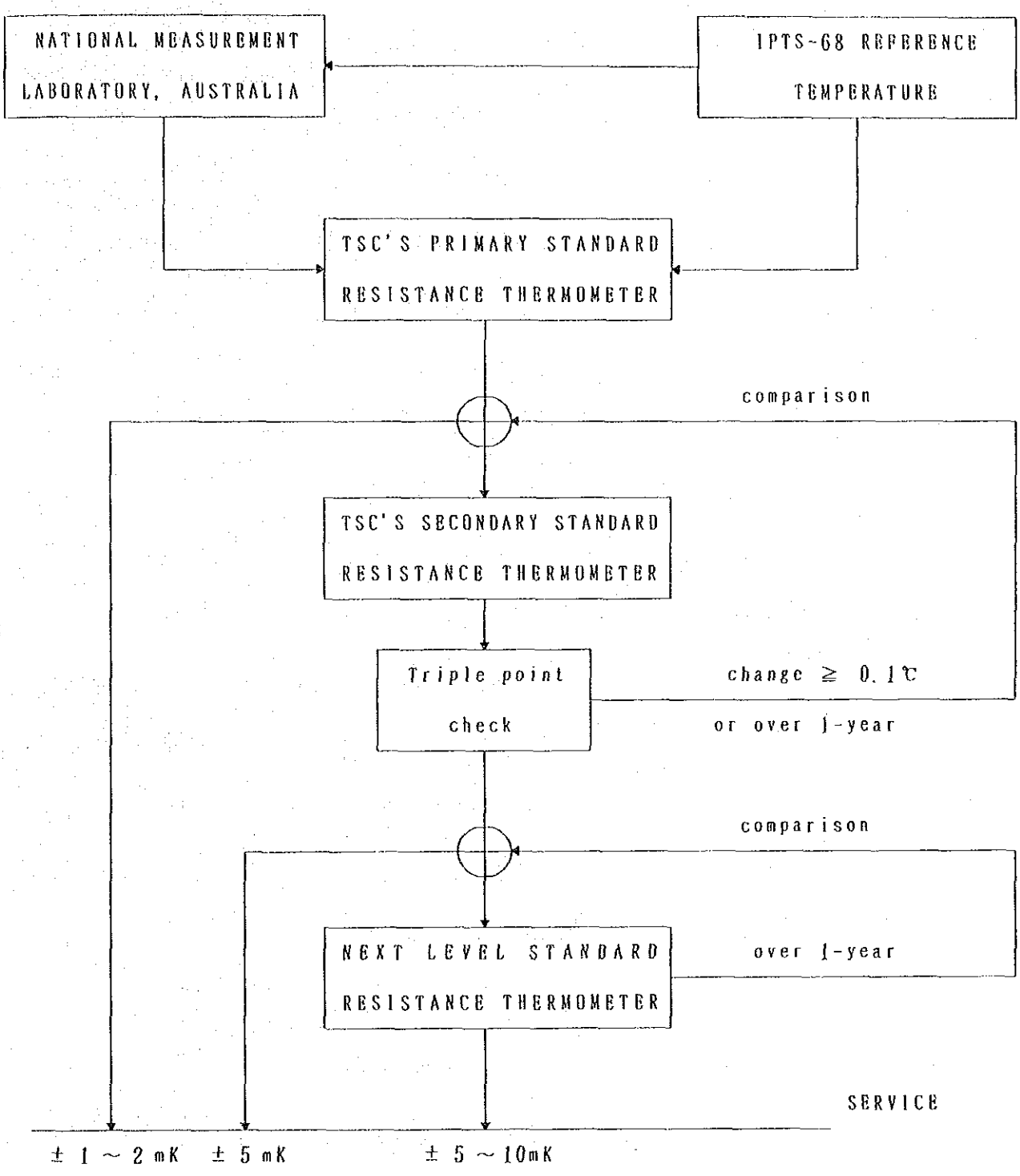
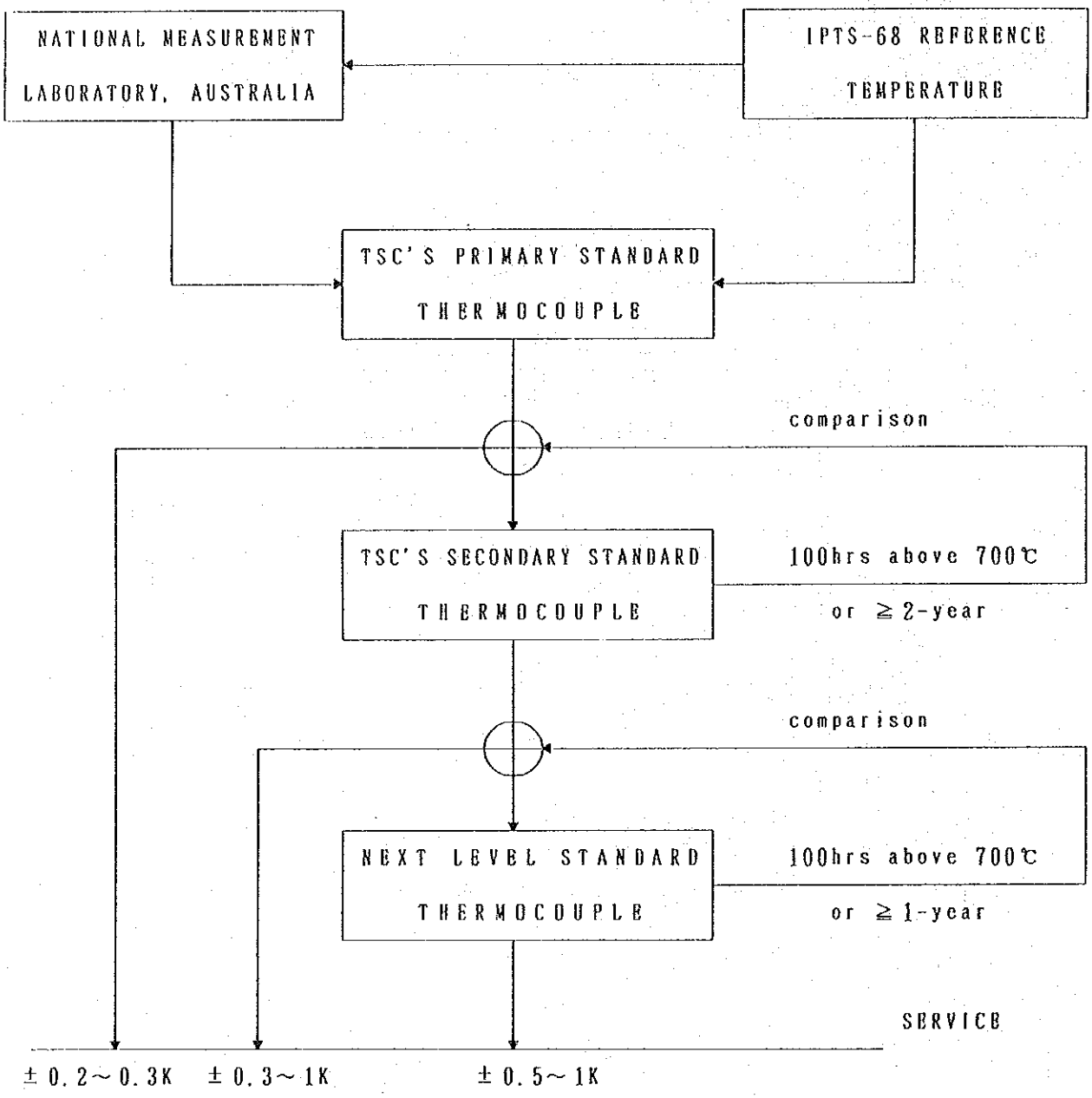


Source: TISTR

Fig. 3.7.2-4 Traceability of Standard Resistance Thermometer



Source: TISTR

Fig. 3.7.2-5 Traceability of Standard Thermocouples

(d) Conditions of Laboratory

The present size of the thermometric laboratory of the TSC is $30m^2$ in total, consisting of the thermal source (furnace) room of $10m^2$ and the working room and others of $20m^2$.

The furnace room and the measuring room are isolated and the former is particularly small.

(e) Thermometric Calibration Performance

As shown in Table 3.7.2-3(1)/(2), actual data of the calibration service at the TSC shows that calibration was done for 46 cases in 1985 and 82 cases in 1986, increasing by 78% in a year.

The significant increase of the actual number of the calibration service included a significant increase for each item. In terms of subject items of calibration, measuring instruments for field use account for the majority, while high precision instruments are few. Those requesting the calibration service were electronic parts manufacturers, can factories, rubber industry and ceramic factories, etc. Although it is difficult to make accurate predictions because of the data being based on only 2 years, it may be said that the need for higher quality and reliabile products is also increasing in the Thai industrial circles.

It is also noted that the thermal measurement requirement for the temperature range has expanded to the range lower than 0°C.

The TSC currently does not have calibration equipment/facilities for the temperature range lower that 0°C and values in this range are not determined by actual measurements but estimated by means of calculation. It will be, therefore, necessary to have fixed point measuring and calibration equipment for the temperature range lower than 0°C as the need in this area is expected to increase.

Table 3.7.2-3(1) Actual Work Done for Calibration of Thermometers

(Thermometric standard) 1985

Equipment	Range	Accuracy	Number
1. Thermo - Hygrograph	0 - 40°C	± 0.5°C	3
2. Temperature Recorder	0 - 300°C	± 0.5°C	3
3. Digital Thermometer	-40 - 200°C	± 0.5°C	8
	32 - 200°F	± 0.5°F	5
	0 - 750°C	± 0.5°C	5
	32 - 1400°F	± 2°F	5
	0 - 1370°C	± 1°C	3
	100 - 500°C	± 0.5°C	1
4. Thermometer	0 - 1200°C	± 1°C	1
	0 - 500°C	± 1°C	12
Total			46

Tested instruments from public laboratories: 8.7%

Tested instruments from private factories : 91.3%

Source: TISTR

Table 3.7.2-3(2) Actual Work Done for Calibration of Thermometers

(Thermometric standard) 1986

Equipment	Range	Accuracy	Number
1. Thermo - Hygrograph	0 - 40°C	± 0.5°C	8
2. Thermograph	-30 - 60°C	± 1°C	1
3. Thermocouple	50 - 400°C	± 1%	1
4. Liquid-in Glass Thermometer	0 - 130°C	± 0.5%	32
	80 - 130°F	± 1%	1
	170 - 220°F	± 1%	1
	-30 - 30°F	± 0.5%	1
5. Digital Thermometer	-60 - 2000°F	± 2°F	1
	-50 - 1100°F	± 2°F	1
	32 - 1400°F	± 2°F	4
	32 - 200°F	± 0.5°F	6
	-40 - 200°C	± 0.5°C	6
	0 - 750°C	± 0.5°C	2
	-50 - 1000°C	± 1°C	4
	-40 - 200°C	± 0.5°C	1
	0 - 1370°C	± 1°C	2
	0 - 200°F	± 0.5°F	1
	0 - 2000°F	± 2°F	6
	0 - 1400°C	± 1°C	1
	32 - 2000°F	± 2°F	2
	-100 - 1300°C	± 1°C	1
	-100 - 2400°F	± 2°F	1
	-90 - 390°C	± 0.5°C	1
	-90 - 740°C	± 0.5°C	1
	0 - 1000°C	± 1°C	1
Total			82

Tested instruments from public laboratories: 12%

Tested instruments from private factories : 88%

Source: TISTR

(3) Photometry

(a) Provision of Equipment

Along with the electric standards, the technology transfer for photometric standards was also conducted under the same ITIT project between 1975 and 1987. Photometric equipment is currently fully available as shown in Table 3.7.1-7. It can thus be said that additional installation or supplementation of photometric equipment is not necessary at present.

(b) Technological Level and ITIT Project

The ITIT Project for photometric technology was initiated in 1975 between the Electrotechnical Laboratory (ETL) in Japan and the TISTR, by which reference standard lamps for luminous intensity, luminous flux and distributed temperatures - standards for photometric units and quantities - waer first provided at the TSC.

According to the ITIT Project report, the basic photometric technology is established due to the joint study conducted by Japan and Thailand under the ITIT Project. In addition, various applications of the photometric technology have been promoted owing to the expansion of the application technology. The TSC's calibration accuracy is said to have become almost equivalent to that of the ETL.

(c) Traceability of Photometric Standards and Measuring Environment

The photometric primary standard was provided to the TSC by the ETL in Japan as part of the ITIT Project, and has subsequently been maintained and controlled. Table 3.7.2-4 shows the calibration certificate which demonstrates the traceability of the photometric standards to those of the ETL of Japan.

The photometric laboratory consists of a $35m^2$ dark room with temperature control. While it has no problem in performing the assigned work its expansion seems to be preferable.

(d) Staff Engaged in Photometry

A university graduate is engaged in the work of maintenance and control of metrological standards related to photometry.

Table 3.7.2-4 Example of Calibration Certificate

Request No. 739/29

TSC. No. 1342/29

Lab. No. PT.61/29

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

196 Phahonyothin Road, Bang Khen, Bangkok 10900

CALIBRATION CERTIFICATE

Nomenclature: Opto-Meter TM, United Detector Technology Model/Type 40X

Submitted by: Signatic Thailand Co. Serial No: 46593

Ambient temperature: 25 ± 1 °C Relative humidity: 60 %

The above instrument with Photometric detector No. ~~21738~~ 21377 assembled photometric filter 111 and cosine diffuser 112, was adjusted and calibrated against the reference standard lamps of Testing and Standards Centre, traceable to the Electrotechnical Laboratory, Japan National Standards. The accuracy of the instrument can be certified :

Footcandle scale	Accuracy, % of full scale
0 - 1	± 3.6
0 - 10	± 4.5
0 - 100	± 5.0
0 - 1000	± 4.0

Calibrated by

1 Niwat Srithanu

2 (Mr Niwat Srithanu)

3

Examined by P. Disathien

(Mr. Preecha Disathien)

Chief of Photometric Standard Lab.

Approved by

(Mr. Suri Nanomsuk)

Director

TESTING AND STANDARDS CENTRE

Date: 10 Sept. 86

Due: 9 Mar. 87

Remark: The above results are valid exclusively for calibrated samples as mentioned in this report.
Publicity of the results on calibrating is prohibited unless written permission is obtained from the governor of TISTR.

Source: TISTR

(4) Physical/Dynamic Quantities (Mass, Length and Pressure/Force)

The maintenance and calibration service for standards of physical/dynamic quantities - mass, length, force, pressure, etc. - are conducted by the Mechanical Engineering Laboratory.

(a) Scope of Operations

The scope of operations of the Mechanical Engineering Laboratory is shown in Fig. 3.7.2-6.

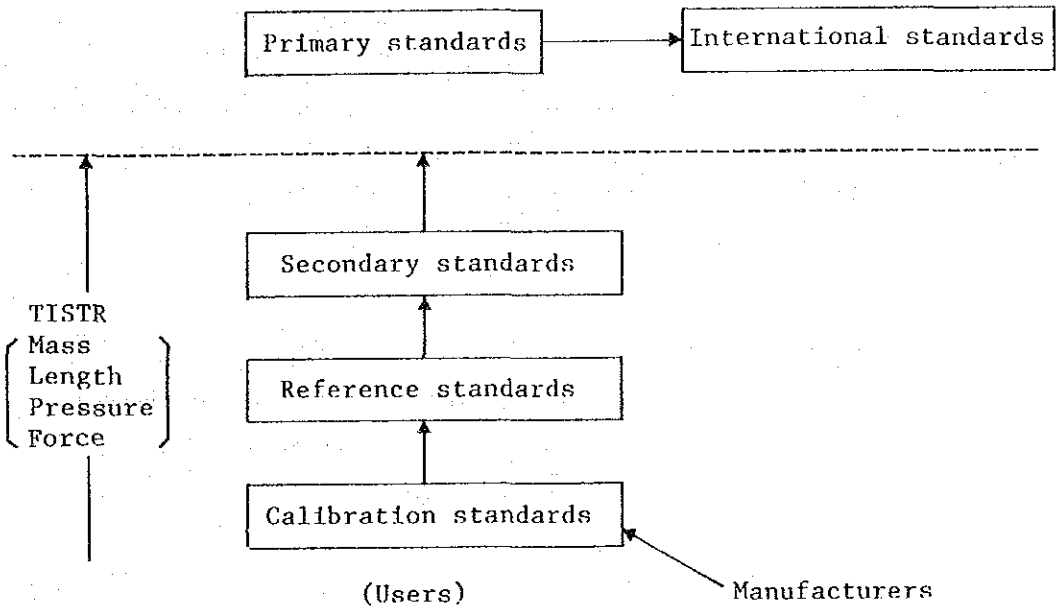


Fig. 3.7.2-6 Scope of Operations Done by Mechanical Engineering Laboratory

(b) Provision of Equipment

The standards and the equipment for calibration services mentioned above are as shown in Tables 3.7.1-8(1), (2).

Mass

A set of standard weights ranging from 10mg to 2kg (25 pcs) are available as mass standards, which are regarded as scientific research standards in Thailand. According to the calibration accuracy rated by the NSL (Australia), these standard weights are equivalent to that of the secondary class (10^{-6}). In addition, a set of copper weights are available, but are used as working standards.

Two balances, an equi-ratio balance of 1kg weighing capability and 0.5mg sensibility reciprocal and a scientific balance of 200g weighing capability and 0.1mg sensibility reciprocal, are available.

Length

Standards and related equipment for length are as shown in Table 3.7.1-8(1), including several micrometers, height gauges, vernier calipers and dial gauges.

Pressure/Force

There are 3 types of proving rings for 5t, 10t and 50t forces which are used in tensile tests and compression tests. Apart from these, some loading weights (1 - 20kg) are also available. There are deadweight piston gauges of 10 to 8,000 psi and 5 to 3,000 psi. In addition Fortin type and Aneroid type barometers are installed but are in a deteriorated conditions

Volume and Flow Rate

Neither standards nor related measuring equipment are available for both volume and flow rate.

(c) Staff in Mechanical Engineering Laboratory

The total number of the Mechanical Engineering Laboratory staff is 13, consisting of 5 university graduates and others with certificate or lower level. 10 of them are engaged in the work of testing and the rest who are all university graduates are engaged in maintenance and control of metrological standards and calibration services.

(d) Actual Calibration Work

The total number of calibration works in 1986 was 65.

Most of the companies subjected to calibration requirements belong to the electronics industry, computer/semiconductor related industries and the construction industry. 16 companies in these fields request the TSC to carry out annual calibration services for their measuring instruments and related equipment.

(5) Non-Ionizing Radiation

The TISTR is required by the NCM to maintain primary standards and is striving to improve the provision of such equipment with the national budget for the establishment of industrial standards in the 5 years from 1986.

It also actively tries to upgrade the technological level by sending people to industrialized countries including Japan for technical education/training. At present, however, equipment and facilities are inadequate in terms of both quality and quantity, and therefore, calibration service cannot be provided.

(6) Acoustics and Vibration

The TSC strongly intends to maintain secondary standards for acoustics and vibration, but the equipment is totally inadequate and the technological level is still in the primitive stage.

3.7.3 Problems of Metrological Calibrations

3.7.3.1 Standards and Calibration Equipment for Each Physical Quality

(1) Electric Quantities

Further provision of standard equipment and peripherals will be necessary to cope with the increase of the demand in the future, considering the current provision level of standards and equipment held at the TSC, development of the industrial strength of Thailand and the position of the TISTR as the body responsible for primary standards, etc. The following problems may be pointed out in relation to the existing equipment.

(a) There are few standard cells and resistors which constitute the basic units of electricity, and some of them used over a long period of time have unstable operating characteristics.

(b) There are also few secondary and lower standards.

(c) The maintenance work required for the expansion of the measuring range of equipment is inadequate and some of the equipment is not integrated to the relevant system.

(d) The maintenance conditions of standards (resistors) are not satisfactory due to the small capacity of the temperature controlled oil vessel to accommodate verification standards.

(e) There is no environmental test equipment (variable temperature-humidity tank) for measurements of characteristics of standard measuring equipment and electronic parts.

(f) Hardly any calibration equipment is available for the high

frequency range despite the projection that the demand in this field will be increased in line with the growth of the electronic equipment industry.

(g) The size of the laboratory appears to be inadequate in view of the present provision level of equipment and its usage.

(h) A sealed room required for the measurement of high frequency electric equipment is absent. In addition, a thermostatic test room where temperature control should be provided for 24 hours a day lacks this function despite this control being indispensable for highly accurate electric measurements.

(2) Thermometry

(a) Education/Training for Technical Staff

The thermometric standards at the TSC are already at a fairly high level owing to technical cooperation of the NRLM (Japan) and NML (Australia), etc. The measurements, however, have been limited to the temperature range above 0°C. If measuring equipment capable of measuring the temperature range below 0°C becomes available in the future, education/training of the staff will be needed.

(b) Condition of Equipment

The fixed-point systems specified under the IPTS-68 and thermometric measuring standards are currently provided at the TSC. The measuring equipment for the temperature range below 0°C, however, is inadequate as a low temperature setting vessel, and platinum resistance thermometers, etc. are absent.

(c) The present thermometric test room is rather small and should be enlarged.

(3) Photometry

Photometric standards at the TSC are appropriate in terms of equipment and technological level. The standard room is, however, is small and should be enlarged.

(4) Mass

The following problems can be pointed out for the mass standard measurement.

(a) Secondary standards are not traceable to the kilogramme prototype held in Thailand.

(b) Buoyancy correction equipment is not available. One of the vital items in calibration of standard weights is the correction of air buoyancy (flotation force). Since the necessary devices (precise barometers and hygrometers) are absent, proper calibrations cannot be ensured for weights.

(c) Precise equi-ratio balances with scaling capabilities exceeding 1kg are absent, making it impossible to calibrate weights heavier than 1kg.

(d) The number of standard weights is insufficient.

(e) As the reference weights of 20kg are absent, measurement of the range above this cannot be done accurately.

(f) The number of calibration balances for standard weights is insufficient.

(g) Specific gravity balances and platform balances, etc. are not available.

(h) Division/multiplication technology for the calibration of weights is absent.

(i) Measuring environment is poor due to the fact that pressure meter and length tests share the same room, causing a lot of disturbance in view of vibration and dust due to frequent use.

(5) Length

The following problems are pointed out for the length standard measurement.

(a) End measure and line measure standards are inadequate.

(b) Straight and tape measure standards are absent.

(c) Shape and dimension measuring equipment is practically nil.

(d) Comparators indispensable for the calibration work are absent.

(e) Large industrial measuring equipment and precise measuring equipment are practically nil.

(f) Angular standards and peripherals are practically absent.

(g) Test rooms dedicated to precise measurement are absent (constant temperature/humidity rooms, etc.).

(6) Pressure/Force

The following problems are pointed out for the pressure and force measurements.

(1) Hydraulic force standard machine necessary for the calibration of force gauges is absent.

(2) Deadweight piston gauges necessary for the calibration of pressure gauges are absent.

(7) Others

Equipment related to volume and flow rate is practically nil.

3.7.3.2 Manpower, Education/Training

The technological level at certain divisions of the TISTR is already adequate to respond to requirements of industrial circles.

In order to cope with the anticipated increase of calibration demands for high precision measuring instruments in the future, the recruitment of engineers with expertise in each field concerned is indispensable. Therefore, technical staff should be secured and their training be carried out, as well as budgetary measures conducted.

3.7.3.3 Future Problems and Countermeasures to Cope with

Problems in metrology and calibration services vis-a-vis their future demands are summarized in the following.

(1) Precise Measurement Automation System

It is a global trend that electronics are making significant progress in recent years in line with the rapid progress made in areas of IC and microprocessors, with particularly significant effects on the area of electric measurement.

Passive elements based on the use of electromagnetic induction and electromagnetic force used to play a central role in conventional measuring technology. Now that the electronization, digitalization, utilization of semiconductor sensors and the systemization of measurement by means of linkage with computers have become easier owing to the introduction of IC technology, the recent trend is characterized by the transition into electronic measurement accompanying multi-functional measurement technology and measured data processing technology.

Therefore, multi-functional measuring instruments capable of highly accurate measurements are often used recently in order to maintain

the accuracy of metrological calibration in the traceability system to link measuring instruments used in field with national standards. Such instruments are called "smart" or "intelligent" measuring instruments, which have been used in automatic measurement of various electric quantities, including those of DC low and high frequency ranges.

Education and training of engineers (technical staff) will become a vital requirement in order to make the full use of such multi-functional instruments.

(2) Clear Determination of Traceability System

The traceability system for TISTR's electric standards is presently linked directly to electric basic units in Japan, but the system is not necessarily functioning on a regular basis due to the high transportation cost of standard equipment, etc.

While it will be necessary for Thailand to depend on the supply of national electric standards from overseas until Thailand becomes capable of establishing the said standards by itself through the upgrading of the technological capabilities, the clear determination of traceability of the basic units and the faithful implementation of the traceability system is imperative.

(3) Improvement of Standard Equipment

Electric standard measuring instruments and systems currently possessed by the TSC have been added from time to time over many years in the past and not necessarily systemized. Such standard equipment should be systemized, and additional measuring systems should be introduced in a proper manner in order to respond to the expansion of the calibration range and other needs in future.

The number of electric standards (standard batteries and 1Ω standard resistors in particular) should be increased, and a system to maintain

the precision by means of comparisons among individual standards should be established.

Some of the existing equipment is unstable due to its long use. Secondary and third standard measuring standards that are required to meet the increasing demand for calibration services are also in short supply.

Most of the standards and measuring instruments in Thailand appear to be of foreign origin. Multiple sets of the same measuring equipment or multiple sets of different models but compatible equipment should be made available for secondary and lower standards, taking the possible failure of such equipment into account.

(4) Environment of Standard Room

Special air conditioners to maintain basic units of metrological standards, having the performance controlling the temperature at 25±1°C for 24 hours a day should be required. However, these requirement are not met at present. Since the 24 hours continuous operation necessitates a high operating cost, attention must be paid to separate the standard rooms from general calibration rooms with separate air conditioning systems, etc.

In a reference standard calibration room, mechanical vibrations often cause noise against electric measurements. It is, therefore, advisable to make the construction of the room resistant to vibration.

(5) Recognition of Need for Metrological Calibration

Using measuring equipment which has been calibrated by the "Propet standards" might be a major premise to manufacture high quality and highly reliable products. Most of the manufacturers in Thailand, however, appear to lack the proper recognition of the need for metrological calibration, and the voluntary demand for the calibration service seems somewhat weak. This is simply a reflection

of the situation where many of the manufacturers do not understand the necessity to control and calibrate their measuring equipment.

The policy to improve the quality of industrial products has been promoted in Thailand as part of export promotion measures. For the successful implementation of export promotion, however, the satisfaction of the TIS standards, foreign standards and those required by buyers must be stressed. Quality improvement has in fact become a crucial question for those Thai products with export potential. The proper maintenance of standards and the consolidation of calibration services should prove very effective for bringing about an improvement of product quality.

The importance of the calibration of measuring equipment was barely recognized even by the large Japanese affiliates visited by the Study Team.

3.8 Current Status and Problems of Quality Control

3.8.1 Outline

Improvement of Thai product quality is the primary requirement for the enhancement of the international competitiveness of Thai industry and for the promotion of exports. The TISI has already improved the certification system with the expectation of the positive implementation of quality control by the private sector. However, the recognition of product quality by general consumers is not so strong and the difference in price rather than the difference in quality is often the dominant factor in market competitiveness. Therefore, it cannot be said that private businesses are actively promoting quality control because of the absence of strong pressure for quality control.

In the case of export-oriented companies, however, the sense of quality control is considerably strong in comparison to companies producing products for the domestic market, since ensuring product quality over a certain level constitutes a precondition for exports.

Many foreign capital companies are also making considerable efforts to improve product quality. Companies with Japanese investments (including technical/engineering agreements), for example, usually have Japanese engineers sent from Japan to provide local education on special skills and technologies unique to such companies, or at each parent company in Japan, with the quality control system somewhat modified to fit to local production. Emergence of such business groups with advanced technologies in Thailand has increased opportunities for consumers to see merchandise of good quality, and the increase in consumers' incomes has also resulted in an increase of consumers' buying power. These two factors interact and the recognition of the importance or merits of quality control by private companies is expected to be strengthened markedly in the near future.

3.8.2 Quality Control Propagation Activities

(1) Propagation by TISI

The TISI is promoting the introduction of the quality control systems in the private sector through interpretation of national standards and the application of such standards to the certification system. Namely, the TISI examines whether an appropriate quality control system is established in a factory - as a requirement for the acquisition of the certification mark - so that certain products are steadily produced based on the strict conformity between the in-house standards and the applicable national standards. The TISI grants its certification mark only to products which meet the standard concerned. Even after granting the certification mark, the TISI often carries out follow-up inspections to verify the conformity. Moreover, the TISI holds its own seminars for further promotion of the introduction of the quality control system into private factories and the improvement of product quality by the use of the certification system, and provides technical guidance on production processes, facilities, equipment, etc. as well as guidance on introduction of quality control system. Targets of such guidance are small to medium size companies. The diffusion of quality control to private companies is rather difficult - particularly so for small to medium companies - due to the low degree of recognition of the merits of quality control, as mentioned earlier. The number of acquisitions of the certification mark, however, tends to increase steadily. The serious problem of the TISI is the insufficient capability to test product quality, which hinders the smooth operation of the certification system.

Of the certification criteria employed by the TISI, those items related to quality control are summarized below for reference. It is found that the TISI is placing great emphasis on the introduction of quality control system into private companies.

Certification Scheme on Use of Industrial Standard Mark (TIS Mark)

1. General (Omitted)

2. Quality Control

Those wishing to be granted the certification mark (TIS mark) must have an adequate quality control system. In such a case, introducing statistical quality control would be effective. The quality control reduces the production cost and, at the same time, improves the productivity. A test chamber with adequate facilities/equipment shall be provided in such a factory with an adequate number of staff and shall be maintained in good condition. It is necessary for each factory to have an appropriate quality control system for at least each stage of production, as shown below, in order to ensure that the quality of the final products conforms with the applicable national standard.

(Example of Canned Sardine Manufacturing Factory)

(1) Conditions of Factory (Omitted)

(2) Raw Materials

(a) Sardines: sample inspection per truck
Inspection items: freshness and size

(b) Tomato sauce: sample inspection per truck
Inspection items: concentration, flavour and colour

(c) Vegetable oil: inspection of colour for all lots purchased

(d) CMC (carboxy methyl cellulose)
Verification that the manufacturer's certificate is attached to every lot purchased.

(e) Colouring agents: Verification that the manufacturer's certificate is attached to every lot purchased.

(f) Cans: take samples from all lots purchased and check on finished condition of joints on cans.

(3) Production

(a) Canning stage: take a sample every 4 hours and check the following items:

- weight of sardines
- number of sardines per can and the number of cans with insufficient contents

(b) At the stage prior to the steaming process: the number of sardines per can and the weight of contents

(c) At the sauce filling stage: the weight of sauce

(d) At the stage after sterilization: take a sample out of the retort every 4 hours, and check on the weight of sardines.

(e) At the stage after cleaning: take a sardine can out of the retort every 4 hours and measure the net weight.

(4) Final Products

(a) Take 4 samples per can retort and check the following items for one of the cans.

- net weight
- weight of sardines after treatments
- colour, smell and flavour
- defects, if any
- PH

Use remaining 3 cans for the bacteria test.

(b) In case of using new cans, check the following items:

- tin content
- mercury content

When the TISI staff carry out the factory inspection for the grant of the certification mark, the following quality control items are reported.

Report of Factory Inspection (before approval of the certification

(1) Information on the applicant

(2) Results of inspection

(3) Opinion on the factory, products or the applicable standard

(4) Steps to be taken by the TISI prior to granting the certification mark:

Assessment on quality control

Assessment on product quality

Factory Assessment Form:

This form is for the collection of data required for the determination of the capability of the factory concerned for the steady maintenance of the product quality control system.

(1) General (Omitted)

(2) Management

(a) Organizational Structure

(Quality Control Division)

- Manager
- Are the quality section and the control section separated or combined?
- Is QC being carried out or not?
- Details of the Quality Control Division

(b) Responsible divisions or staff to test following items

- Raw materials : QC Division, Production or Procurement Division?

- Manufacture : QC Division, Production or Procurement Division?
- Final products: QC Division, Production or Procurement Division?

(c) Conditions of Factory

Observation of the cleaning/maintenance conditions of the factory.

In follow-up inspections after the grant of the certification, the following items shall be reported.

Factory Inspection Reports (after approval)

(1) Modifications within Factory

(a) Administrative structure
(b) Production structure
(c) Quality control structure

(2) Quality Control

(a) Raw materials:
- Have you implemented tests? Yes or no
- Test results Passed or failed tests
- List of items requiring modifications

(b) Processing:
- Have you implemented tests? Yes or no
- Test results Passed or failed tests
- List of items requiring modifications

(c) Final Products:
- Have you implemented tests? Yes or no
- Test results Passed or failed tests
- List of items requiring modifications

(3) Calibrations

(a) Frequency of calibrations

(b) Calibration staff

(2) Propagation by Other Organizations

In addition to the TISI, organizations listed in Table 3.8.2-1 are also engaged in education and diffusion of quality control in Thailand.

Table 3.8.2-1 Organizations for Promotion of Quality Control

Names	Form of Institution	Major activities
Thailand Management Development and Productivity Centre (MOI)	Government agency	Consultation, seminars/ training
Q.C. Association	Private	"
Thai/Japan, Technology Promotion Association	"	"
Thai Management Association	"	"
Q.C. Headquarters	"	"

These organizations hold seminars, symposia, etc. independently or under joint sponsorship. Their major activities are as follows.

(a) Thailand Management Development and Productivity Centre (TMPDC, MOI)

This organization was founded with the aid of the United Nations in January, 1962 and belongs to the Department of Industrial Promotion of the Ministry of Industry. Experts were sent from ILO to train the Centre staff for a period of 5 years after its establishment. Since 1967, such staff has been conducting training programmes for trainees.

The Centre consists of the following 4 divisions:

- Extension and Training Services
- Management Training
- Industrial Engineering
- Management Consultancy

Various activities are conducted by these divisions, of which the training activities and seminars are as follows.

There are 6 training courses - production control, accounting management, market control, human resources management, organization and method control and computer services. The duration of one course ranges from one day to two weeks. The great majority of lecturers are the staff of the Centre.

The actual data for 1986 show that there were 92 group training courses held at the Centre in which 2,478 persons participated. Training courses implemented in individual private companies amounted to 28, in which 803 people participated. 16 seminars were held, in which 973 people participated. In addition, special lecture meetings were conducted by the Centre's staff at 44 locations with 1,781 participants.

Of the training programmes planned for 1987, those related to quality control are as given below.

Name of Courses

General Management	
Q.C. Management	5 days x 3 times
Management QCC in Practice	5 days x 6 times
Industrial Engineering	
Quality Control for Supervision	5 days x 2 times
Production Planning and Control	5 days x 2 times

(b) Thai/Japan Technology Promotion Association (TPA)

This was founded with the aid of the Japanese Government and the private sector in 1973 for the purpose of technological enhancement of Thai industry. Major activities are the diffusion and guidance of technology by holding seminars. The coverage is extensive, including for example, the industrial measurement seminars held in 1977. The quality control course was initiated in 1982 and 110 seminars and 230 training courses have been held since then. Subjects of training courses carried out in the past year were as follows, indicating that training courses have been conducted from a practical viewpoint.

April - June, 1986:

1. Problems of middle management class in quality control activities
2. QC circle activities and top management
3. Basic requirements of QC circle activities
4. Factory tours on QC activities
5. Techniques for identification of problems
6. Leader's role for the promotion of QC circle activities

July - September, 1986:

1. On-the-job training for QC circle
2. Fundamental philosophy of QC circle activities
3. Effects of QC techniques for analysis of problems
4. QC circle activities for factory supervisors and foremen
5. Basic qualifications for QC circle leaders

October - December, 1986:

1. The 4th QC Circle General Meeting
2. Management and QC circle
3. QC techniques
4. Basic requirements of QC circle activities

January - March, 1987:

1. Value Engineering for QC
2. Basic requirements of QC circle activities
3. QC techniques
4. Statistical quality control

3.8.3 Problems in the Promotion of Quality Control Practices

As described in the previous clause, the importance of quality control has now been recognized in Thailand and several organizations for the promotion of quality control practices have been established, providing seminars and training. Quality control has become part of the educational curriculum for civil servants at a governmental level, particularly in the Air Force, Power Corporation and Water Corporation. In the private sector, not only foreign affiliates but also companies with national capital in the export sector are showing increasing interest in quality control and their plants in particular require manpower development in this field.

The following problems, however, can still be pointed out in the efforts promoting quality control.

(1) There is a lack of appropriate teaching materials in view of the required large variety of quality control courses.

(2) There is a shortage of capable instructors.

(3) Implementation of QC education at the shopfloor level appears difficult and, therefore, has not been adequately conducted.

(4) Because of (3) above, the provision of QC education throughout an entire company is seldom seen.

(5) The concept of QC circle activities is fairly spread among large-scale industries with 200 workers or more but not in medium and small-scale industries.

CHAPTER 4

PROGRAMME FOR DEVELOPING INDUSTRIAL STANDARDIZATION, TESTING AND METROLOGY

4. PROGRAMME FOR DEVELOPING INDUSTRIAL STANDARDIZATION, TESTING AND METROLOGY

The underlying problems and remedial measures for developing industrial standardization, testing and metrology are recapitulated in Fig. 4, at the end of this Chapter. In this Figure, a number of development programmes are proposed for remedying the problems identified through site survey, to be implemented at levels of Government, of private industry, and jointly between government and private industry levels, as well as at levels of individual enterprises and of the entire ASEAN Region.

The different programmes are described in what follows.

Legally regulated metrology is a matter involving the law, and is moreover only remotely related to the purpose of the present Development Programmes, which is contribution to enhancing the level of Thai industry and to promoting exports: It is thus considered appropriate to limit advice to be presented in the domain of legally regulated metrology to what is of relevance to the national metrological standard quantities and system.

A Programmes for Implementation at Government Level

Programmes for implementation at government level include those for:-

- Encouraging preparation of drafts for National Industrial Standards to be drawn up on private initiative
- Promoting move for drafting/amending criteria for accrediting testing institutions
- Promoting increase in the number of metrological standards; extending the metrological system
- Promoting testing and research for developing industrial standardization
- Disseminating and promoting in-house standards and quality control

- Promoting extension and reinforcement of the capability of testing institutions
- Extending and strengthening metrological standards and metrological instrument calibration service
- Promoting reinforcement of instruction and training to enhance manpower
- Promoting establishment of industrial associations for different product groups and products
- Promoting dissemination of industrial standards

The substances of the above programmes are as described below.

4.1 Encouraging Preparation of Drafts for National Industrial Standards to be Drawn up on Private Initiative

4.1.1 Background of Proposal

The underlying problems relevant to industrial standardization and to the certification system --treated in §3-- reduce upon analysis to the following.

(a) Problems underlying industrial standardization

(1) As noted in §3.3, the measures adopted in the past have not been adequate and timely for meeting the rapidly multiplying needs for various industrial standards brought by the progress of Thai industrialization ---particularly in the domains of electrical, electronic, mechanical, metalworking and chemical industries.

(2) Industrial standards covering basic principles and those prescribing procedures and methods are not adequately established.

(3) Difficulties are encountered in the acquisition of a growing portion of the data required for drafting the envisaged industrial standards, which are from year to year increasing their complexity.

(4) Delays in drafting industrial standards are caused by long waiting time spent in having requisite data checked by foreign institutions --when this is necessary.

(5) Much time is lost in manually proofreading, correcting and retyping the texts of standards before their publication.

(b) Problems underlying certification system

(1) Facilities for certification testing are not available in certain domains.

(2) Inspite of an increasing number of test samples, they cannot be processed in due time with the available equipment

(3) Few testing institutions are equipped to undertake all the items requiring to be tested in a given case.

(4) Inadequacies in the testing instrument calibration service impair traceability of the available testing equipment.

It is revealed from the above analysis that a major part of the underlying problem relates to testing, which, considered independently, could be solved through implementation of the proposals 1 and 2 presented in the next chapter. The basic obstacle to smooth extension of industrial standards, however, lies in the drafting of these standards. To expedite this work, the measures enumerated below need to be adopted.

(1) A strategic approach to the question of drafting industrial standards

(2) As practical measures for expediting the drafting of industrial standards:-

a. Enlist active participation and collaboration of eligible industrial associations and other groups already from the stage of drafting

b. Promote pertinent surveys and studies --i.e. survey, testing and research for assembling the basic data required for drafting industrial standards

c. Instruct/train relevant personnel in industrial standardization, to enhance their capability for administrating industrial standards

d. Enhance clerical processing capability through the introduction of electronic office equipment for documentation processing.

The foregoing measures are detailed in what follows.

4.1.2 Strategic Approach to Drafting Industrial Standards

There is a rapidly rising need for industrial standardization, but meeting this need calls for application of considerable human and financial resources: In consideration of the limitations imposed by actual circumstances, rationality and efficacy in establishing new standards require to be sought by according priority to standards that are the most urgently needed from considerations of overall economic development and of human, social and cultural needs.

In order to pursue such a strategic approach to the question of drafting industrial standards, the essential factor should be to organize a system that would effectively reflect in the national policy the true needs felt

by industry.

Various councils and committees have been established in this connection --including the Industrial Product Standards Council and the Technical Committee-- with the view to reflecting practical needs in national policy at various stages of formation. In actuality, however, taking the instance of the Industrial Product Standards Council, 12 out of the legally prescribed membership of 18 represent Government institutions, which cannot be considered a balanced constitution for having the needs of industry at large voiced in the Council's deliberations. The Council should profit by having its membership reconstituted with a larger representation of industrial and academic circles, in order to equitably reflect the interest of manufacturers, equipment users and product consumers.

The Industrial Product Standards Council thus reconstituted to effectively reflect the needs of industry should then proceed to determining the principles to govern a long-term programme for establishing national industrial standards, and the schemes for putting the principles into practice.

The principles to be determined should include:-

- Criteria for determining the key domains in which industrial standards should be first extended

- Domains and subjects to be accorded weight

- Target number of standards to be established within a specific period.

The criteria for key domains in which to first extend industrial standards should include the following, in consideration of the current status of industry and the aims set forth in the National Economic and Social Development Plan:

(1) Basic and commonly applicable standards, for strengthening the industrial infrastructure:

(a) Basic elements of standardization --common technical terms/symbols/testing methods

(b) Standards conducive to enhancement of material/component durability, reliability and other performance indices

(c) Standards conducive to enhanced interchangeability among products/components/materials, and other factors that contribute to rationalization of productive processes

(d) Standards conducive to smoothing the physical distribution of products from manufacturer to consumer.

(2) Standardization conducive to extending exports

(3) Standardization conducive to extention of the industrial domain in keeping with technological innovations

(4) Standardization conducive to enhancement of the quality of life:

(a) Standards conducive to enhancing the safety and durability of consumer goods

(b) Standards conducive to enhancing the health and safety of the people, and to protection of the environment

(c) Standards related to medical care, welfare, housing, transportation and other factors directly affecting the communal environment

(d) Standards conducive to economizing the consumption of natural resources and energy.

With the foregoing key targets held in view as primary criteria for the standards to be established first, the domains to be accorded priority should be:-

- Electrical/electronic industries

- Mechanical industries, (particularly manufacture of motor-car components, of agricultural machinery and components), metalworking and chemical industries.

4.1.3 Setting Up the System for Drafting Industrial Standards

The practice should be established of entrusting the drafting of national industrial standards to eligible private bodies, such as pertinent industrial associations or testing institutions. If a suitable private body does not exist, or is not deemed qualified in capability, the Government should promote enhancement of industrial standard drafting capability through reinforcement of the existing body or through establishment of a new body that should group together enterprises engaged in the relevant line of industry or in the manufacture of relevant products. In doing this, the Government should undertake relevant testing work within the public institutions, and otherwise assist the drafting work with technical information.

With particular respect to standards requiring to be urgently established without awaiting such spontaneous private initiative, and which call for preliminary survey and study that could better be undertaken by appropriate private body, Government subsidization should be provided in the form of grants to cover part or whole of costs incurred for drawing up a tentative standard by a designated drafting body.

This practical system should operate on the following principles:

(a) Standards to be subsidized for drafting should be those that are both:-

(1) Of nature to require establishment without delay, and

(2) Of such substance as to call for preliminary surveys/studies/ testing which could more suitably be undertaken outside government institutions

(b) The bodies to be entrusted with the drafting of a standard under this system should be in a position to gather and properly reflect the requirements and desires of relevant interests, and further, either:-

(1) Possess the documentation, data and information necessary for drafting the standard, even if not equipped with testing facilities, or

(2) If testing is indispensable for the drafting work, be equipped with the requisite testing facilities

(c) Before designating a body for entrusting the drafting of a standard, the body is requested submission of written information to permit judging that it meets the criteria set forth under Paragraph (b) above. The information should include:-

- Articles of association or equivalent document giving the nature of the body; latest business report containing financial statements; programme of forthcoming activities

- Plan and schedule for drafting the envisaged industrial standard

- Estimate of expenses expected to be incurred for drafting the envisaged industrial standard

- Descriptive statement backed with valid evidence to prove the capability to undertake requisite surveys and studies

- Description of organization for assembling requisite technical data

(d) The procedure for entrusting the drafting of a standard should be as follows:

(1) The scope of application and items to be covered are specified, for instance:-

1. Range of application of the standard
2. Kind of product covered by the standard
3. Performance specifications
4. Structural arrangement specifications
5. Material specifications
6. Tests to be applied
7. Inspections to be applied
8. Designations to be applied to product
9. Indications to appear on product
10. Instructions for use.

Notes: Industrial standards should desirably follow certain set patterns, and a manual setting forth the form to be followed in drafting industrial standards should be drawn up and handed to the body to be entrusted with drafting.

(2) The amount of subsidy to be granted and conditions of payment are specified.

(3) A written expression of acceptance is demanded of the entrusted body, to be submitted within a prescribed term.

(4) An interim report is demanded submission within a prescribed term, containing:-

- Estimated and actually incurred expenses
- Composition of drafting committee; attendance of members at committee meetings

(5) The draft standard thus prepared is submitted by the entrusted body within the prescribed term, together with a report containing any and all information that might serve as reference in establishing the national industrial standard, including minority views expressed during deliberations, and surveys/studies/tests conducted in connection with the drafting work.

4.2 Promoting Move for Drafting/Amending Criteria for Accrediting Testing Institutions

In order to enable smooth and prompt conduct of tests to verify conformity of products with applicable industrial standards, an important question calling for solution is to make available testing facilities and proficient testing personnel matched to the needs for such testing.

It is advised to draw up general criteria for the accreditation of testing institutions based on the guidelines issued by the International Electrotechnical Commission (IEC) and the International Standardization Organization (ISO), to be supplemented by detailed individual criteria for application to different domains of technology and to different industrial standards, in reference to which to reinforce and enhance the capability of existing testing institutions.

The general and the detailed criteria referred to above should both contain requirements governing at least the items of:

(1) Nature of testing institution

(2) Range of responsibilities to be undertaken in respect of testing service

(3) Obligation of maintaining secrecy

(4) Quantity and specifications of testing equipment available

(5) System of equipment calibration

(6) Number and qualifications of testing personnel

(7) System of testing personnel instruction and training.

Following reaccreditation, periodical inspections should be made of the institutions, and any insufficiencies revealed should be demanded correction, in order to have the institutions maintain their accredited level at all times; guidance should be given to encourage incessant enhancement of their level of capability.

Implementation of this Programme should contribute effectively to remedying such shortcomings as noted in §3.5 of :-

- Having to entrust testing to non-accredited institutions, on account of ambiguities in criteria governing accreditation and of insufficient exercise of authority

- Incapability of testing institutions to undertake all the test items required by applicable industrial standard

- Low testing efficiency, on account of inadequate testing facilities and equipment

- Excessive waiting time demanded for results to be obtained on requested tests, on account of concentration of requests on certain testing institutions.

The foregoing measures should further contribute to:-

- Enhancing the capability of the institutions for performing testing to verify conformity of products with industrial standards

- Raising the reliability on test results

- Approaching the relevant test institutions toward internationally recognized testing establishments.

4.3 Promoting Increase in the Number of Metrological Standards; Extending the Metrological System

Industrial development is premised upon increase in the number of metrological standards and on extension of the metrological system in keeping with national economic, social and technological development, and with compatibility ensured with the international metrological system.

It is advised to establish without delay a national metrological system matched to national circumstances and needs, and to foresee progress of industrialization, with the extension of coverage by primary national metrological standards, through the creation of new primary standards as necessary and with the institutions responsible for their management and maintenance clearly designated.

In implementing this programme, coordination of the metrological system at State should desirably be promoted. Moreover, all relevant institutions should possess a clear understanding of their mutual relations and functions, in order to realize traceability to a single national primary standard by all metrological standards, both industrial and commercial.

Implementation of this Programme should contribute effectively to remedying such shortcomings as noted in §3.6 and §3.7 of:-

- Insufficient availability of metrological standards
- Incompletely established national metrological standards
- Ambiguities in the responsibilities of different institutions for managing and maintaining the metrological standards

The foregoing measures should further contribute to:-

- Eliminating overlapping research efforts directed by different institutions in the domain of metrology
- Concentrating investments in key facilities, for higher economic efficiency
- Making the best use of available specialized personnel.

4.4 Promoting Testing and Research for Developing Industrial Standardization

The drafting of industrial standards --particularly authoritative standards of international or national standing-- calls for extensive testing and research to be conducted to determine such factors as the general level of product quality, conditions of their use, and technical substance of the provisions to be specified in the standards.

It is advised to take measures for promoting such testing and research through the means of:-

(a) Entrusting specific testing and research work to institutions accredited by TISI or to universities, with whole or part of the incurred expenses borne by TISI in the form of grant for study.

(b) Subsidizing relevant studies already being undertaken by eligible private research institutes (through grants for study or other measures).

Implementation of this Programme should contribute effectively to remedying such shortcomings as noted in §3.3 and §3.5 of:-

- Lag behind the needs of industry seen in the current status of development of industrial standards

- Inadequacies in the testing and research facilities required for such development.

Implementing this Programme, in view of the fact that the grants and subsidies will require to be of substantial amount in order to ensure effective work, they should be limited in number to cover solely subjects of top priority in reference to the national economy and to public health and safety.

The foregoing measures should further contribute to:-

- Awakening the testing institutions and private research institutes to the importance of industrial standards

- Improvement and wider application of the industrial standards.

4.5 Disseminating and Promoting In-House Standards and Quality Control

4.5.1 Background of Proposal

The problems underlying the dissemination in private industry of in-house standards and of quality control practice reduce upon analysis to the following:

(1) Problems relevant to government policy

(a) Inadequacies in technical guidance and instruction/training provided to factories and operating establishments on quality control in its relation to the certification system covered by the Industrial Product Standards Act

(b) Insufficient Government support for promoting the sale of commodities carrying the TIS Mark by inducing consumers to accord preference to such commodities, which should contribute vastly to disseminating quality control practice in private industry

(c) Inadequate measures for surveying and studying means of establishing quality control procedures and practices matched to national circumstances and needs.

(2) Problems underlying the implementation of instruction and training

As noted in §3.8, there is shortage of:

(a) Appropriate teaching materials for use in seminars and training courses

(b) Capable instructors for same

(3) Problems within enterprises

As noted similarly in §3.8,

(a) Interest in quality control cannot be considered high among enterprises, with the exception of those of foreign affiliation, those producing commodities for export, and those of large business scale

(b) Enterprise top management is generally not fully aware of the importance of quality control, and few enterprises have adopted a company-wide quality control system

(c) Quality-mindedness has not penetrated the front-line worker layers.

4.5.2 Remedial Measures

For remedying the foregoing difficulties, it is advised to adopt the measures set forth below.

In respect of the instruction/training of seminar and training course instructors, refer to §4.8

(1) Development of teaching materials on quality control

Training courses should be organized separately for top management, middle-management personnel, front-line superintendents, and workers, with curricula arranged separately to match the different levels of trainees. Even for a given level of trainee, the subjects of interest may differ according to the trainees' background, and the teaching materials to be made available should be matched to the individual needs of different trainee groups.

In compiling the teaching materials, similar and related materials used in foreign countries should be assembled, and their substance studied and adapted to national circumstances and needs. It is advised to set up a committee for teaching material compilation, with membership including experts competent in quality control instruction and eventual users of the materials.

The teaching materials needing to be prepared before all others are those intended for "quality control leaders" to become the leading spirits in promoting quality control within their enterprises and for "quality control staff" to engage in practical quality control promotion under the direction of quality control leader.

(2) Enterprise-wide promotion of quality control

As remedy for the problems noted under 3 headings in §4.5.1-(3), it should be extremely effective to encourage enterprise-wide promotion of quality control practice. Such enterprise-wide quality control promotion calls for participation of all and every member of the enterprise personnel, from president down to the last worker, in their respective ranks.

What is essential for ensuring success in this connection is for top management to clearly set forth before the entire enterprise personnel, the basic approach adopted by the enterprise in respect of quality control. Small-group activity for promoting quality control can be made effective only upon its being encouraged in association with enterprise-wide move for quality control promotion. To this end, instruction and training should be administered with courses organized separately for top management, middle management, shop-floor superintendents and workers, to impart the knowledge, techniques and skills benefitting their respective roles and functions in promoting quality control.

In addition to instruction through training courses, the motivation of front-line workers toward participation by each and all in the

practice of quality control is an essential key to success, and an effective incentive for awakening interest in quality control is to establish within the enterprise a system of public recognition made through awards of merit granted to employees for suggestions put forward through quality control groups that result in effectively contributing to improvement of product quality or to rationalization of production processes.

(3) Dissemination of quality control practice among small enterprises

Small enterprises in the manufacturing industry are extremely numerous, and generally have little to spare in capital and manpower for enhancing their level of quality control. Being certified for TIS Mark licence, however, will require the enterprise to dispose of a certain level of production and testing equipment, as well as to present a sound corporate organization.

For effectively disseminating quality control practice among small enterprises, it is advised to select a limited number of enterprises calling for improvement of product quality, on the criterion of contribution towards exports or towards enhancement of the health and safety of the people, for administration of instruction and training to their personnel with the view to raising their level of quality control. Also, financial assistance should advisably be provide for their acquisition of necessary production and testing equipment. It should also be effective to repeatedly provide guidance in managerial and technical matters.

(4) Talks on successful cases of quality control practice

A very effective measure for disseminating quality control practice among private enterprises is the organization under public sponsorship of talks given by people from other enterprises that have successfully gained marked benefits from their introduction of quality control practice. Such talks could with highest effect be given on the occasion of meetings aimed at disseminating industrial

standardization and quality control, where personnel directly charged with quality control promotion would gather.

Such successful cases of quality control dissemination could also be taken up as subjects for case study in seminars and training courses, or else be treated in articles published in technical journals.

The talks, case studies or journal articles should be of concrete substance, such as to be of interest and of practical values to enterprises contemplating the introduction of quality control practice.

The Government should encourage such activities by incorporating such talks in meetings and events aimed at promoting industrial standardization, and inviting relevant enterprises to give and to hear the talks.

4.6 Promoting Extension and Reinforcement of the Capability of Testing Institutions

Testing and analysis for evaluating the product quality and for assembling technical data are essential elements for seeking product quality improvement, as well as for research and development. Extending and reinforcing the capability of testing institutions is thus an indispensable requirement.

It is advised as measure for extending and reinforcing the capability of testing and research institutions.

(a) To have existing institutions periodically and systematically recruit testing personnel in specified domains of specialization, to match expected demands for testing: to provide them with instruction and training in accordance with an established programme that should include courses of instruction abroad and instruction by foreign experts.

(b) To have existing institutions regularly renew the testing equipment and to systematically acquire new equipment, to meet the progressing demands of developing technology and the enhancing requirements of industrial standards continuously raised in level, to regularly and correctly recalibrate the installed testing equipment, to improve the reliability of test results.

(c) To set up an establishment to serve as national centre for industrial standard testing.

(d) To set up an establishment to serve as national centre for industrial testing and research, and for metrological standards and calibration service.

Implementation of this Programme should contribute effectively to remedying such shortcomings as noted in §3.5 of:-

- Excessive workload burdening the testing institutions
- Insufficient and outdated testing facilities and equipment
- Available equipment not matching the demands for testing
- Inadequate accuracies ensurable with available equipment
- Insufficient availability of documentation on international and foreign standards
- Ditto of technical documentation
- Inadequate maintenance and calibration of metrological standards and equipment.
- Shortage of proficient testing and research personnel

The measures set forth under the headings (a) and (b) above --relating to existing institutions-- would have to be implemented without affecting the continuing work being carried on by the institutions, and for this reason, the current problem of excessively long waiting time for results to be obtained from requested certification tests --with further increase of demand for such tests expected in the coming years-- could not possibly be solved through such measures.

This is why it is advised to complement these measures by newly setting up a national centre for industrial standardization testing, proposed under the heading (c) above.

The centre for industrial testing and metrological calibration --proposed under the heading (d)-- is of equal importance and urgency, for enhancing the nation level of technological capability.

The above measures (c) and (d) would further present the merit of having expensive specialized equipment --that will not be very frequently used-- concentrated in two national centres, to enhance their rate of utilization. The centralization of certification tests that would be realized upon implementation of the measure (c) should moreover contribute to minimizing disparities in test results arising from differences in testing accuracy between institutions, and enhancing reproducibility of the results, as well as improving administrative control over the progress of test operations.

The function of instruction and training added to the above two centres should further permit ensuring the supply of urgently demanded testing and calibration personnel in numbers that could be regulated to match the foreseen demands.

4.7 Extending and Strengthening Metrological Standards and Metrological Instrument Calibration Service

It is advised to proceed with the establishment of metrological standards and with extending/strengthening the service for calibrating the standards and measuring instruments, in view of their indispensability for enhancement of industrial product quality and for the development of industry, since these factors constitute the basis of industrial technology.

To this end, it is further advised to establish national metrological standards for each quantity, with the national primary standard occupying the apex of the traceable pyramid, and with secondary, working and other

standards of respectively adequate accuracy ensured through modern calibrating equipment of adequate accuracy. Such equipment should advisably be stored, maintained and operated in properly conditioned environment of constant temperature, humidity and other conditions.

Implementation of this Programme should contribute effectively to remedying such shortcomings as noted in §3.6 and §3.7 of:-

- Inadequacies in the established national metrological system
- Insufficiencies in the numbers and accuracies of the various metrological standards and equipment covering different quantities and grades of accuracy.

The foregoing measures should further contribute to:-

- Answering with additional equipment the increasing demand for calibration service
- Providing the techniques and facilities to serve as basis for extending --in both technical capability and equipment --the coverage of national metrological standards

4.8 Promoting Reinforcement of Instruction and Training to Enhance Manpower

(a) In-house standardization and quality control

As noted under §3.8, promoting the dissemination of in-house standardization and quality control calls for the availability of instructors in this practice, who --themselves-- must be trained for the work. In consideration of the underlying problems noted in §4.5.1, what needs to be given priority consideration in this connection is training to generate instructors who, in turn, are to engage in training enterprise personnel to become "in-house standardization leaders" and "quality control leaders" --to become the

leading spirits in promoting in-house standardization and quality control, respectively, within their enterprises-- and "quality control staff" to be charged with front-line quality control practice. These leaders and staff would, in their turn, spearhead in-house dissemination activities.

Training of the instructors should follow a curriculum that should include the subjects set forth below:

(1) Instructors for those to become in-house standardization leaders:-

- General notions of in-house standardization
- Procedure for advancing in-house standardization
- Compiling and arranging in-house standards
- Practical application of in-house standards
- Compatibility of in-house standards with national and international industrial standards,

With a view to enabling the instructors to impart to their trainees the capability of leading enterprise-wide activities for the promotion of in-house standardization.

(2) Instructors for those to become quality control leaders:-

- Introduction, promotion, development and stabilization of enterprise-wide quality control practice
- Organization, implementation, instruction in quality control practice
- Improving enterprise-wide quality control practice
- Quality assurance and reliability.

With a view to enabling the instructors to impart to their trainees the capability of leading enterprise-wide activities for the promotion of quality control.

(3) Instructors for those to become quality control staff:-

- Notions of statistics
- The seven standard tools for quality control
- Organizing and promoting small-group activities for furthering quality control
- Improving quality control practice.

The training for instructorship should advisably be provided by domestic experts, and if necessary by requesting assignment of foreign experts experienced in the matter and/or by assigning personnel to undergo training abroad.

(b) Testing, metrology

As mentioned in Chapter 2, the total number of 1,428 graduating in the technical subjects from universities in 1980 represents a technical manpower quite inadequate for satisfying the present and future demands of industry. The numbers of graduates from vocational and professional schools also are said to be insufficient in the fields of electrical, mechanical and chemical engineering. The low percentage of the work force engaged in manufacturing, as compared with agriculture, and the extremely small portion of specialists and technical staff joining the manufacturing industries also were pointed out in Chapter 2 as weaknesses that could well constitute an obstructive factor for future industrial development.

Adequate schemes are indispensable for overcoming the above impediment, and the extension of school education --particularly in the technical domains-- is a matter calling for urgent attention.

In view of the fact, however, that school education in testing and metrology will call for considerable lead time, and that graduates with school education are not provided with the practical knowledge and skills to immediately engage in productive work, it is advisable to reinforce the technical instruction and training functions of

existing institutions such as TISI and TISTR, to provide for their accepting trainees from private enterprises.

To this end, training courses of set form should advisably be repeatedly organized, with curricula devised separately for trainees with different objectives and of different levels.

Examples of the subjects to be included in such curricula are set forth below for the various courses.

(a) Testing techniques course:-

- Elementary notions of testing
- Principles of testing/measuring equipment, their manipulation
- Interpretation of standards
- Practical exercises in testing
- Analyzing test results
- Compiling test reports: points to be heeded.

(b) Metrological techniques course:-

- Elementary notions of measurement and of the management of metrological standards
- Principles of measuring instruments; measuring techniques
- Technical aspects of establishing metrological standards; their maintenance and supply.

Implementation of this Programme should contribute effectively to remedying such shortcomings as noted in §3.5 of:-

- Insufficiencies in the number and proficiency of testing and metrological personnel
- Mismatching of the fields of specialization between available and demanded personnel

4.9 Promoting Establishment of Industrial Associations for Different Product Groups and Products

Certain of the remedial measures proposed to be adopted by Government to solve the problems underlying industrial standardization, certification and metrology --as set forth in the preceding Chapter-- should benefit markedly by entrusting relevant work or by otherwise enlisting the participation of industrial associations for different product groups and products.

The measures of such nature reduce upon analysis, to activities such as:

(a) Tentative drafting of new industrial standards (cf §4.1.3)

(b) Dissemination of industrial standards and of information on key matters concerning certification and metrological systems, with the collaboration of associations that are conversant with the aims and substances of the relevant standards

(c) Certification testing, with the establishment of joint private testing laboratories, to supplement the current shortage of testing capability (cf. §3.5)

(d) Promotion of TIS Mark commodities with the collaboration of associations grouping the enterprises manufacturing the commodities.

Such important measures to be implemented by Government can in many instances be effectively implemented through or with the collaboration of industrial associations encouraged establishment in relevant industrial circles. The effect of combining the efforts of interested enterprises, and the spirit of solidarity fostered through the establishment of such associations should positively serve in furthering such actions as the drafting of tentative national industrial standards --as referred to in §4.1-- and the establishment of joint testing institutions --as referred to in §4.14. The associations should be in a position to grasp underlying

problems besetting the member enterprises, and to channel communication between the member enterprises: The efforts and forces of the enterprises could thus be effectively mobilized toward solution of common problems, to contribute toward more rapid, more extensive development of the relevant branch of industry.

There already exist many industrial associations in Thailand, and which are respectively pursuing their activities, but for further promoting industrial development, encouragement should be given to the additional establishment of associations systematically grouping together all enterprises for promoting certain functions and to the federation of existing associations so as to combine their forces for realizing specific projects.

In this connection, the development and systematization of industry will bring about closer vertical ties between assemblers and suppliers, and horizontal ties between supplier groups. This tendency should not fail to deeply influence industrial development. Sound development of this trend should be encouraged by Government where appropriate, and be guided in correct direction through restrictive measures where necessary.

4.10 Promoting Dissemination of Industrial Standards

4.10.1 Background of Proposal

As noted in §3.3, in view of the importance of disseminating industrial standardization, TISI has its Standardization Promotion Division actively engaged in various promotive activities. Other measures to supplement these activities would include:

(a) Stronger support for promoting TIS Mark commodity sales

(b) Establishment of an award for according public recognition to enterprises and individuals that have actively and successfully introduced and practiced standardization with marked results.

4.10.2 Promotive Measures

(a) Establishment of a permanent showroom for TIS Mark commodities

A Buyer's Guide is compiled and issued every year by TISI. This practice might be advanced a step further in the form of a permanent showroom for TIS Mark commodities, located conveniently for visiting consumers and users, not only domestic but also from abroad.

(b) Industrial standardization awards

Among other measures that might be adopted as incentive for promoting industrial standardization, a system that should not fail to have marked effect is that of according public recognition through the granting of commendatory awards, to be conferred by the Minister, or by the Secretary General of TISI --in accordance with the degree of merit-- to enterprises and individuals noted for meritorious service to individual enterprises (which should already be licenced for TIS Mark), to industry, to the nation and/or to the society at large, in the matter of industrial standardization.

The honour conferred by the award might further be supplemented by priority or other privileges given for exhibiting at the TIS Mark showroom.

B Programmes for Implementation at Private Industry Level

The programmes for implementation at private industry level can in many cases be expected more effective realization through cooperative action promoted by an industrial association grouping together enterprises following similar lines of activity or manufacturing similar products. Such associations could well come to bring about measures that would be difficult to realize by individual enterprises acting alone.

In whatever form such private industry programmes are realized, Government encouragement and guidance or moral support will not fail to provide beneficial impetus to their realization, and to producing fuller effect.

The programmes that would aptly come under this heading include those already cited under the foregoing sections of:-

- Promoting establishment of associations for developing testing
- Promoting establishment of associations for developing metrology
- Promoting establishment of industrial associations for different product groups and products
- Promoting establishment of joint private testing laboratories

4.11 Promoting Establishment of Associations for Developing Testing

In the endeavour for enhancing product quality, testing and the evaluation of test results constitute essential factors not only in the development of products and processes but also as tools for production and quality control. For this reason, it is advised to establish an association grouping together specialized private testing laboratories and enterprises, with a view to developing industrial testing.

The activities of such an association should include:

(a) Assembly and exchange of technical information, including foreign standards and codes

(b) Surveys conducive to improvement of testing techniques

(c) Development of in-house testing techniques; compilation of testing manuals

(d) Assistance in drawing up in-house standards.

National and public testing institutions would be expected to participate in the activities of the association, with guidance and advice provided either as sponsoring member or as interested outsider.

The cost of establishing and running the association should in principle be covered by membership fees, but until the association is firmly set on foot with the number of members grown to a sizable level, part of the expenses might have to be subsidized by government.

Implementation of this Programme should contribute effectively to remedying such shortcomings as noted in §3.5 of;-

- Shortage of proficient testing personnel
- Shortage of testing facilities at the disposal of enterprises
- Insufficient knowledge in industry of domestic, foreign and international industrial standards
- Insufficiently available relevant technical information
- Lack of testing and inspection manuals in enterprises.

The foregoing measures should further contribute, with the spread of quality control practice, to:-

- Development of in-house standards
- Enhancement and stabilization of product quality.

4.12 Promoting Establishment of Associations for Developing Metrology

It is essential to further the enlightenment of industrial enterprises on the vital part played by measuring techniques and proper management of measuring instruments in assuring product quality, and in thus enhancing technological capability.

For this reason, it is advised to establish an association grouping together manufacturers of measuring instruments, institutions providing metrological calibration service and pertinent enterprises, with a view to:

(a) Assembly and exchange of foreign documentation and technical information concerning metrological standards and calibration

(b) Surveys and studies for improving the techniques used in calibrating metrological and measuring instruments and in determining instrument accuracy

(c) Development of techniques used in metrology and industrial measurements and in the calibration of instruments

(d) Assistance in the compilation of manuals on industrial measurements and instrument calibration

(e) Dissemination of metrology-mindedness.

National and public testing institutions would be expected to participate in the activities of the association, with guidance and advice provided either as sponsoring member or as interested outsider.

The cost of establishing and running the association should in principle be covered by membership fees, but until the association is firmly set on foot with the number of members grown to a sizable level, part of the expenses might have to be subsidized by government.

Implementation of this Programme should contribute effectively to remedying such shortcomings as noted in §3.6 and §3.7 of:-

- Shortage of proficient metrological and measuring personnel
- Insufficient interest and knowledge in industry concerning metrology and measurement
- Insufficiently available relevant technical documentation

- Lack of manuals on industrial measurements and instrument calibration.

The foregoing measures should further contribute --with the spread of metrology-mindedness in industry-- to:-

- Enhancing the reliability of measured results
- Raising the dimensional accuracy of production equipment performance, jigs and tools,
- Consequent improvement and stability of product quality

4.13 Promoting Establishment of Industrial Associations for Different Product Groups and Products

Reference to this Programme has already been made under §4.9 for the Programme to be implemented at Government level. The guidance and support of Government and other public institutions will of course be indispensable for their establishment, but once established, the associations should promptly proceed to organizing themselves for undertaking on their own initiative various activities beneficial to the member enterprises. The activities should centre around such pursuits as exchanges of information, obtaining the consensus of the industrial circles on promotional schemes, arrangements for joint testing, selection of subjects for joint research and development, assembly and processing of statistical data, as well as arrangement for joint procurement and marketing. Another important activity of the association should be participation in drawing up tentative drafts of national industrial standards.

In the case of industrial associations grouping together enterprises engaged in assembly and such processing operations, they should also strive for industry-wide establishment of the quality assurance system.

4.14 Promoting Establishment of Joint Private Testing Laboratories

In order to improve industrial product quality and promote their exportation, the relevant enterprises need to undertake research and development, as well as testing to determine conformity with industrial standards, and this calls for enhancement of their testing capability. For this reason, it is advised to promote the establishment of joint private testing laboratories by manufacturers and exporters, with the participation of private testing and inspection institutions, with a view to undertaking such activities as:

(1) Requested testing

(2) Instruction and training in testing techniques

(3) Unifying the interpretation of industrial standards; compiling unified testing manuals

(4) Making available to enterprises the use of testing facilities and equipment.

In implementing this Programme, the cost of establishing and running the joint laboratories should, in principle, be covered by contributions from member enterprises, but the considerable sums involved should call for government support and guidance in funding. The same applies to operating and equipment renewal expenses, which should in principle be covered by membership fees and charges for requested tests and for use of laboratory facilities, but until the laboratories are firmly set on foot with the number of members grown to a sizable level, part of the expenses might have to be subsidized by government.

C Programmes for Implementation at Joint Government-Private Industry Level

4.15 Joint Private Administration of Programmes

All the programmes enumerated in the preceding sections for implementation respectively at levels of Government and of private industry call for co-ordination and collaboration of the other level, at whichever level the programmes may have been initiated. Such co-operation between Government and private levels is particularly necessary for such activities as the preparation of tentative drafts for national industrial standards, the effective utilization of testing facilities in public institutions, and the dissemination of production management (quality/process/cost control,...) practices and of industrial standardization. Moreover, the activities referred to under §4.4, 4.5, 4.6, 4.7, 4.8, and 4.10 for implementation at Government level should in future be administered under joint Government-private management, to uphold the principle of burden shouldered by beneficiary, and thereby ensure continuing activation through the years.

D Programmes for Implementation at Individual Enterprise Level

Programmes that might be promoted under this heading include:-

- Promoting Establishment of co-operative associations and similar bodies
- Promoting enhancement of technological and management capability.

Details are set forth in what follows.

4.16 Promoting Establishment of Co-operative Associations and Similar Bodies

Private enterprises engaged in similar lines of industry should seek to pool their resources through the establishment of co-operative associations, for rationalizing management and enhancing productivity. Such pooling of means should alleviate problems of financing and staffing --which could be particularly acute in the case of the smaller-scale enterprises.

The Government should assist and encourage such moves for establishing co-operative associations through fiscal and financial privileges, and through opportune guidance.

The activities to be undertaken by the associations should include:

(1) Co-ordination of interests among member enterprises: assembly and dissemination of technical information

(2) Co-operative buying; mutual interchange of raw materials

(3) Mutual use of testing facilities/equipment; establishment of joint testing laboratory

(4) Joint undertaking of market research and development, and of publicity

(5) Joint planning and implementation of personnel instruction and training programmes

(6) Facilitating and guaranteeing loans.

4.17 Promoting Enhancement of Technological and Management Capability

All the foregoing measures set forth as programmes for implementation at levels of Government or of industrial associations will bear fruit only upon the individual enterprises constituting the Thai industry coming to interest themselves in actively taking part in the programme activities and regularly practicing the measures that are recommended.

The measures requiring to be put into practice by the individual enterprises, in order to let the foregoing programmes produce maximum effect, include:

(1) Having enterprise personnel participate actively in seminars and training courses on business and administrative management

(2) Setting up standard procedures, manuals and other in-house working standards, as well as adopting enterprise-wide quality control practice and other measures, with the view to establishing a system for enhancing product quality and for stably manufacturing products of uniform high quality

E Programmes for Implementation at ASEAN Regional Level

4.18 Promoting Regional Co-operation

The ASEAN nations are directing their efforts towards achieving the purpose of their Association through promotion of region-wide economic exchanges. For the economic development of member countries, significant importance is presented by technological exchanges, which cannot proceed without proper establishment of basic prerequisites including industrial standardization, quality control practice, adequate testing facilities, a reliable metrological system, and accurate calibration service.

With progress of trade between the member nations, there will be a widening variety and an increasing quantity of goods exchanged between Thailand and the other member nations, and this will without doubt raise mounting among these nations of necessity of adopting common industrial standards and of unifying the means of providing quality assurance.

It is to be hoped that development of industrial standardization, testing and metrology in Thailand through implementation of the proposed projects will lead eventually to widening exchange of persons between member countries, as well as other measures of technical cooperation conducive to the spread of industrial standardization, testing and metrology in the ASEAN Region.

		CURRENT STATUS	COUNTERMEASURES	★
INDUSTRIAL STANDARDIZATION	1	Increasing need for industrial standards	Promote participation of private sector in drafting industrial standards	G + P
			Strengthen testing capability to enable drafting industrial standards	
	2	Insufficient diffusion of industrial standards	Implement activities for dissemination	G+P +E
			Encourage sales of TIS Mark products	G+ P
CERTIFICATION SYSTEM	3	Inadequate, outdated certification test facilities available at TISI and accredited institutions	Extend test facilities at relevant institutions	G
	4	Inadequate outdated test facilities at private enterprises	Extend test facilities at relevant enterprises	G + P
QUALITY CONTROL SYSTEM	5	Inadequate system of production control in private enterprises	Promote dissemination of in-house standards and quality control in private enterprises	G + P + E
	6	Shortcomings in education system	Introduce instruction in production/quality control at school level; train qualified instructors	G + E
TESTING/INSPECTION SERVICE	7	Insufficient, inadequate, outdated facilities for testing industrial and export products	Extend/renovate relevant facilities	G
	8	Equipment for testing industrial and export products remaining uncalibrated	Develop and implement adequate calibration system	G + P
	9	Insufficient number and inadequate proficiency of staff charged with testing	Establish qualification system	G
	10	Inadequate testing techniques	Establish instruction/ training system/establishments	G + P + A
			Extend chances for personnel to be attend instruction courses at home and abroad	
			Draw up manuals prescribing test/inspection procedures	
			Set up a Testing Institution Committee	
	11	Clear definition of criteria for accrediting testing institutions	Establish criteria governing accreditation; strengthen authority over administration of testing requested to accredited institutions	G
METROLOGY/CALIBRATION SERVICE	12	Insufficient number of metrological standards	Increase the number of metrological standards	G
	13	Inadequately organized system of metrological standards	Promote proper establishment of adequate metrological standards	G + P
			Promote establishment of traceable metrological system	
			Strengthen and extend functions of National Committee on Metrology	
	14	Insufficient popular awareness of the importance of metrology and calibration	Implement activities for dissemination	G + P
			Organize seminars and instruction courses	
			Establish organizations for promoting metrology-mindedness	
	15	Inadequate maintenance and calibration capability of institutions entrusted with metrological standards	Extend and modernize calibration equipment for metrological standards of different precision grades	G
	16	Power environmental conditions of laboratories entrusted with metrological standards and calibration	Increase laboratory space	G
			Enhance control accuracy of constant-temperature, constant-humidity chambers	
	17	Insufficient number and inadequate proficiency of staff charged with accurate measurements	Establish instruction/ training system/institutions	G + P + A
			Extend chances for personnel to be attend institution courses at home and abroad	
			Draw up manuals prescribing measurement procedures	

★		DEVELOPMENT PROGRAMMES
G	1	Encouraging preparation of drafts for National Industrial Standards to be drawn up on private initiative
	2	Promoting move for drafting/amending criteria for accrediting testing institutions
	3	Promoting increase in the number of metrological standards; extending the metrological system
	4	Promoting testing and research for developing industrial standardization
	5	Disseminating and promoting in-house standards and quality control
	6	Promoting extension and reinforcement of the capability of testing institutions
	7	Extending and strengthening metrological standards and metrological instrument calibration service
	8	Promoting reinforcement of instruction and training to enhance manpower
	9	Promoting establishment of industrial associations for different product groups and products
	10	Promoting dissemination of industrial standards
P	11	Promoting establishment of associations for developing testing
	12	Promoting establishment of associations for developing metrology
	13	Promoting establishment of industrial associations for different product groups and products
	14	Promoting establishment of joint private testing laboratories
G + P	15	Long-term target: Administering the activities 4, 5, 6, 7, 8, 10 above under joint government-private management
E	16	Promoting establishment of co-operative associations and similar bodies
	17	Promoting enhancement of technological and management capabilities
A	18	Promoting regional co-operation

DEVELOPMENT PROJECTS	
1	Establishment of development centres for industrial standardization, testing and metrology : - Industrial Standardization Testing and Training Centre - Industrial Metrology Testing Service Centre
2	Establishment of joint private testing laboratories

* Meanings of symbols

G: Government level

P: Private industry level

E: Individual enterprise level

A: ASEAN regional level

Fig. 4 SUMMARIZED PRESENTATION OF MEASURES FOR DEVELOPING INDUSTRIAL STANDARDIZATION, TESTING AND METROLOGY IN THE KINGDOM OF THAILAND

CHAPTER 5

OUTLINE OF THE PLANS FOR IMPLEMENTING INDIVIDUAL PROJECTS

5. OUTLINE OF THE PLANS FOR IMPLEMENTATING INDIVIDUAL PROJECTS

The preceding Chapter 4 set forth advisable programmes proposed for developing industrial standardization, testing and metrology at levels of government, private industry etc. It is strongly advised to let all and every relevant institution actively undertake the measures set forth in the different Programmes, and in this connection it should be effective to plan and implement the measures in the form of organized projects systematically coordinating and bringing out to best effects the individual efforts directing the manpower, financial and material resources towards developing the envisaged system of industrial standardization, testing and metrology effectively throughout the nation.

In consideration of the underlying problems set forth in Chapter 3 and the remedial measures proposed in Chapter 4 with indication of their relative urgency and consequential benefits, and with account further taken of the current circumstances in respect of administrative organization, technical level and available facilities and equipment, the 2 projects set forth below are advised for adoption and implementation:

(1) Establishment of development centres for industrial standardization, testing and metrology

(2) Establishment of joint private testing laboratories

The relations holding between the two projects, and the consequential benefits to be expected from their implementation are presented diagrammatically in Fig. 5.0-1.

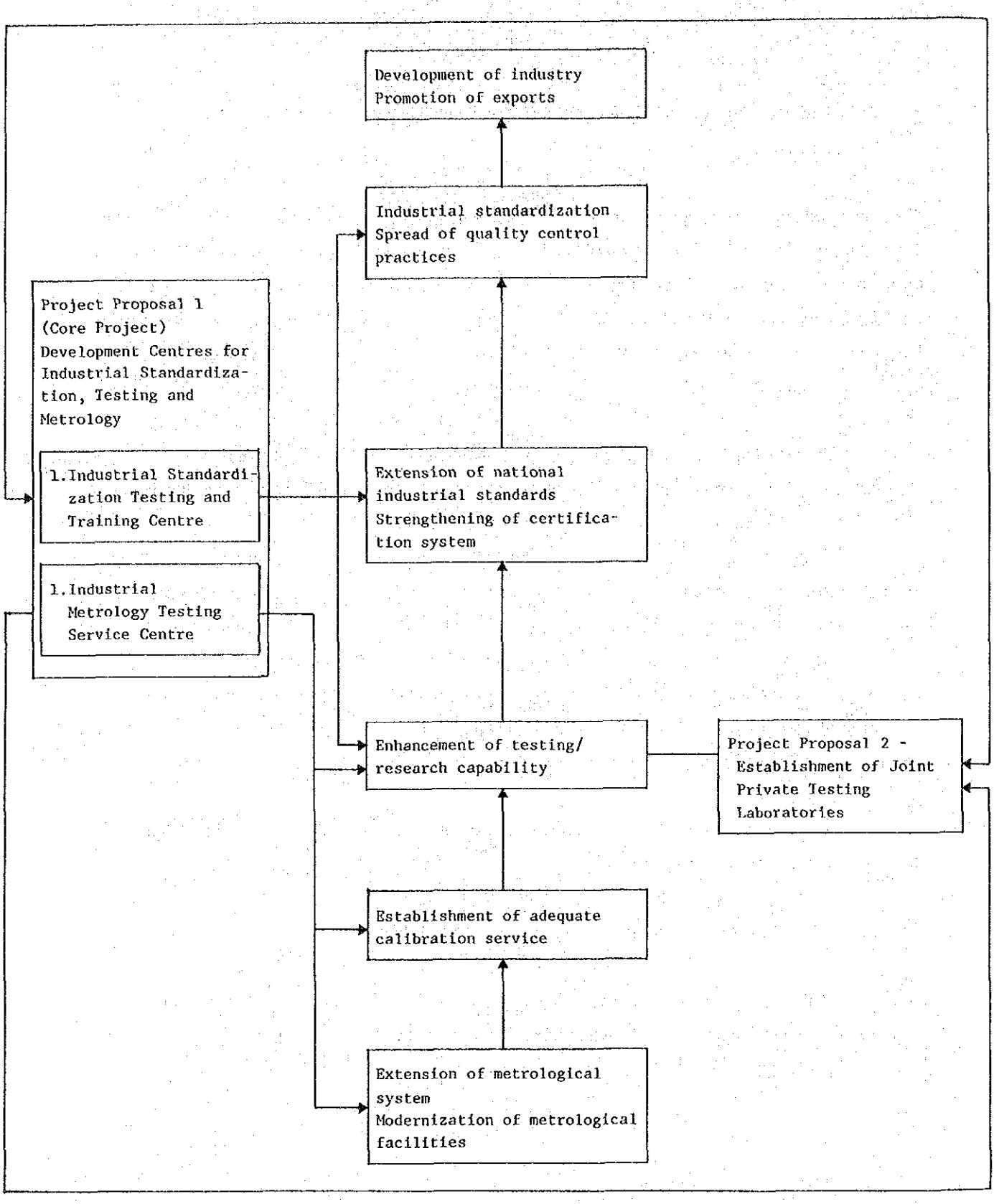


Fig. 5.0-1 Role of the Two Proposed Projects in the Overall Scheme for Promoting Industrial Standardization, Testing and Metrology

5.1 Project Proposal 1 - Development Centres for Industrial Standardization, Testing and Metrology

5.1.1 Background of proposal

In Chapter 3, there were presented the results of site survey and analysis on the current status and underlying problems relevant to the system of industrial standardization, testing and metrology in Thailand, and 18 programmes were proposed for developing the system in question. Some of these programmes can promise results through active independent implementation, while certain others are of a nature that will require mutual coordination for enhancement by reciprocal effect.

Advisable measures for solving the problems referred to above relevant to industrial standardization, testing and metrology, with the aim of industrial development and export promotion, and with due account taken of the current status of industry as presented in Chapter 2, prove to be the following, selected on the criteria of urgency, consequential benefits and the actuality of current technical capability and equipment.

(1) Enhance capability for drafting industrial standards

(2) Enhance capability for certification testing

(3) Extend testing facilities and equipment necessary for drafting industrial standards, for certification testing, and for providing pertinent guidance to private industry in improving product quality

(4) Reinforce guidance provided to private industry by public institutions for improving product quality

(5) Extend coverage of metrological standards and of measuring instrument calibration service

(6) Enhance level of metrological standards and capability of metrological calibration

The most practical and effective measure for approaching the targets enumerated above should be to extend and reinforce the equipment and capability of TISI -- serving as national centre for industrial standardization -- and TISTR -- the legally accredited national authority for industrial metrology and relevant research/development activities. The grounds for advising that first priority be accorded to this project are that:

(1) Undispersed efforts directed on the two institutions for reinforcing testing, metrological standard and calibration facilities and equipment should enhance investment efficiency and maximize effective utilization of the installed equipment.

(2) The two institutions in question are already undertaking relevant operations, and are aptly staffed for assuming the envisaged function, provided a certain extent of reinforcement with additional personnel and technical instruction/training is accorded for their reinforcement.

(3) Industrial enterprises are strongly demanding elimination of the current excessive delays in the execution of certification tests and tests on request, as well as extension of coverage by metrological standards.

(4) Improvement of product quality and extension of the metrological system are essential prerequisites for Thai industrial development and export promotion, and to this end a strong and able leadership by public institutions is more than ever called for.

For this reason, a project advocated to be accorded first priority is to set up:

- Industrial Standardization Testing and Training Centre, to be operated by the Thai Industrial Standards Institute, Ministry of Industry, for promoting industrial standardization, including certification services and quality control promotion

- Industrial Metrology Testing Service Centre, to be operated by the Thailand Institute of Scientific and Technological Research, Ministry of Science, Technology and Energy, for extending and promoting the metrological system, excluding legally designated measurements.

5.1.1.1 Grounds for advocating the establishment of two separate Centres

(a) Distinctly differing functions

The mission of TISI is to serve as the centre for developing industrial standards, as ultimate authority for administering TIS Mark certificates, and as the mainspring for quality control promotion. The Institute disposes of testing equipment and personnel, which it should utilize effectively to reduce the extremely long periods currently required for testing before delivery of TIS Mark certificates, and thus to contribute toward multiplication of TIS Mark factories, and toward consequent diffusion of industrial standardization.

The mission of TISTR, on the other hand, is to promote overall enhancement of the nation's industrial level through technical assistance provided to research, development and industrial standards, within the terms of reference of relevant law, and is entrusted with the establishment, maintenance, and administration of metrological standards and with ensurance of calibration service.

The two Institutes thus are strongly independent of each other in their missions and functions, and furnish private industry with technical guidance and services of distinctly differing nature and technological level: TISI centres around quality control, and TISTR around research and development. Thus, while the two Institutes cover ranges of subject that naturally overlap in certain aspects of testing, they differ greatly in their aims and subjects treated, as well as in the levels and ranges of measurement.

(b) Size of buildings

Setting aside economic considerations such price and availability of land, it might be stated as a general rule that the most convenient layout for testing institutions such as envisaged here would be to have all operations carried out at one level -- i.e. in a single-storey building. Certain facilities, however, such as classrooms and library, as well as rooms for administrative and clerical work, might without too much inconvenience be located on an upper storey, and a 2-storey building might in this instance be considered the most practical form of construction to house the Centres.

As it will be given further on, the required floorage for the Centres should amount to some 10,000 square metres, which is excessive for convient accommodation with a single 2-storey building, in such aspects as central air-conditioning, power supply, waste water treatment and other requisite facilities. Two buildings are thus necessary, to respectively house the two Centres.

(c) Operation of the Centres

The Centres are to be operated respectively by TISI, forming part of the Ministry of Industry, and TISTR, a semi-governmental establishment controlled by the Ministry of Science, Technology and Energy. Administration of the Centres would call for a proper arrangement between the relevant Ministries concerning the upkeep of the two Centres, if the two centres were housed in a common building.

The establishment of two separate Centres as designated above is thus advocated on the grounds of their different and independent functions, of convenient size and scale of buildings and facilities, and of differing modes of operation.

Within TISTR, the Testing and Standards Centre currently takes care of metrology and relevant testing activities. One way of conserving and extending this existing institution might be to let its equipment

be utilized for the envisaged Centre, but the present building is already outdated and unfit for renovation to accommodate apparatus calling for strictly controlled temperature and humidity, besides being too small for housing the additional facilities envisaged for the new Centre. It is also the desire of TISTR to have priority accorded to the acquisition of new premises.

5.1.1.2 Necessity of constructing the two Centres simultaneously

In view of the vital mission to be fulfilled by the two Centres in enhancing the quality of domestically manufactured industrial products, and thereby to promote their exportation, it is of utmost urgency to have both Centres set in operation with minimum delay.

Establishment of the Industrial Standardization Testing and Training Centre is indispensable for solving serious current problems such as the appallingly long delays currently required for completing TIS Mark certification tests, which are critically impairing the mission of TISI to contribute through multiplication of certified TIS Mark factories to enhancement of industrial product quality and to advancement of industrial level and of industrialization.

Of equal urgency is the entrance into service of the Industrial Metrology Testing Service Centre, in that efficient functioning of an effective calibration service is premised upon availability of adequately trained specialists, upon firm establishment of the metrological system and upon development of methods adapted to national needs and circumstances, all of which call for considerable lead time. In the domain of testing also, rapid increase is expected of demands for the Centre's testing services to meet the needs of industry in their research and development efforts.

The foregoing urgent circumstances do not allow for preference to be accorded to one or the other of the two Centres in the sequence of their establishment, and the two call for simultaneous initiation of construction with the shortest possible delay.

5.1.1.3 Conditions assumed for determining the size of the 2 Centres

(a) Industrial Standardization Testing and Training Centre

From the past recorded, as detailed in Section 3.5.2.3(7), certification tests conducted for conformity with industrial standards were estimated to increase at a rate of 700 -- or 3,500 in 5 years. The personnel and facilities necessary for the Centre to adequately cope with this increase in workload were estimated to derive the size of the envisaged buildings.

(b) Industrial Metrology Testing Service Centre

(1) Metrology

a) Metrological standards are to be created and maintained covering:

- Density
- Viscosity
- Hardness
- Surface Roughness
- Roundness
- Volume
- Flow rate
- Sound
- Vibration

b) Coverage of metrological standards is to be extended in the domains of temperature and electricity, and relevant standards managed and maintained.

c) Calibration services have currently barely been begun, so it should be difficult to precisely estimate future trends in workload. It was assumed from the records of the past 3 years -- given in Section 3.8.2(a)(7) -- that it would markedly increase from year to year. In consideration of the limits to serve capacity, the annual growth of workload was set at 20 percent. As a long-term trend, however, it can be foreseen that the rate of increase should eventually settle down to perhaps 10 percent per year, with a traceable system of metrology coming to be established in the individual enterprises, which would relieve the pressure on requested calibration.

(2) Testing

From what was observed in Section 3.5.3(5), the testing workload was estimated at 8 percent annual increase.

The personnel, equipment, and the buildings to house them are determined on the basis of the foregoing assumptions.

5.1.2 Industrial Standardization Testing and Training Centre

5.1.2.1 Functions and activities

In consideration of the foregoing circumstances, and with the aim of contributing to enhancement of industrial standard drafting capability, to effective operation of the certification system, to strengthening of capability for technical consultancy services provided to private manufacturing enterprises, and to extension of testing capability, the Industrial Standardization Testing and Training Centre is to fulfill the functions and to undertake the activities indicated below.

(a) *Testing samples for development of drafts of industrial standards and* for certification.

(b) Instruction and training: Through organization of training courses, seminars, workshops and other means, in the first instance, for TISI personnel to engage in drafting industrial standards and certification testing. The TISI personnel thus trained should then take the lead in instructing and training the personnel of other testing institutions and private enterprises.

(c) Enhancement of testing techniques

(d) Consultancy services for industrial standardization, quality control and testing, preceded as necessary by factory surveys, to be provided to enterprises applying for TIS Mark certification, to those actively furthering in-house standardization, and to others desiring enhancement of in-house testing capability.

(e) Planning: Studies on the method best adapted to national needs and circumstances for promoting quality control.

(f) Technical information and dissemination services: Supply on request of pertinent information concerning industrial standardization,

quality control and testing; compilation and circulation of bulletins and other publications.

(g) Testing on request: The Centre will dispose of the testing facilities described further on, to conduct tests necessary for drafting industrial standards and for certification, as well as chemical analyses and performance tests on request from private enterprises, to aid in their efforts in product quality improvement.

In selecting the tests to be performed at the Centre, priority should be accorded to those necessary for drafting compulsory standards and for compulsory certification, by reason of:

(1) Such compulsory items being closely related to matters of health and safety, or to prevention of harmful effects on the national economy, industry and welfare.

(2) Currently enforced compulsory items being those that govern key components and mass-produced articles for which application of the standards is considered effective for enhancing the national level of industry through promotion of standardization.

(3) Industrial production activities being serious hampered by the current delays in certification tests, causing unnecessary idling of resources, manpower, resources and equipment.

The foregoing activities should be taken in hand in successively extended scope, as indicated in Table 5.1.2-1. The detailed substance of the activities to be undertaken should be varied to best suit the individual subject matters and objectives, as exemplified in Tables 5.1.2-2 to -4. Testing services on products other than mentioned fields in Tables 5.1.2.-2 to -4 may be carried out upon the testing capable activities of TISI.

The position of this centre is shown in Fig. 5.1.2-1

5.1.2.2 Organization and personnel

(a) Organization

The Industrial Standardization Testing and Training Centre should, as presented in Fig. 5.1.2-2, comprise 3 divisions, charged respectively with administration, with training, and with testing.

(1) Administration Division

To undertake:-

- Overall planning and management of the Centre's activities, schedules and budget; personnel administration
- Assembly of domestic and foreign technical information; dissemination of assembled technical information through reports, pamphlets, bulletin.

(2) Training Division

To undertake:-

- Admission of trainees
- Planning and implementing training programmes
- Technical consultancy services and factory survey services for promoting industrial standardization and quality control
- Studies on the method of promoting quality control best adapted to national needs and circumstances.

(3) Testing Division

To undertake:-

- Testing operations requisite for development of industrial standards and for certification under Compulsory and Voluntary Standards
- Testing on request, on request from other public institutions and from private enterprises
- Organization of training courses for those to engage in testing in other laboratories and implementation of the courses.

This Division might be divided into Sections covering testing in the different domains of:-

- Electrical and electronic engineering
- Mechanical engineering
- Chemical and biochemical engineering
- Materials and material properties
- Calibration service

Table 5.1.2-1
Functions and Scope of Activities of
Industrial Standardization Testing and Training Centre
in Successive Phases of Development

Functions	Scope of Activities in Successive Phases of Development		
	Phase 1 (1st-5th Year)	Phase 2 (6th-8th Year)	Phase 3 (9th-11th Year)
(A) Testing samples for development of drafts of industrial standards and for certification	Perform tests in relation to Compulsory Standards	Extend scope of tests in relation to Voluntary Standards	Extend scope of testing based upon International and Foreign Standard
(B) Personnel training	Admit personnel from private enterprises for training in in-house standardization and quality control for factories manufacturing Compulsory Standard products	Extend admittance to personnel from enterprises applying for TIS Mark under Voluntary Standard	Further extend admittance to include personnel from all enterprises
(C) Enhancement of testing capability	Assimilate and enhance techniques for basic and applied testing	Extend application to new products and new methods, as well as to tests conforming with international standards	Same as left
(D) Technical consultancy services	Undertake visiting guidance and consulting services for factories manufacturing Compulsory Standard products	Same as left Extend scope to factories desiring application of Voluntary Standard	Same as left Further extend scope to include all factories applying for test
(E) Planning	Study method best adapted to Thailand for promoting quality control	Experiment with application of the method thus studied	Improve the method
(F) Information service	Compile study/survey reports; issue pamphlets/bulletin	Same as left	Same as left
(G) Testing on request	Accord priority to public institutions, also enterprises manufacturing Compulsory Standard products	Extend scope of tests to factories manufacturing of Voluntary Standard products	Further extend scope of tests to include all factories applying for test

Table 5.1.2-2 Activities to be Undertaken by Industrial Standardization Testing and Training Centre - Phase 1 (1st - 5th year)

DOMAINS \ ACTIVITIES		(i) PERSONNEL TRAINING				(ii) TESTING TECHNIQUES			(iii) TECHNICAL CONSULTANCY SERVICE				(iv) PLANNING				(v) INFORMATION SERVICE				(vi) TESTING			
			Quality Control						In-House Standardization				Method Best Adapted for Promoting Quality Control											
		In-House Standardization	ON-LINE QUALITY CONTROL COURSE	DESIGN OF EXPERIMENTS COURSE	QUALITY CONTROL STAFF COURSE	QUALITY CONTROL LEADER COURSE	TESTING	(a) Establish Private enterprises	(b) Disseminate Other Testing Institutions	(c) Improve Within the Centre	Guidance in In-House Standardization and Quality Control: Prepare personnel organization	Prepare equipment	Implement guidance service	Study the method	Experiment with application	Improve the method	Compile Study/Survey Reports	Compile Pamphlets, Brochures, etc.	Issue Bulletin	Testing for Certification	Testing for Drafting Standards	Testing on Request
Training courses on inhouse standardization and quality control	Quality control leader		○	○		○																		
	Quality control staff				○																			
Services provided to domestic enterprises	Agricultural machinery																							
	Motor car components	○	○	○	○						○	○	○	○								○	○	○
	Machine assembly													○						○				
	Household electric appliances	○	○	○	○						○	○	○							○		○	○	○
	Electronic equipment																			○		○	○	○
	Iron and steel	○	○	○	○						○	○	○	○						○		○	○	○
	Synthetic resins																			○		○	○	○
	Other products																							
	- Compulsory Standard products	○	○	○	○						○	○	○							○		○	○	○
	- Voluntary Standard products																			○		○	○	○
	- Other products																							
Electrical equipment	- Wiring/cabling equipment/materials/parts						○	a c	○ b															
	Household appliances: Refrigerating equipment/motors						○	a c	○ b															
	Household appliances: Lighting equipment						○	a c	○ b															
Electronic equipment	Audio equipment						○	a c	○ b															
	Video equipment																							
	Office equipment																							
	Components						○	a c																
Machinery	Metallic materials						○	a c	○ b															
	Motor car components						○	a c																
Chemical	Foodstuff						○	a c	○ b															
	Polymers, gas, pharmaceuticals						○	a c																
ASEAN Region																								

Table 5.1.2-3 Activities to be Undertaken by Industrial Standardization Testing and Training Centre - Phase 2 (6th - 8th year)

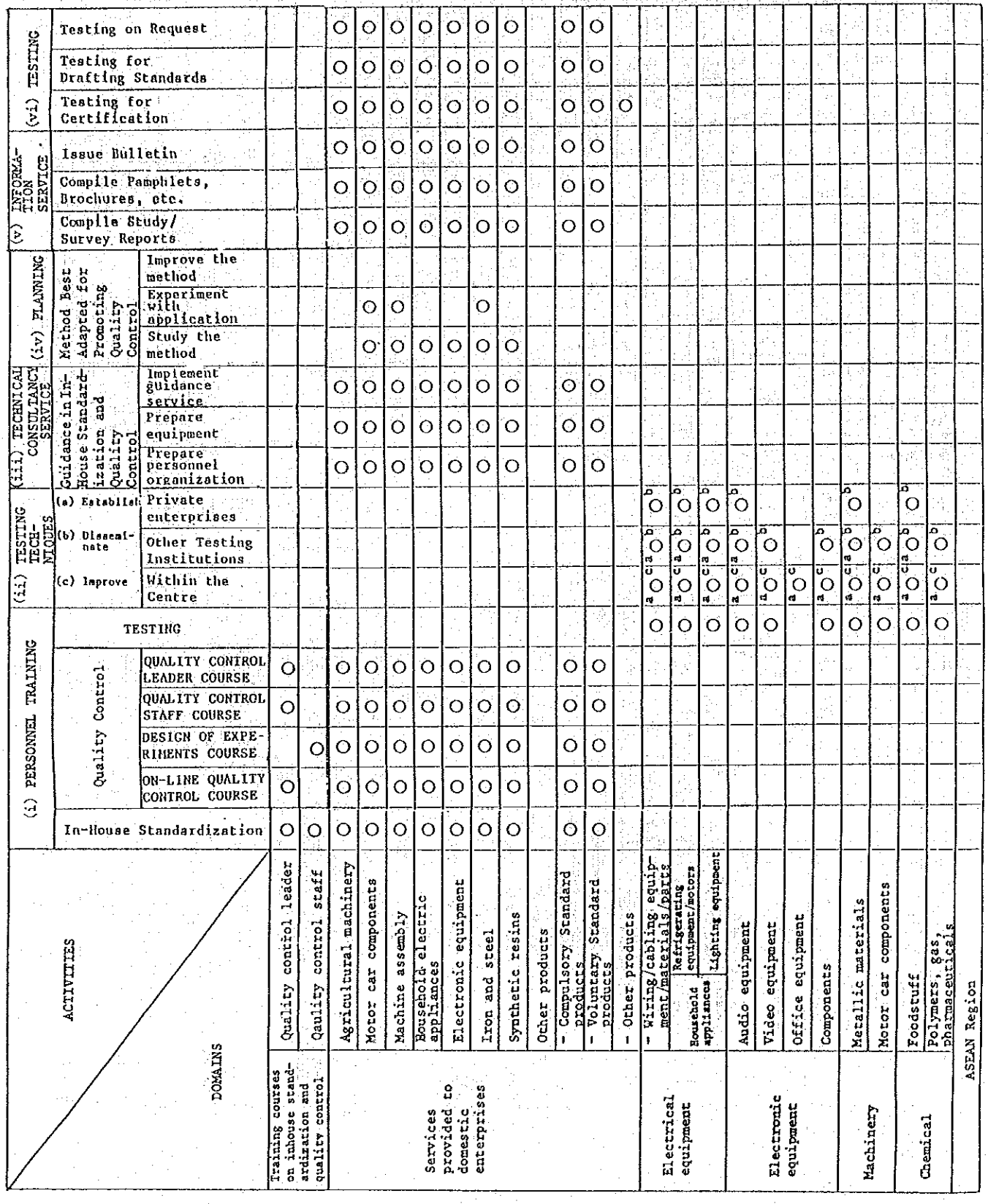


Table 5.1.2-4 Activities to be Undertaken by Industrial Standardization Testing and Training Centre - Phase 3 (9th - 11 year)

ACTIVITIES			Quality control leader	Quality control staff	Agricultural machinery	Motor car components	Machine assembly	Household electric appliances	Electronic equipment	Iron and steel	Synthetic resins	Other products	- Compulsory Standard products	- Voluntary Standard products	- Other products	- Wiring/cabling equipment/materials/parts	Household appliances: Refrigerating equipment/motors	Household appliances: Lighting equipment	Audio equipment	Video equipment	Office equipment	Components	Metallic materials	Motor car components	Foodstuff	Polymers, gas, pharmaceuticals	ASEAN Region
DOMAINS			Training courses on inhouse standardization and quality control	Training courses on inhouse standardization and quality control	Services provided to domestic enterprises	Services provided to domestic enterprises	Services provided to domestic enterprises	Services provided to domestic enterprises	Services provided to domestic enterprises	Services provided to domestic enterprises	Services provided to domestic enterprises	Services provided to domestic enterprises	Services provided to domestic enterprises	Services provided to domestic enterprises	Services provided to domestic enterprises	Electrical equipment	Electrical equipment	Electrical equipment	Electronic equipment	Electronic equipment	Electronic equipment	Electronic equipment	Machinery	Machinery	Chemical	Chemical	ASEAN Region
(vi) TESTING	Testing on Request				○	○	○	○	○	○	○		○	○	○												
(vi) TESTING	Testing for Drafting Standards				○	○	○	○	○	○	○		○	○	○												
(vi) TESTING	Testing for Certification				○	○	○	○	○	○	○		○	○	○												
(v) INFORMATION SERVICE	Issue Bulletin				○	○	○	○	○	○	○		○	○	○												○
(v) INFORMATION SERVICE	Compile Pamphlets, Brochures, etc.				○	○	○	○	○	○	○		○	○	○												○
(v) INFORMATION SERVICE	Compile Study/ Survey Reports				○	○	○	○	○	○	○		○	○	○												○
(iv) PLANNING	Method Best Adapted for Promoting Quality Control	Improve the method				○	○			○																	
(iv) PLANNING	Method Best Adapted for Promoting Quality Control	Experiment with application				○	○	○	○	○	○																
(iv) PLANNING	Method Best Adapted for Promoting Quality Control	Study the method			○	○	○	○	○	○	○		○	○													
(iii) TECHNICAL CONSULTANCY SERVICE	Guidance in In-house Standardization and Quality Control	Implement guidance service			○	○	○	○	○	○	○		○	○	○												○
(iii) TECHNICAL CONSULTANCY SERVICE	Guidance in In-house Standardization and Quality Control	Prepare equipment			○	○	○	○	○	○	○		○	○	○												○
(iii) TECHNICAL CONSULTANCY SERVICE	Guidance in In-house Standardization and Quality Control	Prepare personnel organization			○	○	○	○	○	○	○		○	○	○												○
(ii) TESTING TECHNIQUES	(a) Establish	Private enterprises														a ○ b	a ○ b	a ○ b	a ○ b	a ○ b	a ○ b	a ○ b	a ○ b	a ○ b	a ○ b	a ○ b	
(ii) TESTING TECHNIQUES	(b) Disseminate	Other Testing Institutions														a ○ b	a ○ b	a ○ b	a ○ b	a ○ b	a ○ b	a ○ b	a ○ b	a ○ b	a ○ b	a ○ b	
(ii) TESTING TECHNIQUES	(c) Improve	Within the Centre														a ○ c	a ○ c	a ○ c	a ○ c	a ○ c	a ○ c	a ○ c	a ○ c	a ○ c	a ○ c	a ○ c	
(i) PERSONNEL TRAINING	TESTING															○	○	○	○	○	○	○	○	○	○	○	
(i) PERSONNEL TRAINING	Quality Control	QUALITY CONTROL STAFF COURSE		○	○	○	○	○	○	○	○		○	○	○												○
(i) PERSONNEL TRAINING	Quality Control	QUALITY CONTROL LEADER COURSE	○	○	○	○	○	○	○	○	○		○	○	○												○
(i) PERSONNEL TRAINING	In-House Standardization		○	○	○	○	○	○	○	○	○		○	○	○												○

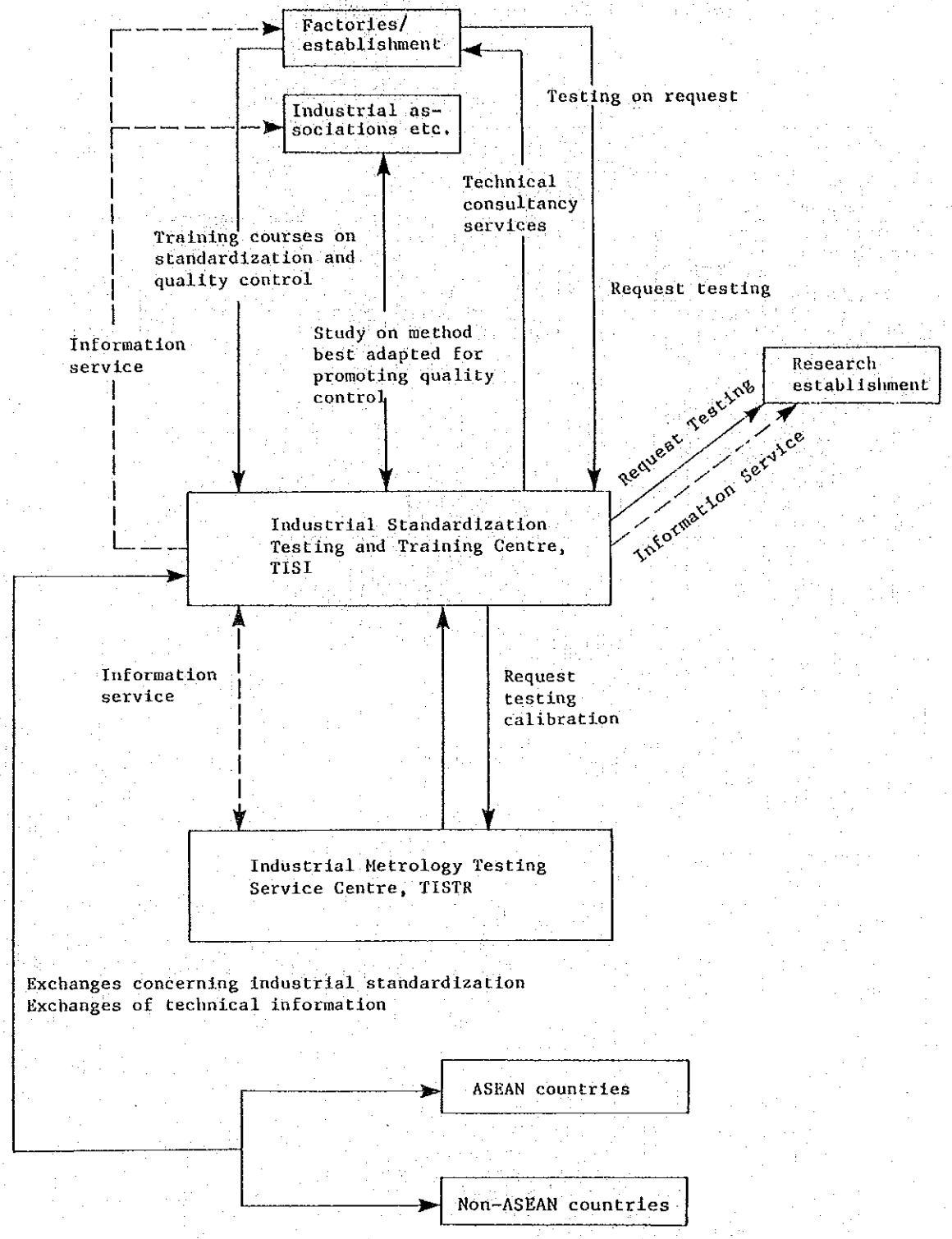


Fig. 5.1.2-1 Position of Industrial Standardization Testing and Training Centre

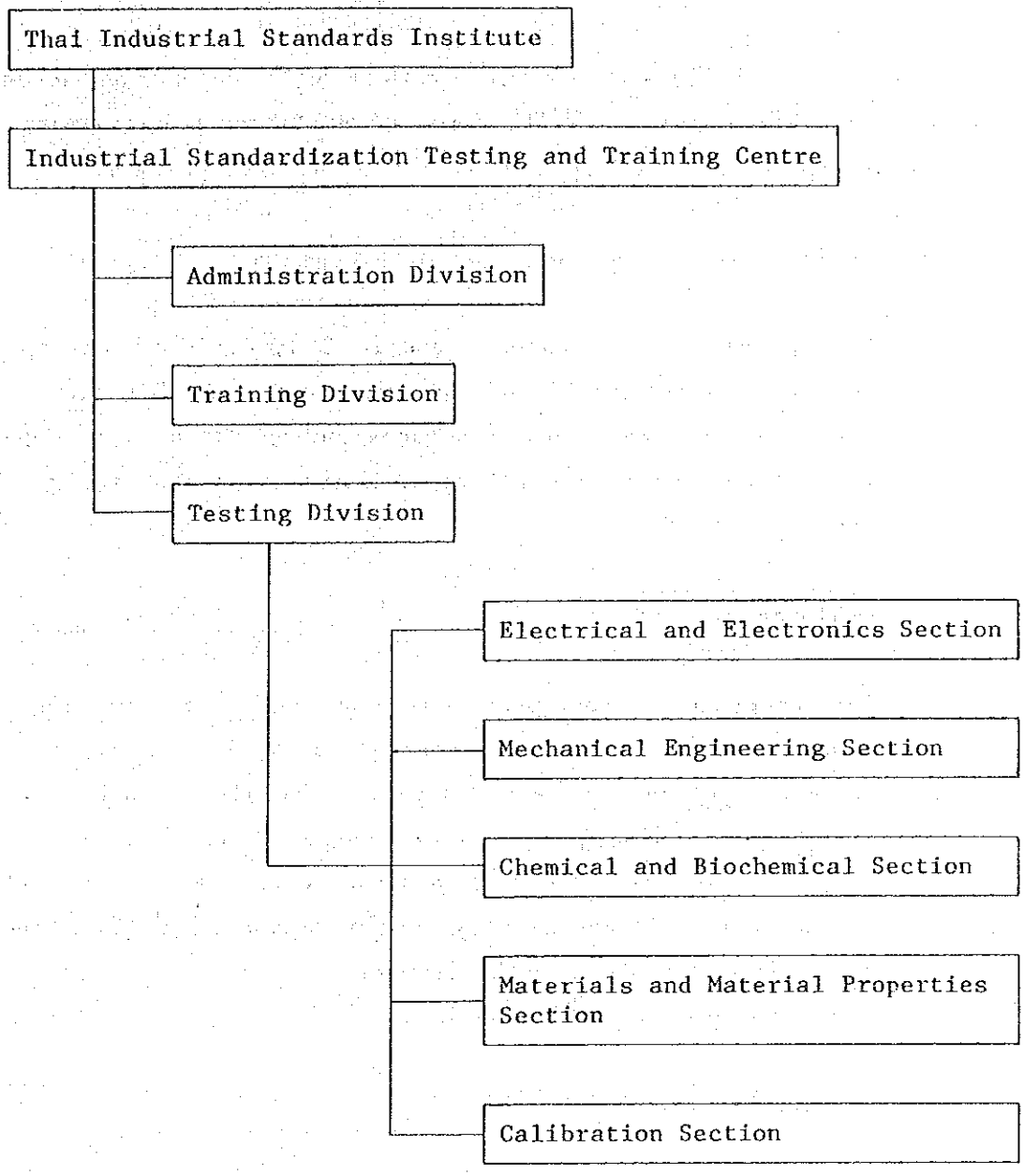


Fig. 5.1.2-2 Organization of Industrial Standardization Testing and Training Centre

(b) Staffing schedule

The successful fruiton of this project will depend on adequately providing the personnel -- in terms of proficiency and number --- to operate the Centre during each phase of its development.

(1) Administration Division

During the initial Phases 1 and 2, 2 senior/intermediate and 1 junior official could suffice to staff this Division, to be increased by 1 each in both grades during Phase 3, to cope with the increasing administrative work attendant upon the growth of Centre personnel.

(2) Training Division

For undertaking the practical work of promoting industrial standardization and quality control, as well as associated work, 4 senior/intermediate and 2 junior officials would be necessary for this Division, to be increased by 1 each in both grades during Phase 2 for training in standardization, and by further 2 in the senior/intermediate grades in Phase 3, to cope with the added work of extending the promotion of industrial standardization to cover the entire nation.

(3) Testing Division

The personnel of this Division will be expected to answer the need of shortening the current excessively long waiting time for test results to be obtained, in the face of the foreseen increase in demands for testing in the years to come. Estimating this increase to amount to, perhaps 700 every year, around 3,500 additional demands would have to be met 5 years hence. The workload per person should be held to within perhaps 35 per year, with allowance made for the freshly engaged staff while

they are aquiring proficiency through their practice of daily testing work (cf. 40 - 50 tests per year per person recorded in well-established Japanese institutions). Accordingly, 60 senior/ intermediate and 38 junior officials would be necessary for Phase 1, to be increased respectively by 30 and 18 in Phase 2 and by further 30 and 16 in Phase 3, to cope with the above-mentiond rise in the amount of testing demand, and with account taken of the enhanced average testing proficiency and efficiency that will have been gained in the meantime.

The foregoing tentative staffing schedule is summarized below:

		Phase 1 (1st-5th year)	Phase 2 (6th-8th year)	Phase 3 (9th-11th year)
Senior/intermediate grade officials		66	97	130
Junior officials		41	60	77
Foreign experts on temporary assignment	Long-term	9		
	Short-term	10		

A more detailed tentative schedule covering the individual Divisions and Sections is presented in Table 5.1.2-5.

The foregoing staffing schedule should coordinated with the schedule for extending the corresponding facilities and equipment, and commensurate measures should be adopted for ensuring timely availability of qualified personnel in adequate numbers.

It might be mentioned in this connection that the current recruiting schedule of TISI is as follows.

	1988	1989	1990
Senior/Intermediate officials	12	33	56
Junior officials	12	23	33
Total	24	56	89

Table 5.1.2-5 Staff Force - Industrial Standardization Testing and Training Centre

		Phase 1 (1st - 5th year)				Phase 2 (6th - 8th year)				Phase 3 (9th - 11th year)			
		Senior/intermediate grade officials	Junior officials	Foreign experts on temporary assignment		Senior/intermediate grade officials	Junior officials	Foreign experts on temporary assignment		Senior intermediate grade officials	Junior officials	Foreign experts on temporary assignment	
				Long-term	Short-term			Long-term	Short-term			Long-term	Short-term
Administration Division	Planning/administering activities of Centre; administering budget/scheduling; personnel administration; clerical services	1	1			1	1			2	2		
	Information services	1	(1)			1	(1)			1	(1)		
	Subtotal	2	1			2	1			3	2		
Training Division	Admission of trainees	(1)	1			(1)	1			1	1		
	Planning/executing training programmes	3	1	3	2	4	2			5	2		
	Instruction/guidance/consultation on standardization/quality control in enterprises	(3)	(1)			(4)	(1)			(5)	(1)		
	Study method best adapted for promoting quality control	1	(1)			1	(1)			1	(1)		
	Subtotal	4	2	3	2	5	3			7	3		
Testing Division	Electrical and Electronics Section	20	8	2	4	30	12			45	19		
	Mechanical Engineering Section	22	16	1	2	33	22			43	26		
	Chemical and Biochemical Section	7	6	2	1	11	9			14	12		
	Material and Mechanical Properties Section	10	8	1	1	15	13			17	15		
	Calibration Service Section	3 (2)	2 (2)			3 (2)	2 (2)			3 (2)	2 (2)		
	Subtotal	60 (2)	38 (2)	6	8	90 (2)	56 (2)			120 (2)	72 (2)		
Total		66	41	9	10	97	60			130	77		

NOTES: (1) Numerals given between parentheses indicate number of staff charged part-time with the duties indicated, but having their main duties in the Centre.

(2) Foreign experts may not necessarily be assigned in groups residing at Centre at the same time.

5.1.2.3 Personnel training for the staff of the Centre

(a) Instructors in in-house standardization and quality control

Institution and training of Centre personnel to serve as instructors in in-house standardization and quality control in courses for outside trainees are to be implemented through:

(1) Training provided within the Centre by foreign experts

(2) Assignment of Centre personnel to foreign institutions for training.

The foreign experts to be called upon to provide the training on different subjects during different periods of time are:-

1 for 4 years in in-house standardization
1 for 4 years in quality control -- for senior personnel in charge of promoting quality control
1 for 4 years in quality control -- Staff in charge of quality control
1 for 3 months in design of experiments
1 for 3 months in on-line quality control

(b) Personnel for testing

Personnel to engage in testing and inspection operations in the Centre, also, are to be trained through:

(1) Training provided within the Centre by foreign experts

(2) Assignment of Centre personnel to foreign institutions for training.

The training is to be provided separately for the different domains, the individual courses being to last about 3 months, as indicated in Table 5.1.2-6. As also indicated in the same Table, certain foreign experts should be assigned during 1.5 year to undertake instruction in basic notions of testing, in lectures given in common to trainees of different domains.

Detailed curriculum items are given in Table 5.1.2-7; Table 5.1.2-8 contains the programme for personnel training.

Table 5.1.2-6 Programmes of Assignment to Centre of Foreign Specialists and for Assignments Abroad of Centre Personnel for Training Abroad

Domain \ Year		1st year	2nd year	3rd year	4th year	5th year
In-House Standardization			⇠------⇢ 2			
Qaulity Control	Leaders		⇠------⇢ 2			
	Staff		⇠------⇢ 2			
	Design of Experiments				⟷	
	On-line QC					⟷
Electric	Household Electrical Equipment				⇠------⇢	⟷
	Electrical Conponent	⇠------⇢		⟷		
Electronic	Audio equipment Electronic Compo	⇠------⇢ ⟷	⟷	⟷	⇠------⇢	
	Video Equipment OA Equipment					⟷
Machinary	Automotive Parts Precision machine parts	⇠------⇢ ⟷	⟷	⟷		
	Industrial machine parts Machine tool			⇠------⇢	⟷	
Material & Physical	Metal material Non-metal material	⇠------⇢ ⟷	⟷	⇠------⇢	⟷	
Chemical	Chemical Analysis	⇠------⇢ ⟷	⟷	⟷		
	Food & Pharmaceutical	⇠------⇢			⟷	⇠------⇢

⇠------⇢ Assignment abroad of Centre Personnel

⟷ Assignment to the Centre of Foreign Specialists

Table 5.1.2-7 Training Course Curricula - Training Centre

Course	Trainees, Objectives	Programmes	Substance
Company standardization	Enterprise directors, middle-management employees, shop-floor superintendents, workers. Training on company standardization.	- General notions of company standardization	. Definition of company standardization . Objectives and benefits of company standardization . Basic concepts of company standardization
		- Procedure for promoting company standardization	. Company-wide standardization adopted as integral part of a total quality control system . Standardization within departments as part of routine operations
		- Compiling and arranging company standards	. Scope and systematic arrangement of company standards . Required substance of company standards . Compiling and arranging company standards . Style manual of company standards
		- Principal company standards; their utilization	. Rules governing management of company standards . Rules governing management of quality control . Standardization of products; product standards . Standardization of materials; standards governing materials . Standardization of processes; standards governing processes . Standardization of inspection; standards governing inspection . Standardization of equipment management standards governing equipment management . Standardization of warehouse management; standards governing warehouse management . Standardization of procedures for dealing with claims; standards governing procedures for dealing with claims
		- Ensuring harmonization with national and international standards	

Course	Trainees, Objectives	Programmes	Substance
Staff who will be incharge of quality control (beginner)	Technicians and other staff constituting key personnel in respective groups, but who have had little practical experience in quality control. Currently applied concepts, principles and techniques.	- Company-wide quality control (Fundamental concept and its promotion)	. General notions and history of quality control; introducing and promoting company-wide quality control
		- How to collect data - Part 1	. Collecting data; check sheets, graphs, cause and effect diagms, stratification etc. . Practical exercises
		- How to collect data - Part 2	. Pareto diagrams, histograms, scatter diagrams, quantification of data . Practical experiences
		- Preparing control charts	. Meaning and preparation of control charts
		- Process control and analysis using control charts	. Evaluation of the process through control charts . Process analysis and process control
		- Improvement and advancement through Q.C.activities	. Standardization and improvement activities
		- Statistical tests and estimation - Part 1	. Concept of statistical data analysis
		- Statistical tests and estimation - Part 2	. Tests and estimation of population mean and variance
		- Sampling inspection	. Sampling methods; objectives and kinds of inspection; sampling inspection methods; planning, performing, managing inspection . Practical exercises
		- Process analysis by simplified method	. Data analysis using bionominal probability paper
		- Company standardization	. Objectives and benefits of company standardization . Organization and procedure for promoting company standardization
		- Quality assurance activities	. Concept and promotion of quality assurance; quality control circle activity

Course	Trainees, Objectives	Programmes	Substance
Quality control leader	Technicians and engineers. Fostering capability as the leader of quality control promotion in respective enterprises or factories	- General matters of company-wide quality control	. Aim of company-wide quality control; proper philosophy; definition of quality control; constitution improvement of the enterprise; quality consciousness; quality control of the future
		- Organization and management of company-wide quality control - CWQC training	. Planning for introduction and promotion of company-wide quality control and methods of implementation; organization for promoting company-wide quality control; management of company-wide quality control; quality control and standardization; problems encountered in promoting stage; quality control training
		- Improvement and advancement through CWQC activities	. Detecting and identifying problems; statistical approach and utilizing statistical methods; standardization and improvement activities; role of statistical methods
		- Quality assurance and product reliability	. Collecting information; quality assurance activities from planning, design to sales; after-sale service on the products sold; general thinking of quality assurance; reliability management in quality assurance, analysing techniques for reliability
		- Introducing, promoting, developing and ensuring stable application of company-wide quality control	. Case study presentation of successful enterprises and discussion

Course	Trainees, Objectives	Programmes
On-line quality control	Production engineers or middle-management of manufacturing department Advanced quality control techniques	- Product standards and quality; losses by dispersion; determining tolerances Practical exercises - Process diagnosis and adjustment; designing process control system - Part 1 (methods of process improvement and preventive maintenance) Practical exercises - Designing process control systems - Part 2 (improving the method of process diagnosis); ditto - Part 3 (improving the method of process adjustment) Practical exercises - System design of process linking; design of feedback control system of variables - Part 1 (control based on quality) Practical exercises - Function of inspection; percent defective of break-even point taking account of inspection errors; designing the inspection method Practical exercises - Design of feedback control system of variables - Part 2 (control based on process conditions) Practical exercises
Design of experiments	For design and other engineers in testing and research departments	- What is design of experiments? Notions of variation, degrees of freedom, variance, analysis of variance Practical exercises - One-way layout; resolution into polynominal components Practical exercises - Two-way layout Practical exercises - Two-way layout with resolution; Two-way layout with repetition Practical exercises - Classification of characteristic values; 0, 1 data analysis Practical exercises - Cumulative χ^2 test Practical exercises - Notions of orthogonal arrays table Practical exercises - Linear graph and their utilization Practical exercises - Multi-level arrangement; dummy treatment method; combination design Practical exercises

Course	Trainees, Objectives	Programmes	Substance
Electrical appliances	To train technicians/engineers engaging in electrical appliances testing. Overall proficiency in testing - including both general principles and practice.	- Basic notions of testing	. Explanations and guidance in basic notions of testing
		- Manipulation of testing equipment	. Guidance in manipulation of measuring and testing equipment
		- Interpretation of standards	. Explanation and guidance in aspects of safety, performance, reliability; surveys on whether or not relevant standards exist
		- Techniques of testing	. Practice in drafting testing procedures; explanation of procedure for compiling test reports; guidance in performing tests
		- Practical exercises in testing	. Practice in tests on electrical household appliances (components):- o Prepare measuring equipment o Perform measurements in accordance with relevant standard o Prepare manual for maintenance and manipulation of testing apparatus, instruments, jigs and tools o Prepare manual of test procedure o Develop techniques for application to other products
		- Analyzing test results	. Drafting requests for improvement; devising measures for dealing with non-conformities; evaluating test results; confirming reliability of test results
		- Compiling reports	. Compiling test reports

Course	Trainees, Objectives	Programmes	Substance
Electronic equipment	To train technicians/engineers engaging in electronic equipment testing. Overall proficiency in testing - including both general principles and practice	- Elementary notions of testing	. Explanations and guidance in elementary notions of testing
		- Manipulation of equipment	. Guidance in manipulation of measuring and testing apparatus
		- Interpretation of standards	. Explanation and guidance in aspects of safety, performance, reliability; surveys on whether or not relevant standards exist
		- Techniques of testing	. Practice in drafting testing procedures; explanation of procedure for compiling test reports; guidance in performing tests
		- Practical exercises in testing	. Practice testing on audio, video, office equipment, electronic components:- o Prepare apparatus for measurements o Prepare manual for maintenance and manipulation of testing apparatus, instruments, jigs and tools o Prepare manual of test procedure o Perform measurements in accordance with relevant standard o Develop techniques for application to other products
		- Analyzing test results	. Drafting requests for improvements; devising measures for dealing with non-conformities; evaluating test results; determining reliability
		- Compiling reports	. Compiling test reports

Course	Trainees, Objectives	Programmes	Substance
Mechanical equipment	To train technicians/engineers engaging in mechanical equipment testing. Overall proficiency in testing - including both general principles and practice	- Elementary notions of testing	. Explanations and guidance in elementary notions of testing
		- Manipulation of equipment	. Guidance and manipulation of measuring and testing apparatus
		- Interpretation of standards	. Explanation and guidance in aspects of safety, performance, reliability; survey on whether or not relevant standards exist
		- Techniques of testing	. Practice in drafting testing procedures; explanation of procedure for compiling test reports; guidance in performing tests
		- Practical exercises in testing	. Practice testing on mechanical equipment:- o Prepare apparatus for measurements o Prepare manual for maintenance and manipulation of testing apparatus, instruments, jigs and tools o Prepare manual of test procedure o Perform measurements in accordance with relevant standard o Develop techniques for application to other products
		- Analyzing test results	. Drafting requests for improvements; divising measures for dealing with non-conformities; evaluating test results; determining reliability
		- Compiling reports	. Compiling test reports

Course	Trainees, Objectives	Programmes	Substance
Chemical products	To train technicians/engineers engaging in chemical products analyses. Overall proficiency in chemical analyses - including both general principles and practice	- Elementary notions of chemical analysis	. Explanations and guidance in elementary notions of chemical analysis
		- Manipulation of apparatus	. Guidance in manipulation of apparatus used in chemical analysis
		- Interpretation of standards	. Explanation and guidance in aspects of safety, performance, reliability; surveys, on whether or not relevant standards exist
		- Techniques of testing	. Practice in drafting testing procedures; explanation of procedure for compiling test reports; guidance in performing tests
		- Practical exercises in testing	. Practice chemical analysis on foodstuff (or polymers, gas, pharmaceuticals, whichever is relevant):- o Prepare apparatus for analysis o Prepare manual for maintenance and manipulation of apparatus, preparation of reagents o Prepare manual of procedure used in analysis o Perform analysis in accordance with relevant standard o Develop techniques for application to other products
		- Analyzing test results	. Drafting requests for improvement; divising measures for dealing with non-conformities; evaluating results of analysis; determining reliability
		- Compiling reports	. Compiling test reports

Curriculum Items for Training Courses - Industrial Standardization
Testing and Training Course - Testing

SUBJECT / TRAINEE CATEGORY / DOMAIN		(1) Testing																					(2) Inspection: Elementary notions of factory management			(3) Conformity with international and foreign standards		
		(a) Elementary notions			(b) Testing techniques																(c) Drafting of standards							
					Performance			Safety			Reliability			Analysis			Non-destructive testing											
		A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Electrical equipment	Wiring/cabling equipment	○	○	○	○	○		○	○												○	○	○	○			○	○
	Materials, components	○	○	○	○	○		○	○												○	○	○	○			○	○
	Household electrical appliances: Refrigerating equipment	○	○	○	○	○		○	○		○	○									○	○	○	○			○	○
	Household electrical appliances: Motor applications	○	○	○	○	○		○	○		○	○									○	○	○	○			○	○
	Household electrical appliances: Lighting equipment	○	○	○	○	○		○	○												○	○	○	○			○	○
Electronic equipment	Audio equipment	○	○	○	○	○		○	○		○	○									○	○	○	○			○	○
	Video equipment	○	○	○	○	○		○	○		○	○									○	○	○	○			○	○
	Office equipment	○	○	○	○	○		○	○		○	○									○	○	○	○			○	○
	Electronic components	○	○	○	○	○		○	○		○	○									○	○	○	○			○	○
Machinery	Metallic materials	○	○	○	○	○		○	○					○	○		○	○			○	○	○	○			○	○
	Motorcar components	○	○	○	○	○		○	○					○	○		○	○			○	○	○	○			○	○
Chemicals	Foodstuff	○	○	○										○	○						○	○	○	○			○	○
	Polymers	○	○	○	○	○								○	○						○	○	○	○			○	○
	Gas	○	○	○										○	○						○	○	○	○			○	○
	Pharmaceuticals	○	○	○				○	○					○	○						○	○	○	○			○	○

A: Personnel engaging in practical testing; B: Personnel engaging in testing instruction/guidance; C: Personnel engaging in testing management