.

Tokyo metropolitan area, Hokkaido area and other 45 prefectures have each inspection organization where the verification is performed relying on the model measuring devices qualified at NRLM. Verification of weights and thermometers performed at NRLM and electric power meters at the Japan Electric Meters Inspection Corporation are some of exceptions. Another exception is the certified measurer who can do a kind of inspection on oil meters.

The measuring device which conforms to the requirements of verification is regarded as qualified and affixed a verification stamp. The measurement in transaction or certification must be performed by using only the verified measuring device.



4. Metrlogical Services

Local governments get standards in the form of the qualified model measuring devices for the use of their verification work, by which verified devices are supplied to the public users.

Besides, some public and private organizations provide standards.

Prefectural and specified municipal laboratories: Calibration for the measuring devices.

Japan Electric Meters Inspection Corporation: Verification of electric power meters, authorized by the Minister of International Trade and Industry.

Japan Marine Association: Calibration and test for material testing machines.

Japan Society for the Promotion of Machine Industry:
Calibration and test for measuring devices and instruments.

Manufacturer can also make application for the inspection of the model measuring device or for the calibration of any measuring device in a higher accuracy than in former. The latter is generally used as a master device which occupies the first place of the metrological service system in the enterprise, and plays important role in the spread of standard.

In small-scale enterprises, administration of standards and quality control are not so suficient that NRLM or local governments actively make contact with them, give advice and help to raise their technical level.

The type approval examination system that designing, material, mechanism and construction of each type of device are examined to improve the quality of spring scale, taximeter, gas-meter and water-meter, makes the chance of technical guidance increased, contributes to raise the technical level, and decreases the difference in technical grade from large-scale industry.

5. National Standards and its Improvements

Establishment and maintenance of national standards are the responsibility of NRLM and partly of the Electrotechnical Laboratory under the administration of the Minister of International Trade and Industry. The equipments and methods to produce the national standards are based on the determination of the General Conference of Weights and Measures. Further research is also made in a broad range aiming at the improvement of standards.

Length:

Kr-86 lamp assembled at NRLM.
Investigation for frequency stabilized laser is under Progress. A 3.39 μm He-Ne laser is forced to tune

to the absorption line of methane (2947.906 cm^{-1}) which has an excellent feature for a high degree of absolute stability and reproducibility.

Mass:

National Prototype of Kilogram.
A new precision balance for the comparison of the National Prototype and standard weights of 1 kg is constructed and improved based on the principle that the weights to be compared may be exchanged keeping the knife edges contacted with the bearing planes during the beam of balance is freely oscillating. A high sensibility and reproducibility ob 1 μg or better is attained.

Time:

The "second" is defined as the radiation frequency corresponding to a certain transition of cesium-133 atom.
A cesium beam frequency standard is newly constructed and now under improvement. Rubidium gas-cell frequency standard are also investigated.

Temperature:

The triple point of water gives the standard of the International Practical Temperature Scale (IPTS).
An extension of the IPTS to lower range and its improvement for making close approach to the thermodynamic temperature scale, the primary standard, are essential research projects on the temperature standard. Pursuing the thermodynamic absolute measurement of temperature, a gas-thermometer and a method by the thermionic emission are studied ranging from 13 to 2,500 K.

6. Legal Terminology

Calibration:

Similar to the verification. A calibration record is provided.

Certification:

Act of certifying to the public or to other persons that a certain fact is true in the course of business.

Inspection of model measuring device:

Qualification for a model measuring device. Usually a calibration record is provided..

Measuring device:

Instrument, machinery or equipment listed in the Measurement Law for measurement use, excluding the Prototype Kilogram, primary standards, model measuring device and etc.

MITI:

The Ministry of International Trade and Industry.

NRLM:

The National Research Laboratory of Metrology.

Model measuring device:

Qualified measuring device used for the verification and calibration work. It is of kind prescribed by Cabinet Order and of construction prescribed by MITI Ordinance, and its instrumental error does not exceed the model measuring device tolerance prescribed by Cabinet Order.

On- the-spot inspection:

Inspection performed at at discretion at the installation.

Periodical inspection:

Inspection every certain years for a measuring device being in use for transaction and/or certification.

Transaction:

Any act in business the object of which is either the

delivery of goods or performance of services.

Verification:

Qualification for a measuring device, that it is a kind prescribed by Cabinet Order, that it is of a construction (including quality or material) prescribed by MITI Ordinance and that its instrumental error does not exceed the verification tolerance prescribed by Cabinet Order.

7. Information in the Field of Metrology

Internationally, the situation is the same as in other countries. Correspondence with international organisations and research laboratories in many countries is principal.

Information is also brought by the participants to the international conferences held in the countries other than Japan, who sum up to two hundred persons a year, and by a number of metrologists attending at the conferences held in Japan, such as committees of ISO and the International Congress on Rheology.

Informations exchanged in such a way gather into NRLM. Some of them are sent to the National Committee for the International Weights and Measures, Science Council of Japan, where the informations are treated and recommendation is made to the government.

The one similar to the NCSL in the United States is the Industrial Metrlogy Committee, Japan Industrial Technology Association. It consists of five technical groups and widely functions on information exchange.

NRLM publishes "Handbook of Measurement Technology" and "Dictionary of Measurement", and periodically "Report of NRLM", "Bulletin of NRLM" and "NRLM News" etc. Information

on legal metrology are distributed through the administrative organization described beforehand.

Two weekly newspapers, periodicals of many corporations such as "Journal of the Instrumentation and Control Association, Japan", "Journal of the Society of Instrument and Control Engineers" and "Technical Bulletin of the Certified Measurer Association", are also distributed.

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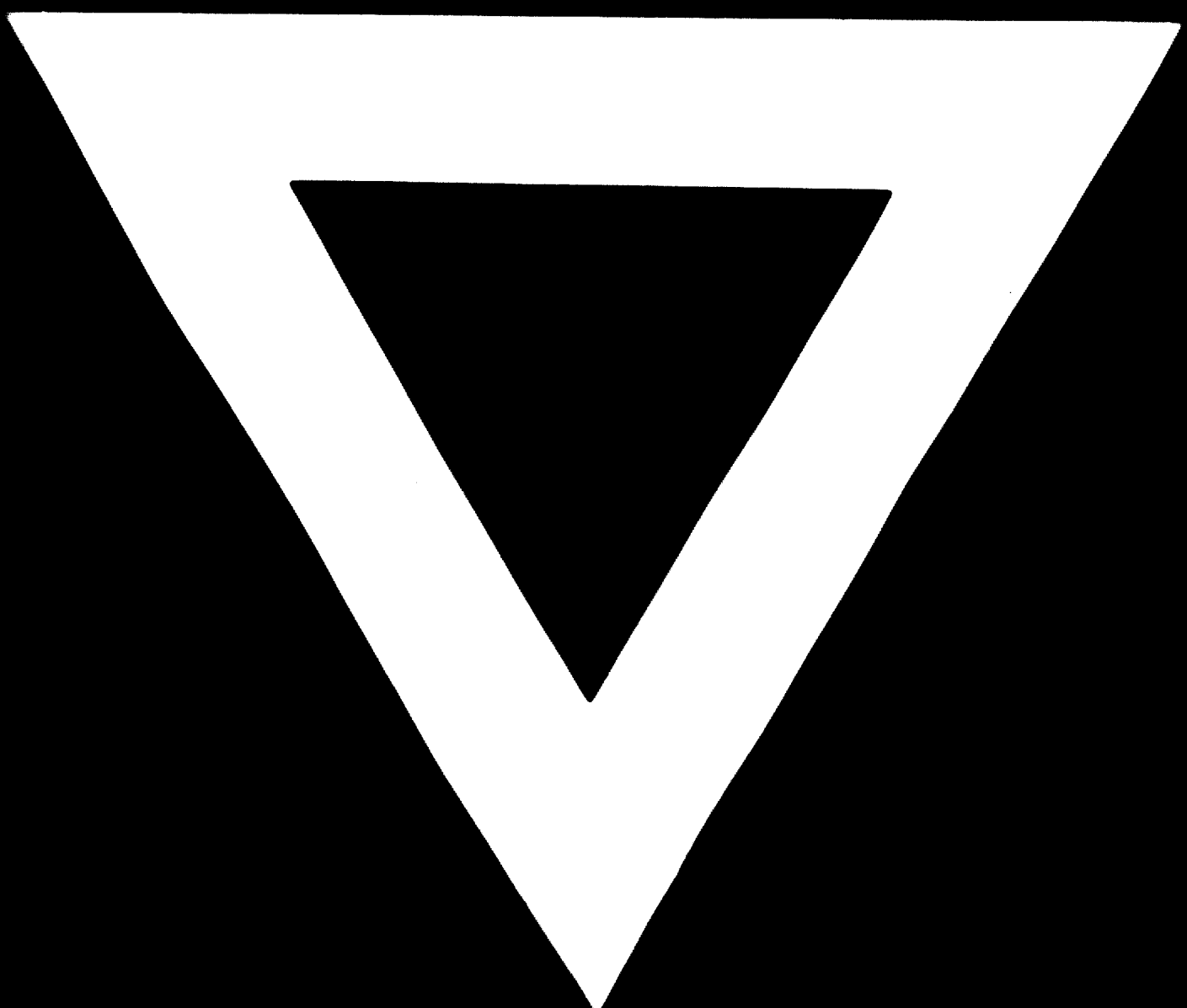

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