(a) APSTC started, in 1986, the certification system for export salmon and trout. At present, the system has taken root. APSTC has accredited the powerful testing laboratories of organizations such as Fundacion Chile and CESMEC and issues Conformity mark certification seals.

(b) CESMEC operates a Conformity Mark Certification service and has approved five companies (shoe, paint and interior decor manufacturers). Of all systems intended for Chilean industrial products, this is the most advanced system. In the creation of a future certification service system, the CESMEC system should be considered as a base.

(c) INFOR is a corporate organization which belongs to CORFO. It provides lot certification services for export timber.

(d) Austral University felt there was a need to create a certification system for wood preserving paints and started a service which is now being operated on a trial basis for one year, according to schedule.

(e) MINECOM aiming at fruit and marine products set up a certification service with its own registration activities. The lot certification service system is operated by 46 certification bodies registered with MINECOM and having cleared INN accreditation.

3.3.2 Details of Individual Certification Bodies

(1) CESMEC

CESMEC is a private certification body with a general, comprehensive capability. Initially, it was established as a public certification body, but was privatized in 1977, and this is its status today. Its headquarters are in Santiago. It has eight branches in the whole of Chile and a total staff of 600 employees. Its organization is shown in Fig. 3.3-4.

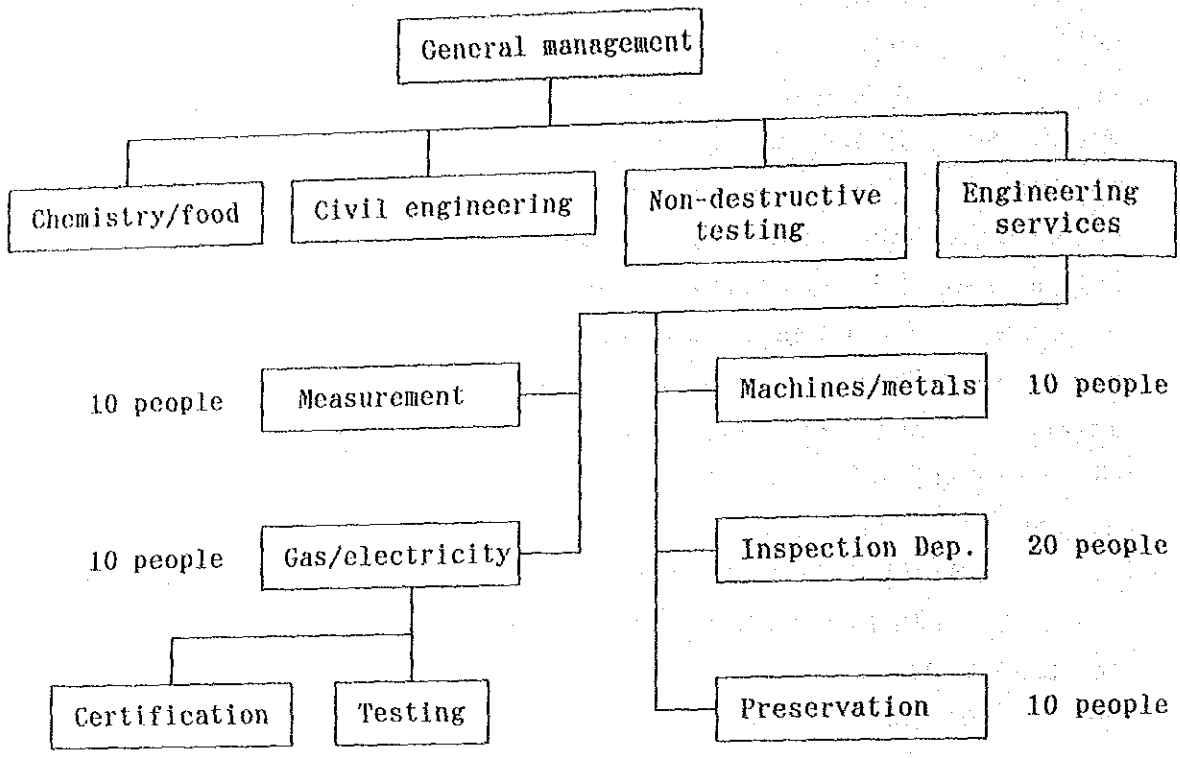


Fig. 3.3-4 CESMEC Organization Chart

The Inspection Department mainly handles certification. The Machines and Metals Department within the Engineering Service division does its work by relying only on its in-house laboratory. The other department use their in-house laboratories and also provide site visiting services.

The Inspection Department has a team of 15 engineers handling lot certification. It plays a liaison role for certification. For mark certification, there is a team of 5 engineers. By way of exception, the gas and electricity department performs model tests on gas and electrical appliances and equipment. It has 20 engineers involved in certification work all of which are qualified as quality system auditors for the quality systems operated in-house. Four of the staff are university graduates.

CESMEC does not only act as a certification body but also provides a wide range of other services, including the calibration of weighing instruments/equipment, technical consultancy, failure

analysis, and the drawing up of product specifications. About 50% of its activities are concentrated in the Santiago region. The regional branches undertake their work by taking the local conditions into consideration.

CESMEC has three certification methods: the CESMEC seal of quality, Lot certification, and Type certification. For each method, it has its particular regulations which it puts into practice. The following are the particular features of CESMEC's certification services, including the above (three types of certification).

1) Conformity mark certification

Using a methods complying with ISO/5, CESMEC has developed this method by itself. Applicants for the seal of quality are required to submit documentation about their product quality and quality control. They must then accept a site inspection visit. If they pass the inspection, the CESMEC Mark of Quality will be granted. This system is related to the ISO 9000 Series, and as already stated earlier (in 3.3.1-(3) above) it has a chance of becoming the base on which the future nationwide voluntary certification system will be based.

2) Lot certification

This certification is to assure product quality between the manufacturer and user. Either party can apply for certification.

Judging from the performance records, the service is used by both public and private sector entities. When it is used by public authorities, the financial amount tends to be large although the number of cases is small. Conversely, the private sector uses the system very extensively but the financial rewards tend to be small. The public authorities use this type of certification for both compulsory and

voluntary certification.

One of the problems of the certification service provided by CESMEC is that it often has no clearly defined specifications on which to base its certification (those cases account for about 95% of all certification). As a result, CESMEC does provide specifications and draft inspection plans to carry out certification procedures, accordingly, once the customer has agreed. Since the certification service only involved the certifying of the product quality of the lot (products) submitted, there is generally no continuity.

3) Type certification

This is conducted for the purpose of price estimation when public tender (bidding) procedures are launched by MINVU.

The following results have so far been achieved.

1) Electric - Gas - Petroleum equipment certification

Aimed at six companies approved by CESMEC, CESMEC provides certification in accordance with SEC safety standards for electric and gas equipment, electrical household appliances, household gas cylinders etc. CESMEC will inspect samples taken by the companies concerned on a random sampling basis.

2) Water supply pipe installation materials certification

This service covers the compulsory certification requirements under MOP and MINVU regulations. CESMEC as an INN-accredited certification body performs certification services in accordance with NCh and SSSA standards. Four of its six customer companies produce castings, two rubber packings. Since castings are produced in a continuous production process samples are taken, one for each check item, at a rate of once a week for inspection. Certificates are issued on a lot basis.

Products for export and products for the domestic market (including imports) are handled at a ratio of 2:8. As many as 18 Ministerial Authorities have approved CESMEC. The main authorities are as listed below.

(a) MINECOM ...
Trade Department: Export Certification Body Registration
SERNAP: Certification Body Registration (Ministerial Decrees 57,696 and 882, Government Ordinance 78 and 98)
SEC official testing laboratory registration

(b) MDS ....
Official testing laboratory registration

(c) MOP

(d) MINVU ... Ministerial Decree 15

(e) INN ... Agricultural product certification

(f) Metropolitan (Santiago) Service Corporation

(g) Supply Water and Sewage Service Corporation

(h) Others: MDN, Customs and Excise Department, MDH, MINTRATEL, etc.

(2) IDIC

IDIC is a research center belonging to MDN. Its proper activities cover quality control over arms, weapons and foods for army use. It also handles MDN procurement. Besides these activities conducted based upon the relevant laws and regulations, it renders consulting and certification services for the private sector on a voluntary basis. The areas covered by its consulting and

certification activities include metals, metal machinery, electrical engineering, electronics, chemistry, textile fiber, plastics, rubber, food products, shoes, protective implements and wear, and explosives. Its services in the explosives field are in particularly strong demand for the mining industry. Approximately 60% of all certification tasks can be accounted for by military demand and private demand in the explosives field. It also takes an active part in the drafting and establishment to national standards (NCh) and in quality control and also provides significant cooperation in connection with the activities of INN and ASCAL.

(3) DICTUC

DICTUC is a research center belonging to the Pontificia Universidad Catholica de Chile. Apart from quality certification, its activities include research and development as well as consultancy. For the industrial sector, it provides education and training through the organization of seminars.

Certification activities cover areas such as mechanical parts, construction materials and foods, with its services being directed primarily at the industrial sector. So heavy is the demand for its certification services that it records an average 25,000 - 30,000 certification jobs/year. This is therefore quite a substantial source of revenue to cover the institute's costs of research and development. Since the start of its certification services, the institute has established a proud record of over 50 years of service. It has currently over 50 experts on its staff.

Apart from lot certification, its certification services also include ISO/5 type certification with the inclusion of witnessed in-process inspection. Yet, the certification service is not based on the ISO 9000 series. The total of some 20 companies covered have factories operating primarily in the mechanical engineering sector.

Practically all of its certification activities meet domestic demand, and the export products certified by DICTUC are primarily agricultural and fishery products. The standards applied for the certification services are overwhelmingly NCh and international standards accounting for 90%. If no standards are applied for certification, DICTUC makes specifications based on, and specific to, the particular products to be certified.

(4) IDIEM

IDIEM is a materials research institute belonging to the Universidad de Chile. In addition to Santiago, there are branch offices in Arica, Iquique, and Concepcion. This general research institute covers geological/soil quality studies, physical tests, (chemical) analysis, non-destructive testing, fireproof materials, ceramics, concrete and metals for construction materials. The orders for certification break down roughly equally (50:50) between the government/public and the private sectors. For steel bar materials used for reinforced concrete, IDIEM is the only certification body appointed by MOP to handle all certification tasks under compulsory certification systems, including products of national manufacture and imported materials. It has an inspection staff of 130 assigned to the compulsory and voluntary certification service system. In part, it does provide a permanent certification service, with inspection staff permanently stationed at the factory to be certified. Yet, it is not an organization specialized to undertake certification services. Thus, the required staff is mobilized from each section according to the nature of the certification request. As a result, certificates are signed by the department leaders in charge of the particular certification tasks. It does not operate a conformity mark certification system.

(5) CIMM

CIMM belongs to MDM. It has been in existence for 20 years and is mainly a research and development organization. Certification accounts for only a small proportion of its activities and cover

essentially the analyzing of samples brought to CIMM and the issuing of a test report based on the analysis results. Rather than describing it as a certification body, it is more apt to define it as testing and inspection body. It issues about 4,500 certificates a year. Since mineral resources are Chile's main export item, CIMM has maintained a high technical level and is internationally recognized for its competence in the field. The calibration of measuring equipment and the purchase of standard materials is mainly placed on order with NIST of the United States.

(6) INTEC

INTEC is an organization belong to CORFO. Its main activities include technical development in a large range of fields such as mining, agriculture, pasture-farming, fisheries, chemistry and general industry. It services primarily small and medium-scale companies. it comes into its own as a testing and inspection body and its activities have much in common with those of CIMM. It differs from CIMM, however, in that INTEC covers many other, non-mining areas. Product certification services extended to coal, food products, fruit, fish and shellfish, canned products, and wine. Practically all orders from these areas are placed by manufacturers or purchasers.

(7) Fundacion Chile

Fundacion Chile was founded in 1976, chiefly for the promotion of agriculture, animal farming, fisheries and forestry. It provides certification services as part of its business operations. For these certification services, it has been accredited by INN as well as SERNAP, MINECOM, and MDA. Its business activities concentrate on the examination and investigation of technology successfully developed abroad and promising technologies with a view to introducing them on the domestic market for the merits they are believed to earn Chile. In more specific details, it will build pilot plants for demonstration on the basis of technology developed abroad and will then build new plant

installations for companies wishing to introduce the technology. In addition to the introduction of new technology, it will sell the facilities to companies interested in their acquisition. By this method, more than 30 new companies have already been established. Fundacion Chile has a staff of 180, including 113 specialists. Its turnover is around 9 million US dollars.

With its certification services for the fisheries sector it has established a provide record of success under the voluntary export certification system for APSTC. Fundacion Chile is one of the three organizations (IFOP, CESMEC, and Fundacion Chile) in Chile accredited and approved by FDA as a certification body. More than 90% or so of salmon and trout production is from the members of APSTC. Though certification is compulsory for the members of APSTC, the system has taken root and sound results have been established so that it follows that the service is seen to offer significant merits in the industry.

In the forestry field, it is engaged in research and development to impart a high value-added content to wood and lumber resources. The revenue from certification in this sector is relatively low at only 10%, and the organization's activities are directed primarily at enhancing the level of technology of the companies in the field rather than certification services.

In the agricultural area, is provides voluntary certification services for dried, frozen, and natural products. It provides certification for residual concentration of pesticides/ insecticides under FDA (USA) accreditation. It certifies some 15 - 20% of Chile's overall agricultural exports a year for canned agricultural products and pastes.

(8) BV

This body has a long tradition in providing certification services for shipping and maritime machinery on a worldwide scale. BV Chile has a record of some 3000 certification orders a year and has established a trade section as part of its operational

organization to start certification services for agricultural, pasture-farming, and fishery exports using this network. It has no testing laboratory of its own and uses seven independent testing laboratories to have the tests performed by them for certification.

(9) SERNAP

Established in 1978, SERNAP belongs to MINECOM. Based on the policies laid down by the Fishery Agency of the MINECOM, it is responsible for the implementation of these policies which include certification. Its activities and services include establishment of regulations and standards for fishery production, the compilation of economic statistics for the fishery sector and the handling of legal affairs. As a certification body, it is unique in its role of representing the nation in the fishery sector. However, its certification services do not exactly fall under the scope of compulsory certification but answer the voluntary certification needs of foreign parties. These certification orders from abroad are issued by the foreign government bodies concerned. Since SERNAP assumes responsibility as a government appointed organization, it has been classed, within the present study, as falling under the compulsory certification system.

It has no independent testing laboratory and uses certification bodies accredited by INN for its testing. It will issue certificates on the basis of the test reports obtained from these bodies. SERNAP has 40 technical fishery product experts on its internal staff whose responsibility includes the checking of the test reports and data. The size of its services amounts to approximately 20,300 certification orders a year. Chilean standards (NCh) are used for certification by SERNAP, with internal SERNAP and international standards being used as supplementary standards.

(10) IFOP

Under the control of CORFO, IFOP has a long history of 27 years as research institution. It also acts as a powerful certification body supporting SERNAP. The production engineering department takes care of research which covers areas such as production processes for fish meal and fish paste products as well as canned preservation methods. In the certification sector, it activities range from the detection of harmful components of fish meat to the loading of products as ship cargo. It has 119 engineer graduated from universities and 57 engineers on its staff. In addition to Santiago, it also has research laboratories in Arica and Iquique. They conduct chemical analyses, bio-assays, physical testing and assessment based on sensory perception. Financially, its income from services rendered for the private sector accounts for more than 50% of its revenue. Export certification accounts for 27% of its certification services. The most important items on its analysis schedule include pre-shiploading temperature measurement and assay of fats and antioxidants. Its quality control program includes the monitoring of protein, ash, salt and sand levels by chemical analysis. Its special analysis program includes for the detection of heavy metals. It commands an exclusive position in the certification of fish meal, and has gained substantial confidence from domestic and foreign users. For establishment of NCh standards, it gives INN an active cooperation. Its certification services cover to a large extent certification based on overseas standards and specifications as well as inter-government agreements.

(11) Universidad de Chile - Facultad de Ciencias Fisicas y Matematicas

The Chile University offers certification services for construction materials. These are primarily handled by IDIEM as described above. In addition, the Facultad de Ciencias Fisicas y Matematicas provides certification and calibration services undertaken by its Electrical Engineering Department and the Space Science Center. The Electrical Engineering Section acts as a certification body accredited by SEC. With the backing of an

extensive staff and a well-equipped organization, it certifies the safety of electrical products and parts. Thanks to its high level of technology, the Space Science Center maintains collaborative ties with NASA of the U.S.A., the German Antarctic Base, and the various countries of Europe. In the area of electronic equipment measurements, it calibrates measuring equipment once a year with NIST. For the calibration of time, voltage, resistance, and current, the University performs calibration with major foreign organization on a regular basis. Its calibration is provided for domestic services and instituted on the basis of such secondary metrological standards.

(12) SGS

SGS, a private certification body with a worldwide network, provides certification services, in Chile, to suit the structure of the nation's industry so that the main sectors are mining, agriculture, cattle-raising, and fishery production. Industrial products account for a rather small share in its certification schedule, amounting to only a little less than 10% of its turnover, although this area has shown a rising trend in recent years. Main lot certification is carried out for a product range, including primarily electric wire, luminescent light strips, electric bulbs, ceramics, wood/timber and products processed therefrom, textile fiber, and chemical products. It also performs certification services for quality systems, although these account for a very minor share of its business. At present, it has about ten regular customers, whose products requiring certification include industrial, agricultural, petroleum, and mining products. This certification services are rendered on orders placed by buyers and performed in accordance with manual specifically drawn up by SGS. These cannot be described as being of the ISO 9000 Series level, however, it has a staff of 40 auditors, with seven auditors responsible for industrial products. The breakdown of export to domestic certification services is 65:35. It has been accredited and approved as a certification body by the MINECOM, INN, MDS and MOP.

(13) ISP

ISP was founded in 1980 under the jurisdiction of the MDS. Its activities lie mainly in the public health area, including microbiology, preventive medicine, nutrition, pharmacology, pollution, risks due to natural disasters for workers, and workers' health. It has a staff of 580 employed at the Santiago center and the 25 regional branches. This includes 17 branches handling food products. Analysis techniques and results are under the supervision of MDS. ISP has double role as Chile's central certification body for pharmaceutical, medical products and food products and as an accreditation authority for 180 public and private testing laboratories. All of its services for pharmaceutical products are subject to the compulsory certification system pursuant to Codigo Sanitario. The products covered are not limited to products for the domestic market alone, but also included export products. For new drugs, ISP has the authority to grant marketing permission/approval. In the area of workers' protection against disasters and health protection, it provides witnessed inspection services in pursuance to national legislation in its capacity as the competent body for environmental control in the mining sector. it has legal duties to report to MDS. In the safety and protection equipment area, it approves certification bodies for safety helmets used in the mining industry and for large-scale construction projects, safety boots, belts, dust protection masks, and safety goggles. This system is maintained by regular once-a-year re-inspection. At present, accreditation has been granted to CESMEC and IDIC. Also within the scope of its certification activities come the fire extinguishers used by workers. While the certification regulations for extinguishers differ according to the supervisory ministerial authority in charge (MINTRATEL, MINECOM, MOP, etc.), they are invariably subject to compulsory certification. These regulations are based on NCh modified in such a manner as to take the particular nature of each Ministry into account.

(14) INFOR

INFOR is an organization belong to CORFO. With CORMA, it is the central body for the forestry industry. Its activities include research on re-afforestation to ensure lumber production (re-afforestation and felling), and research and certification for industrial exploitation, control of the forest environment, lumber market research studies, development of lumber technology, and the preparation of statistical data and technical information. Research for industrial exploitation and certification of timber products includes research on wood preservation techniques and resistance to aging, development of construction materials, designing of wood products (mainly dimensional standardization), and the market development for plywood and chip board, in addition to timber certification. Its wood and timber-oriented services concentrate on the City of Concepcion (No. 8 Province). INFOR is currently building a new research complex in Concepcion with plans to appoint it as a Technical Development Center. It has a staff of 130, including the Concepcion and Coyhaique branches. Its operation is assured on an annual budget of approximately 2.80 million US dollars, which is covered to 80% by revenue from projects under CORFO instructions.

Certification is primarily handled by the Concepcion branch. The standards used for certifications are partly NCh. The majority, however consists of export certification subject to the requests from export destinations. The items on the certification schedule include moisture analysis of timber, anti-rotting agents, chip inspection, dimensional inspection, and confirmatory (quantity) inspection. Radiata Pine (a pine variety) accounts for 86% of the total wooded land area (1.40 million hectares).

The certification mark is a hot-seal brand with the legend INFOR CONTROL CALIDAD. The fact that the branded mark differs from that of other certification bodies (using marks such as INSPECCION, GARANTIA, or CALIDAD CERTIFICADA) underscores the particular nature of this industry. Rather than being a certification body, it would be more appropriate to say that INFOR is recognized as a

quality control service.

(15) Universidad de Concepción

Following the central academic-technical institution for the industrial region around the capital, the Universidad de Concepcion conducts research and provides technical services for the region. The main industrial sectors of the region are wood and marine products. These also account for most of its certification activities. In the food area, including marine products, it issues test certificates under MDS. For marine product exports, it acts as a testing laboratory under SERNAP accreditation to issue test reports. It does, however, not have FDA accreditation. Universidad de Concepcion does act as a certification body with SEC and MOP accreditation. It certifies, though to only a very small extent, weighing instruments, safety of electrical household appliances, and construction/building materials. Preparations are currently being made to include wood/timber certification and testing services in its schedule.

(16) Other certification bodies

Besides the above 15 certification bodies, there are many other organizations which conduct certification. However, because of time restraint, site visit by the Study Team was not conducted.

3.3.3 Problem Areas Concerning the Certification System

To upgrade the quality standards of Chile's industrial products, promote exports and improve living standards for the nation's population, the establishment of a certification system meeting the EC market integration policies and the trade impediments policies of the GATT will be an urgent priority. In view of the present state of affairs, this will take at least five or more years to achieve. To make the certification system succeed, it will be vital to ensure quality control by the manufacturers. In this chapter, we will discuss the various problems areas on the premise that this condition is

recognized.

For the compulsory certification system, most regulations have now been established by the government aiming at the domestic market. Certification is also partly being provided for exports. In general terms, however, it is clear that more attention is given to the achievement of a voluntary certification system.

The results of this study have made it clear, however, that the voluntary certification system, especially the voluntary certification system using quality system evaluation is an extremely weak one. This is the biggest problem in and for the certification system. The following itemizes the various problems areas.

(1) Accreditation (or designation) method for the compulsory certification system

In certain cases it may be unavoidable for government and public authorities to implement a compulsory certification system of their own in pursuance to or on the basis of laws and decrees. The accreditation methods, however, are not unified, nor are they related to each other in any form. For example, MOP and MINVU lay down the condition that an INN-accredited certification body shall be responsible for the certification of the pipe material used for construction projects. For other products, however, MINVU will accredit (or rather designate as is the case in practice) its own certification body. At the same time, it will exercise an indirect inspection function by assessing the on-site achievement level reached by the certification body in its task implementation. SERNAP will approve only such certification bodies as have passed INN qualification.

In some cases, the approved range of activities is broken down. For example, the INN-accredited certification bodies include bodies whose activities are limited exclusively to sampling.

The following two observation will be made here as possible measures to overcome these problems.

The first measure to impart objectivity and transparency to the examination standards for accreditation may be to centralize the execution of accreditation procedure in the hands of a single entity such as INN, that is, a single or a very small number of accreditation bodies.

The second possibility is to regulate in a clear manner the range of certification activities. This may imply, for example, unification of sampling and testing/inspection.

In the near future, the issues of objectivity and transparency will be of very decisive importance for the evaluation of auditors and for the procedures. This is particularly important now as mutual recognition of the certification and inspection bodies has become an international problem. For the accreditation of certification bodies little known abroad and with a little record of trade in the industrial products sector, in particular, it will be essential to at least document the accreditation system and base the examination standards and the qualifications of the auditors as well as the followup for the accreditation procedures on ISO/IEC standards and guides.

In connection with the European market integration, the EC promotes a model approach system based on ISO/9000 series. Already 11 product items have been specified as having a potential for exports from Chile. This list is likely to be extended.

Chile has at present no department assuming overall responsibility for these activities as a whole. It is therefore worthwhile considering the possibility of unifying the accreditation procedures made individually by each ministerial authority concerned. It is proposed that this unification of ministerial accreditation may be directed through INN as the center. This would naturally create the absolute need for strengthening INN to cope with this role.

As plans to upgrade the qualification capabilities at INN, it will be of paramount importance to ensure the expansion and reinforcement of staff education and training and enlist the cooperation of specialists.

This may ensure the formation of a certification body with overall capabilities and permit the development of a unified certification system under the voluntary certification system in which INN plays a central role.

(2) Laying down of NCh Standards used for certification

The importance of the establishment of a comprehensive standards system has already been stressed in 3.2. as a major prerequisite for the success of the certification system. In this connection, details have been given concerning practical measures to achieve this.

The activities required for providing the standards are best covered by INN's organization and should be undertaken ahead of the preparations for the broader system. Standards overlapping other standards in areas such as testing and inspection methods, in particular, should be adjusted to the latest ISO standards. Priority in the creation of the standards system should be given to standards for products designed for the domestic market and products considered to have a promising export potential.

(3) Establishment of accreditation criteria

At present, none of the criteria applied for examining and assessing certification bodies by the accreditation bodies are documented. For conducting the examination procedures for accreditation, specific criteria will necessarily be required as these criteria vary according to product category with the certification procedures, the required equipment and staff.

By determining the accreditation assessment criteria beforehand, certification bodies seeking accreditation will be enabled to make

the necessary preparations for accreditation assessment. This will also have the benefit that the assessment for accreditation will be made clear and transparent for outside parties.

This will be an indispensable requirement in case that mutual certification with foreign countries will be demanded.

(4) Differentiation between certification bodies and testing/ inspection bodies

In Chile, certification bodies and testing/inspection bodies are mostly viewed as one and the same. In view of the human resources, equipment, operating procedures for the service, and the accreditation assessment criteria, however, it must be recognized that these have different functions. While one body can and may be capable of performing the work of both, there should be a distinction between the two as they represent totally different functions as is also clear from the viewpoint of transparency.

Current world trends agree that the accreditation bodies apply different assessment criteria for certification bodies and testing/inspection bodies, respectively.

(5) Product traceability

In Chile's certification system, both for compulsory and voluntary certification, most certification takes the form of lot (product) certification. In this case, it is absolutely vital that there should be a clear and unambiguous correspondence between the product lot in question and the certificate concerned. This correspondence must be obvious even to third parties. The correspondence between shipment lots and production lots must be traceable within the quality system. Under present conditions, however, there is fear that the certification body may not even have sight of, or monitor, the mark (including certification seal) display control. This makes it most desirable, therefore, to introduce urgent improvement to ensure that methods for a clearer

differentiation of certification lots are adopted.

(6) Improvement in certification mark use

The certification mark must be useful for the user and purchaser alike. At present, however, the numbers and codes showing the certification body and the lot code number, standard applicable, certification date, the code for the officer in charge, the differentiation code to distinguish between compulsory and voluntary certification are mostly in need of review. Thus, for example, the certification marks currently in use have a different design for each certification body. This means that different marks may be attached to the same type of product (if certified by different certification bodies).

In view of the essential purpose and meaning of the certification system and also in terms of the future propagation of the certification system, however, it is more desirable that a mark showing the certification system itself (rather than the individual certification bodies) should be used, as is the case with the JIS mark, for example.

(7) Documentation of the certification procedures

Conformity mark certification and lot certification require the preparation of manuals for documenting the certification procedures. The main details should be indicated to the manufacturer and buyer. In some cases it may be necessary to take a stand between the manufacturer and buyer in preparing or agreeing the specifications. This makes it vital that the certification procedures should be laid down in written form (documented).

The auditors in charge of certification duties at present, are recruited at all certification bodies from the top ranks of graduated students academic record, but there is no training provided in accordance with organized training programs. This suggests the need for the inclusion of personnel training in the

service programs within the certification system creating program. It will thus be necessary to prepare certification manuals to serve as textbooks for such training purposes.

(8) Provision of weights and measures system

This will form the subject of a more detailed discussion in a separate chapter. The weights and measures system is a major support on which the certification will rest. We will therefore only mention this as an improvement area and refer to the chapter dedicated to this topic.

(9) Use of international units for certification

NCh Standards are generally drawn up in SI units in accordance with ISO guidelines. For site certification, however, the previous units of weight and measure are used (for example, for tensile strength). The difficulty of changing over to a different system of units has been experienced by many countries. INN has prepared such promotional materials as conversion measures and tables. In view of the difficulties of changing to the new unit system, more extensive efforts should be made so as not to lag behind the international trends.

(10) Speeding up the certification process

The national universities and public research institutes conduct certification side by side with private certification bodies. The public and private or specialized bodies all have their particular characteristics so that some investigation will be needed to identify the problems that may prevent each certification body from achieving a faster turn-round in its certification service as a result of its particular nature. Applicants seeking certification will use an approved certification body, and the fact that the different certification bodies operate on a vastly different time scale to complete the certification process with the issue of the certificate is bound to be a major hindrance in the propagation of the certification system.

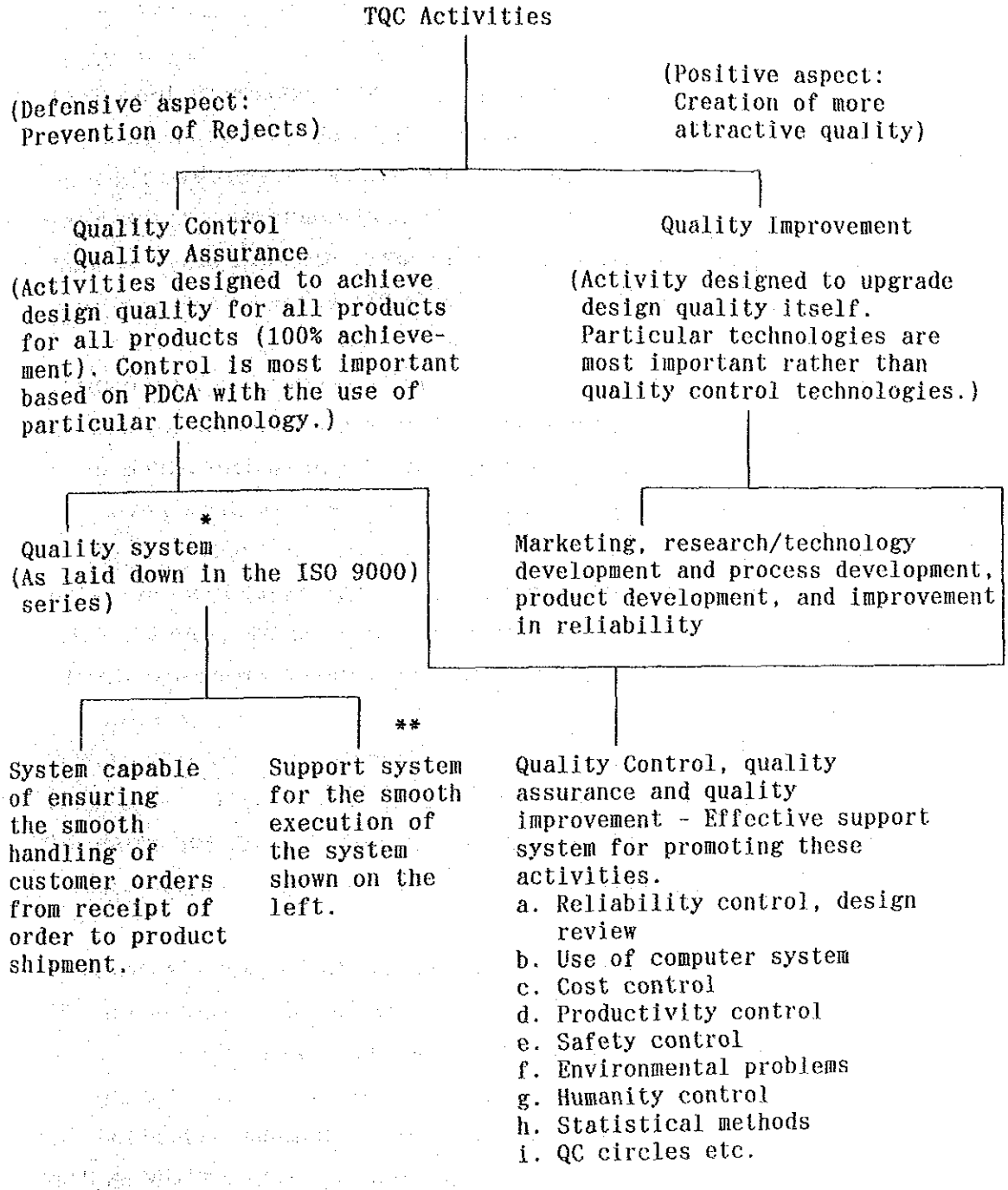
3.4 Quality Control

3.4.1 System and Legislation

(1) Worldwide trends in Quality Control

In recent years, one of the worldwide trends in quality control has been to adopt quality control activities on a more global and universal level rather than in the narrow sense of simple production control. This is known as Total Quality Control or TQC for short. In Quality Control, it is thus not only a matter of paying attention to the conformity to customer's requirements or specification. Instead, Quality Control is taken as a "big QC effort" including company-wide and society-wide quality control such as cost control, reliability control, environmental issues and safety problems and including a dynamic, positive approach to create more attractive quality. In this section, we will present the "quality system" concept of the ISO 9000 series as being one of the worldwide trends in recent quality control activities. This section will also try to define the position of this "quality system." Fig. 3.4-1 shows the system. As can be seen in the figure, TQC has a double aspect. One is the defensive-protective aspect designed to prevent the occurrence of nonconformities. The other is a more dynamic and positive aspect which tries to create more attractive quality. In quality activities, the latter, that is, the dynamic aspect of TQC is more important. The defensive aspect of preventing the occurrence of nonconformities is essential as the foundation of TQC.

But with this "foundation" alone, quality activities are not positive in the sense of trying to create attractive or appealing quality. Total Quality Control must therefore be a well-poised balance between the two.



* : Quality system may, if necessary, be required official accreditation under the CERTIFICATION SYSTEM.

** : EQUIPMENT CALIBRATION is included herein as a sub-system.

Fig. 3.4-1 TQC Activity System

(2) Quality System

The previous Figure 3.4-1 makes it clear how extremely important the "quality system" is in preventing the occurrence of nonconformances as part of the TQC activities, that is the achievement of design quality for all (100%) products. To prevent the occurrence of nonconformances, the minimum requirement is that the following two items should be implemented.

1) Products (including services) must meet the customer's specifications and must give customer satisfaction. This is not a particularly new concept, but the next item (item 2) is a novel idea.

2) The system creating the product must be properly controlled and technology properly conveyed so that design quality will not give rise to "flaws" and lead to excellent reproducibility for quality.

   Such a system is normally called a "quality system". Recently, it can be frequently encountered in the form of "quality assurance manuals".

   Most recent ideas about quality control favor the view that it is essential that the "quality system" presented in 2) functions perfectly in order to assure item 1).

   Let us liken this to medical therapy on humans. If 1) is the therapy to cure the disease concerned, then 2), quality system will correspond to the daily health control system.

(3) Worldwide trends concerning current ideas about quality systems

In human therapy, there is a tendency to view the daily health control system as more important than the specific therapy to cure the disease concerned. In the same manner, more importance has recently been put on the background environment (state of health of corporate quality control) that produces good or poor quality

rather than the respective occurrence of good or bad quality products.

This suggests that the concept of "quality" used in a recent context, does not refer to any specific product but is taken in a more broader sense. It has a more global scope including environmental problems, safety issues and so forth. It has quite clearly emerged in the gradual evolution of the TQC philosophy. The recent swift sociological changes also be taken into account in the concept of "quality" above, such that towering urbanization, electronic systematization and increasing in size of socio-structure are rapidly emerging. This brings with it moves to demand manufacturers to accept liability as has been seen in airplane crashes and incidents or accidents at nuclear power stations. There are also moves demanding that the consumer should have the right to insist on safety, the right to know, the right to be informed, the right to choose, and the right to have his own opinion heard. This quality system philosophy in the context of quality control activities is assuming worldwide significance.

(4) Introduction of the quality series based on the international standards of the ISO 9000 Series in Quality Control System

Now we shall have the philosophy that "this quality system approach is thus the basis of quality control and without it no real quality activity is possible and no technology transfer can be made. It is a social obligation to bring this about and ensure that all concerned with quality control follow it up. If this is not carried out, the company will not win when an accident has occurred and the case is brought to court. It leads to mistaken corporation action. This philosophy is currently endorsed on the drafting of standards concerned. The ISO 9000 Series was established as an international standards as a general expression of this philosophy.

This shows how the world is changing. It is no longer just a matter of "good quality.". Rather "Good Control" is also regarded important in assessing the value of a product. But this "good

quality" is not a matter of one person's opinions. It must be objective "Good Quality" that is accepted or recognized throughout the world on the basis of the international standards of the ISO 9000 Series.

When we speak of the ISO 9000 series international standards, this shows a meaning that countries from all over the world are positively trying to introduce these standards into their quality control system.

(5) The positive aspect of TQC activities

In (2), (3), and (4) above reference was made to the "defensive-protective aspect of the TQC activities, which, as shown in the left part of Fig. 3.4-1, include "the prevention of occurrence of nonconformities and the achievement of design quality for all (100%) products."

This concern over the prevention of occurrence of nonconformities and the achievement of design quality for all (100%) products, is something the customer tends to "take for granted." It is not something which is considered "attractive" or "interesting."

It goes without saying that "the prevention of the occurrence of nonconformities" is part and parcel of the upgrading of quality through improvement programs. But this too is something taken for a granted.

TQC activities the aspect given in the right half of Fig. 3.4-1 is of true importance. This is the positive aspect of creating an attractive quality."

ISO 9000 and ISO 9004 make it clear in the prefaces that this consideration is of crucial importance.

Yet, the positive aspect of "creating an attractive quality" is a function that starts from the basis of "the prevention of the occurrence of nonconformities" and "the achievement of design

quality for all (100%) products."

The proposals which will be presented here in 5.2 centers mainly on the "defensive-protective aspect" of "the prevention of the occurrence of nonconformities" and "the achievement of design quality for all (100%) products." It does not center on the "positive aspect" of "creating an attractive quality."

The proposal suggested here says the implementation, in Chile, of the "defensive aspect of TQC activities" by introducing a quality system based on ISO 9002 of the type to be presented later.

The background for these proposals is of course the idea that quality control/TQC activities in Chile will not be going to stand still at the "defensive aspect" of quality control alone. Rather, the point is that this must form the foundation or based for a further evolution in the direction towards spontaneous quality control/TQC system based on ISO 9004, thus holding out the hope for activities developed on the "positive aspect" of quality control.

Fig. 3.4-2 "Stages in the Upgrading of Quality Control/TQC Activities" sums up the points made here.

This figure starts with stage 1 in the process of Upgrading Quality Control/TQC Activities and comes to completion in stage 4 which entails the positive quality activities.

The suggestions made in this section and the proposal to be presented in section 5.2 correspond to stage 2 (Basic Quality Stage).

As stated earlier, after Chilean Quality Control/TQC Activities has reached the stage 2 shown in Fig. 3.4-2, a further move toward more positive quality control activities should be undertaken toward stages 3 and 4. It is important to realize that the configuration of the quality system under the ISO 9000 Series is thus not the "end" of quality control but rather the "beginning" of it.

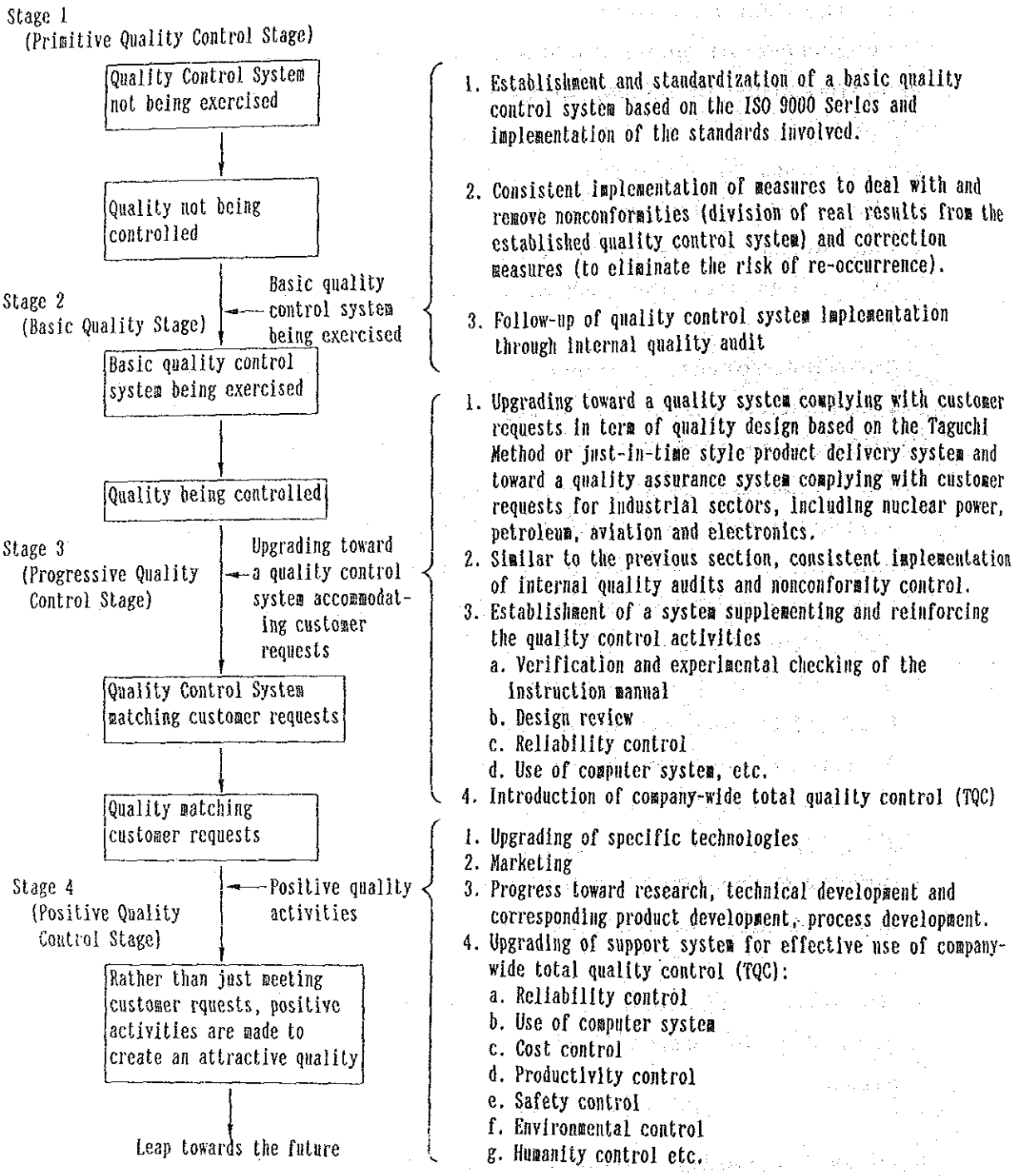


Fig. 3.4-2 Stages in the Upgrading of Quality Control/TQC Actitivies

3.4.2 Diffusion Body

(1) General outline

For the diffusion of quality control, it is essential that the following should be established:

1) Body capable of correctly assessing the real state of a company implementing quality control and trying to diffuse quality control in accordance with the needs of each company.

2) Body accepting the above needs given in 1) and teaching quality control by establishing a teaching curriculum.

3) Body providing financial support for quality control training.

4) Body capable of balancing the above actions from the viewpoint of a national policy. Disregarding some very few exceptions, a system of this kind is currently in operation or in service in Chile.

In Chile, the bodies given under 1) above correspond to the various industrial organizations or associations, 2) corresponds to INN or ASCAL or similar training organizations, 3) corresponds to SENCE as being a government body, and 4) corresponds to INN. Since there is no effective system in operation of 4) in Chile at present, we will present the type of system there should in 5.2.2-1.

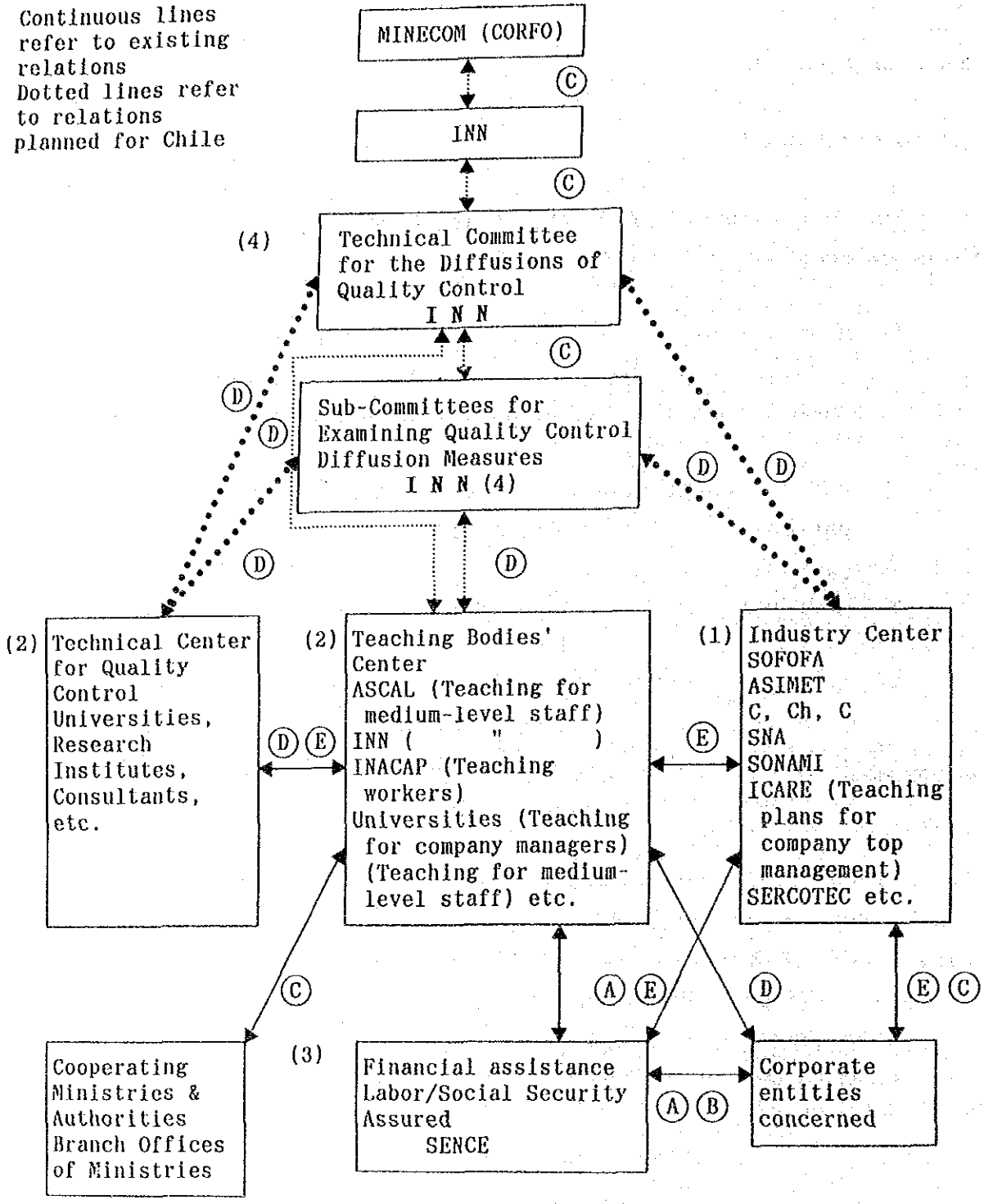


Fig. 3.4-3 Overview Chart of Quality Control Diffusion

Notes: Explanation of letters (A - E)
(1) - (4): Apply to above
A: Inspection and providing with Codigo SENCE mark for teaching bodies, equipment, curricula
B: Tax exemption amount associated with implementation of teaching
C: Control - Supervision
D: Sending out of lecturers, committee members etc.
E: Exchange of information
Activities of sections shown in (1) - (3) above are given in outline.

(2) Diffusion of quality control by the industrial associations

Chile has various industrial associations which have departments for the training of staff with the inclusion of activities to propagate quality control for the companies they represent as shown below. These draw up teaching programs.

1) ASIMET

Apart from the labor, environment, and economics departments, it also has a training department holding 2000 courses a year, with a curriculum of 100,000 hours of teaching.

2) C.Ch.C

With the American style construction warranty system being introduced, a new "Quality Promotion Department" has been created during the current fiscal year taking up quality problems.

3) ASEXMA

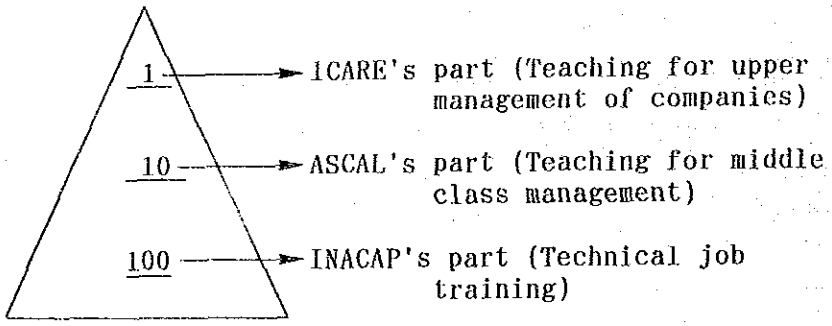
As a general meeting of the boards of governors within the Association, it has committees for training, finance, transport, QC, and agreements with foreign countries. They handle questions concerning the companies represented by the Association. The activities devoted to training and QC started in 1990.

4) SOFOFA

In addition to its departments relating to economic affairs, exhibitions, international relations, and housing for workers, it also has a vocational training department and offers curricular courses for the employees of the companies represented by the Association.

5) ICARE

This organization has a similar nature to that of the Japanese Federation of Economic Organizations. It has 400 companies under its umbrella. This Federation is characterized by the fact that it provides training for companies represented by it. ASCAL's activities are mainly directed at training staff of middle class management while INACAP offers mainly technical job training. In contrast, ICARE provides training for upper management. Yet, ICARE does not conduct teaching activities itself. The relative breakdown of the teaching activities is as outlined below.



However, the role these various Associations and Federations play in connection with the training their own members has not advanced to a level of providing actual training, as it basically goes only as far as training program planning, though special seminars are held by the Associations and Federations to meet the needs of the companies represented by them.

Actual training is provided by a teaching system centering on SENCE (as shown in (4)) which presents particular tax advantages.

(3) Training organization (INN, ASCAL, SANTIAGO University given as examples)

1) INN

(a) INN organization

See Fig. 3.1-1

(b) INN's teaching activities

INN's teaching activities are undertaken by the education section within INN.

Teaching and training in INN goes back to the time of its forerunner, INDITECNOR, which commenced teaching in 1969. Training courses are as shown in section 3.4.5. There are five courses on different subjects.

The courses are divided into three sections per year, each designed for a different target audience. That is, there are three levels of courses, one for inspectors, one for professionals, and one for advanced students.

a) Inspectors' course: during a year
b) Professionals' course: for a total of 50 hours, during a year
c) Advanced course: for a total of 50 hours, from October through November.

In addition to these courses, INN also arranges meetings to explain new standards (SI units etc.) and seminars taking place on an irregular basis. In 1991, seminars are to be held on the subject of the ISO 9000 Series.

These teaching and instruction programs are decided through mutual talks (taking place on an irregular basis) between INN and the companies releasing their staff to

participate in the event. INN has four permanent in-house lectures.

For ordinary courses, INN does not invite outside lectures. For special courses, however, INN will occasionally call on external lectures, including foreign lectures. Prior to fiscal 1990, INN had organized three special courses, but none were held in fiscal 1990. Course arrangement for fiscal 1991 are now in preparation.

Training events are normally held only in Santiago. Seminars have been known to take place also in Conception and other cities on requests. Performance assessment of the trainee is made on the basis of their homework and intermediate as well as final examinations. The qualifying conditions for a pass in the examinations is that examinees must acquire at least four awards out of seven and have an attendance record of at least 75%.

2) ASCAL

(a) Outline of ASCAL

Quality control activities in Chile have seen a rapid growth over the last ten years or so. This is due mainly to the heightened need for product improvement, a need felt primarily among the exporting companies. Quality consciousness has gone so far that pharmaceutical and chemical companies, for example, are now obligated to have their own testing laboratories for quality assurance.

ASCAL came into being in 1968 as a private body and has played a crucial role in the teaching and training of quality control in Chile ever since.

At present, it has a total membership of some 200 companies, ranging from industrial to service enterprises

in the private sector as well as some public corporations. ASCAL personnel organization consists of one Chairman, seven Directors of the Board (one Director of Finance, two Directors of Training, one Director for Membership, two Directors for Development, and one Director for Events), six full-time staff members, ten part-time lecturers (staff members of job experience sent from the member companies), two university teaching/professional staff members (in charge of weights and measures control and of "drawings reading").

ASCAL has branches in Concepcion, Vina del mar, and Arica. Its operating costs amount to 25 million pesos (830,000 US dollars) a year. These are covered by membership fees to 40%, while the remaining 60% is earned by operating profits. It receives to financial aid from the government and has to rely solely on its own budget.

(b) Relationship between ASCAL and other teaching/training bodies

ASCAL provides general training on standardization and quality control. The other teaching/training organizations have a more specialized nature. There are some other general teaching organization similar to ASCAL. In view of the desirability of competition between the teaching bodies, these organizations do generally not adjust the contents of their teaching.

There were certain engineering colleges, however, which will conferred with ASCAL to adjust their teaching programs, when they offered quality control courses in their curriculum.

(c) ASCAL's teaching activities

ASCAL's teaching activities are streamed to various directions, including QC, general quality control, reading

of drawings/charts, control of weights and measures, etc.

The training courses are aimed at a wide range of candidates, including operators, supervisors, and company owners. In the quality control area, ASCAL also assists companies in the organization of quality control.

Participants attending ASCAL courses are assessed on the basis of their attendance record and the submission of a report, but no passes are given after the course. On course completion, a certificate will be issued.

Questions concerning the offering of new courses and the changing of the contents of existing courses are decided by ASCAL's Teaching Department Head and the lecturing staff who discuss and agree such matters. TQC, QC circles and diffusion of the ISO 900 Series are to be included in future training courses.

Publicity for ASCAL's teaching courses takes the form of direct mail shots to the subscriber companies. Every October has been instituted by the 1986 Presidential Ordinance as the Quality Control Month, and for ASCAL this is an occasion to invite foreign lectures for quality control seminars. In 1990, Chile hosted the QC Congress. At this Congress, thirty participants made presentations about ISO 9000 Series.

Exchange of information and opinions were also made at the congress by participants. ASCAL also has a publishing department, releasing, ASCAL's official bimonthly journal. It elicits awareness of quality control from the consumer and the management level.

3) Special quality control courses offered by Santiago University

The Santiago University offers an annual special quality control course entitled "Gestion y Control de la Calidad" - Quality Management and Control.

Aimed at company employees, this course is available only to candidates who have graduated from university after completion of a full four-year university course. This special training course has been given the SENCE Code number 06-28-0376-13 (see later).

Quality control teaching at university level concentrated in technical methodology such as "inspection" and "statistical methods". The Special Course offered by the Santiago University is directed at the upper level of management. At present, there is a permanent staff of 12.

Initially, the course was research-based concentrating on a quality control system for nuclear power stations. Although Chile has currently shelved its plans for nuclear power generation, there is still interest in new research on quality control systems for nuclear power generating facilities, when the interest is holding courses of this nature.

The current course started from 1990, and a course of the same standing, that is, the "Production and Quality" course, has begun to be offered since last year at the Catholic University.

(4) SENCE's leading role in the cost aid system for vocational training

1) Outline of SENCE

SENCE is a government body belonging to MTPS. It sees its basis mission as an institution trying to make a contribution to resolving the labor problems in Chile by offering vocation

or Job training for workers and job-seekers.

At present, SENCE has a regular staff of 140 (80 at the Santiago headquarters and the remaining 60 in its branches).

2) Merits of the training system offered by SENCE

Business proprietors can avail themselves of tax advantages, if they offer their employees training through SENCE in that they are eligible for a 1% deduction in tax on the personnel costs for the employees sent on the training. However, the tax authorities will not cover more than 50% of this 1% bracket for high-salary earners whose personnel costs are equal to or in excess of 260,000 pesos/months.

3) Teaching bodies and training courses in the training system offered by SENCE

The training bodies and training courses coming under this training system, include courses at the Specialist Job Training Center as well as courses run by companies.

Eligibility for inclusion in this system, however, is subject to the training body's being registered with SENCE. All training courses must have a SENCE-registered registration number (Codigo Sense).

For this purpose, SENCE receives a large number of applications for registration from various teaching organizations for new courses. SENSE will examine these applications for new courses before granting registration. Let us take computer courses as an example. SENCE will examine whether the organization making application has computer facilities and will investigate similar details of the teaching facilities available and check the qualifications of the lecturers as well as the course fees.

This is also the case, when the in-house training of companies is applied to this system. At present, a little under 900 teaching/training organizations are registered with SENCE. This includes the twenty bodies concerned with quality control such as INN, ASCAL, INCAP, INTEC and SERCOTEL. Also acknowledged by SENCE are the University and Technical College. The cases of INN, ASCAL, and Santiago University are shown in 3).

4) Implementation of education under the SENCE training system

In 1990, this training system had a record of having attracted some 6,000 companies and some 200,000 people, with a cost compensation award under the tax exemption system totaling some 30 million US dollars.

Seen in perspective, however, the above total of 200,000 people is only 5% of Chile's working population. In 1991, attendance is to be increased to 240,000 people.

The performance records of the SENCE teaching system show that the number of companies has increased by 15% and the number of participants by 17% over the last 15 years. The area with the biggest rate of growth has been the computer sector. The next-biggest growth area has been the maintenance and servicing of agricultural, forestry, fishery machines and equipment.

The SENCE training system has also attracted, for the last two years, attendance from young people aged 15 to 21 and employed by manufacturers intending to train them. These courses also attract favorable tax exemption conditions as presented in (4) - 2), and legislation does not allow companies to employ more than 10% of its total personnel for the purpose of training. The rate at which the total cost compensation award under the tax exemption scheme has growth amounts to 3% over the last 15 years. SENCE hopes that the total cost compensation award money will register a 5% growth as quickly as possible.

5) Relationship between the SENCE training system and the training offered by the various associations or companies presented in 3.4.2-(1) - 1).

The associations do not more than draw up teaching programs, and 90% of all teaching and training programs envisaged by these plans are carried out through the SENCE teaching/ training system.

Some companies may spend more on teaching/training than the amount awarded under the cost compensation scheme.

3.4.3 Teaching and Training Facilities (with INN and ASCAL as representative examples)

(1) INN's facilities

Teaching and training at INN is normally conducted in INN's in-house class rooms.

(2) ASCAL's facilities

Similarly, teaching and training at ASCAL is normally conducted in its in-house class rooms. QC circle teaching, however, is conducted by sending the lecturing staff out to the companies concerned.

The facilities owned by the teaching and training bodies are now rather well equipped, so that it is felt that they need no particular remodeling or reinforcement at present.

3.4.4 Level of Qualification and Number of Lecturers

Staff (taking the INN and ASCAL teaching programs and the Santiago University Special Quality Control Courses as examples)

(1) Situation at INN

For its ordinary teaching and training program, INN has a permanent lecturing staff of four, all of whom are in the employ of INN and university graduates. It should be noted, however, that they are not exclusively attached to INN's education section.

(2) Situation at ASCAL

ASCAL has ten part-time lecturers (managers sent from the various companies concerned) and two university professors (in charge of weights and measures control and of "drawing/chart reading")

(3) Situation for the Santiago University Special Quality Control Courses

A total of 14 members are available for conducting the Santiago University's Special Quality Control Courses. All are university graduates. They consist of 11 Santiago University professorial staff members (professor and assistant professor), one INN staff member, and 2 company managers.

3.4.5 Curriculum and Textbook (Taking the INN and ASCA Teaching Program and the Santiago University Special Quality Control Courses as Examples)

(1) Situation at INN

INN offers the five in-house quality control teaching courses covering the following detailed subjects:

1) Basic quality control - SENCE Code: 06-28-0235-13

- Introduction to Quality Control
- Basic mathematical principles

(a) Probability theory

(b) Frequency distribution
(c) Normal distribution

- In-process quality control
- Acceptance/reception inspection

2) Index (Attribute) - Based Quality Control SENCE Code: 06-28-0236-13

- Introduction to Quality Control
- Technical standardization
- Basic mathematical principles
- Tolerances
- In-process quality control by variables
- In-process quality control by indicates/attributes
- Acceptance/reception inspection
- Principles and methods for sample selection
- Drawing up sampling plans by indices/attributes
- Drawing up acceptance plans by indices/attributes
- Product acceptance concept by variables

3) - Quality Control by variables
- Basic mathematical principles
- Statistical in-process quality control
- Sampling plans by indices/attributes
- Sampling plans by variables

4) Total companywide Quality Control

- Concepts of quality
- Concepts of technical standardization
- Company control functions
- Modern philosophy on in-company Quality Control
- Total Quality Control
- Criteria for quality concerning each company function

5) Causal analysis and solution of quality problems at the company level

- Classification and origin of defects and errors
- Value analysis
- Pareto analysis
- Ishikawa or cause/effect diagram
- Application examples

(2) Situation at ASCAL

ASCAL offers seven Quality Control courses.

1) Basic Quality Control for workers

Teaching time: 34 hrs.
Instruction time/day: 2 hrs.
SENCE Code: 01.06-0408-13

2) Quality Control for supervisors

Teaching time: 30 hrs.
SENCE Code: 01.06.0348-13

3) Total training for QC circle members

Teaching time: 30 hrs.
SENCE Code: 01.08.1905-13

4) Quality Control circles for leaders

Teaching time: 30 hrs.
SENCE Code: 01.01.1118-13

5) Quality Control circles for executives

Teaching time: 12 hrs.
SENCE Code: 01.08.1955-13

6) Teaching methods

Teaching time: 40 hrs.
SENCE Code: 01.08.2668-13

7) Statistics in Quality Control

Teaching time: 40 hrs.
SENCE Code: 01.28.0339-13

(3) Situation for the Santiago University Special Quality Control Course

Santiago University offers Special Quality Control Courses (SENCE Code: 06-28-0376-13) covering the following subjects:

- Module 1

Applied statistics, 48 hours
Production management, 32 hours
Standardization and the drawing up of technical specifications and standards, 16 hours

- Module 2

In-process Quality Control
Materials Quality Control, 16 hours
Total Quality Control, 32 hours

- Module 3

Quality Assurance, 16 hours
Experimental design and process optimization, 32 hours
Reliability and maintainability, 32 hours
Conformity certification, 16 hours

- Module 4

Strategical Quality Control, 32 hours
Quality Inspection techniques, 32 hours
Metrology, 32 hours

3.4.6 Teaching and Training Records

(1) Teaching and training records established by INN

Fig. 3.4-4 sums up the teaching and training records achieved by INN in the period from 1973 through 1989. The results show that INN ran an average of 12 courses a year, attended by an average of 288 participants a year, with an average class size of 24 persons per course.

(2) Teaching and training records established by ASCAL

Table 3.4-1 sums up the teaching and training records achieved by ASCAL during the fiscal year of 1990. The results show that ASCAL held 21 courses during the year, attended by a total of 314 participants, with an average class size of 15 persons per course. The average cost per student was 21,695 pesos.

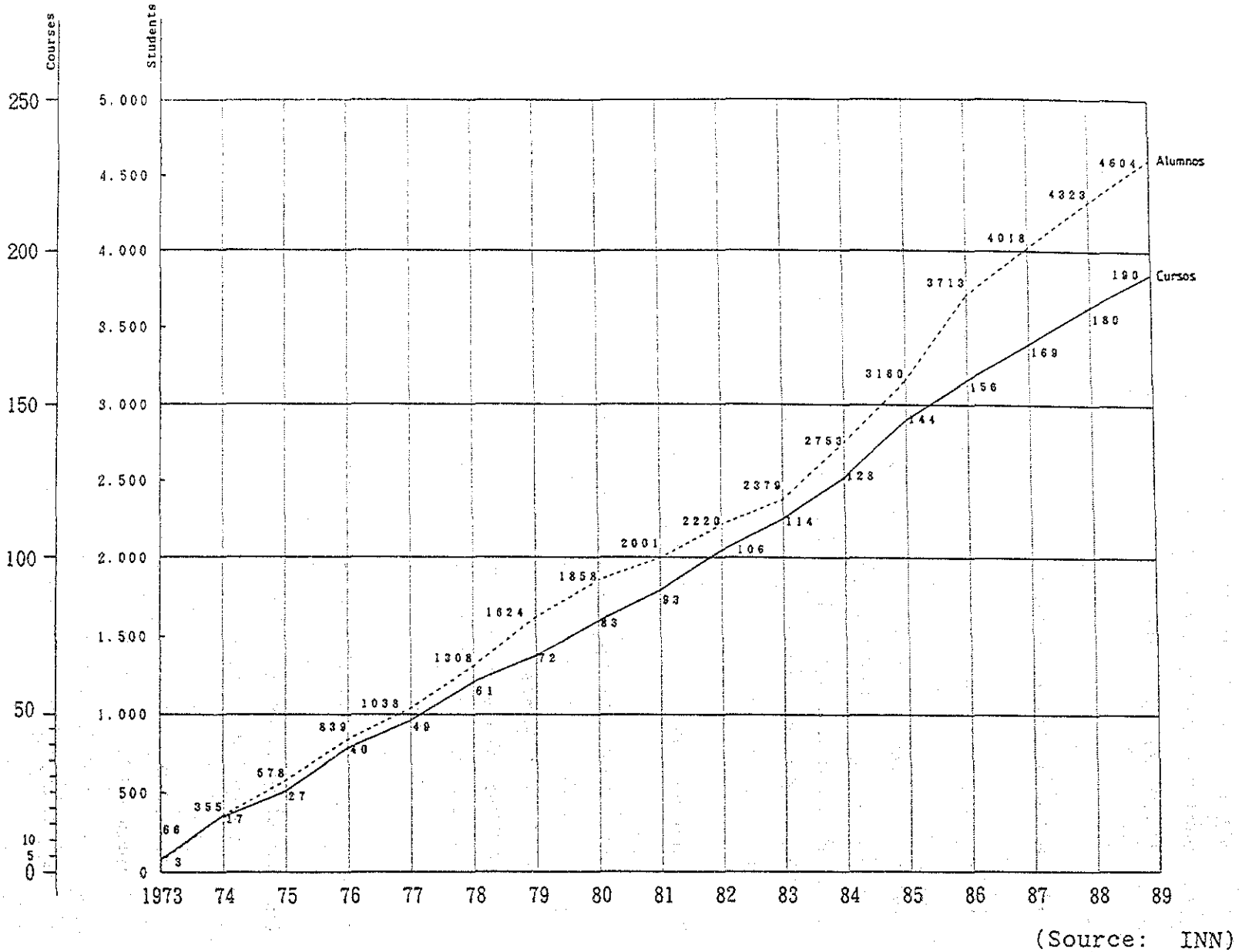
3.4.7 Current Status for Quality Control in Private-sector Companies

(1) Questionnaire inquiry on the current status of industrial standardization/Quality Control

The responses to the questions on Quality Control/TQC of the questionnaire can be summed up as follows.

1) Recognition and awareness of Quality Control/TQC in Chile

In Chile's industry, the word Quality Control tends to be taken as meaning INSPECTION to a very large extent.



(Source: INN)

Fig. 3.4-4 Courses and Seminars Held by INN and Participants in the Years 1973 - 1989

Table 3.4-1 Teaching and Training Records Established by ASCAL

Course Number	No. of courses offered		Attending students		Revenue
			Qualified students		
Basic QC	7	21 QC course	98	QC 314	2,215,502
QC for Supervisors	7		103		2,161,118
QC Circle Members	2		45		580,720
CC Circle Leaders	1		12		435,435
CC Circle Executives	1		12		297,555
Statistical QC	3		44		1,145,532
Metrology	2		33		708,720
Instruction methods	1		14		228,492
Non-destructive testing	1		9		253,500
Total	25		370		8,026,574 pesos

(Source: ASCAL)

The factory visits made by the study team have produced information suggesting that Chile's industry is moving toward the introduction of the recent ISO 9000 Series, and at some companies it was found that their understanding of the term Quality Control was not merely a "Product Inspection" procedures but that the interpretation of the term was gradually developing toward "In-Process Inspection" and "Product Inspection" conducted by the Inspection Department as an independent entity from the manufacturing department. Some other companies bore witness to a further change in meaning with a much broader interpretation of quality activities in a wide sense, including the notion of AUTO-CONTROL or SELF-IMPOSED INSPECTION as defined in ISO 9002, 4.8.1-b).

It is thus clear from the questionnaire responses and the comments heard during the factory visits that while the terms Control de Calidad or Control Total de Calidad may not be synonymous with Japanese QC activities and TQC activities, they are gradually assuming an interpretation of a more global quality activity including the more advanced upstream processes rather than simple "Product Inspection".

It must be noted, however, that in Chile's present-day industrial sector no clear distinction is made between Control de Calidad and Control Total de Calidad. This calls for the urgent need to teach and propagate the latest ideas about Quality Control, quality systems, and TQC as shown in Section 3.4.1 in the light of the most recent worldwide trends.

2) Introduction of Quality Control/TQC

Many companies are contemplating the introduction of Quality Control/TQC (72% of all companies responding to the questionnaire. If the term Quality Control/TQC is interpreted in the sense given toward the end of Section 1) above, it is clear from these responses that there is a willingness on the part of Chilean industry to accept Japanese-style TQC thinking, although it is also true that the terms of Quality Control and Total Quality Control are still being confused in Chile.

Yet, it is also true that a substantial 28% of Chile's companies have not introduced Quality Control or Total Quality Control due to the lack of equipment and human resources. The situation shows that Chile's industry has not yet reached the perception of Quality Control/TQC activities as something that can be done leaving aside these shortcomings in terms of equipment and human resources.

There is also evidence of Chile's companies having some misgivings about the negative aspects that the effects in terms of saving materials, reducing manufacturing costs,

achieving shorter delivery times, and reducing manpower were not so significant as had been anticipated, and that may easily be associated with the introduction of Quality Control and Total Quality Control.

It indicates that the quality activities intent on optimizing all quality-related factors from a broad angle of view, in other word, that the TQC activities, have not reached maturity yet.

This is one of the factors that suggests the very substantial need for TQC teaching.

3) Quality Control and Total Quality Control Promoters

While 69% of all respondents stated that intermediate Quality Control officers and staff were promoters of Quality Control and Total Quality Control, only 12% felt so about the companies' top management.

In view of the absolute need for company top management to take the initiative in the promotion of Quality Control and Total Quality Control, this result indicates that Chile is still at the stage at which Quality Control and Total Quality Control is left to the personnel in charge.

The above figure (of only 12% of the respsondents feeling top management was trying to promote Quality Control and Total Quality Control) is an unambiguous vindication of the need for stepping up Quality Control and Total Quality Control teaching for top management at Chile's companies.

4) Need for introducing a quality system philosophy

As stated above, the essential factor of Quality Control and Total Quality Control were in terms of the broader understanding of QUALITY, the questionnaire responses may be summarized as follows.

(a) Internal or in-house standardization

The inquiry showed that 70% of the respondents stated that external standards and specifications are used directly as internal (in-house) standards. This indicates that the basic principle of in-house standardization as an effort to translate the requirements given from outside into terms easily applicable to the inside organization of the company has not been generally endorsed yet.

(b) Quality system style control

The inquiry showed that a high proportion of 57% of all respondents felt that the areas in which Quality Control and Total Quality Control are being applied extend only to production control and the final products.

This is clear evidence of a lack of understanding for the vital need to embrace a quality system approach that includes the upstream and downstream processes as well as external factors.

(c) Nonconformity control

The responses indicate that the most widespread statistical methods used in Quality Control and Total Quality Control are the check sheet and the control chart. (43% and 36% of the respondents gave these methods, respectively.)

These two statistical methods are the most widely applied techniques for on-line control. For off-line control, however, the use of factorial analysis (histogram, distribution graphs, Paleto chart, Cause & Effect or Ishikawa diagram techniques) is still not adequately developed.

At present, nonconformity control as an important item in the context of Quality System, is being carried out in the form of "passive responsive measures" or "actions" involving the isolation of downgrading or rejection of nonconforming products. Yet, there is little evidence of activities seeking to take "active remedial measures" on an off-line basis with a search for means to prevent the reoccurrence of defects.

(d) Training and teaching

A substantial proportion of the respondents stated that teaching was conducted either by releasing personnel to take part of external seminars (48%) or by giving on-the-job or on-site instructions.

This is evidence of a high level of interest in external seminar participation and of the possibility that the Quality Control and Total Quality Control idea may penetrate and reach the inside organization of the company through on-the-job or on-site training/instruction.

The above results indicate that many factors and aspects concerning Quality Control and Total Quality Control have not developed to maturity in Chile. In order to ensure the early establishment of a Quality Control and Total Quality Control System in Chile, however, it will be essential, in the first instance, to consolidate such Quality System factors as in-house standardization, process control, purchase control, defect control, and in-house training/instruction as these are vital prerequisites. For this purpose, it will be desirable that a Quality System be established on the basis of the ISO 9000 Series as the prerequisite for achieving these first-instance objectives.

5) Other items

The questionnaire inquiry showed that 47% of the respondents demanded the execution of Quality Control and Total Quality Control campaigns on a national level.

A further 31% saw that the low level of Quality Control and Total Quality Control seminars and technical standardization in Chile presented a problem.

To account for the strongly felt desire to upgrade the level of Quality Control and Total Quality Control seminars, we may refer to the fact that it is being recognized that there is a gap between the current trend toward the adoption of the ISO 9000 Series and the present contents offered by the seminars. Thus, while the worldwide trend in Quality Control and Total Quality Control is intent to the gradual adoption of more global and systematic activities concentrating on the introduction of the ISO 9000 Series with an approach based on a philosophy as shown in 3.4.1 and a thrust backed by company top management as the main driving force, the contents of the seminars on Quality Control and Total Quality Control in Chile have only progressed to the level of concentrating on specific methods and on the level of the particular operator staff concerned.

The results of these studies make it abundantly clear that there is now a good opportunity for Chile's Quality Control System to progress toward a system that matches the needs of a new era and for a review of the Quality Control System issues on a national level.

This will be taken up more fully in the proposals formulated in a different section of this report.

(2) Factory visiting

It was felt that the results of the questionnaire study referred to in Section (1) should be checked out against the practical realities of Quality Control implementation on the shop floor in the private sector. For this purpose, visits were made by the study team to companies for inspection.

The visits were arranged so that ten companies specified by INN were inspected to examine their endeavors and results with respect to quality, on the basis of 35 essential criteria for general quality control/quality assurance. These criteria correspond to the specification requirements laid down in the ISO 9000 Series. The following Table 3.4-2 will take up Company B as an example.

The ten companies specified by INN are mostly mass-production type of companies, and only one of the candidates was an assembly firm with small but diversified production runs.

These companies may not necessarily be representative of the average Chilean company and may rather deserve to be classed among the nation's "better companies". The findings for their Quality Control endeavors may be summed up as follows, on an itemized basis.

1) Progress in quality system establishment (interest or commitment toward the introduction of the ISO

The findings revealed that one company was seriously endeavoring to establish a quality system (based on the ISO 9000 Series) and one company had just started to engage in quality system research with a view to the possibility of introducing TQC on a companywide basis in compliance with ISO 9000. Yet, practically all of the remaining (eight) companies were establishing Quality Control systems not on a quality system philosophy as stated in 3.4.1 and though their Quality Control systems were of a certain level, they did not appear to show a "very strong commitment" to Quality Control

and were, for the most part, somewhere in the middle.

It is fair to say, however, that all companies had appointed staff in charge of promoting quality activities. There is a strong need for the urgent provision, on a broad scale, of the quality instruction described in Section 3.4.1. There was only one company with quality system manual meeting the requirements for submission to customers, and this company was a joint-venture operation with foreign partners.

2) In-house standardization

Those companies which were technically influenced in some way or other by foreign companies presented a fairly good progress in in-house standardization. Chilean companies without foreign affiliations, however, are showing a rather poor state on companywide in-house standardization, except for the testing and inspection departments and those activities which require clearly specified Quality Control rules. In many, many cases, NCh and foreign standards are being used directly. Among the ten companies visited by the team, only one had its own in-house standard control rules (in-house standard format, serial number system, standard drafting, modification, and withdrawal rules).

In most cases, however, the companies were found to have their own in-process control sheets and operation specification documents/product drawings, that is, standard formats directly connected with process operation.

It should be noted, however, that these documents are not treated as in-house standards.

3) Quality Control system - and its functions

Many companies have established Quality Control Departments and merge them with the Inspection Department. These activities are primarily concerned with in-process and product

inspection. They are not TQC-style technical control organizations based on the wide philosophy that also include cost control, production control, Quality Control, quality improvement and modification. The visits showed that only two companies were serious endeavoring to upgrade their voluntary factory inspection function (styled "auto control") as part of a process directed at such a TQC type system. However, they did not have technical control department staff permanently assigned for the promoting and Japanese-style TQC. In the absence of such a department with permanently appointed TQC staff, problems are usually dealt with as they arise by forming technical committees held by management.

This type of problem management does not produce effective solutions. This organization for dealing with problems bears witness to the fact that the Japanese style bottom-up problem-solving system has still not found its way into Chilean company management. At the TQC - The Japanese Approach seminar organized during the study period, it became clear, however, that there is much interest in the Japanese-style technical control department type organization.

4) Nonconformity control

Chile's companies have no clear systematic procedures for dealing with corrective measures to prevent the re-occurrence of nonconformities.

While the records give the reject rate for finished products as 1% or so, these defects are mostly rectified during the process. In some cases, this disturbs the production process in factories, since the in-line rectification of defects often entails the risk that these corrections overflows the process capacity. With regard to nonconforming action (including cases such as the use of incorrectly calibrated measuring equipment or mistaken operating instruction), there is little recognition of the need to make correcting actions, because there are no clear in-house standards by which to judge

nonconforming actions. This testifies to the important need for the urgent introduction of in-house standards on whose basis nonconformity control and management can be established. As an integral part of this endeavor, it will be equally essential to create a quality system teaching organization providing instruction about the importance of defect control and management.

5) Calibration of measuring equipment

The companies under CESMEC certification and the Chilean companies with foreign affiliations, operate, in most cases, control systems on the basis of the "CESMEC-based Standard Calibration PLUS Practical Calibration by Voluntary In-House Quality Control" formula. In the advanced industrialized nations, it is the normal practice to affix labels to measuring equipment, stating the period for the validity of calibration. This label display practice is extremely rare in Chile. Chile still lacks a national calibration system for measuring equipment. While it is logical that under these conditions there should be little interest in calibration in Chile, the fact remains that calibration is a vital factor for quality system establishment, whence the urgent need to create a calibration system.

6) Purchase control

Many companies were seen to practice purchase control, including purchase and acceptance inspections based on the buying specifications and material storage control. In some cases, purchase control activities were also found to include technical exchange with the supplier on the basis of inspection procedures to examine the supplier's Quality Control system and nonconformity reports for supplies.

7) Production control

Many or most of the companies with mass-production factories use process sheets, process control charts, and operating instruction documents to implement process control. Some companies were seen to operate a feed-back system for information on nonconformities occurring in the production process. But these process control activities do not provide for voluntary operation control within the authority and competence possessed by the operator. In many or most cases, the authority to decide on actions to be taken during operation lies with the line foreman.

In new factories, production instruction issuing and implementation control is accomplished under computer control, and some companies were found to have computerized even product history control.

Companies in the assembly type sector with small and diversified production runs presented a different picture. Only one of the companies visited by the team had a system for production control, but this was entirely without work progress control. Control diagrams are in comparatively widespread use, but the manner in which they are used is not appropriate as it was found in many cases that the procedures for taking action were slow.

8) Equipment maintenance control

The petroleum industry with its strong influence by foreign industry and its concern for safety control, was seen to exercise equipment maintenance control by adopting preventive maintenance procedures. In the other sectors of industry, however, the approach to maintenance is based on repair after the event. Some of the enterprises made it clear that the cause of major defects of product in intermediate processes is due to equipment failures. They did not make it clear, however, what procedures they take to correct the situation.

Except for the petroleum industry, there is little indication to suggest that Chile's industry has great interest in general equipment maintenance (preventive maintenance).

9) In-company training-staff qualification and QC circles activities

There were some companies with QC circle activities. Generally, however, management is opposed to handing down decision making and therefore also opposed to QC activities. Where such circle activities do take place, the member tend to have little "drive" for the want of encouragement, seeing that management is not likely to accept proposals from the circle. The fact is that these circles do not function properly. An approval system for employee/staff qualifications and their level of skill is being operated in the petroleum industry. In practice, this involve a system of in-house tests or examinations to assess the employee's competence in the operation of the plant and equipment and in the handling of emergency situations.

Only one company was found to actively teach its employees.

To sum up the above, it can be observed that there is a certain difference in nuance between those of Chile's companies which are technically influenced by foreign companies or have foreign affiliations in some way or other and those of Chile's companies which do not have such foreign affiliations. The level of general quality control systems operated at the companies visited by the study team has still not progressed to the quality system stage and to the establishment of Quality Control based on this philosophy.

There was no evidence of companies without any process control and with mere finished product inspection to sort out the good-quality products. This therefore indicates that each companies have quality control procedures with some of the quality system elements.

Many companies have amalgamated their inspection functions with the appointment of the Quality Control Department. This testifies to a move toward the diffusion of Quality Control and the dissemination of the principle and philosophy of Quality Control on a wider scale by upgrading the Quality Control functions. This may eventually develop to the formation of a Technical Control Department Type Staff Grouping as the nucleus of TQC.

The most important requirement for the time being, however, is to aim at the introduction of the Quality Control system approach and the teaching and propagation of this approach so as to facilitate the "leap" from the present stage to the higher Quality Control system/TQC system level for Chile's companies and ensure the establishment of a new quality system.

Such training and teaching must be newly organized and come in addition to the instruction curriculum practiced so far (as described in Section 3.4.5). It must not be a replacement of the traditional system.

Table 3.4-2 Quality Systems Functional Chart

– (refered to the requirements of 4.1.2.1 of ISO 9002)–

(Example of Company B)

Key Jobs on quality systems implementation	RESPONSIBLE SECTION									
Items in group 1. which refer to processing respective order from order entry to shipping and certified material test report issuance.	Managing Director	Mr.QA	General Affair Sect.	Sales Sect.	Purchasing Sect.	Quality Assurance Sect.	Manufacturing Sect.	R&D, In-Process Tech. Control Sect.	Inspection and Test Sect.	Ref. No. of ISO QS rules (9002)
(1) Receipt and review of customer's order/ spec.				◎		○				4.3
(2) Quality design and documentation of production/inspection procedure for customer		○		○		◎	○		○	4.3
(3) Production scheduling and its following up				◎	○		○		○	4.8.1
(4) Production instruction				◎	○		○		○	4.8.1
(5) Acceptance test, identification and stock control of purchased material and supplied material by the customr, and operational record documentation for above					◎		○			4.5.4 4.6 4.9.1
(6) Statistical control of purchased material		○			◎	○	○	○	○	4.5.3 4.15
(7) Production and identification of material in production line, and operational record documentation for above					○		◎		○	4.15 4.7
(8) Statistical process control on production		○				○	○	◎	○	4.18
(9) Inprocess inspection and identification of inprocess-inspected product, and operational record documentation for above				○		○	◎		○	4.9.2
(10) Statistical control on in-process inspection		○				○	○	◎	○	4.18

◎: Key section ○: Supporting section

Quality Systems Functional Chart

– (refered to the requirements of 4.1.2.1 of ISO 9002)–

Key Jobs on quality systems implementation	RESPONSIBLE SECTION									
Items in group 1. (continued) which refer to processing respective order from order entry to shipping and certified material test report issuance.	Managing Director	Mr.QA	General Affair Sect.	Sales Sect.	Purchasing Sect.	Quality Assurance Sect.	Manufacturing Sect.	R&D, In-Process Tech. Control Sect.	Inspection and Test Sect.	Ref. No. of ISO QS rules (9002)
(11) Disposition of nonconformity and customer complaints, and its acknowledgment to sections concerned	○ d	a ◎ d		○ b		○ e	○ b	○ c	○ b	4.1.2.1 4.9.2 4.12 4.12.1
(12) Inspection and identification on final product, and operational record documentation for above				○		○	○		◎	4.9.3 4.9.4
(13) Statistical control on final product inspection		○				○	○	◎	◎	4.18
(14) Storage and delivery control of product				◎		○	○		○	4.14
(15) Certified material test report issuance		○		○		◎	○		○	4.11

◎: Key section ○: Supporting section

Quality Systems Functional Chart

– (refered to the requirements of 4.1.2.1 of ISO 9002) –

Key Jobs on quality systems implementation	RESPONSIBLE SECTION									
Items in group 2. which refer to QA/QC systems implementation that supports smooth performance of the key jobs stated in group 1.	Managing Director	Mr.QA	General Affair Sect.	Sales Sect.	Purchasing Sect.	Quality Assurance Sect.	Manufacturing Sect.	R&D, In-Process Tech. Control Sect.	Inspection and Test Sect.	Ref. No. of ISO QS rules (9002)
(16) Quality policy by management	◎	○	○	○	○	○	○	○	○	4.1.1
(17) Quality systems program and its documentation(QS manual)	○	○	○	○	○	◎	○	○	○	4.2
(18) Production procedure chart		○		○	○	○	○	◎	○	4.8.1
(19) Enactment of quality-related incompany standard, such as product specification, technical standard and work standard for production/inspection activity etc. and these indoctrinations		○				◎	○	○	○	4.8.1
(20) Purchasing management(purchasing specification enactment and vendor control etc.)		○			◎	○	○			4.5
(21) Before/after technical advice, after-sales service		○		○		◎	○		○	N/A
(22) Corrective action for nonconformity and customer's complaints	○d	a ◎ b		○b		○e	○b	○c	○b	4.1.2.1 4.12 4.12.1 4.13
(23) Enactment of incompany standard except for that stated in (19) (20) and these indoctrinations	○	○	◎	○	○	○	○	○	○	4.4
(24) Company-wide standardization activity and document control	○	○	◎	○	○	○	○	○	○	4.4
(25) Coordination activity by Mr. QA on standardization and QA/QC performance	○	◎	○	○	○	○	○	○	○	4.1.2.3

◎: Key section ○: Supporting section

Quality Systems Functional Chart

– (refered to the requirements of 4.1.2.1 of ISO 9002)–

Key Jobs on quality systems implementation	RESPONSIBLE SECTION									
Items in group 2. (continued) which refer to QA/QC systems implementation that supports smooth performance of the key jobs stated in group 1.	Managing Director	Mr.QA	General Affair Sect.	Sales Sect.	Purchasing Sect.	Quality Assurance Sect.	Manufacturing Sect.	R&D, In-Process Tech. Control Sect.	Inspection and Test Sect.	Ref. No. of ISO QS rules (9002)
(26) Monitoring on QA/QC performance by Mr. QA and his assistant		◎		○	○		○		○	4.1.2.1 4.1.2.3
(27) Maintenance of production/inspection facilities	○	○				○	◎	○		4.10
(28) Calibration	○	○			○	○	○	◎	○	4.10
(29) Personnel allocation	◎	○	○	○	○	○	○	○	○	4.1.2
(30) Indoctrination of QA/QC	○	○				◎				4.17
(31) Personnel qualification	○	○				◎				4.8.2
(32) QA/QC incompany audit.	◎	◎	○	○	○	◎	○	○	○	4.16
(33) QC(Quality Commitment) Circle & "Suggestion" activity	○	○	◎	○	○	○	○	○	○	N/A
(34) Environmental management	○		◎		○		○		○	N/A
(35) Housekeeping	○		◎		○		○		○	N/A

◎: Key section ○: Supporting section

Guide to Symbols

1. Implemented by laboratory or operation staff

2. Implemented control personnel through technical supervisor staff and/or the technical service section

3. Implemented by the QC Group

4. Implemented by Dispatch Control Group under the supervision of the QC Group

5. Implemented on a joint basis between the QC Group and the laboratory of the R&D Department

6. Implemented by the laboratory of the R&D Department, Operation Control Section, and the QC Group

7. Purchase specifications are drawn up by the Operation Control Section Manager or the QC Group. Control of purchased products (supplies) is handled by the Purchase Group.

8. Implemented by technical supervisor staff based on consultation between the technical staff and the sales staff

9. Implemented by the Control Staff

10. Implemented by the Control Staff of the Technical Department

11. Implemented by the Plant Maintenance Group

O : Points checked by CESMEC

< : Items for future action

X : Items described as "being done"

3.4.8 Technical Exchange with Foreign Entities

ASCAL is a member of EOQC (European Organization for Quality Control) and ASQC (American Society for Quality Control). It is also a founding member of OLAC (Latin-American Organization for Quality Control). This shows its active commitment to international exchange.

INTEC-CHILE invited, two years ago, specialists of Japanese companies to provide aid and guidance in the introduction of the Just-In-Time system and TQC. Mostly this concerns companies of small and medium-scale status. The reason for implementing these systems is that the small-medium companies have recognized the useful and relevance of Japanese small/medium company quality control to their own situation in connection with the manufacture of standardized products.

3.4.9 Problems in Connection with the Diffusion of Quality Control and TQC

(1) The gap that exists between the latest world trends in Quality Control/TQC and the awareness shown by Chile's companies with respect to Quality Control/TQC is a hindrance in the diffusion and penetration of Quality Control/TQC to the nation's companies and an obstacle to the upgrading of their quality level.

As stated in Section 3.4.1, the latest world trends in Quality Control/TQC attach as much importance to the traditional active aspect of Quality Control as they do to the preventive side of Quality Control with the objective of creating a system that "does not produce nonconformities". The efforts made on the preventive side are seen as being attainable through the creation of a quality system based on the ISO 9000 Series.

To change this perception, it will be necessary, in the first instance, to establish a new teaching effort with a curriculum concentrating on these aspects.

(2) Chile's companies hold out much hope for the teaching of Quality Control/TQC, but the teaching courses on Quality Control/TQC offered in Chile are not of a nature that justifies or satisfies these hopes. As has been seen from the questionnaire results of Section 3.4.7 and from the site visits, companies are contemplating the introduction of Quality Control/TQC from a much wider perspective, including the introduction of quality systems based on the ISO 9000 Series. This makes it most desirable, therefore, to restructure the teaching courses on Quality Control/TQC offered in Chile (notably by INN and ASCAL) from their present preoccupation with methods and staff-level procedures to a higher level of Quality Control/TQC.

Both the responses to the questionnaire inquiries, dealt with in Section 3.4.7-(1), item 5, and the comments about the improvement of the situation in terms of the above Quality Control/TQC teaching and the explanations concerning the Special Quality Control Courses of the Santiago University dealt with in Section 3.4.4 suggest that training on Quality Control/TQC in Chile tends to be mostly of a school-teaching and job-training type instruction concentrating on quality control staff and inspection personnel. This is inevitable because Chile has little experience with Quality Control/TQC.

To align with world trends in Quality Control/TQC, it is recognized that there is a need for teaching on the ISO 9000 Series. Yet, there is a lack of experts familiar with the ISO 9000 Series in Chile.

Yet, there is a definite need for high-level teaching of a nature in line with world trends in Quality Control/TQC and of a substance capable of meeting the expectations of Chile's companies and of such a depth as to include a philosophy of Quality Control/TQC. And this teaching must also be of a level to satisfy top management.

It must be pointed out, however, that the above comments do not signify in the least that the conventional teaching aimed at the

practical side (the "doers" and the method of "doing") will not be necessary.

The new curricular activities of the nature described above should be added to, and integrated with, the conventional teaching activities in quality control as an important element.

In other words, The Quality Control/TQC courses of INN and ASCAL registered with SENCE for fiscal 1990 as shown in Section 3.4.5 offer little teaching on "education for top management" and "quality systems". The latter item is particularly neglected and to make up for its absence it should be added as a new subject to the course curricula.

Moreover, the "education for top management" subject needs to be supplemented by the items referring to the importance of quality systems as shown in Section 3.4.1. This topic should be added to the course contents which already exist.

The establishment and implementation of a quality system is connected with a commensurate level of expenses and costs, so that it will ultimately depend on top management whether quality systems will take concrete shape or not. Without the understanding and cooperation of top management, there can be no achieving such a quality system.

It should be noted also that the establishment of quality system is not merely a matter of interpreting the rulings of the ISO 9000 Series. Rather, it will be necessary to develop new teaching material considering the problem as to the best way of putting the prescriptions and rulings of the ISO 9000 Series into practice.

(3) Lag of Government Response to a Quality Control/TQC Teaching and Diffusion System in Chile as a Factor for the Retardation in the Nation's Establishment of a Quality Control/TQC System

The upgrading of Chile's Quality Control/TQC System calls for the urgent establishment of the type of system described in 3.4.2-(1).

This includes the very urgent need for the appointment, at INN, of a technical committee with the appropriate subcommittees devoted to the teaching and diffusion of Quality Control/TQC System. The objective of the committee and subcommittee formation is to review, in a unified manner, the teaching and educational activities undertaken so far by the disparate areas which have not maintained mutual contact, including the Quality Control Technical Sector (the Universities and Consultants), the teaching sector (entities such as ASCAL) and the industrial sector (entities such as FOFA and ASIMET) and to make an efforts towards creating a new Quality Control/TQC System.

(4) Cultural aspects related to the diffusion of Quality Control/TQC in Chile

The essential preconditions for the implementation of Quality Control/TQC are generally given as follows.

1) Respect for the human nature of all persons concerned with Quality Control/TQC

2) A well-balanced top-down and bottom-up system and team work activities

3) Clear demarcation of the areas of "line" and "staff" competence and appropriate expansion of the technical control staff through above

4) Adopting the view that the quality system philosophy is "something so natural that it can be taken for granted" so that the appropriate control tasks are performed even when not specific orders have been given to this effect. For nonconformities, in particular, activities should be undertaken spontaneously to improve and modify.

5) The establishment of a quality system should be seen as the minimum requirement for the commencement of quality Activities.

6) Rather than signing contracts with the customer (customer specifications, etc.), importance should be attached to being of one mind with the customer (that is, receiving the trust of the customer).

7) In the basis of such customer relations founded on trust, it should be possible to initiate spontaneous improvement activities in an attempt to upgrade quality.

8) These facts should be properly understood by top management.

The results of the present study have led to the conclusion that the obstacles to the introduction of TQC activities in Chile are due to the lack of items 2), 3), 4), 5), 6) and 7).

The lack of items 3), 4) and 5) are attributable to Chile's backwardness in "technical control system" terms. The lack of items 2), 6) and 7) may be associated with cultural factors.

3.5 Testing and Inspection System

On the basis of a multiplicity of mutually independent certification systems, a large number up to but under a hundred of testing and inspection organizations, notably CESMEC Ltd. (Centro de estudios medicion y certificacion de calidad) have been approved to conduct tests in the particular field or fields in which they have been approved.

The following briefly described the most typical of these testing organizations:

3.5.1 Testing and Inspection Organization

(1) CESMEC

1) General (See 3.3)

2) Testing and inspection performance record

CESMEC is an organization accredited by INN, and conducts standard conformity testing based on the NCh standards. The range of certification this organization is taking charge for is considerably wide, and conducts testing and inspecting in all fields excluding those related to environment protection. This organization is regarded as one of the most representative overall testing institution in Chile, and has been playing an important role in testing and inspection for industrial purposes in the country. Especially, in testing for strength of steel materials for construction and cement, this organization has satisfied demands for testing and inspection in cooperation with other universities and laboratories in the countries. Furthermore, this organization has an excellent record in testing of gas bombs by means of non-destructive testing including searching for flaws with gamma ray.

In recent years however, requests for testing and inspection have been increasing, staff in CESMEC are always busy with field tests and inspections in production plants of clients, and engineers required for testing are always short, so that this organization cannot fully satisfy demands for testing and inspection.

3) Existing equipment and facilities

Testing Equipment

The testing equipment in the possession of CESMEC consists in the main of equipment relating to ore-mining and forestry/lumbering. In view of the large number of equipment which has broken down, uncalibrated equipment, and old type of equipment, it is possible to perform tests only for a limited number of test items among those required by the standards for standard conformity testing. It is thus not possible to carry out tests covering all standard/requirements. Especially in

the electrical and electronic field, it is practically not possible to test any of the standard requirements. To obtain accurate test data it is also essential to calibrate the measuring equipment. While calibration is performed inside the organization, such calibration is not carried out in accordance with the national traceability system.

Autograph (10t - 25t)

Impact testing unit

Brinell hardness tester

Rockwell hardness tester

Helmet impact testing unit

Extensometer

Metallurgical microscope with projector

Tool maker's microscope

Sample preparation unit

Temperature recording unit

Constant-temperature, constant-humidity oven

Gas cylinder compressive strength testing unit (installed underground in the testing laboratory)

X - Y recorder

Microwave oven motor locked testing unit (to IEC335)

Non-destructive testing unit (Shield Chamber at rear, left has a wall thickness of 60 cm) - Can accommodate gamma radiation (gamma radiation, X ray, ultrasonic, radioactive isotopes, magnetic flaw detector, magnetic particle, etc.)

Concrete breaking tester

Compression tester (100t)

Gas chromatograph

GC/FTIR (Fourier transformer infrared)

Chemical analysis processing unit

High speed centrifuge

Atomic absorption spectrophotometer

UV/VIS spectrophotometer

Fluorescent X-ray analyzer

Infrared spectroanalyzer

Survey meter

4) Technical level of technical staff and education/training

No particular provisions are made for the education and training of technical staff, with no training courses being conducted. Generally, members of the staff will receive on-the-job-training (OJT) after joining the organization. For inspection officials in charge of quality control, however, participation in the seminars organized by INN is insisted upon.

Education and training abroad is being considered with applications having been made for the release of technical staff members to Japan for training to study Weights and Measures Testing Techniques. Since the organization is a private enterprise, its members are not entitled to take part in the training courses organized by the Japanese government. These efforts have thus remained without any positive results. Data collection concerning worldwide trends in standardization is being handled by the relevant Chilean Committees, including ASTM, AWS, NACE, ASME, ASNT, and INN.

The level of technical competence of the organization's technical staff members can be described as rather low in all areas except non-destructive testing. In this field, there are four engineers of a high standard.

(2) IDIEM

1) General (See 3.3)

2) Test and inspection performance record

As most of the machines and equipment now being used are out of date, it takes a relatively long time to conduct testing with the available machines and equipment.

Furthermore, if any specific testing item can not be carried out in standard conformity testing, this institute has no way but to ask other inspection organization to do it. This organization is not only a certification testing organization, but also must play a role as a research and development organization for development of vibration-proof construction for buildings because earthquakes frequently occur in Chile, so that this institute cannot satisfy an urgent need.

3) Equipment and facilities owned

Testing Equipment

The testing equipment in the possession of IDIEM consists in the main of equipment supplied by UNDP around 1960 and cannot necessarily be classed as new. All measuring equipment is however controlled to a high level of accuracy. Yet, calibration is performed only in-house so that there is no trace with external calibration organizations.

IDIEM functions as an inspection organization for steelreinforced concrete for the construction industry and in this respect it is unique in Chile. The testing and inspection equipment used for this purpose costs of a 50t class universal testing machine and a number of various other large-scale high-strength testing machines and facilities.

Research and development is also being conducted by performing structural analysis of materials such as metals materials and petrochemicals.

Standard conformity testing is carried out on the basis of NCh standards. IDIEM has the capability of performing mechanical strength tests and material analyses on building materials, including mainly cement and concrete apart from the steel-reinforced concrete mentioned above.

Asbestos/concrete board material strength testing unit (of German manufacture)

Stone materials wear tester (made in Germany), year of manufacture around 1960

Concrete compression strength testing machine (made in Germany)

Universal tester, 50t class (made in Germany), year of manufacture around 1960

Universal testing machine, 5t class

Universal testing machine, 2t class

Transmission-type electronmicroscope

Scanning-type electronmicroscope

Noise level meter

4) Technical level of technical staff and education/training

IDIEM has the status of being an organization attached to Universidad de Chile. It has 150 technical staff of Universidad de Chile and 50 post-graduates. Their technical level is high enough to carry out R&D activities.

(3) SGS

1) General (See 3.3)

2) Test and inspection performance record

SGS is a certification body under registered by INN, conducts testing and inspection as business transactions upon requests from their clients, chiefly for products of the primary industry such as agricultural/stock farming products, marine products and processed agricultural/stock farming/marine products. Furthermore, this organization is capable of conducting and inspection for chemical products, and has an excellent performance record (350 inspection tests/year). However, SGS has only a poor record for testing and inspection of machines and others as a certification organization.

3) Equipment and facilities owned

Testing Equipment

SGS CHILE has adequate analysis equipment for organic and inorganic analysis. Using bond analysis to determine the bonding arrangements of organic compounds, SGS CHILE has the capability to perform qualitative and structural analysis. Mass-spectrometry is used to perform qualitative and quantitative analyses. With these capabilities, SGS CHILE is in a position to carry out chemical analysis on sea products and measure pollution (in the atmosphere and water). While it is being recognized that the calibration of the equipment is of vital importance, the fact is that the equipment is not calibrated due to the lack of calibrating organizations in Chile.

This testing institute is capable of conducting tests only for a small range of fields and is practically not in a position to carry out tests in other fields such as electric or electronic equipment, machines and equipment for construction.

The main equipment is listed below.

Distilled water unit

Keldal N Analyzer

Gas Chromatograph

GC/FTIR (Fourier Conversion Infrared Analyzer)

GC/FTIR/MS (Fourier Conversion Infrared Analyzer/Mass Spectrophotometer)

Atomic Absorption Spectroanalyzer

Fat/oil extraction unit

Fluidized material extractor

Electric oven (furnace)

Neutralizing tank

4) Technical level of technical staff and education/training

SGS has testing locations in four South American countries and maintains technical interchange with all of these. This is assured a high level of technical expertise of its staff. It has a very high level of technology especially in the field of chemical analysis, but has little expertise in other fields because they receive no order.

(4) INTEC

1) General (See 3.3)

2) Test and inspection performance record

This organization has been conducting testing of materials especially for mining, but can satisfy only around 60% of the demands.

3) Equipment and facilities owned

Testing Equipment

Most of the testing equipment at INTEC CHILE is set up for testing purposes in the mineral related fields and for conducting chemical analyses. Tests and analyses are also performed on (food-preserving) cans, packaging materials, agricultural produce, and bio-products. It has in particular equipment capable of analyzing the content of heavy metals which are poisonous to the human body.

The future research fields include the anti-pollution area concentrating on atmospheric pollution, water quality and wastes, video-communication, satellite broadcasting, and digital communication, and INTEC CHILE has the chemical analysis and electronic measuring facilities required for these purposes.

The main testing equipment owned are as follows.

Gas chromatographic analyzer

Gas ionizing analyzer

Melt index

Test specimen preparation processing furnace

Gas furnace

Calorimeter

Gas chromatograph

Liquid chromatographic analyzer

Element number table

Atomic absorption Spectrophotometer

Precision balance (on stone table)

Fusion furnace

Metal ladling furnace

Packing vibration tester

Mineral separator

Gas analyzer (FUMI-Scope) 2 units

Gas analyzer (calibration label attached), portable type

Impact tester

Profile projector

Film bending resistance (endurance) testing unit

Failure strength testing unit, Mullen type

Universal testing machine (500kg)

Triple parallel plate plastometer

Fusion furnace equipment

Measuring facilities for electronic equipment (multimeter, oscilloscope, etc.)

Frequency signal generator

Electric field strength meter

Neutralizing tank

Electric furnace

4) Technical level of technical staff and education/training

INTEC sends trainees to Japan to acquire technical skills. This policy is motivated by attempts to upgrade the quality of Chile's products and thus to expand exports. To ensure its capability of performing tests also on standardized products manufactured by smaller and medium scale companies, INTEC

tries to enhance the level of technical competence of its technical staff by having a Japanese specialist on call. INTEC also has researchers engaged in long-, medium-, and short-term research projects on various themes.

(5) Universidad de Chile, Centro de Estudios Espacias

1) General

This institute closed a scientific cooperation agreement with NASA in the United States and became a satellite trace center for the latter. Now this institute provides not only NASA but also industrial, scientific and technological organizations in Chile with information from satellites. This institute also provides geological information on movement of Pacific plates, which is now indispensable for prediction of occurrence of earthquakes in the country. Also this institute conducts surveys on oceanic temperature, and its role for fishery in Chile has been becoming increasingly important. In addition, this institute collects information on the distribution of atmospheric pressure and provides weather forecasting service in the country. This institute maintains and control a device for time standard, precision and accuracy of which are at the highest level in the country. The national time standard of Chile itself is, however, maintained and controlled by a Chilean navy's facility at Valparaiso. Also NTEL (National Telecommunication) is going to purchase a cesium atomic clock for maintenance of time standard at a higher level.

2) Testing and inspection performance record

This institute does not any specific testing or inspection service for organizations in the private sector, but if asked, it can provide clients with such information as voltage standard, time standard, and frequency standard. In the past, this institute provided Lan Chile National Airlines, the Facultad de Ciencias Fisicas y Matematicas - Universidad de Chile and several manufacturing industries with calibration

service, and issued certifications to them.

Currently this institute can anyhow satisfy demands, but if demands for measurement calibration service are presented to this institution systematically in the future, it would be difficult for this institute to satisfy all of the needs because of shortage of engineers in this institute.

3) Equipment and facilities owned

This institute owns the equipment and facilities as listed below.

Equipment for time standard (International primary standard level)

Equipment for voltage standard

Equipment for electric current standard

Equipment for electric capacity standard

Equipment for frequency standard (International primary standard level)

Equipment for resistance standard

Most of the above equipments were provided by NASA when the organization was set up, but some of them were provided recently. All of the standard equipment are traced via NASA by NIST, and also calibration is performed once for every 1 to 3 years.

(6) IDIC

1) General (See 3.3.)

It is legally required that all materials intending to be used by Army must be tested and inspected in IDIC. Also purchase and management of weapons are performed by this institute. In addition to it, this institute provides services (500 cases/month) for private companies in the fields of agriculture and mining.

2) Testing and inspection performance record

Performance record concerning demands by Army is not clear, but this institute is the only testing and inspection organization for gunpowder in Chile, and has completely satisfied the need for testing and inspection of gunpowder.

3) Equipment and facilities owned

Machine tests

This institute has introduced a granite table (150 x 100 x 30 cm) for inspection and measurement of firearms, but has not introduced any three-dimensional measuring equipment, and staff of the institute recognizes the necessity. They are now using a height gauge in place of a three-dimensional measuring equipment. For calibration of UTM, they do not use a proving ring, but use for calibration a number of standard weighs with a static weight of 5 Kg in combination.

Food test (Certification organization under control by MDS)

Equipment and facilities for testing and inspection of canned foods for military use

Testing for strength and life time of cans for canned foods

In this institute, a beam other than sunlight is radiated to foods, and the taste is checked in a state where examiners have been liberated from all existing concepts.

Chemical test

IDIC conducts testing for all types of gunpowder. 90% of gunpowder tested in this facility is for use in mines, and remaining 10% is for military use.

Textile test
(service uniforms, pillows, and safety shoes)

Leather folding durability testing unit
Textile shopper type, Instron type of tensile testing unit
Elemendor of type tearing testing unit
Mulen type explosion testing unit
Impact testing unit based on a pendulum system
Wear testing unit
Compressive elasticity testing unit
Contraction ratio testing system
Side color testing unit
Electrifiability testing unit

General testing equipment

Versatile projector
Climate-proof testing system
Infrared spectro-photometer
Atomic light absorption analyzer
Hot extractor
Centrifugal separator
Electric furnace (1200 degrees)
Distillated water producing unit
Wear testing unit (PERME-O METER)
Hardness meter based on a repulsion system
Ultrasonic flaw detector
Tool microscope

Versatile precision tester (with a controller)
Block gauge
Human brain model for helmet (based on NCh 461)
Granite table (150 x 100 x 30 cm)
Height gauge

(7) CIMM

1) General (See 3.3.)

2) Testing and inspection performance record

CIMM conducts testings and issues certifications for about 4500 items a year.

3) Equipment and facilities owned

The institute currently owns the equipment and facilities as listed below.

Scanning type of microscope
Atomic light absorption analyzer
Standard substance (purchased from NIST)
Fluorescent X ray analyzer
Compression testing unit
Gas chromatography analyzer

(8) Fundacion Chile

1) General (Sec 3.3.)

2) Testing an inspection performance record

This organization has testing facilities at 3 places, Santiago, Puerto Mont, and Concepcion, and conducts testing in these facilities mainly in the fields of chemistry and biochemistry. This organization takes charge for testing of marine products and those related to forestry, and now can

fully satisfy needs for testing and inspection.

3) Equipment and facilities owned

This organization owns the equipment and facilities as listed below.

Liquid chromatography
Atomic light absorption analyzer
Gas chromatography

This organization collects data using reference materials for calibration of analyzers, and the data is sent to calibrating organizations in the United States for comparative calibration. For this reason, reliability of the data provided by this organization is relatively high.

(9) DICTUC

1) General (See 3.3.)

2) Testing an inspection performance record

This is one of certified body for INN, and is conducting testing for conformity to standards based on NCh. This organization is also performing testing based on international standards such as IEC, but when requested, this organization also performs testing not based on the standards. Object items for testing conducted by this organization are those mainly related to materials of machines and construction materials, and 7,000 to 8,000 items are tested by this organization annually in each field. Furthermore, in each of the fields of food analysis and measurement for environmental assessment, around 3,000 items are tested every year. In addition, recently the organization has expanded the testing area, and has been conducting testing in the field of electric and electronics, although the number of items tested annually is only around 1,000.

3) Equipment and facilities owned

Concrete plate pressure resistance testing unit
Concrete compression resistance testing unit
Concrete moisture contents measuring unit
Universal testing unit 50t
Universal testing unit 10t
Universal testing unit 2t
Tool microscope
Distillation unit
Liquid chromatograph
Atomic absorption analyzer
Gas chromatograph
System controller
Electronic density meter
Sprinkler/testing unit
Electronic range door relay
Climate resistant testing system
Constant temperature/high humidity bath
Block gauge
Profile projector
Proving ring
Hardness tester
Standard resistance
Standard water tank
Standard substance

4) Technical level of technical staff and education/training

This university is providing general education in technological fields, and has testing centers in each discipline, totally 9 testing centers. The faculty consists of 70 professors, and among them 59 people have a doctor degree. Each testing center has 3 or 4 specialist engineers and 5 technical assistants called "Technico". Each testing center has the capability to perform testing in quantity. For improving the technical level, internal technical courses are

periodically organized and given.

(10) Casa de Moneda de Chile

1) General

Main job of this Bureau is to print bills and make coins used in Chile. Additionally, this Bureau prints public certificates such as passports, stamps and identity cards.

2) Testing and inspection performance record

All of paper used for printing bills is imported from foreign countries, and this organization checks and verifies data presented by paper manufacturers.

3) Equipment and facilities owned

In this testing facility, the temperature is kept at 21° C and relative humidity at 65% strictly as peripheral conditions.

Paper test

Smoothness testing unit
Extension ratio meter
Bending fatigue testing unit
Hardness testing unit

In addition to equipment listed above, this organization owns testing machines for checking wrinkles, tearing and gloss.

Ink test

Adhesivity testing unit
Viscosity testing unit
Color meter

Metallic test

Metallic surface organization microscope
Hardness testing unit
Gold content meter
Fine weight meter
Weigh for weight calibration (5 Kg) made in France

This organization can not be a certifying organization for INN because of its specific position in the framework of a unified certification system in Chile. This organization deals with a specific technology when viewed only from a viewpoint of technology for testing and inspection, but it can be said that the technology, which this organization specialized in, is at a considerably high level. Also it may be said that the weights owned by this organization are at the highest level in Chile as standard weighs for measurement of weight. Inquiries or requests are sometimes presented to this organization from private companies, but this organization does not have a organizational function or role to satisfy the demands.

3.5.2 Current Situation of Testing and Inspection Organization

Capability of carrying out testing and inspection in each of representative testing and inspection organizations in Chile, and the current situation of and problems in the organizations are as described above, which can be summarized as described below.

It cannot be said that capability of each organization for testing and inspection is adequate in an assigned range because equipment and facilities owned are rather out of date and a number of engineers and their technical skill level are not enough. Generally, their capability of testing and inspection for products in the primary industry is at an acceptable level, but their capability of testing and inspection for industrial products is still inadequate.

Of the primary industry products, (1) for agricultural and stock farming products, BV can conduct standard conformity testing as a private testing organization, in addition to the above organization. (2) for marine products, such organizations as IFOP, and so on, which are under control by the MINECOM have the capability, and (3) for processed agricultural/stock farming/marine products, in addition to testing organizations for marine products, Concepcion University has the capability of testing. (4) For forestry industries and processed wood products, INFOR has many testing performance records, in addition to the above-described organizations.

Thus, it may be said that several testing organizations in addition to the main testing and inspection organizations described above are available for testing and inspection of products from the primary industry. For industrial products such as machines, metal or electricity, there is no private testing organization besides those described above, and the demands have not been satisfied. Of industrial products, however, for chemical products, BV, ISP and Austral University have the capability for testing and can conduct standard conformity testing, so it may be said that the current needs are almost satisfied.

3.5.3 Equipment and Facilities for Testing and Inspection in Manufacturing Companies

(1) Sheet metal working company A

1) Products manufactured and production output

This company is based on Italian capital, and in the initial stage after incorporation the main products of this company were elevators. According to shift in demands, however, in recent years this company is manufacturing enameled pans in a stamp system using such materials as aluminium, iron and stainless steel as the raw materials. 84% of the production is shipped to the domestic market, while the remaining portion is exported to 15 countries including the United States.

2) Organization and the number of employees

Foundation	:	1939
Number of employees	:	350 people (1990)
Capital	:	$2,560,000 (1990)
Annual sales	:	$10,000,000 (1990)

3) Used standards

NCh 2009/7, IEC 335 (Compatible with NCh 2008) etc.

4) Equipment and facilities owned

Testing equipment

The quality control room is located near the production line, and sampling tests for products are performed there.

Most of the equipment are available for standard conformity testing based on the IEC standards, but some of the NCh standards themselves have not been revised, so that the testing machines are based on the standards before revision. Appropriate means for securing safety of persons responsible for testing and inspection have been introduced to the testing machines. Especially, the alerting systems for dangers in mechanical operations and in handling electricity to protect safety of operators is rather excellent.

Electric washer constant load test (Cover open/close interlock used)

Thermocouple temperature test (Digital output)

Rainfall testing unit (based on IEC 335)

Electric washer leak current test.

Research for automation of manufacturing process (Robot)

5) Technical level of technical staff responsible for testing and inspection

They can perform testing and inspection accurately for basic items in the IEC/NCh standards, but their experience is inadequate for items concerning abnormal testing. They well understand related standards and also interpret the standards correctly.

6) Current situation of and policy for education and training

From the viewpoint that they must produce products satisfying related standards, the company send employees to attend the Chilean Standard Technical Committee in INN and also give them many chances for studying. Up to this day, the company has not internal rules clearly written in any document, but necessary rules are prepared, for instance, in purchasing materials. Also the company staff recognized the necessity of QC circles when they participated in a training course for small and medium scale industries in Japan, so that they now hope to establish QC circles as soon as possible.

(2) Paint company B

1) Products manufactured and production output

This is a medium-scale company which plays an important role in the district and products 100,000 gallons of paint a month. 70% of total production is paint for industrial use, 25% for home use, and remaining 5% for use in ship building. A small quantity of paint produced in this company is exported to Peru, Bolivia and Polynesia.

2) Organization and number of employees

Foundation : 1969
Number of employees: 250 people (80 people in the production department) (1990)

3) Standards used

ASTM 963,IDIC (Chilean Army Institute) Standards

4) Equipment and facilities owned

Testing equipment

Color degree meter made by Minolta

Viscosity meter (which can correspond to different UK and US units respectively)

Density meter

Specific gravity meter

5) Technical level of technical staff responsible for testing and inspection

6) Current Situation of and policy for education and training

Education and training are not provided systematically, and necessary measures are taken case by case by OJT.

(3) Steel material company C

1) Products manufactured and production output

This is a joint venture founded jointly by 8 companies which produce cement products, galvanized iron sheets, drainpipes, carpets, hoses, adhesive, lime and others, and now this

company hopes to produce products satisfying related standards.

2) Organization and number of employees

Foundation	:	1930
Number of employees:		1532 people (1990)
Capital	:	$80,000,000 (1990)
Annual sales	:	$90,000,000 (1990)

3) Standards used

According to requests from clients

4) Equipment and facilities owned for testing and inspection

Testing equipment

Machine testing center

Concrete pipe load testing unit	Max. 10 t
Concrete bending testing unit	
Concrete pipe hydraulic load breakage testing unit	
Concrete pipe expansion ratio measuring system	
Rubber joint strength testing unit	
Adhesive degradation testing unit	

Material testing facility

Precision scale	
Ozone aging,rubber joint degradation testing unit	
Adhesive degradation testing unit	

5) Technical level of technical staff responsible for testing and inspection

Testing and inspection are performed to products sampled from the production line according to the accurate procedure, and testing and inspection data are prepared in a good order. Also, standard works are performed by each worker, and a

reasonable working range for each worker has been clearly defined, so that miss can be prevented and even if a miss occurs, the cause can be traced.

6) Current situation of and policy for education and training

Education and training are not provided systematically, and necessary measures are taken case by case by OJT. The characteristics of this company as a joint venture is well made use of, and interchange of human resource between the member companies is very active, which contributes to improvement of their technical level.

(4) Electric houseware manufacturing company D

1) Products manufactured and production output

The foreign companies merged to set up this company. Most of the products of this company are shipped for the domestic markets, but 5% of the products is exported mainly to Central and South American countries.

Electric washing machines (100,000 units)
Refrigerators (80,000 units)
Oil stove and gas stove (60,000 units)
Gas stove for cooking (80,000 units) (1990)

2) Organization and number of employees

Foundation : 1905
Number of employees: 850 people
Capital : $33,000,000 (1990)

3) Standards used

NCh 2008, IEC standards

4) Equipment and facilities owned for testing and inspection

Testing equipment

Final safety verification testing is performed with automated testing machines in the production line, and the data is recorded and stored in a good order.

This organization owns the equipment and facilities as listed below.

Pressure-proof testing unit
Grounding continuity testing unit
Leak current testing unit
500 V insulation resistor
Temperature recorder based on a multi-point system
Voltage stabilizer

5) Technical level of technical staff responsible for testing and inspection

Their technics for testing and inspection as well as for production control are at a high level because of technological cooperation with foreign countries. Their technological interchange with Italy and Japan has been very successful, and the high technical level has been maintained. The works for verifying safety in the intermediate testing and inspection process in the production line has completely been automated, and human labour is not required for that purpose.

6) Current situation of and policy for education and training

Education and training are not provided systematically, and necessary measures are taken case by case by OJT. This company also dispatched their engineers to advanced industrialized countries including Japan with good results.

(5) Balance production company E

1) Products manufactured and production output

This company produces weight measuring equipment such as platform scales and plate balances, and gasoline flow meters. Although this company is producing measuring equipment with electronic circuits, but the electronic circuit components are imported from foreign countries. More than 20% of all products produced in this company are exported. The range of measurement by the weight measuring equipment is from 10^{-3}g to 700 ton.

Units used are basically international ones, but sometimes other units such as pound and ounce are used according to the partner countries for export.

Products produced by this company share 60 to 65% of the domestic market.

2) Organization and number of employees

Foundation : 1931
Number of employees: 160 people (1990)
Annual sales : $4,000,000 (1990)

3) Standards used

According to requests from customers

4) Equipment and facilities owned for testing and inspection

Testing equipment

This organization is used the equipments and facilities as listed below.

20 Kg weigh as a comparator (10^{-5} Kg)
Sophisticated equipment (electronic ones and machines) for R&D
Signal generator

The measuring equipment are calibrated periodically by CESMEC.

5) Technical level of technical staff responsible for testing and inspection

Accurate data is collected efficiently according to the test and inspection manuals, and testing and inspection are performed correctly.

6) Current situation of and policy for education and training

Education and training are not provided systematically, and necessary measures are taken case by case by OJT.

(6) Flow meter manufacturing company F

1) Products manufactured and production output

Water supply meters (4 types of 3,5,7 and 20m^3/h): 150,000 units/year

Accumulated watt meter (Single-phase meter, 10A to 50A): 100,000 units/year

2) Organization and number of employees

Foundation : 1952
Number of employees: 200 people (1990)
Capital : $5,000,000 (1990)

3) Standards used

According to requests from clients

4) Equipment and facilities owned for testing and inspection

Testing equipment

Sophisticated precision equipment for R&D (Electronic ones and machines)

The measuring equipment are calibrated periodically by CESMEC

5) Technical level of technical staff responsible for testing and inspection

Data is collected according to testing and inspection manuals, and testing and inspection are performed correctly.

6) Current situation of and policy for education and training

Education and training are not provided systematically, and necessary measures are taken case by case by OJT.

3.5.4 Current Problems for Testing and Inspection in Manufacturing Companies

Equipment and facilities for testing and inspection in manufacturers as well as technical level of their technical staff are described above, and generally it can be said that most of large enterprises have automated production lines, and their procedure for

testing and inspection are clear. Also it can be said that their production facilities have been considerably modernized and the manufacturing efficiency is at a very high level. Measuring equipment used for testing and inspection are not only calibrated by private measuring organizations in the country, but also they are very active in approach to organizations in foreign countries. Also technical level of technical staff is fairly high. They dispatch engineers to advanced industrialized countries, and sometimes introduce necessary technologies from foreign countries.

In small and medium scale enterprises, production is made by human labour, and it can not be said that their production line has been modernized. Equipment and facilities used when the plants were built are still used, and most of works depend on individual skill. Some of technical staff are so-called amateur and some are professionals, which is reflected in non-unified product quality.

3.6 Metrological System

3.6.1 Metrological System and the Present Legal System

Chile adopted the metric system in 1848 after examining its legalization following the adoption of the metric system in France in 1840. This metrification law is still effective to-date.

After this, legislation was introduced in Chile making it compulsory to the kilogram as the official unit of weight, the meter as the official unit of length, and the liter as the official unit of volume. In practice, however, a variety of units of measure exist and are still being used side by side, including units such as the CGS, MKS, MTS, MKFS, MKSA, and PSI systems.

This is the result of the lack, in Chile, of legislative law laying down a metrological system in all its practical aspects, including the national standards and the verification of metrological apparatus, as well as the absence of provisions for the practical enforcement of the legal metrology, and this despite the fact that

Chile has formally adopted the metric system for its units of metrology.

The Chilean government recognizes the need for a new metrological law and realizes that such legislation will be essential in view of the economic development brought about through industrialization and in the interest of consumer protection. A working group has therefore been appointed within MINECOM to prepare the legislation needed for the establishment of a metrological law. This Group is now studying the matter, giving consideration to the actual national systems in use throughout the world. Based on the various requests, the INN is also drafting a new metrological law in accordance with the advice from the OIML (International Organization of Legal Metrology). Its work has not yet progressed far enough to publish its findings and broaden the scope of its investigations.

3.6.2 Metrology Administration and Current Status of Policy-making

At present, metrology administration is not enforced by Chile's national and regional governments. The main reason lies in the structure of Chile's industry. As the primary product sector, including mining and agriculture/fisheries/forestry has traditionally been the leading area of the economy, there has been no substantially felt need for industrial weights and measures. This retardation in the nation's industrialization which generates technical progress, kept Chile at a level which did not necessitate the introduction of official industrial weights and measures. This explains why the government has not shown a keen interest in a weights and measures administration as part of an infrastructure required to provide the administrative basis for industrialization. Nor has industry itself made any particular demands for the establishment of a metrological system.

In recent years, however, there has been a shift of emphasis from the primary product sector (mining and agriculture/fisheries/forestry) to the processed, value-added and the export areas. This change was prompted by the price stagnation seen in the recent past on the international primary product (raw materials) markets on the one hand,

and the globalization of the market economy on the other. With this change of direction, there is now a greater recognition of the need for a metrological system shared by the government and the private sector. This is essential both in the interest of product quality and for improving productivity.

The Chilean government has therefore declared that it considers the establishment of a modern metrological law and the creation of a proper system administering this law a vital part of its policy to promote industry. The importance attached to the metrological system is due to its role as the basis for achieving a greater competitiveness in exports by way of enhancing productivity and product quality for the processed goods manufactured from ores and agricultural, fishery and forestry produce.

3.6.3 The Traceability System (National Primary Standards - Secondary Standards, Working Standards and Calibration Apparatus)

The Metrological Law, established in the middle of the 19th century, fixed the standard units for length, mass, and volume. As no infrastructural system has since then been created to administer the law, Chile does not now have any specialized metrology organizations for the maintaining and controlling of metrology. Nor does Chile have its own national metrological standards.

As a result, the metrological apparatus maintained and controlled by the universities as well as private and public testing organizations serve merely the practical calibration needs of industry, without forming a national traceability system.

All standards in the possession of Chile's universities as well as private and public testing organizations must therefore be considered as being secondary or below-secondary standards by international criteria. In the maintaining and controlling of these standards, it is now the general practice in Chile to have the standards calibrated by the suppliers, that is, the manufacturers of the standards, and the related overseas organizations. The lack of national standard

organization in Chile creates a major problem in terms of reliability.

3.6.4 Verification of Standards and Calibration Organizations

(1) General

As the Republic of Chile has no measurement law including regulations for measurement administration, there is no compulsory authorization system for measuring instruments. However, such measuring instruments as a watt meter, a water supply meter, a gas meter, a taxi meter are objects for compulsory inspection under a decree by MINECOM, like electric homeware such as a television set and an electronic range, for fair transaction and protection of consumers. Such organizations as the Electric Power/Fuel Agency, Water Supply Corporation, Gas Supply Corporation, and Car Check Center are responsible for authorization of models and display of authorization marks. Staff of these organizations sometimes make entrance inspection. But these organizations ask DICTUC to do actual jobs for testing for informal authorization, and such organizations as USAC, DICTUC, CESMEC, Facultad de Ciencias Fisicas y Matematicas - Universidad de Chile, ENDESA, and Universidad de Santiago to test meters for electricity according to types of each meter. Also, it is required that difference between units is adjusted in each manufacturing plant and the authorization mark should be adhered to all of the products which passed testing for conformity to standards, but a period of validity for the testing has not been legally established, and in many cases the authorization mark is removed at a site of installation. On the other hand, calibration of measuring instruments is performed by CESMEC LTDA in relation to a portion of physical quantities such as weight and volume to satisfy needs of private companies, and also Facultad de Ciencias Fisicas y Matematicas - Universidad de Chile, Facultad de Ciencia - Universidad Tecnica Federico Santa Maria, and Armada de Chile and other organizations are providing calibration services in relation to a small number of physical quantities.

As upper national standards for a measurement system have not been established, scaling and calibration are requested to measurement standard organizations in overseas countries or manufacturers of measuring instruments, but a system of periodical calibration by the manufacturers or overseas organizations has not been established yet, and there are many problems in identification of precision and reliability. However, CESMEC has been accredited by SIM (Measurement System Committee in American Area) in relation to certificating of weight control for weight meters and products. So it can be said that this organization has been playing a substantially central role in the field of measurement in Chile where a formal measurement system has not been established.

(2) Performance result in calibration of measuring instruments which are objects for compulsory inspection

As it is difficult to obtain performance result data on authorization systems in the country, hearing is made for the matter. According to information supplied by MEDIDORES boasting a market share of 70 to 75% in the country, the number of water supply meters authorized a year is around 150,000 units.

In the field meters for electricity supply, data for MINECOM shows that electricity meters have been installed in about 3 million homes with the annual growth rate of about 3% and 1 to 2% of them are updated every year, so it can be estimated that the number of electricity meters authorized every year is in a range from 120,000 to 150,000 units.

In the field of gas meters, those for propane gas are not objective ones for the authorization system. For this reason, the demand is limited to areas in Santiago, Concepcion, and Punta Arenas where city gas is now supplied, and the number of gas meter units authorized annually is a large number up to but under a ten several ten thousands units. As for taxi meters, there are many imported cars now in use, and restrictions for a compulsory car inspection system were just introduced in 1990, and there are few performance data on the restrictions, so that the actual situation

is still unknown.

(3) Performance data for measurement calibration service

Such organizations as CESMEC and Facultad de Ciencias Fisicas y Matematicas - Universidad de Chile, Departamento de Ingenieria - Universidad de Concepcion, Departamento de Ciencia - Universidad de Santiago, Departamento de Ciencia - Universidad Tecnica Federico Santa Maria, and laboratories of Army are providing calibration services, but the number of clients who periodically request calibration of their equipment in CESMEC, which is the most active in this field, is only around 5 companies, so it can be considered that, corresponding to lack of the measurement administration, performance result in calibration of industrial equipment is very scare.

(4) Equipment and facilities owned

The standard equipment for measurement and those for calibration owned by CESMEC are as shown by double-line frames in each of the following measurement system drawings: Figs. 3.6-1, 3.6-2, 3.6-3, 3.6-4, 3.6-5 and 3.6-6.

Excluding CESMEC, there are the following organizations which own standards for each measurement system (physical quantities) and are providing calibration services.

Time

Universidad de Chile: This university owns a cesium 133 watch in the Space Laboratory having close relationships with NASA in the United States.

Armada de Chile: The Army has a cesium 133 watch at a national standard level in Palparaiso Laboratory.

Fuerza Aerea de Chile

Length

Cormecanica
Universidad de Chile
Universidad de Santiago

Mass

INN
Casa de Moneda de Chile
Cientec Chile

Capacity

Refineria de Petroleo de Con-Con
Sociedad Chilena de Medidores
GASCO

Force

Universidad de Chile
Pontifica Universidad Catolica de Chile

Pressure

Fuerza Aerea de Chile

Temperature

Universidad de Chile
Pontificia Universidad Catolica de Chile
Universidad de Santiago
INTEC
Universidad Tecnica Federico Santa Maria

(Length)

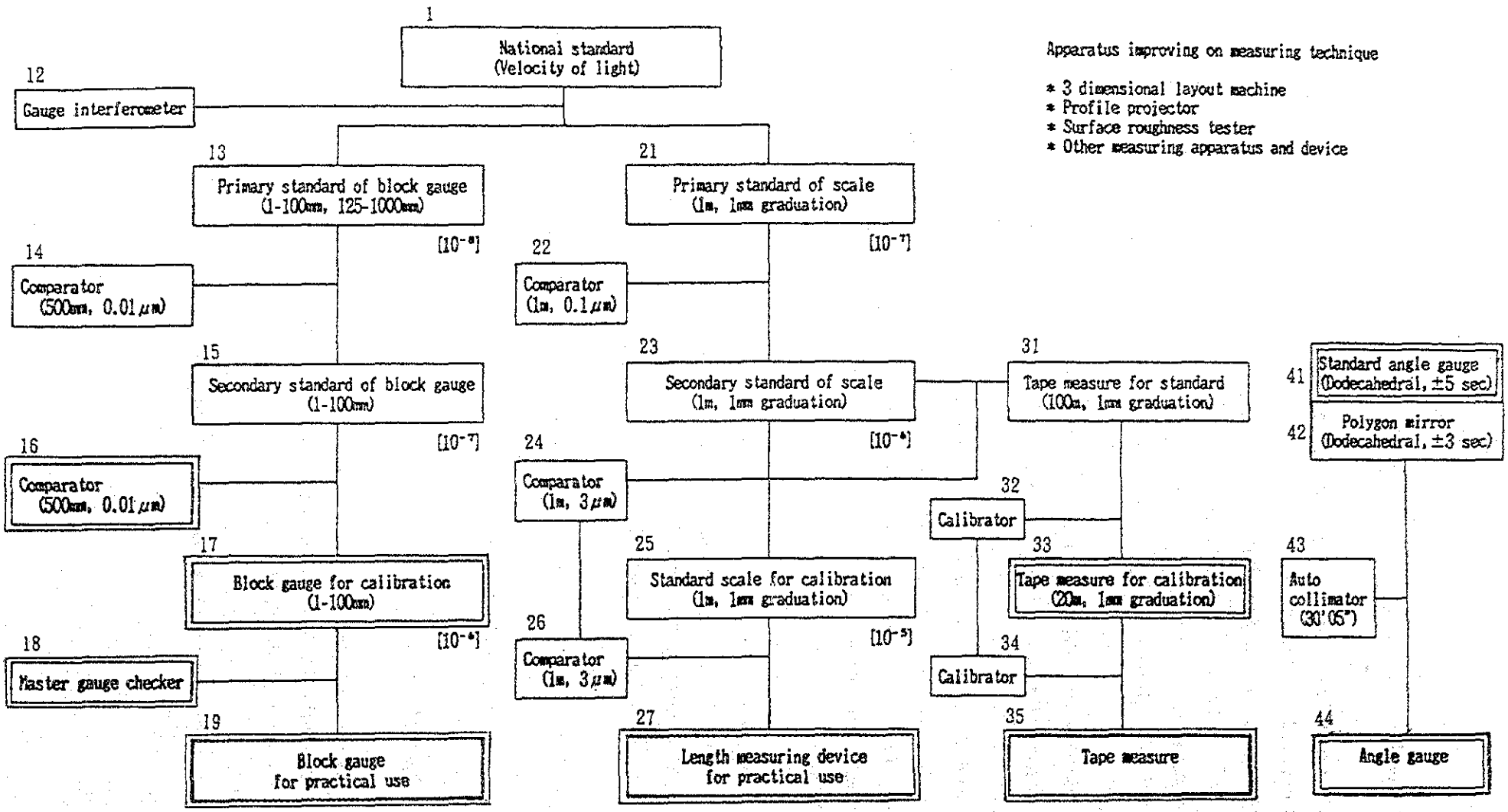


Fig. 3.6-1 Metrology/Calibration Equipment of CESMEC

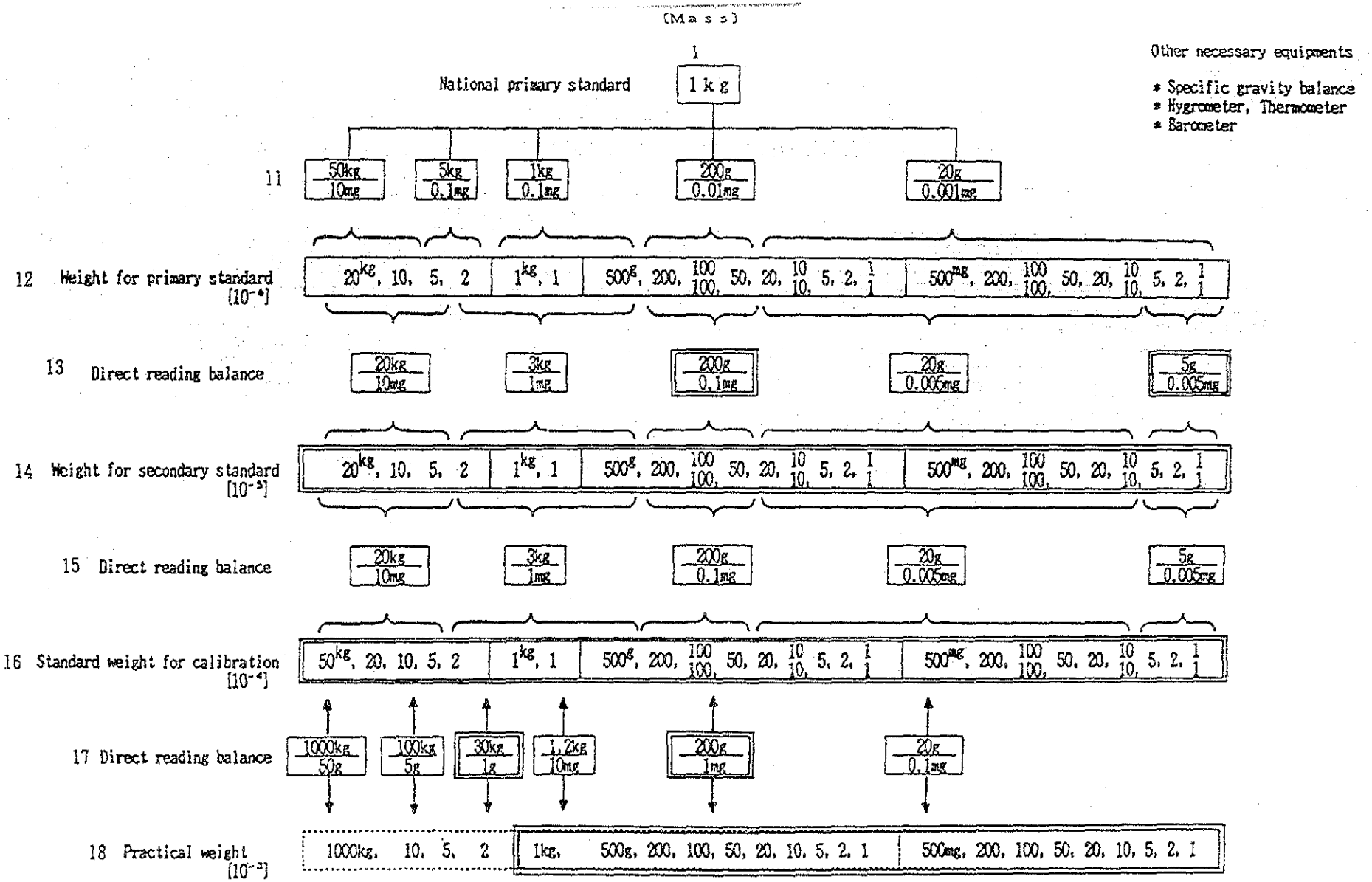


Fig. 3.6－2 Metrology/Calibration Equipment of CESMEC

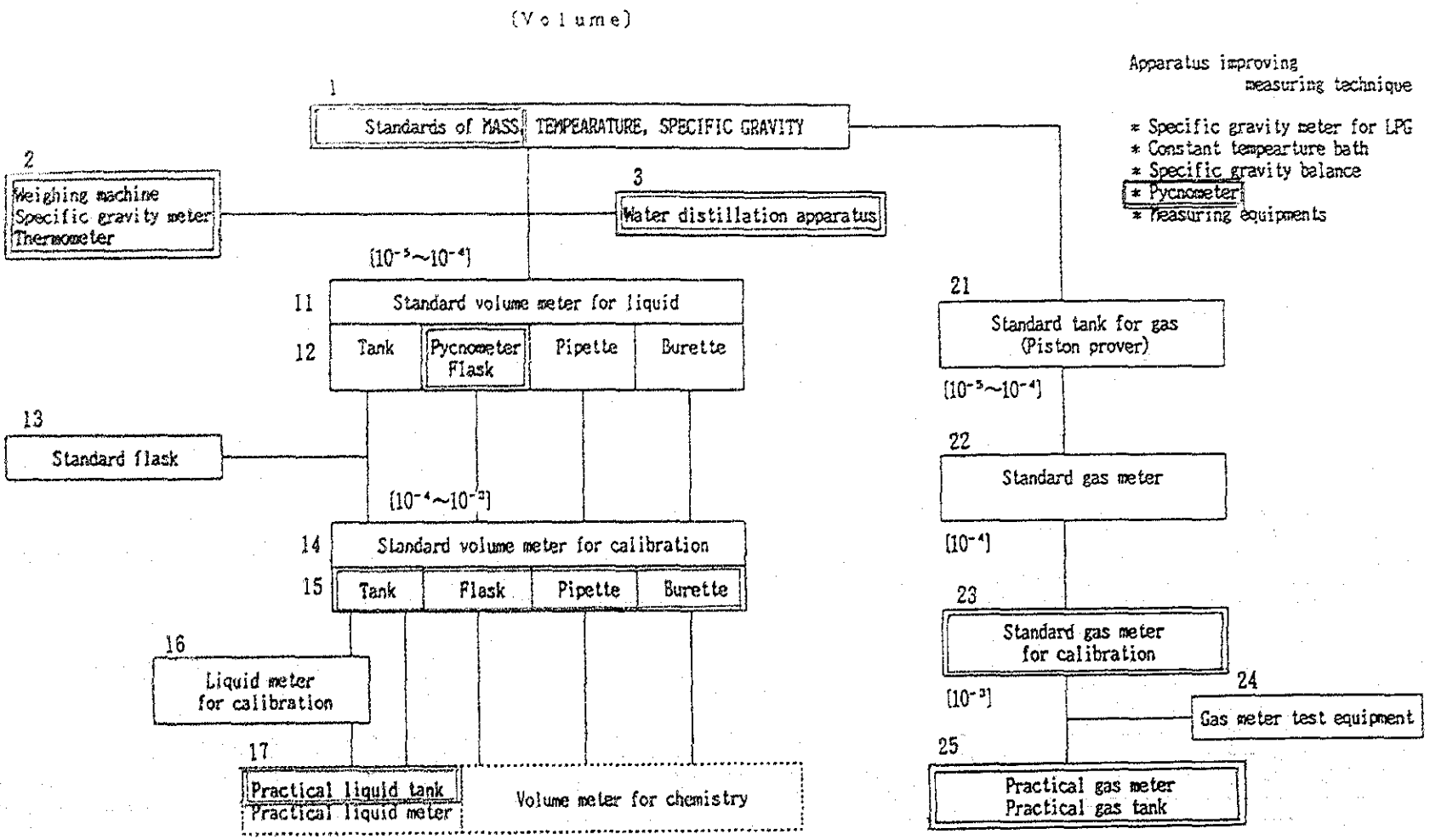


Fig. 3.6-3 Metrology/Calibration Equipment of CESMEC

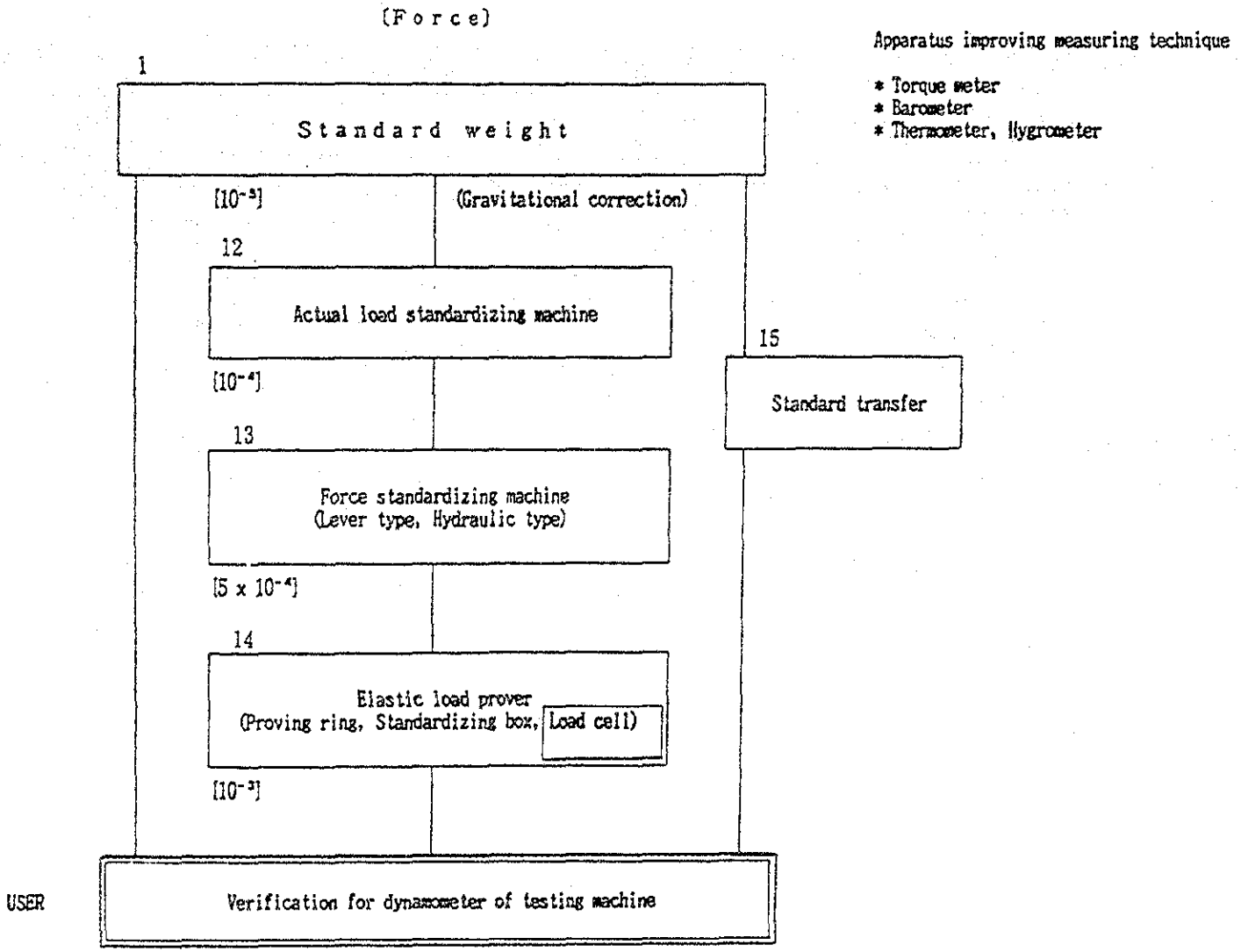


Fig. 3.6－4 Metrology/Calibration Equipment of CESMEC

(Pressure)

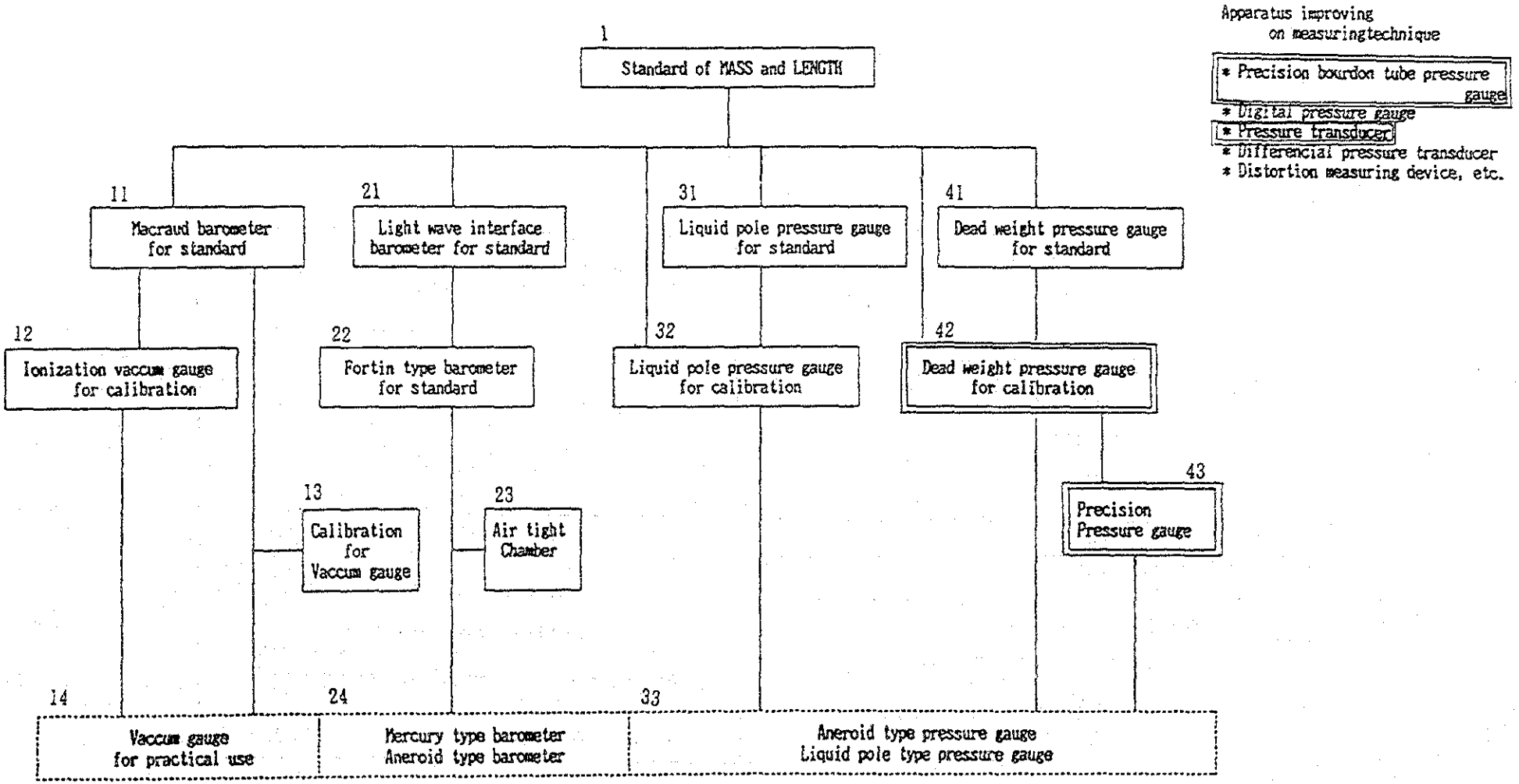


Fig. 3.6－5 Metrology/Calibration Equipment of CESMEC

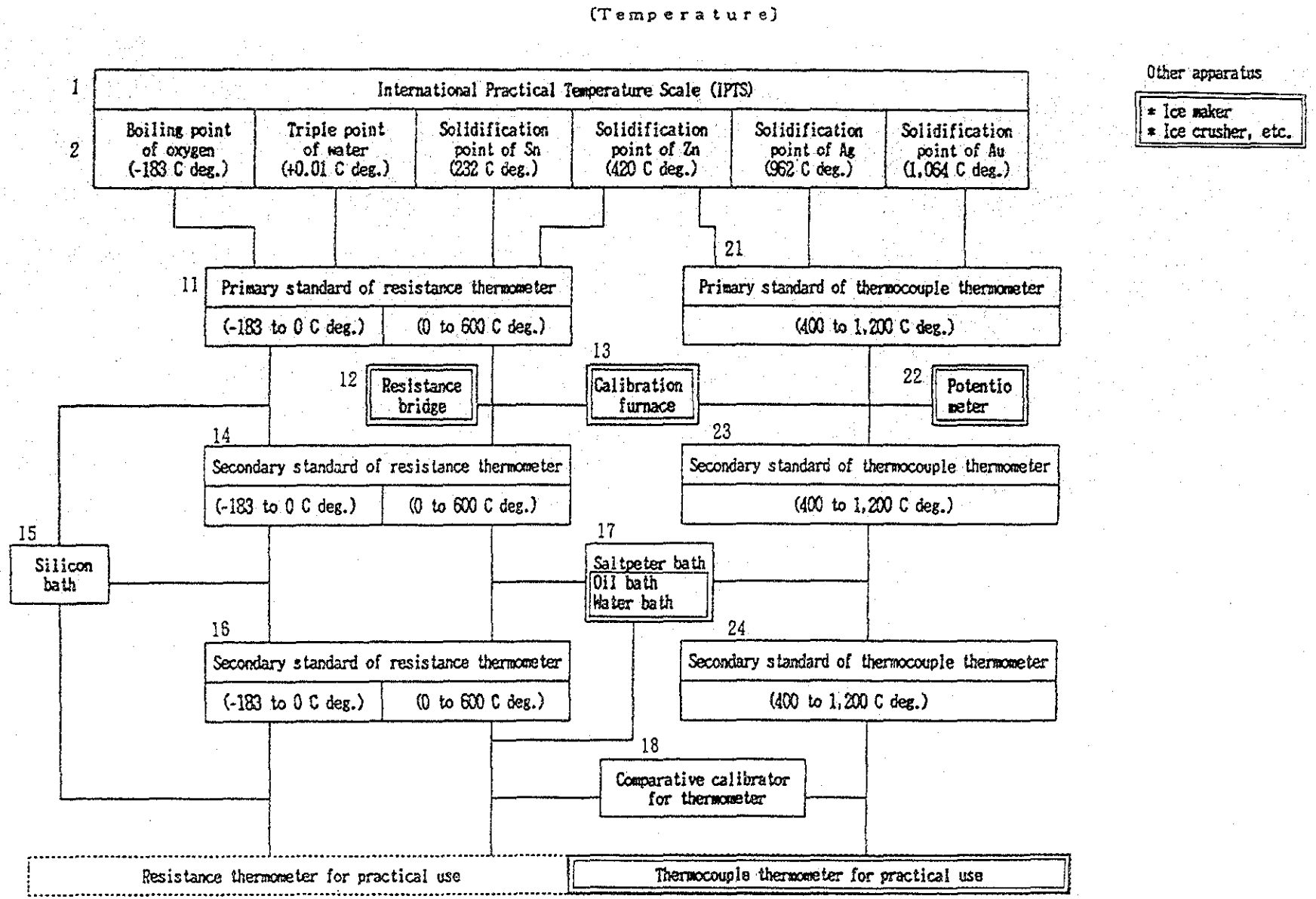


Fig. 3.6-6 Metrology/Calibration Equipment of CESMEC