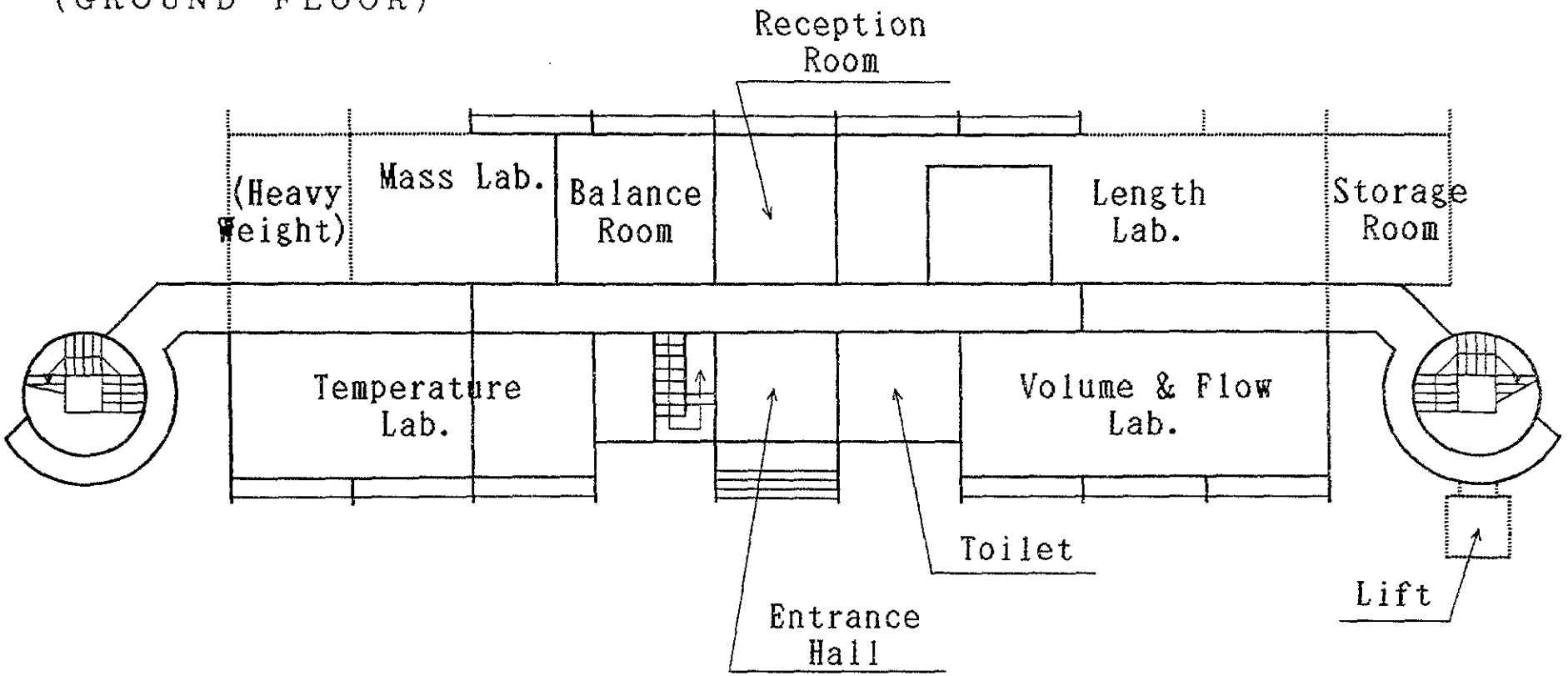
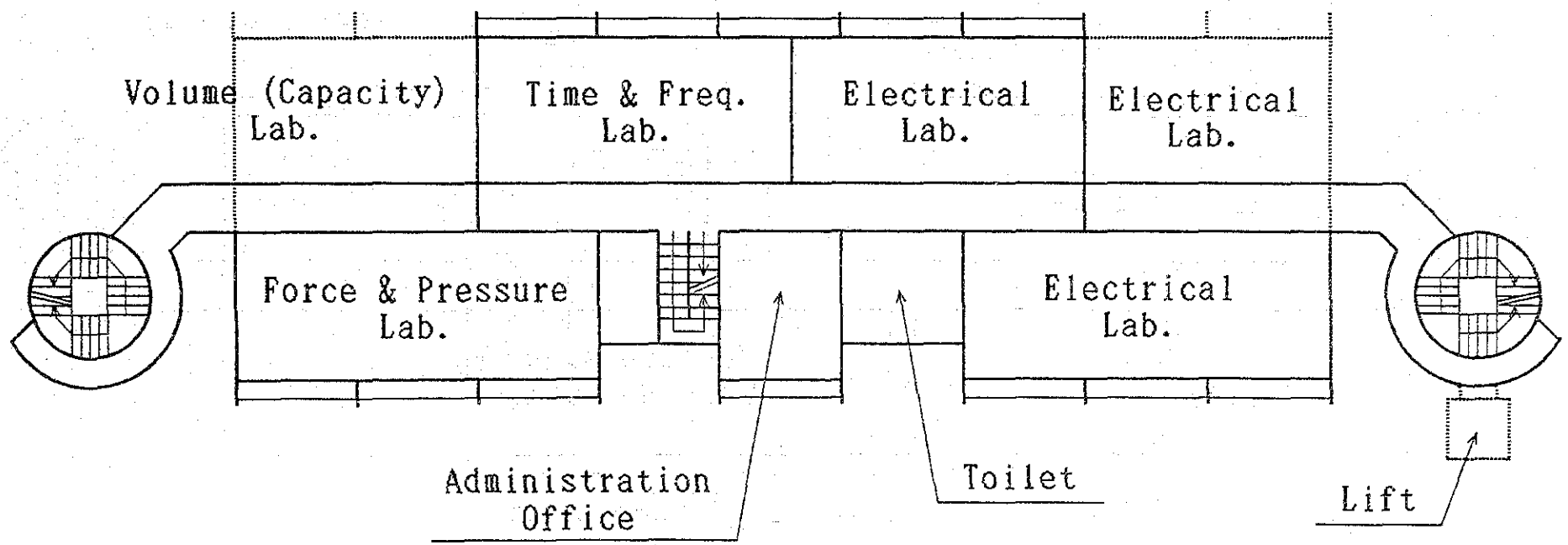
Fig. 7-39 Layout Plan of National Calibration Laboratory



SIRIM MEASUREMENT CENTRE LAYOUT – EXPANSION PLAN
(FIRST FLOOR)



SIRIM MEASUREMENT CENTRE LAYOUT – EXPANSION PLAN
(SECOND FLOOR)

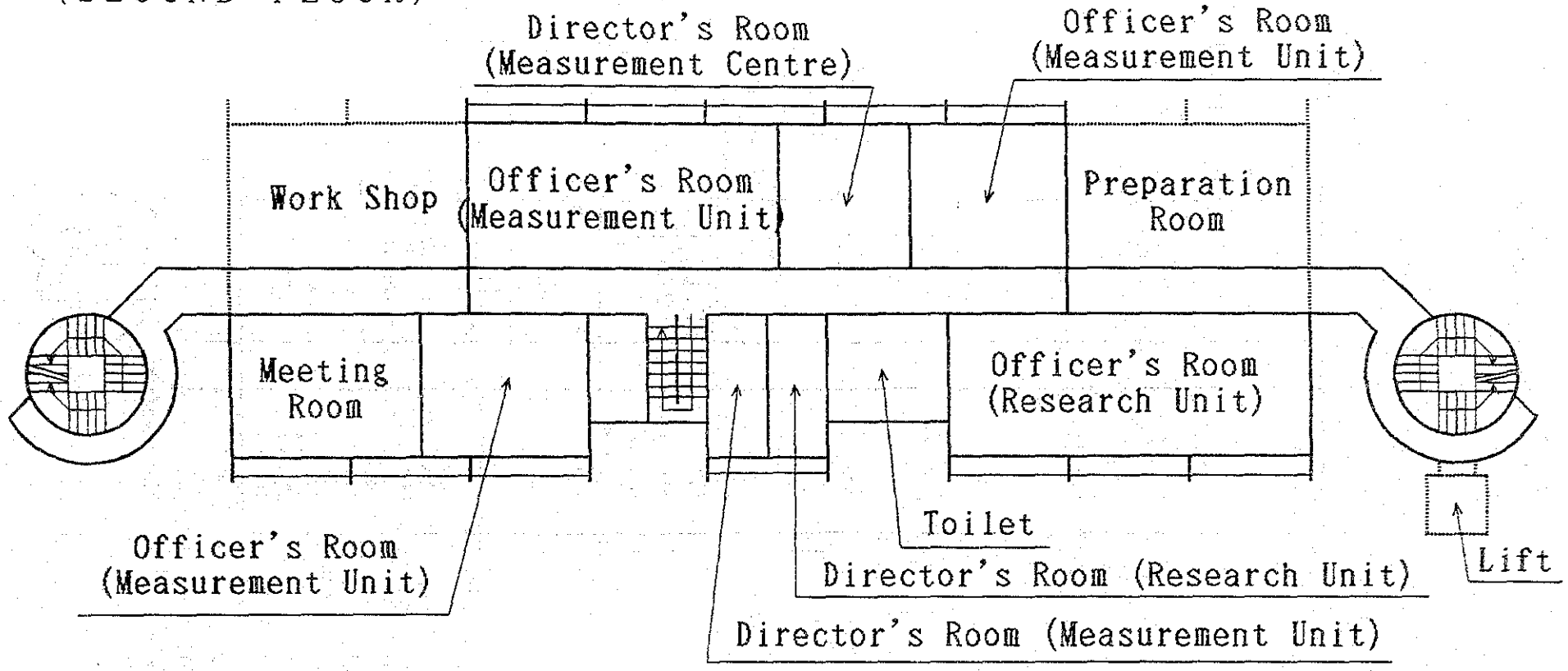
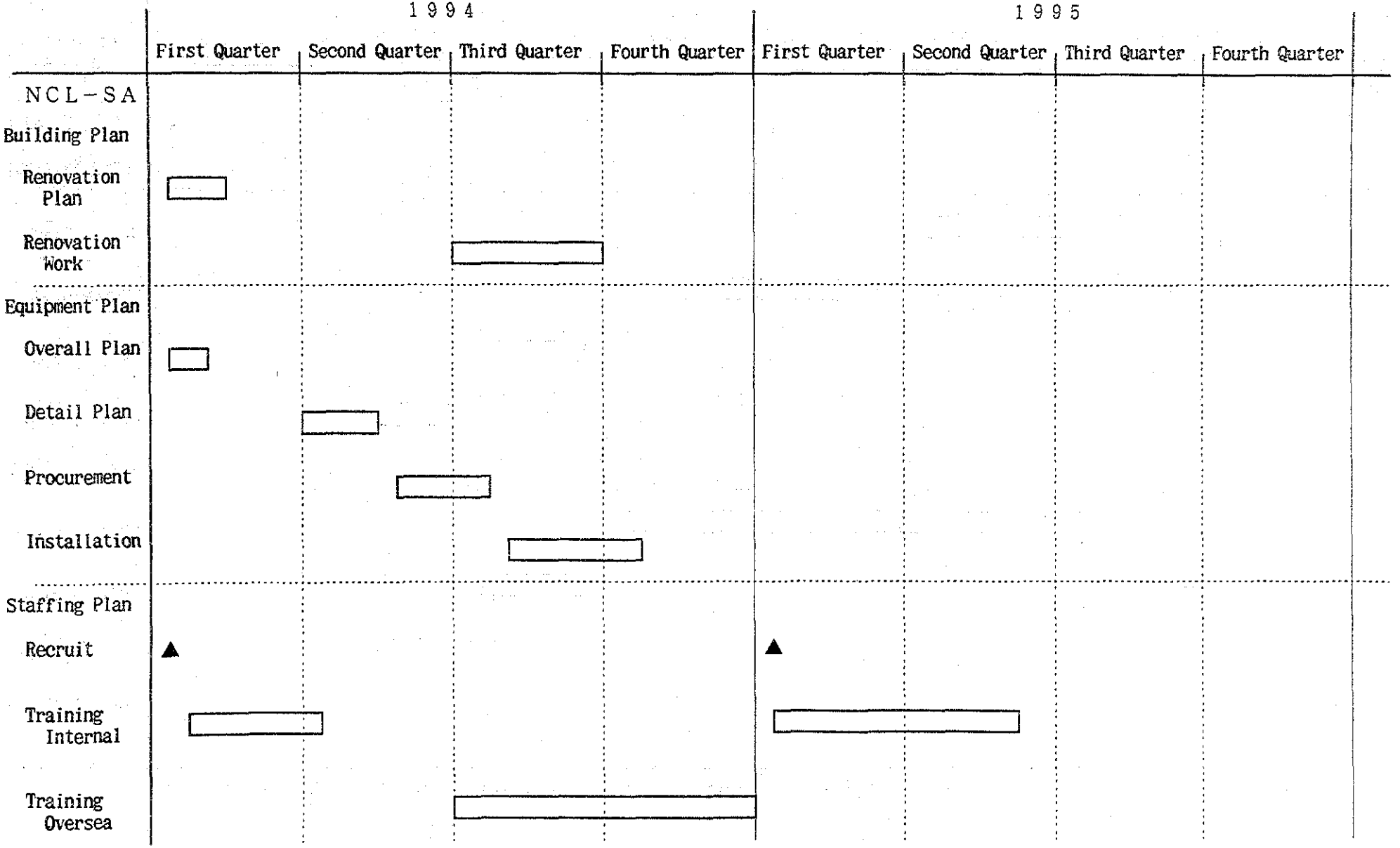
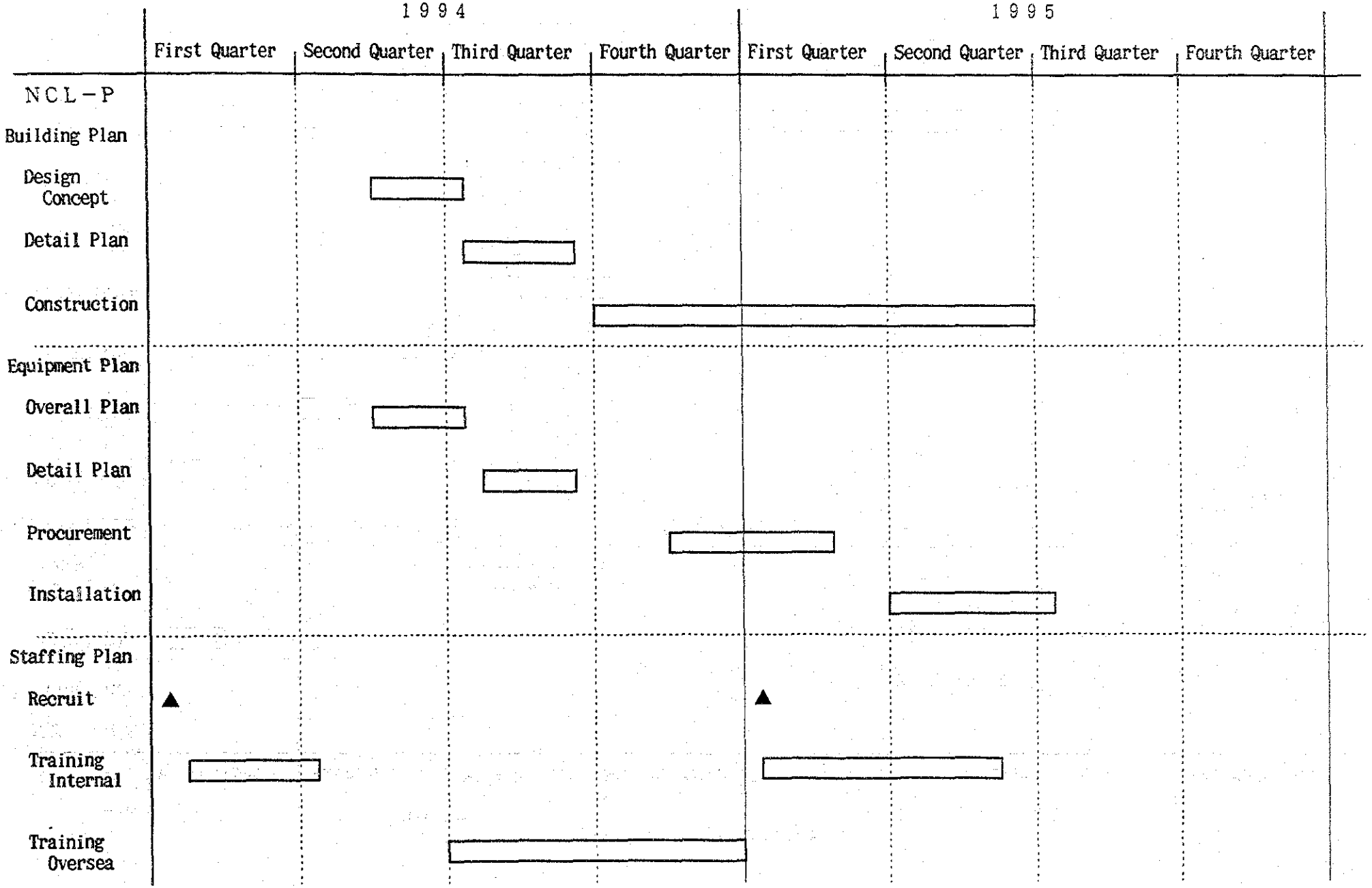
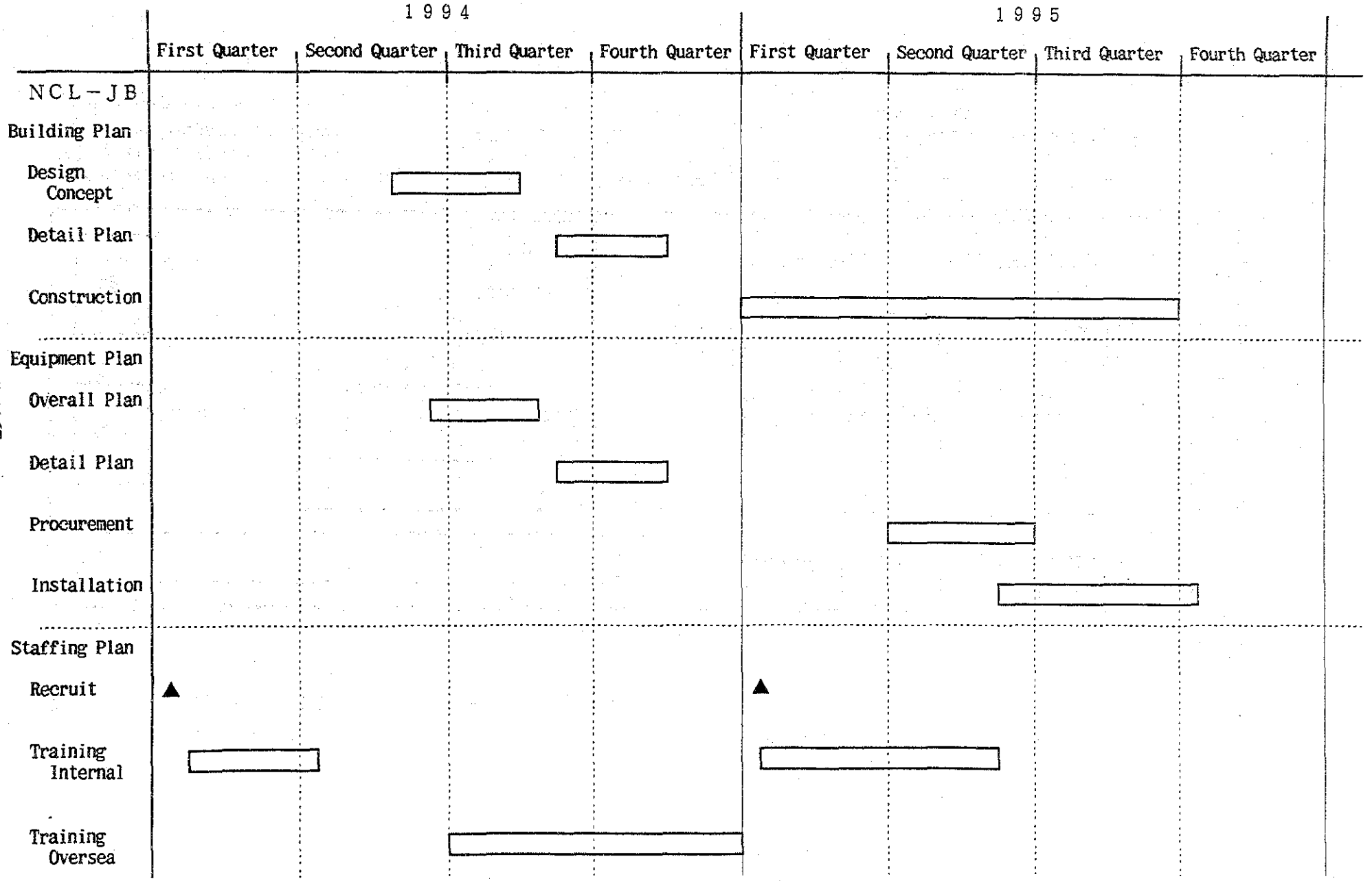


Fig.7-40 Implementation Plan




1994
1995
First Quarter
Second Quarter
Third Quarter
Fourth Quarter
First Quarter
Second Quarter
Third Quarter
Fourth Quarter
NCL-P
Building Plan
Design Concept
Detail Plan
Construction
Equipment Plan
Overall Plan
Detail Plan
Procurement
Installation
Staffing Plan
Recruit
Training Internal
Training Oversea


1994
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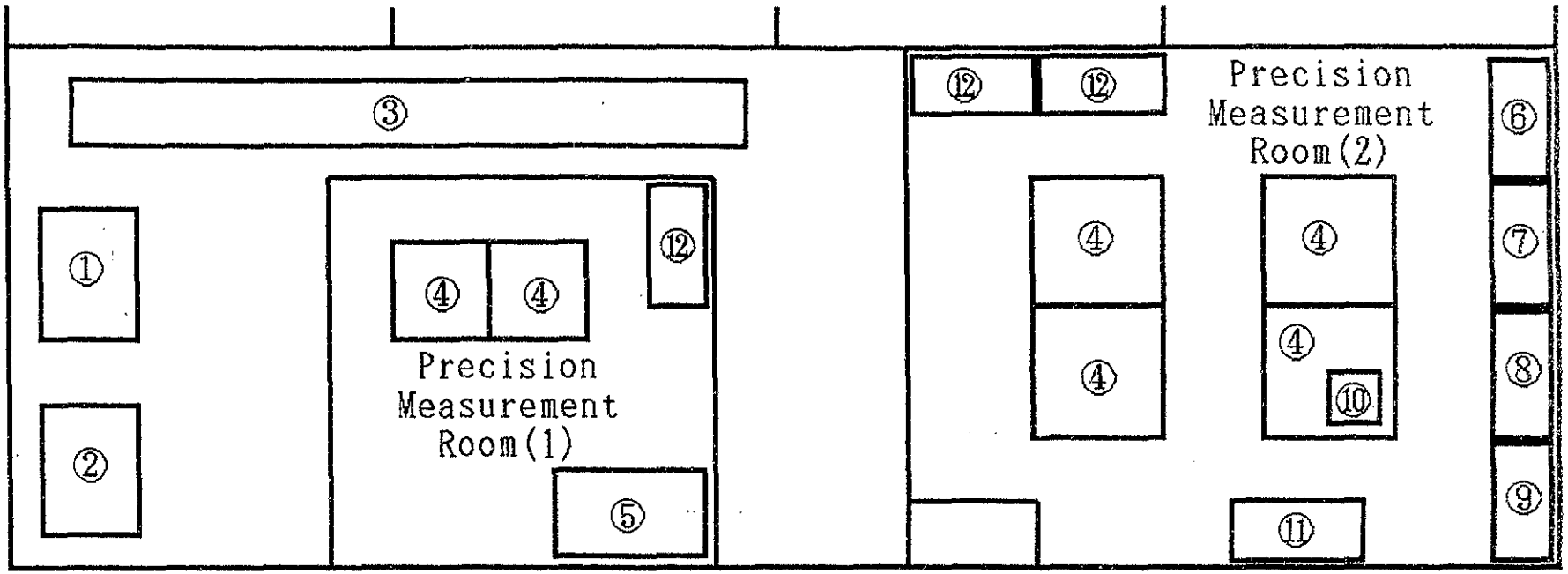
First Quarter
Second Quarter
Third Quarter
Fourth Quarter
First Quarter
Second Quarter
Third Quarter
Fourth Quarter
NCL-JB
Building Plan
Design Concept
Detail Plan
Construction
Equipment Plan
Overall Plan
Detail Plan
Procurement
Installation
Staffing Plan
Recruit
Training Internal
Training Oversea

Fig. 7-41 Layout Plan of Dimensional Calibration Laboratory



①Universal Measuring Machine
②Length Comparator (1m)
③Scale Comparator (10m)
④Surface Plate
⑤Coordinate Measuring Machine
⑥Roughness Measuring Machine
⑦Roundness Measuring Machine
⑨Profile Projector
⑨Toolmaker's Microcope
⑩Autocollimator
⑪Universal Measuring Machine
⑫Storage Lockers

Fig. 7-42 Layout Plan of Mass Calibration Laboratory

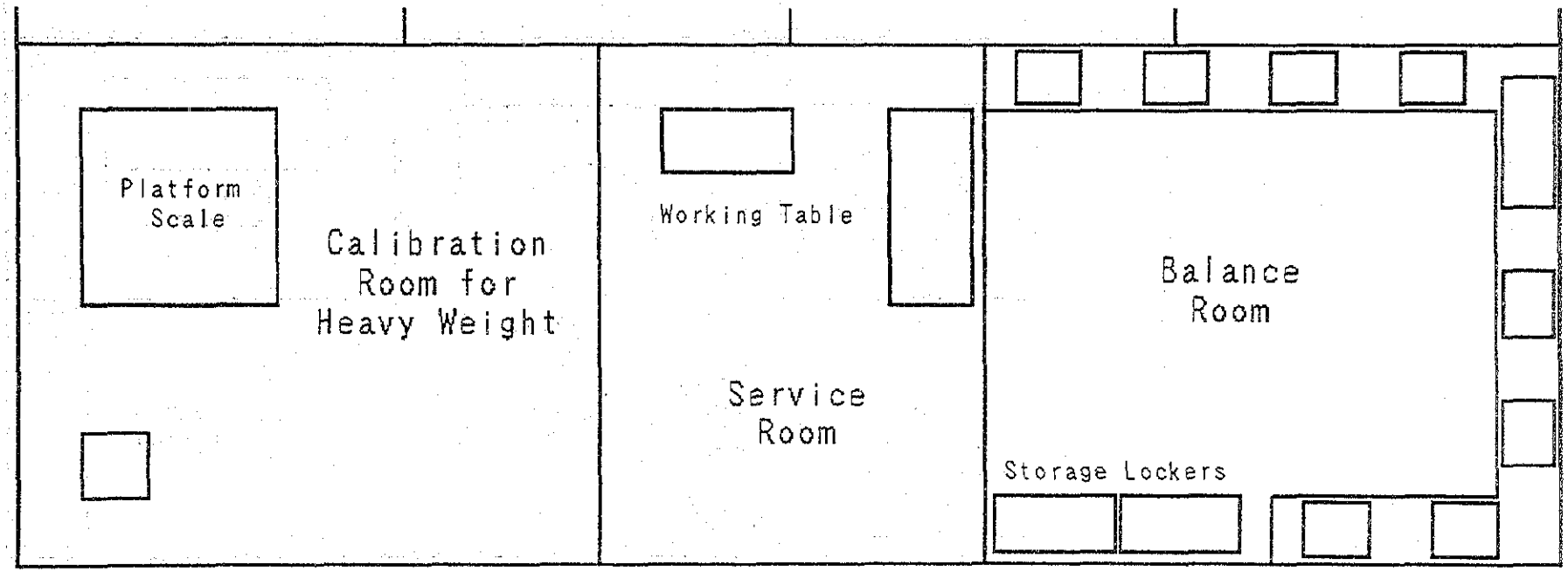


Fig. 7-43 Layout Plan of Volume and Flow Calibration Laboratory

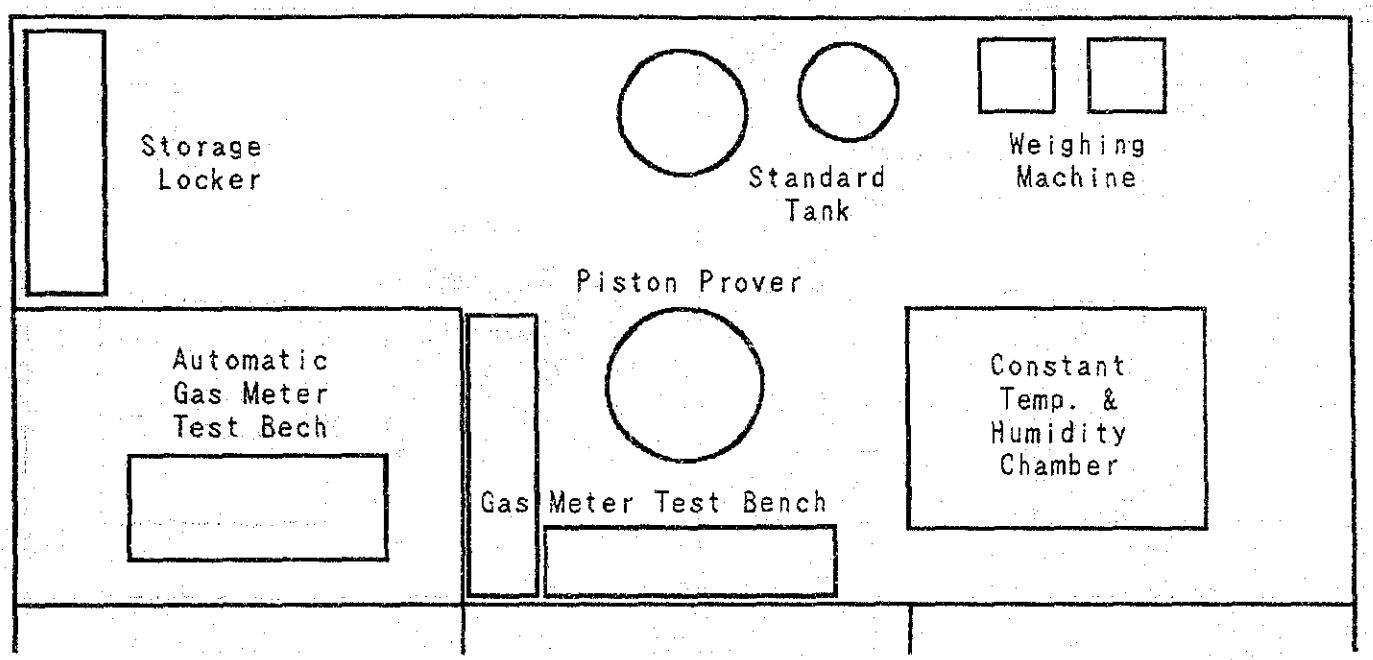
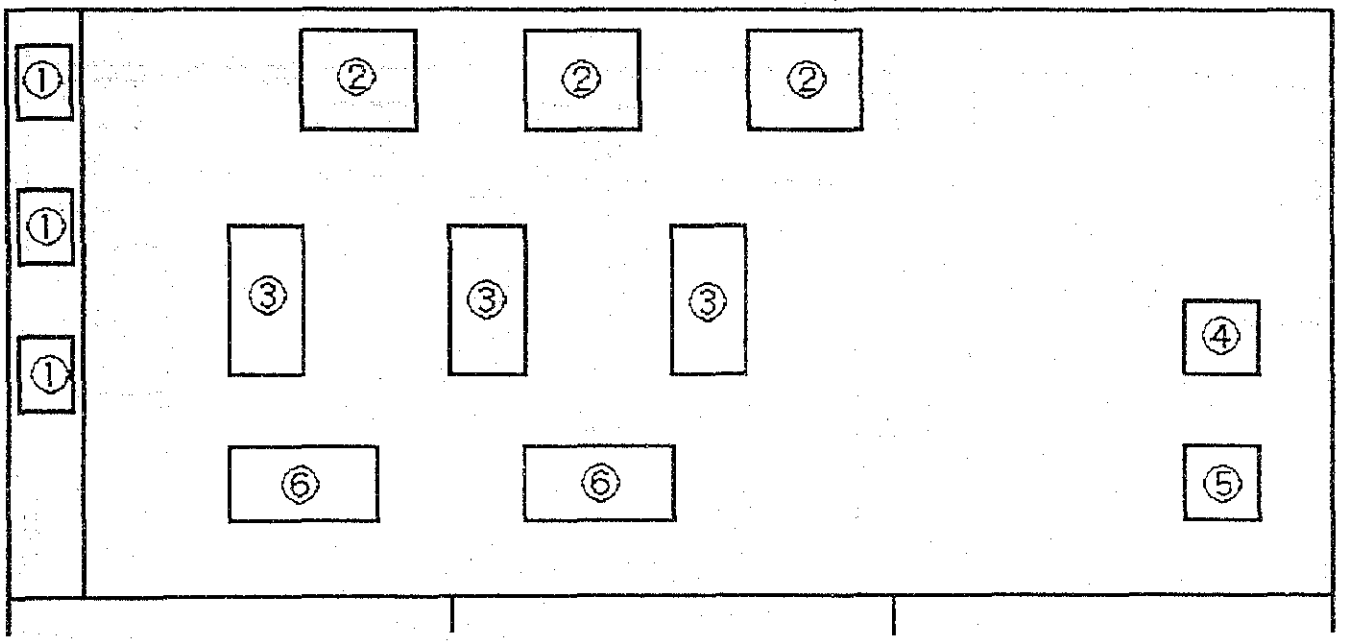
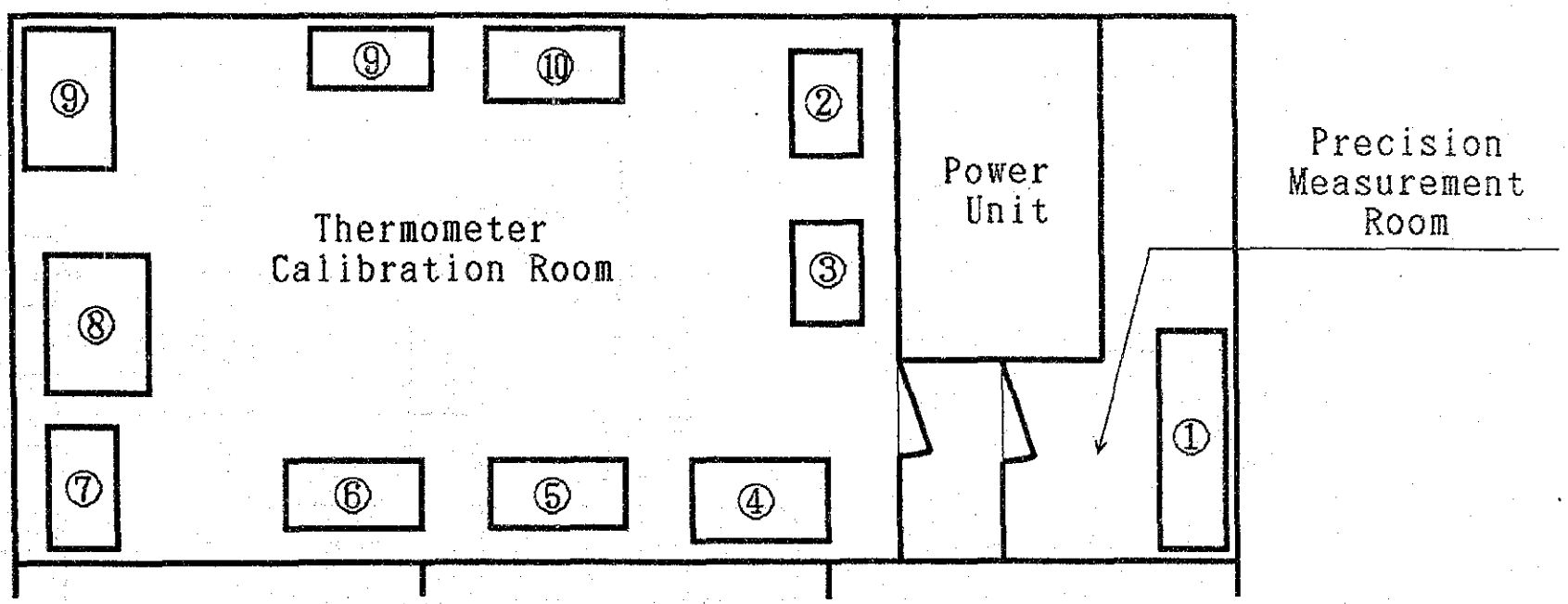


Fig. 7-44 Layout Plan of Force and Pressure Calibration Laboratory



①Pressure Gauge Comparator
②Force Calibration Machine
③Deadweight Pressure Gauge Tester
④Mercury Column Pressure Tester
⑤Water Column Pressure Tester
⑥Work Table

Fig. 7-45 Layout Plan of Temperature Calibration Laboratory



①Electric Measurement Instruments
②Low Temperature Bath (incl. Controller)
③Water Bath
④Thermocouple & Resistance Thermometer Comparison Furnace
⑤Oil Bath
⑥Salt Bath
⑦Vacuum & Inert Gas Supply Unit
⑧Furnace for Radiation Thermometer Comparison
⑨Storage Locker (Standards, Cells, etc.)
⑩Work Table

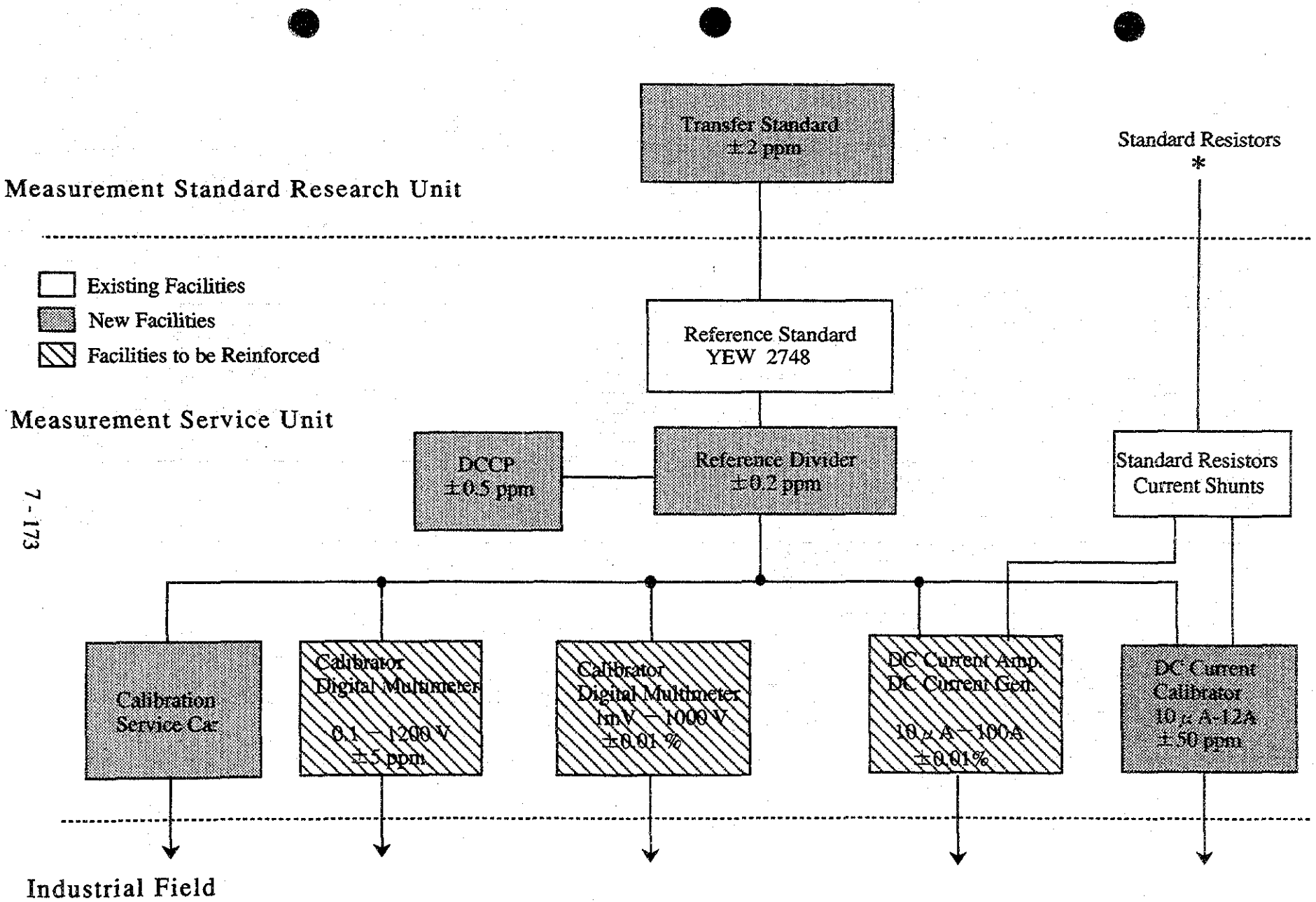


Fig. 7-46 Traceability Chart (Electrical-DC V and A)

SIRIM Laboratory Layout-Expansion Plan
(First Floor)

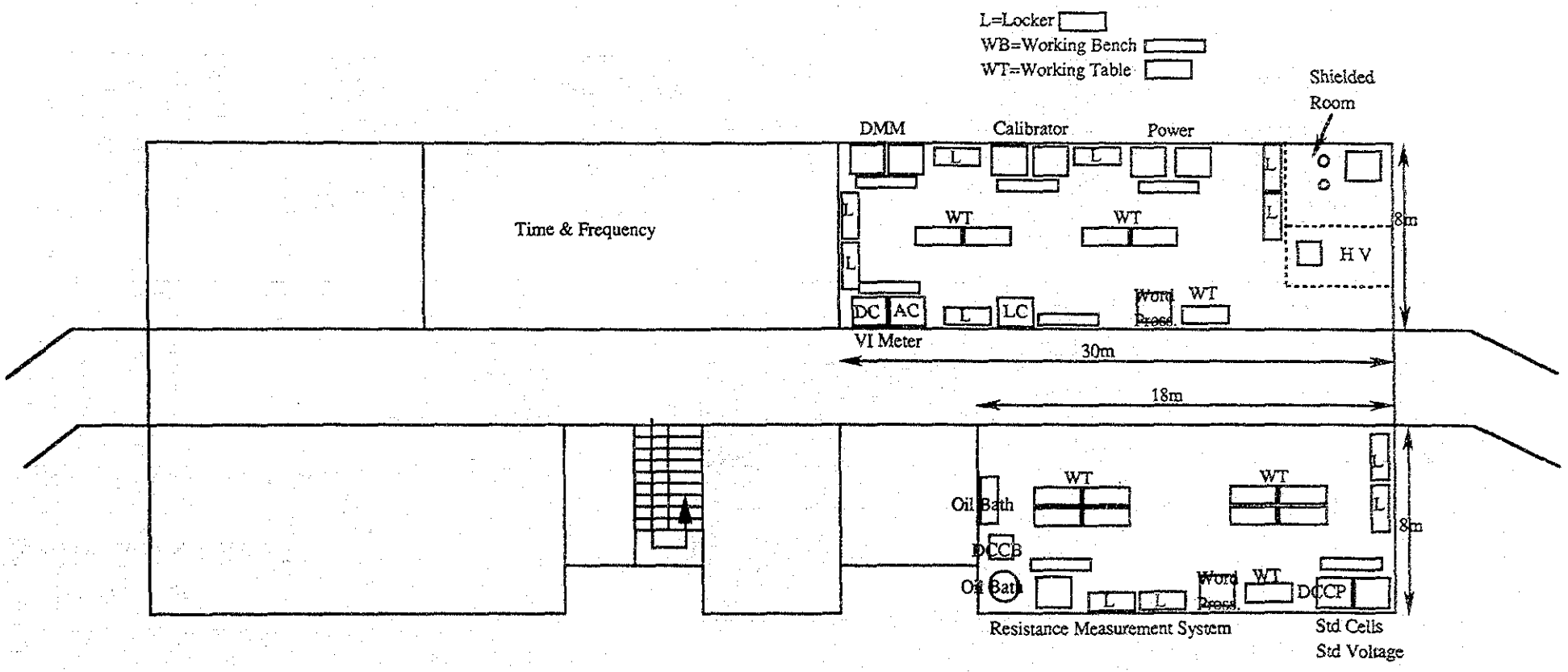


Fig. 7-47 Layout Plan of Electrical Calibration Laboratory

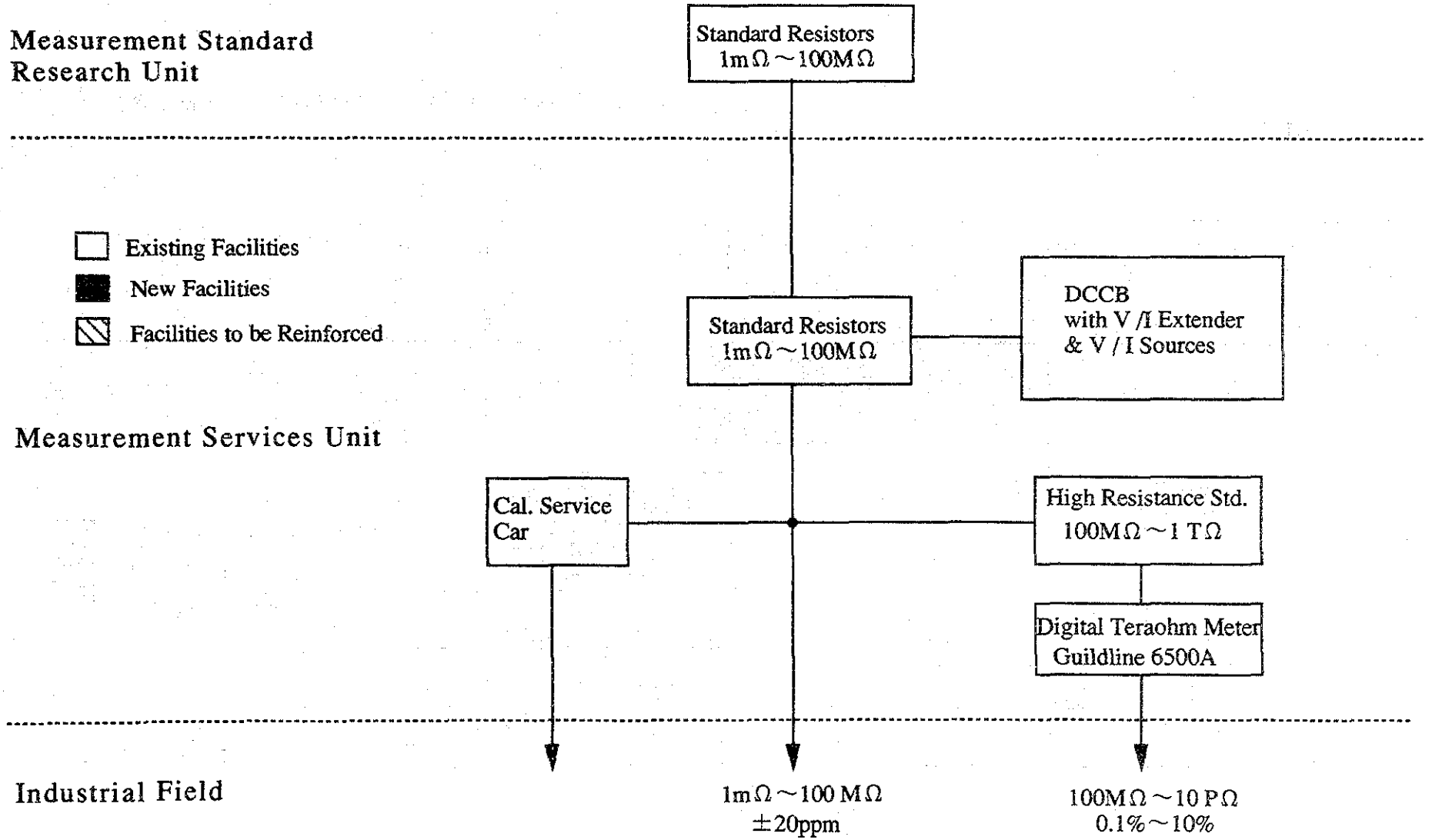


Fig. 7-48 Traceability Chart (Electrical-Resistance)

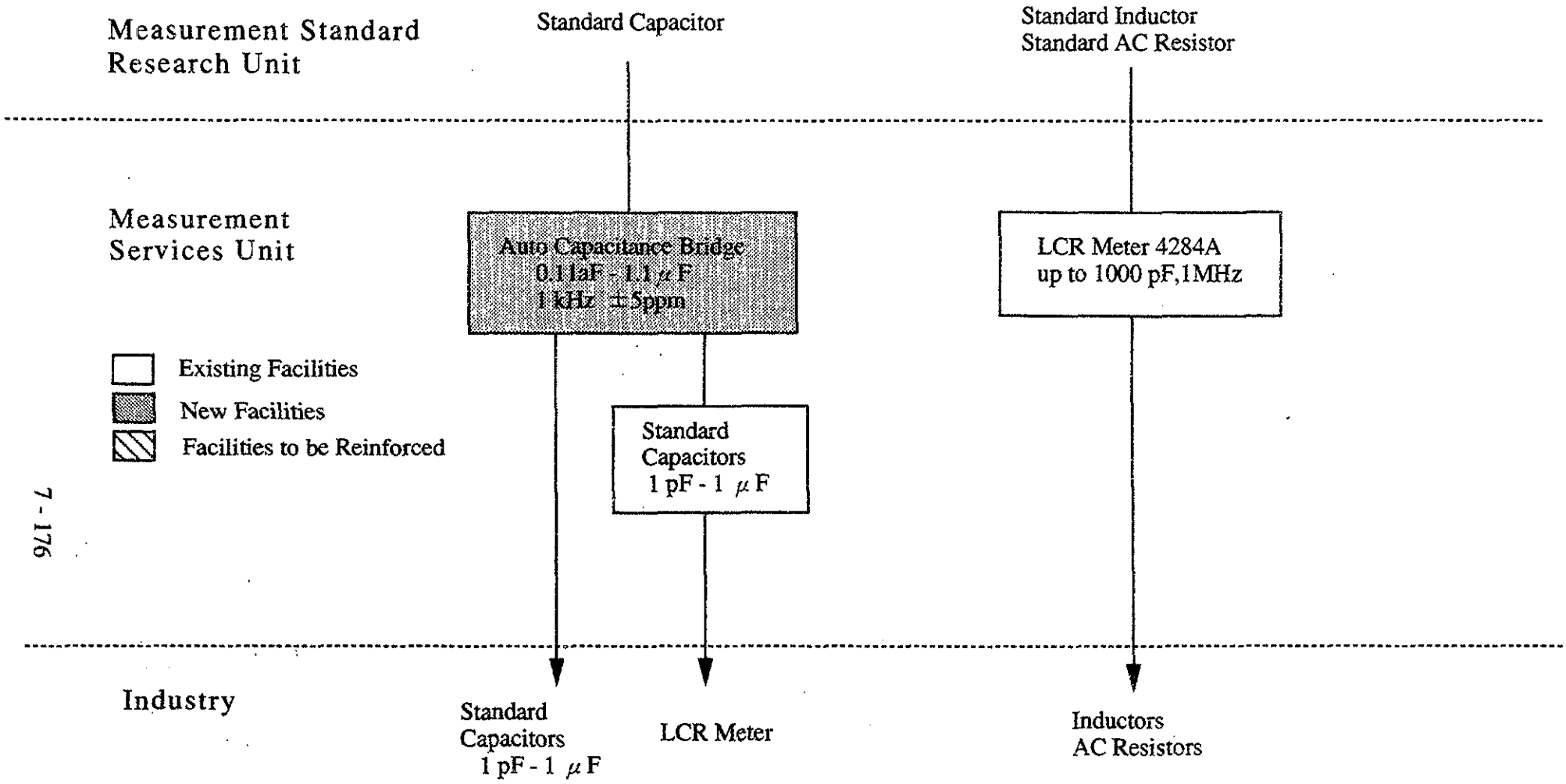


Fig. 7-49 Traceability Chart (Electrical-Capacitance)

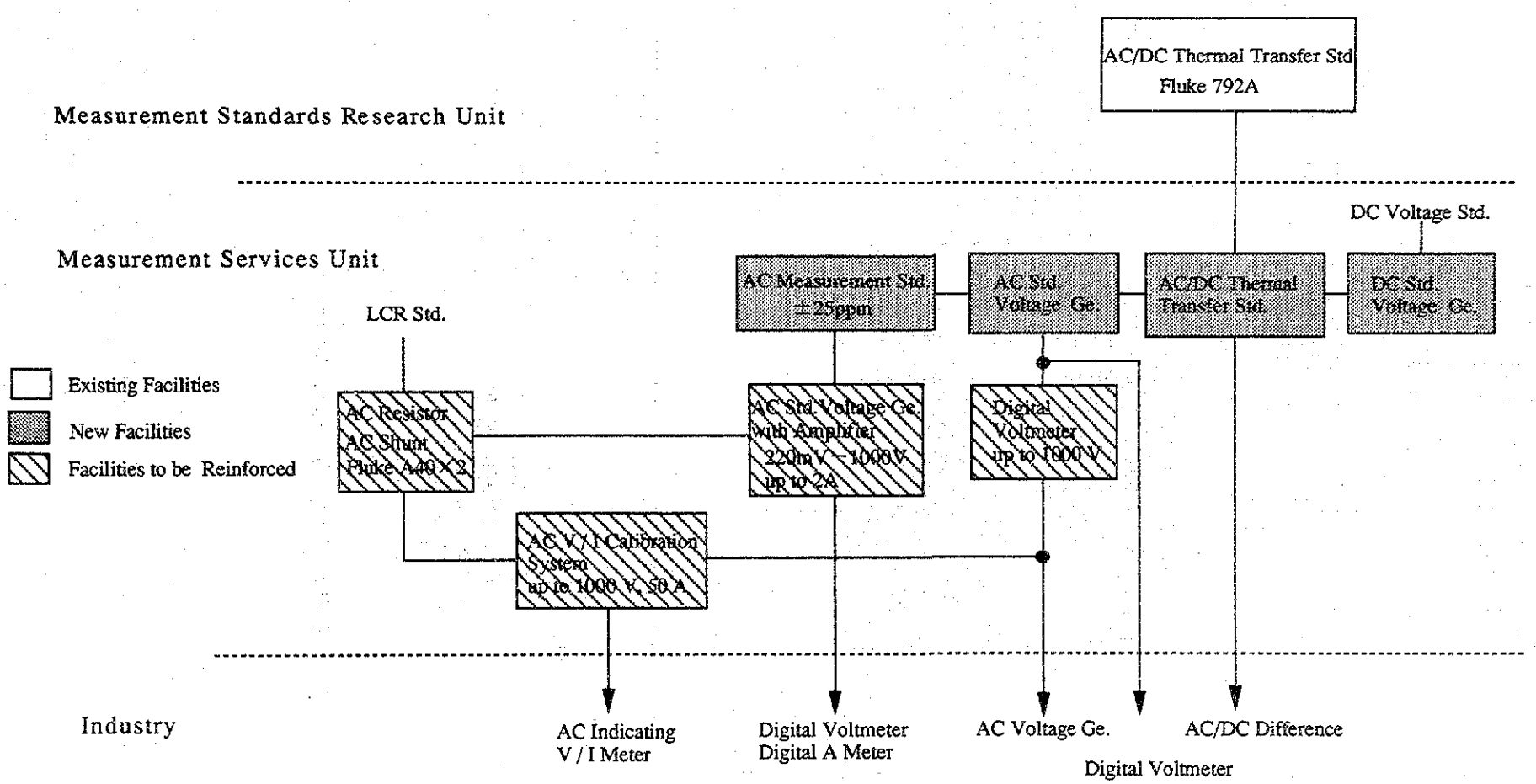


Fig. 7-50 Traceability Chart (Electrical-AC)

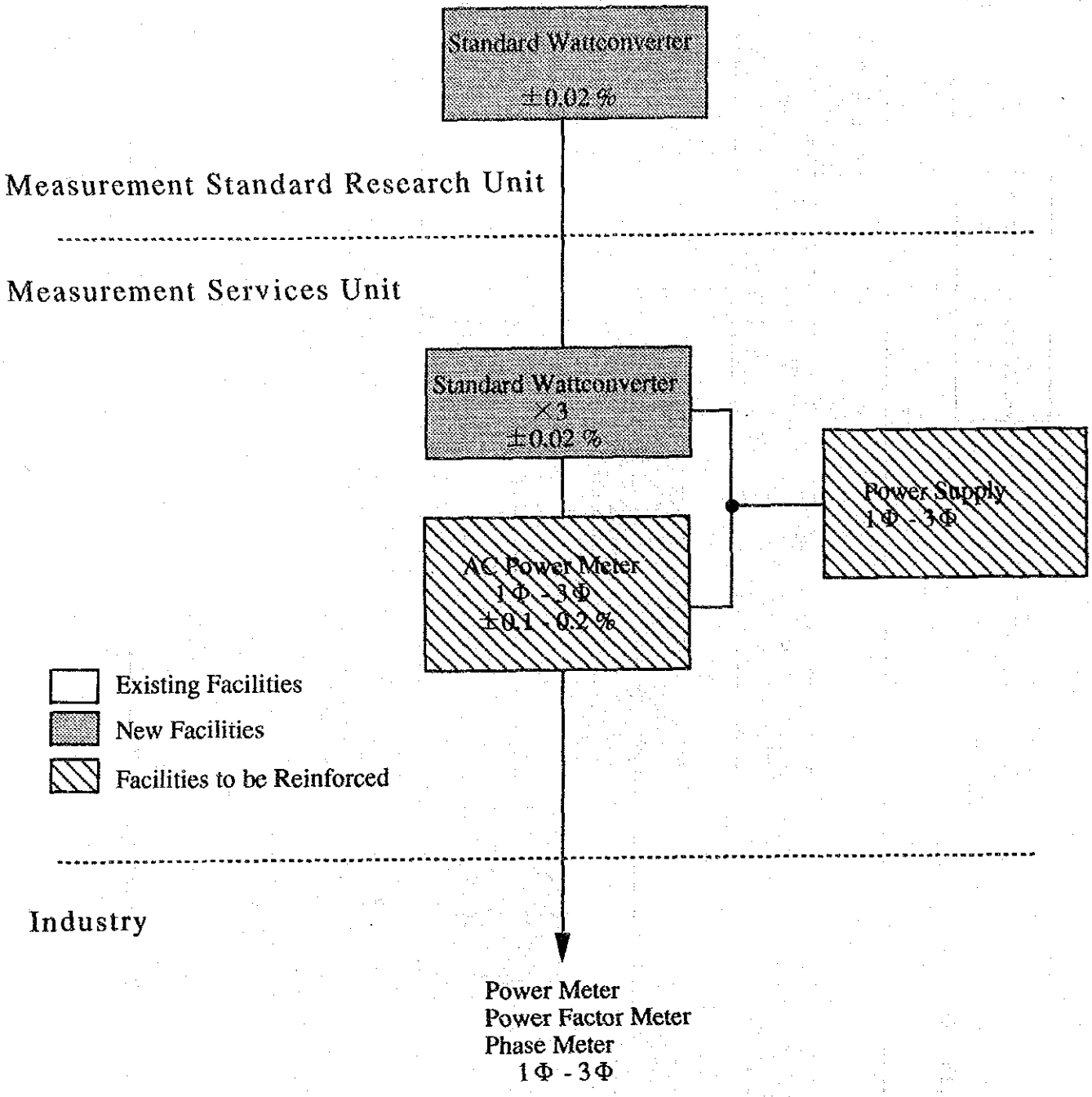
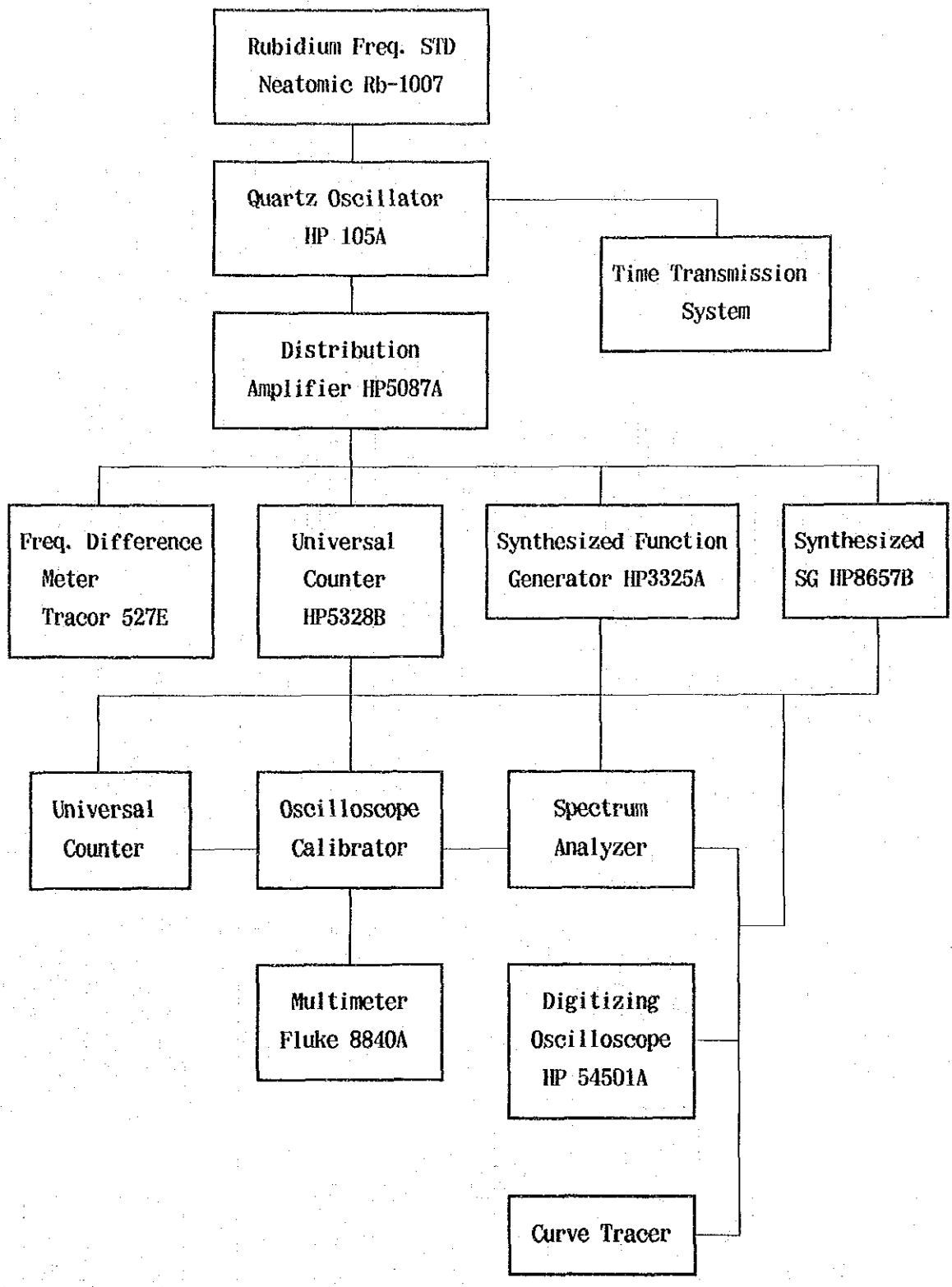


Fig. 7-51 Traceability Chart (Electrical-Power)

Fig.7-52 Traceability Chart (Time/Frequency)



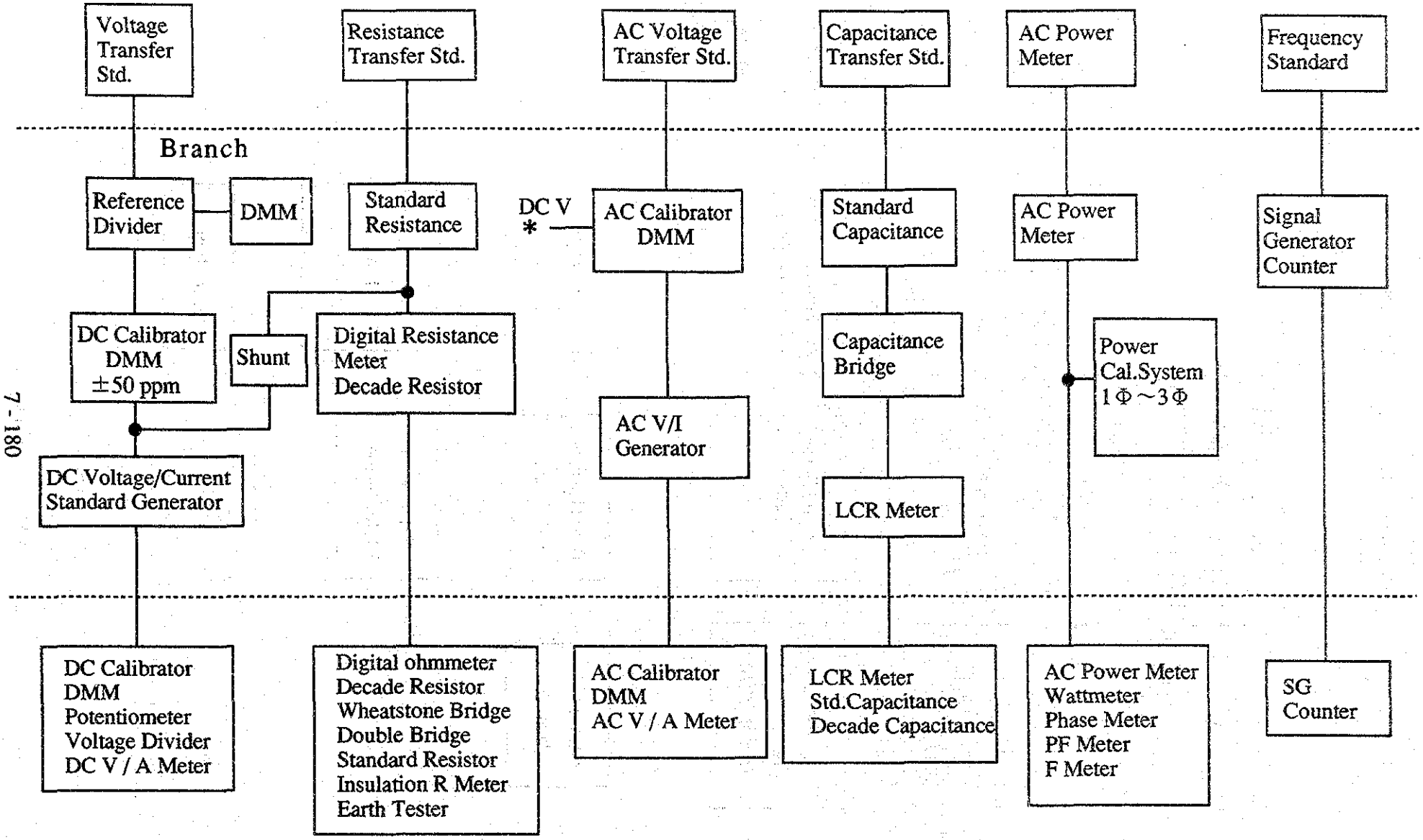


Fig. 7-53 Traceability Chart (Electrical-NCL-P and NCL-JB)

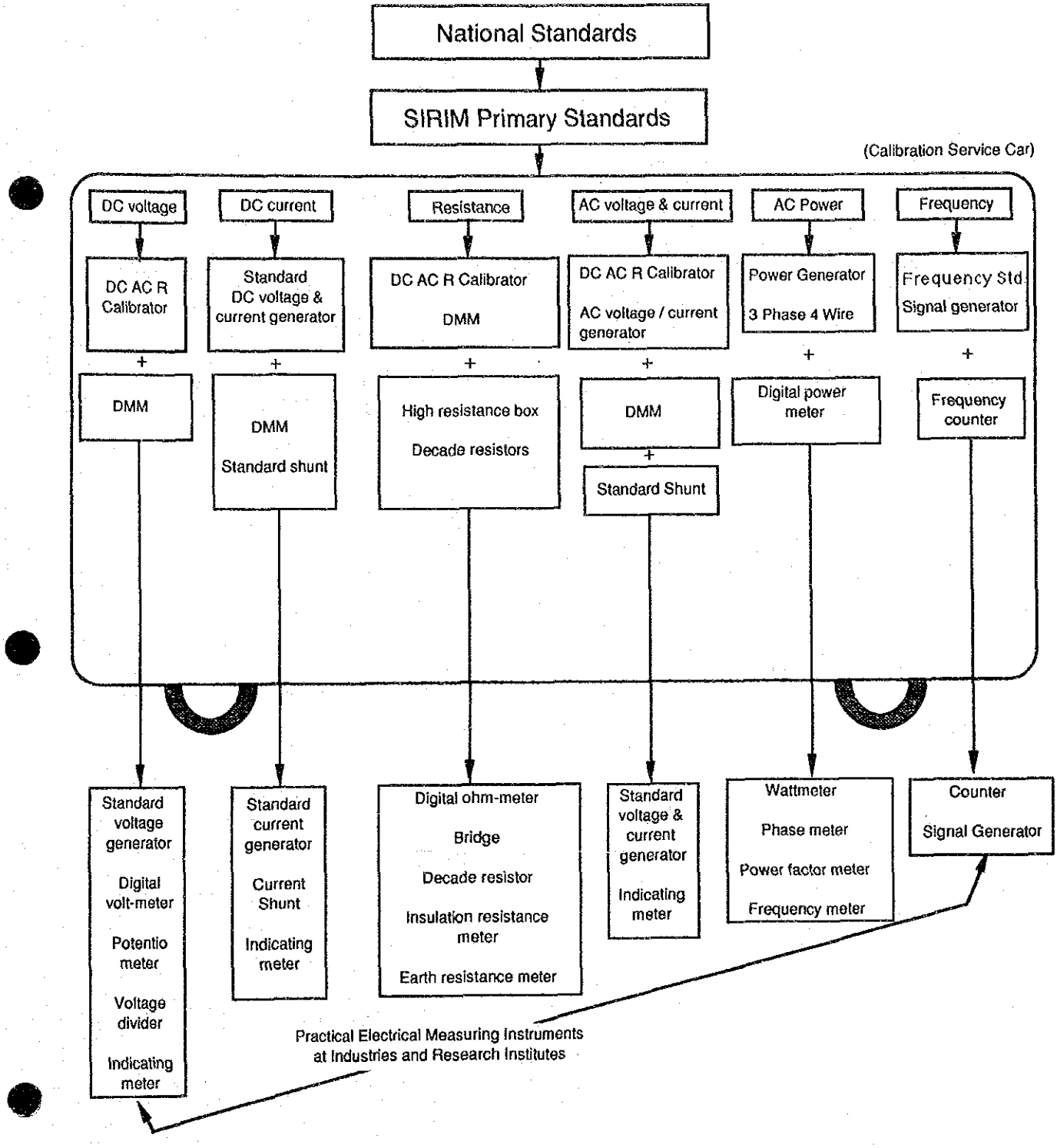


Fig. 7-54 On Site Cal. Services for Woking Standards by the Service Car

APPENDIX

WEIGHTS AND MEASURES ACT, 1972

Part I PRELIMINARY

1 Short title, application and commencement

2 Interpretation

Part II UNITS OF MEASUREMENT

3 International Systems of Units

4 Multiples and submultiples of the International System of Units

5 Measurements to be in the International System of Units

6 Malaysian Primary Standards of mass and measure

7 Secondary Standards of mass and measure

8 Tertiary Standards of mass and measure

9 Working Standards of mass and measure

10 Verification of Malaysian Primary Standards, Secondary Standards, Tertiary Standards and Working Standards

Part III WEIGHTS AND MEASURES FOR TRADE PURPOSES

11 Meaning of "use for trade"

12 Units of measurement, weights and measures lawful for use for trade

13 Marking of weights and measures with denomination

14 Stamping and verification of weights and measures, etc. and issue of certificates of verification

15 Lead or pewter weights

16 Use or possession of unjust weights, etc.

17 Use or possession of false weight or measure, etc. to defraud

18 Manufacture, sale or repair of weights, measure or instrument for weighing or measuring

19 Penalty for trading without the necessary instrument for weighing or measuring

20 Forgery or counterfeiting of certificate or stamp on weights, measures or instruments for weighing or measuring

20A Offence in connection with stamping instrument

21 Evidence as to possession

22 Offence committed by a servant

23 Forfeit

24 Repeal

Part IV ADMINISTRATION

25 Custodian of Weights and Measures

25A Custodian to advise Minister

26 Chief Inspector, Deputy Chief Inspectors and Inspectors

27 Licensing

27A Power of prosecution

28 Power to inspect weights and measures, etc. and to enter premises

28A Forfeiture of instrument for weighing or measuring, etc.

28B Protection of Inspectors, etc. for putting Act in force

Part V GENERAL

29 Regulations

30 Permissible margin of errors

31 Powers of exemption and making of regulations to remove difficulties

32 Transitional provisions

33 Conversion

34 Reference of units of measurements in written law

34A Compounding

35 Repeal and saving

FIRST SCHEDULE S.I. UNITS OF MEASUREMENTS

PART 1 The base units

PART 2 Supplementary and derived units

PART 3 Units which may be used in conjunction with the base units and supplementary and derived units

PART 4 Multiples and submultiples of units of measurements

SECOND SCHEDULE WEIGHTS AND MEASURES FOR USE FOR TRADE

PART 1 Linear measures

PART 2 Square measures

PART 3 Cubic measures

PART 4 Capacity measures

PAET 5 Weights

THIRD SCHEDULE CONVERSION

PART 1 Conversion of the values of SI units in terms of the values of other units of measurement

PART 2 Conversion of the values of other units of measurement in terms of the SI units

FOURTH SCHEDULE REPEAL

ＩＳＯ ９００１ (１９８７)

Quality systems - Model for quality assurance in design/development, production, installation and servicing

0 Introduction

1 Scope and field of application

1.1 Scope

1.2 Field of application

2 References

3 Definitions

4 Quality system requirements

4.1 Management responsibility

4.2 Quality system

4.3 Contract review

4.4 Design control

4.5 Document control

4.6 Purchasing

4.7 Purchaser supplied product

4.8 Product identification and traceability

4.9 Process control

4.10 Inspection and testing

4.11 Inspection, measuring and test equipment

4.12 Inspection and test status

4.13 Control of nonconforming product

4.14 Corrective action

4.15 Handling, storage, packaging and delivery

4.16 Quality records

4.17 Internal quality audits

4.18 Training

4.19 Servicing

4.20 Statistical techniques

ISO 9001 CLAUSE 4.11

4.11 INSPECTION, MEASURING AND TEST EQUIPMENT

The supplier shall control, calibrate and maintain inspection, measuring and test equipment, whether owned by the supplier, on loan, or provided by the purchaser, to demonstrate the conformance of product to the specified requirements. Equipment shall be used in a manner which ensures that measurement uncertainty is known and is consistent with the required measurement capability.

The supplier shall

a) identify the measurements to be made, the accuracy required and select the appropriate inspection, measuring and test equipment;
b) identify, calibrate and adjust all inspection, measuring and test equipment and devices that can affect product quality at prescribed intervals, or prior to use, against certified equipment having a known valid relationship to nationally recognized standards - where no such standards exist, the basis used for calibration shall be documented;
c) establish, document and maintain calibration procedures, including details of equipment type, identification number, location, frequency of checks, check method, acceptance criteria and the action to be taken when resultare unsatisfactory;
d) ensure that inspection, measuring and test equipment is capable of the accuracy and precision necessary;
e) identify inspection, measuring and test equipment with a suitable indicator or approved identification record to show the calibration status;
f) maintain calibration records for inspection, measuring and test equipment;
g) assess and document the validity of previous inspection and test results when inspection, measuring and test equipment is found to be out of calibration;
h) ensure that the environmental conditions are suitable for the calibrations, inspections, measurements and tests being carried out;
i) ensure that handling, preservation and storage of inspection, measuring and test equipment is such that the accuracy and fitness for use is maintained;
j) safeguard inspection, measuring and test facilities, including both test

hardware and test software, from adjustments which would invalidate the calibration setting.

Where test hardware (e.g. jigs, fixtures, templates, patterns) or test software is used as suitable forms of inspection, they shall be checked to prove that they are capable of verifying the acceptability of product prior to release for use during production and installation and shall be rechecked at prescribed intervals. The supplier shall establish the extent and frequency of such evidence of control. Measurement design data shall be made available, when required by the purchaser or his representative, for verification that it is functionally adequate.

ISO/IEC GUIDE 25 (1990)

GENERAL REQUIREMENTS FOR THE COMPETENCE OF CALIBRATION AND TESTING LABORATORIES

INTRODUCTOPN

1 Scope

2 Reference

3 Definitions

4 Organization and management

5 Quality system, audit and review

6 Personnel

7 Accommodation and environment

8 Equipment and reference materials

9 Measurement traceability and calibration

10 Calibration and test methods

11 Handling of calibration and test items

12 Records

13 Certificates and reports

14 Sub-contracting of calibration or testing

15 Outside support services and supplies

16 Complaints

8 Equipment and reference materials

8.1 The laboratory shall be furnished with all items of equipment (including reference materials) required for the correct performance of calibrations and tests. In those cases where the laboratory needs to use equipment outside its permanent control it shall ensure that the relevant requirements of this Guide are met.

8.2 All equipment shall be properly maintained. Maintenance procedures shall be documented. Any item of the equipment which has been subjected to overloading or mishandling, or which gives suspect results, or has been shown by verification or otherwise to be defective, shall be taken out of service, clearly identified and wherever possible stored at a specified place until it has been repaired and shown by calibration, verification or test to perform satisfactory. The laboratory shall examine the effect of this defect on previous calibration or tests.

8.3 Each item of equipment including reference materials shall, when appropriate, be labelled, marked or otherwise identified to indicate its calibration status.

8.4 Records shall be maintained of each item of equipment and all reference materials significant to the calibrations or tests performed. The records shall include

a) the name of the item of equipment;
b) the manufacturer's name, type identification, and serial number or other unique identification;
c) date received and date palced in service;
d) current location, where appropriate;
e) condition when received (e.g. new, used, reconditioned);
f) copy of the manufacturer's instruction, where available;
g) dates and results of calibrations and/or verifications and date of next calibration and/or verification;
h) detailes of maintenance carried out to date and planned for the future;
i) history of any damage, malfunction, modification or repair.

9 Measurement traceability and calibration

9.1 All measuring and testing equipment having an effect on the accuracy or

validity of calibrations or tests shall be calibrated and/or verified before being put into service. The laboratory shall have an established programme for the calibration and verification of its measuring and test equipment.

9.2 The Overall programme of calibration and/or verification and validation of equipment shall be designed and operated so as to ensure that, wherever applicable, measurements made by the laboratory are traceable to national standards of measurement where available. Calibration certificates shall wherever applicable indicate the traceability to national standards of measurement and shall provide the measurement results and associated uncertainty of measurement and/or a statement of compliance with an identified metrological specification.

9.3 Where traceability to national standards of measurement is not applicable, the laboratory shall provide satisfactory evidence of correlation of results, for exsample by participation in a suitable programme of interlaboratory comparisons of proficiency testing.

9.4 Reference standards of measurement held by the laboratory shall be used for calibration only and for no other purpose, unless it can be demonstrated that their performance as reference standards has not been invalidated.

9.5 Reference standards of measurement shall be calibrated by a body that can provide traceability to a national standard of measurement. There shall be a programme of calibration and verification for reference standards.

9.6 Where relevant, reference standards and measuring and testing equipment shall be subjected to in-service checks between calibrations and verifications.

9.7 Reference materials shall, where possible, be traceable to national or international standards of measurement, or to national or international standard reference materials.

INTERNATIONAL DOCUMENT No. 1

LAW ON METROLOGY

This International Document is published with a view to its use as advice for those concerned with the preparation of the Law. It should be regarded as a general proposal which has to be perfected according to the individual legislative requirements of each country.
It should be of interest particularly for Developing Countries.

PREAMBULE

A natioanl Law on Metrology Should:
- on the one hand, facilitate the development of scientific and technical knowledge and progress in the national economy by encouraging the standardization of units and standards of measurement as well as the modernisation of the measurements and measuring equipment and improvement in their accuracy ;
- on the other hand, protect citizens from the harmful effect of inaccurate or false measurements.

Thus, the state metrological control could be applied:
- to measuring equipment used as standards for the verification of ordinary instruments;
- to measuring equipment used in the field of public health and technical security;
- to commercial, postal, fiscal transactions...
- to legal evaluation...

A uniform international legal metrology system will facilitate and promote international commerce; therefore, the Law and subsequent regulations should take account of the Recommendations of the General Conference of Weights and Measures and the International Organisation of Legal Metrology, applying them so far as possible at national level

Their provisions would be put into application progressively, parallel with the technical needs of the countries and the possibilities of their legal metrology services responsible for their enforcement.

PART I LEGAL UNITS OF MEASUREMENT

Article 1 - System of Units

The only legal units of measurements are those of the <<International System of Units>>, adopted by the General Conference of Weights and Measures and recommended by the International Organisation of Legal Metrology, subject to the provisions of article 2 below.

Their use is compulsory throughout the state territory. (*)

These units and their multiples and sub-multiples which are to be used shall be defined by one or several decrees made in pursuance of the present Law.

(*) Alternatively, the state can enumerate the uses for which the units called legal are compulsory.

Article 2 - Units outside the System

The decree or decrees provided for in article 1 may authorize the use of certain derived units which are not included in the International System (*) and quantities or coefficients without physical dimensions, (**) which are considered essential for certain measurements.

These units outside the System shall nevertheless be linked directly to those of the International System.

PART II PHYSICAL REPRESENTATION OF THE UNITS

Article 3 - Standards

A national standard of the metre, a national standard of the kilogramme shall be made.

So as far may be needed and in accordance with the technical possibilities, other national standards or reference value standards shall be created.

These standrds shall be located, kept and maintained in accordance with the provisions laid down in each country.

PART III USE OF THE UNITS

Article 4 - General

The legal units shall be used for all measurements laid down by the Law and regulations made in its application (or in accordance with the requirements of the national legislation)(***)

PART IV MEASURING EQUIPMENT

Article 5 - General

Measuring equipment used for measuring quantities, or ratios or functions of these quantities, for which the units are fixed by the Law and the regulations made in its application, shall give the results of measurements expressed in legal units.

Article 6 - Properties of measuring equipment

Measuring equipment which is subject to compulsory verification by national legislation shall satisfy the operating and accuracy conditions prescribed for : models, new measuring equipment, repaired or modified measuring equipment, measuring equipment in service.

(*) for example, metric carat, litre, bar, tonne.

(**)for example, alcoholometric strength, percentage of sugar, hardness index.

(***) for example : Units used for all transactions which directly or indirectly involve a measurement, units used for keeping inwriting results of measurements in documents which are produced in law, notarial documents, price lists, specifications, units used in price offers, in advertisements and publicity.

PART V METROLOGICAL CONTROLS OF MEASURING EQUIPMENT

Article 7 - Liability to metrological controls

Measuring equipment used or meant to be used for certain measurements(*) provided for in the national legislation on metrology or in other law, is liable to compulsory state metrological controls.

Only measuring equipment can be used which has successfully undergone those of the controls enumerated below which have been laid down by the State.

Article 8 - Categories of controls

According to the methods which are prescribed by the national service of legal metrology, the state metrological controls ca include(**) :

- pattern approval
- initial verification
- verification after repair or modification
- periodical verification
- supervision of the use of measuring equipment.

Article 9 - Exceptions

The national legislation on metrology may exempt certain measuring equipment permanently or temporarily from all or part of the controls concerned (art. 7)(***)

Article 10 - Control marks and legal character of measuring equipment

Measuring equipment which has successfully undergone the controls enumerated above is given marks distinguishing these controls, or provided with corresponding certificates, and thus will have the character of <<legal measuring equipment>>.

It may then be used for its respective purpose.

Measuring equipment which has not undergone these controls successfully can be given a rejection mark and must be modified, repaired or withdrawn. Inthe case of infringements, it may be seized pending a decision of the legal authorities.

The national service of legal metrology will fix the characteristics of these marks.

The keeping or use for transaction specified in the national legislation of false measuring equipment or equipment which does not bear the state control (or verification) mark is illegal.

(*) for example : Measuring equipment used as standards for verification of ordinary instrument, certain specific measuring equipment used in the field of public health or technical security, measuring equipment used for commercial, fiscal or postal transactions, measuring equipment used for legal evaluations.

(**)during the metrological controls, one may sometimes use simplified procedures, for example, in the case of mass production in large quantities :

- checking by sampling
- approval of the manufacturer's mark.

(***) example : when the technical efforts required for these instruments to satisfy the conditions demanded for verification are not in reasonable proportion to the economic importance of the instrument in the area of use concerned.

Only persons specially authorized for the purpose may invest measuring equipment with state marks.

PART VI METROLOGICAL CONTROLS OF MEASUREMENTS

Article 11 - Liability of certain measurements to metrological controls

The measurements made during certain transactions may be liable to state metrological controls(*) (following the national legislation)

Decress or regulations, made in pursuance of the Law, may define the measurements liable to these controls and the methods of these controls.

Article 12 - Measurement Methods

The methods of measurement of certain quantities, certain products, certain goods may be regulated(**).

The national service of legal metrology will fix the regulated measurements and draw up corresponding regulations.

PART VII METROLOGICAL CONTROLS OF PRODUCTS QUANTITIES AND PRE-PACKAGES

Article 13 - Metrological control of product quantities and pre-packages deliverd or exposed for sale

During every transaction involving the delivery of a definite quantity of a productor every exposure for sale involving the indication or labelling of a definite quantity of the product, these product quantities are liable to state metrological controls(***)

Article 14 - Control methods and requirements

The control methods, the metrological conditions with which quantities of products are pre-packages must comply, the tolerances or variations on quantities, will be fixed by regulations made in pursuance of this Law.

Article 15 - Infrongements

It is an infringement of the provisions of this Law for any person or corporate body in selling or offering for sale, buying or offering to buy any goods by weight or by any other measurement or by number of articles to deliver or cause to be delivered a quantity which does not satisfy the requirements of the regulations referred to in Article 14.

(*) example : commercial transaction, fixing of wages by measurement of work done, certain evaluation...

(**)example : sugar contents, mass per hectolitre of cereals, alcoholometric strength by volume or mass.

(***)examples : checking exactness of quantities of products weighed and sold at the same place (bread, meat...)
checking of labelling and marking up of quantities of pre-packed products (foodstuffs, maintenance and cleaning articles...)
standardisation of series of quantities permitted for certain products consumed on a large scale (butter, sugar, milk...)

PART VIII MANUFACTURE - REPAIR - SALE
of measuring equipment

Article 16 - Authorization

Persons or sorporate bodies habitually importing, manufacturing, repairing, selling, or hiring certain measuring equipment determined by decree, must inform the national service of legal metrology of their activity and become registered with it.

PART IX LIABILITY OF PERSONS AND CORPORATE BODIES

Article 17 - Liability to controls

Persons and corporate bodies which use or keep measuring equipment for transactions covered by national legislation on metrology are liable to metrological controls of the measuring equipment which they use or keep.

Persons or corporate bodies habitually importing, manufacturing, repairing, selling, hiring certain measuring equipment determined by decree and meant for uses covered by the national legislation on metrology, are liable to metrological controls of the instruments or installations which are the subject of their activities.

Article 18 - Methods of subjection

A decree drawn up by the department to which the legal metrology service is attached will fix the details of this liability.

PART X METROLOGY SERVICE

Article 19 - Institution of the service

A national service of metrology shall be instituted responsible for the application of this Law.

Article 20 - Composition and prerogatives of the service

The service of metrology might include :

A - A permanent commission : scientific, technical, legal whose composition will be fixed by a decision of the department to which the metrological service is attached and responsible for advising the department on everything concerning metrology questions, and the legal metrology service.

B - A legal metrology service : scientific, technical, legal and administrative whose composition will be fixed by regulations made by the department to which the service is attached, after hearing the opinion of other interested department.

C - Local or departmental metrological control agencies(*)

The legal metrology service, assisted where applicable by the permanent commission and the local or departmental checking agencies, will be responsible for :

1. assuring the execution, upkeep and conservation of national primary and secondary standards in conformity with the legal units;
2. assuring the enforcement of the legal metrology regulations drawn up in puesuance of this Law;
3. drawing up technical prescriptuions relating to measuring equipment which is liable to state controls;
4. carrying out the testing of patterns of measuring equipment;
5. assuring the execution and calibration of standards and verification equipment;

(*) for exsample : verification centres in the undertakings

6. carrying out the verification and supervision of the use of measuring equipment;
7. carrying out evaluation or furnishing on request services in the field of measurements;
8. establishing and enforcing regulations on the measurement and labelling of certain products or goods;
9. taking part in the general teaching of legal metrology ans assuring the training of its metrological staff;
10. assuring the liasons with other national institutions having similar aim;
11. representing the national metrological agencies in international metrological institutions.

Article 21 - Personnel of the services

There shall be appointed a director and scientific, technical, legal and executive assistants to carry out the tasks of the service.

The service may call upon personnel of other state departments, in agreement with these deapartments, or upon private institutions, to carry out certain specific tasks.

PART XI AUTHORITY OF THE LEGAL METROLOGY SERVICE

Article 22 - Freedom of access

The officers of the legal metrology service, duly sworn ans carrying their credentials, and in the discharge of and in order to discharge their duties, have complete freedom of access to all industrial establishments or commercial premises or vehicles, where measuring equipment which is meant to be used for the measurements mentioned in article 7 (according to the country's provision), is installed or kept, or where there is reason to believe it is installed or kept.

Article 23 - Private premises

Regulations made by the department to which the legal metrology service is attached, in agreement with other interested departments, may in certain specified circumstances, authorize officers of the legal metrology service, in order to carry out their duties, to enter into certain parts of private premises where there is installed or if there is reason to believe is installed in those parts, measuring equipment which is kept for certain uses or certain purposes laid down by the present Law(*).

PART XII ATTACHMENT OF THE LEGAL METROLOGY SERVICE

Article 24 - Departmental attachment

The legal metrology service shall be attached to the department of the .... (proposal : Cabinet, Prime Minister.....)

PART XIII FINANCIAL PROVISIONS

Article 25 - Fees

The metrological work carried out by the legal metrology service may give rise to the receipt of official fees sor services rendered(**).

(*) example : electricity, water, gas meters...

(**)with the exception nnevertheless of inspection carried out with a view to ensuring effective enforcement of the legislation.

A financial regulation will fix the procedures to be followed, the operations for which payments have to be made and the amount of these payments(*)

PART XIV INFRINGEMENTS

Article 26 -

Infringements of the provisions of this Law and regulations made in its application will be proceeded with according to the legal procedures applied in the country(:*).

PART XV TRANSITIONAL PROVISIONS

Article 27 - Progressiveness od application

The department to which the legal metrology service is attached will decide in agreement with other interested departments and when advised by the service, on the progressive application of the provisions of this Law, including the progressive subjection of various categories of measuring instruments, or progressive territorial appication.

(*) It is highly desirable that the fees taken are available to improve the legal metrology service.

(**) It is recommended in particular that the Law safeguards accused persons where infringements are committed by mistake.

MEASUREMENT LAW, JAPAN

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APPENDIX

METROLOGY AND STANDARDS RESEARCH INSTITUTES IN FOREIGN COUNTRIES

- **Establishment and Development of the Standards Research Institute in South Korea**

Given the current level of industrial development and the requirement for a metrological standard system in Malaysia, the development of the measurement system in South Korea in the last 10 or so years appears to be the most instructive. The history of the reforms and development of the measurement system in South Korea, including its background, is outlined here from 1978 when the present system and consolidation of the related facilities became a reality.

1. History and Current Situation

The institution responsible for the control and maintenance of national measurement standards in South Korea is the Korean Research Institute for Science and Standards (KRISS) which has the status of a special corporation. Its predecessor, the Korean Standards Research Institute (K-SRI), was formally established in December, 1975 pursuant to a Presidential Decree and commenced actual operation in 1978. The KRISS is located in Daeduk Science City in the heartland of South Korea. It conducts a wide range of research and development activities as the national centre for all types of metrological traceability systems while also provides related technical services. The premises have a total land area of some 50 ha and the total floor area is approximately 42,400m^2, consisting of some 25,600m^2 for research laboratories and some 16,800m^2 for the administration office and other supporting units. It has 220 employees, including 120 researchers, in 1980 when its operation began its course and this figure has subsequently increased to more than 600, including 500 researchers, making the KRISS one of the country's largest public research institutions.

All primary standards (national standards) at the KRISS are realised and maintained based on SI units and are traced by secondary standard laboratories in charge of various activities, such as legal metrology, measurement testing/inspection and industrial measurement, etc. In turn, these secondary standards are supplied directly or indirectly to users via tertiary standard laboratories (see Fig. 1 - National Standard System in South Korea). In addition to its calibration service using primary standards, the KRISS also

for the industrial circle, provides consultation and technical assistance services in the areas of metrology and measurement, conducts surveys on national metrology systems and manufactures and supplies standard reference materials. The organizational structure and present facilities of the KRISS are briefly shown in Fig. 2.

2. Background of K-SRI

When the establishment of the K-SRI was taken up as a national priority target, the K-SRI was expected foremost to have the following functions.

(1) Modernisation of the national metrology system and firm establishment of traceability to national standards

(2) Research and development on the science of measurement and precision engineering

(3) Provision of training programmes and technical cooperation for the industrial circle and related organizations

(4) Provision of a systematic calibration service for institutions and facilities requiring accurate measurements

(5) Preparation and supply of standard reference materials (SRMs) and standard reference data (SRD)

While all the above functions were mainly aimed at catering for industrial requirements, they were seemingly based on requirements expected to arise in the near future rather than on practical, pressing requirements at a time when South Korea was shifting its industrial emphasis from labour-intensive industries to high-tech, highly value-added industries and the predominant objective of the government's policies was the creation and consolidation of the technical base for upcoming industries. At that time, the calibration demand of the industrial circle was increasing at an annual rate as high as some 30%.

The Phase 1 buildings of the K-SRI were constructed in 1978 and the K-SRI boasted an excellent equipment level which far outclassed other research institutes in South Korea, the result of extraordinary investment beyond commonsense. All the laboratory buildings were centrally air-conditioned to achieve the following conditions.

- Ordinary Laboratories

Temperature	: 23 ± 1°C
Relative Humidity	: 45 ± 10%

- Dimension and Mass Laboratory

Temperature	: 20 ± 0.5°C
Relative Humidity	: 45 ± 5%
Cleanliness Level	: Class 10,000
Noise Level	: 50 dB or less

During the Phase 1 period, 500 pieces of equipment were procured at a cost of 3.5 million US$. A further 600 pieces of equipment were added 2 years later with 8 million US$ of investment and a 1.8 DM loan (cf. Fig. 3).

What deserves special attention is the personnel plan for the staffing of the K-SRI. Previously in South Korea, the standards for such basic quantities as dimensions, mass and volume were maintained by the National Industrial Research Institute (NIRI) of the Industrial Promotion Agency. Only a small number of staff moved from the NIRI to the K-SRI and many of the key staff members of the latter were South Korean scientists and engineers formerly employed by universities and private companies in the US. Universities and private companies in South Korea were also important recruitment sources. The salary scales were far better than the ongoing scales at the time and many recruits were given the opportunity to study or train abroad. In the first 3 years of operation, 90 staff members of the K-SRI were sent abroad, to places ranging from the NBS (present NIST) in the US to the PTB in Germany, NML in Australia, NRLM in Japan and BIIM in France, for research or training purposes.

3. Effect on Government and Industries

When the K-SRI was established, technology-oriented industrial development was underway in South Korea based on the Fourth National Development Plan which places special emphasis on the promotion of the heavy and chemical industries. Consolidation of the social infrastructure to support advanced technologies was essential to achieve the objectives of the Plan. In particular, consolidation of the infrastructure to support the precision industry was urgently required for the development of the electronics, petrochemical, metal processing and machine industries. The national metrology system was a fundamental element of such infrastructure and the government decided to face the challenge of its modernisation and restructuring.

It may be useful to note here that the average annual GNP growth from 1975 - 1979 was 11%. The manufacturing production index and exports also recorded annual growth rates of 16% and 28% respectively for the same period. In comparison, both the production volume and export value of the precision industry recorded startling annual growth of almost 70%.

Consolidation of the national metrology system was also expected to positively contribute to the development of science and technology, promotion of industrial standardisation, improvement of productivity and product quality, stimulation of fair trade and smooth transactions and the expansion of exports. The fact that these positive far-reaching effects were materialised was proven by the subsequent growth of South Korean industries, confirming the timely investment in the new standards research institute.

The following sentence has been added to Article 123 of the Constitution for the continuous improvement and consolidation of the infrastructure for technologies as a national policy.

"The State shall establish a National Standards System."

- **Size of Standards Research Institutes in Other Countries**

R & D and technical services relating to the maintenance of measurement standards are often conducted as part of the activities of a general research institute or a group of research institutes. It is difficult, therefore, to present an organization which provides the model for the upgrading project in Malaysia. Several useful figures indicating the size and scope of operation are given below for reference purposes.

Institute	Land Area	Floor Area	No. of Staff (Researchers)	Annual Budget
[Japan]				
NRLM	6 ha	18,000m^2	220 (130)	26 million US$
ETL	9 ha	62,000m^2	750 (580)	80 million US$
[US]				
NIST			5,000 (4,000)	350 million US$
[UK]				
NPL	(refer "Whitepaper on National Measurement System")			

In regard to the cost of maintaining a national measurement system, Dr. T.J. Quinn, the director of BIPM, estimates those of industrialized countries as 30 to 70 parts in 10° of GDP. For the twelve EC countries the total direct spending on national measurement system in 1992 was about 400 Mecu. This is less than 1% of what the nations spent on measurement and measurement-related operations.

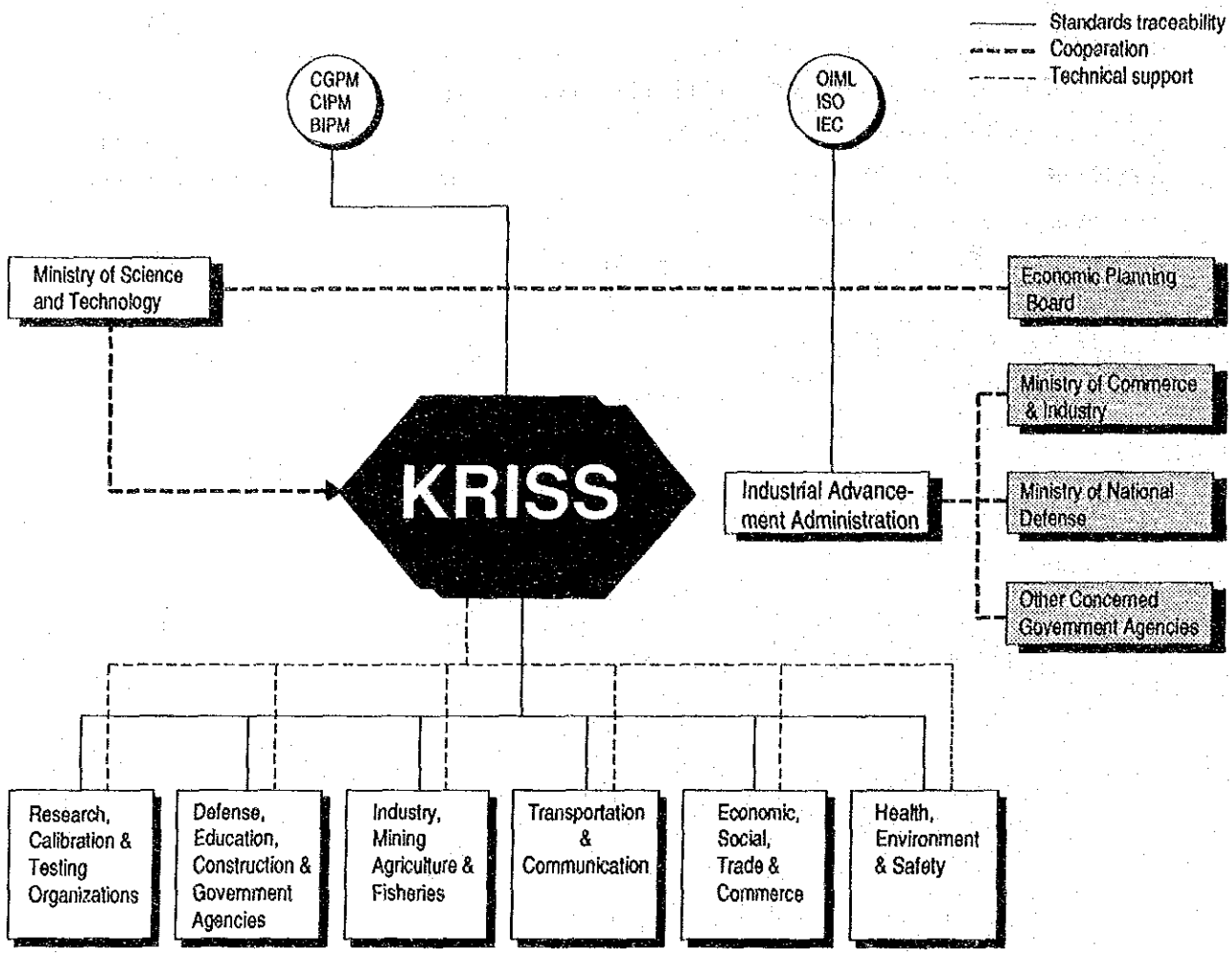

Fig. 1 National Standards System (NSS)

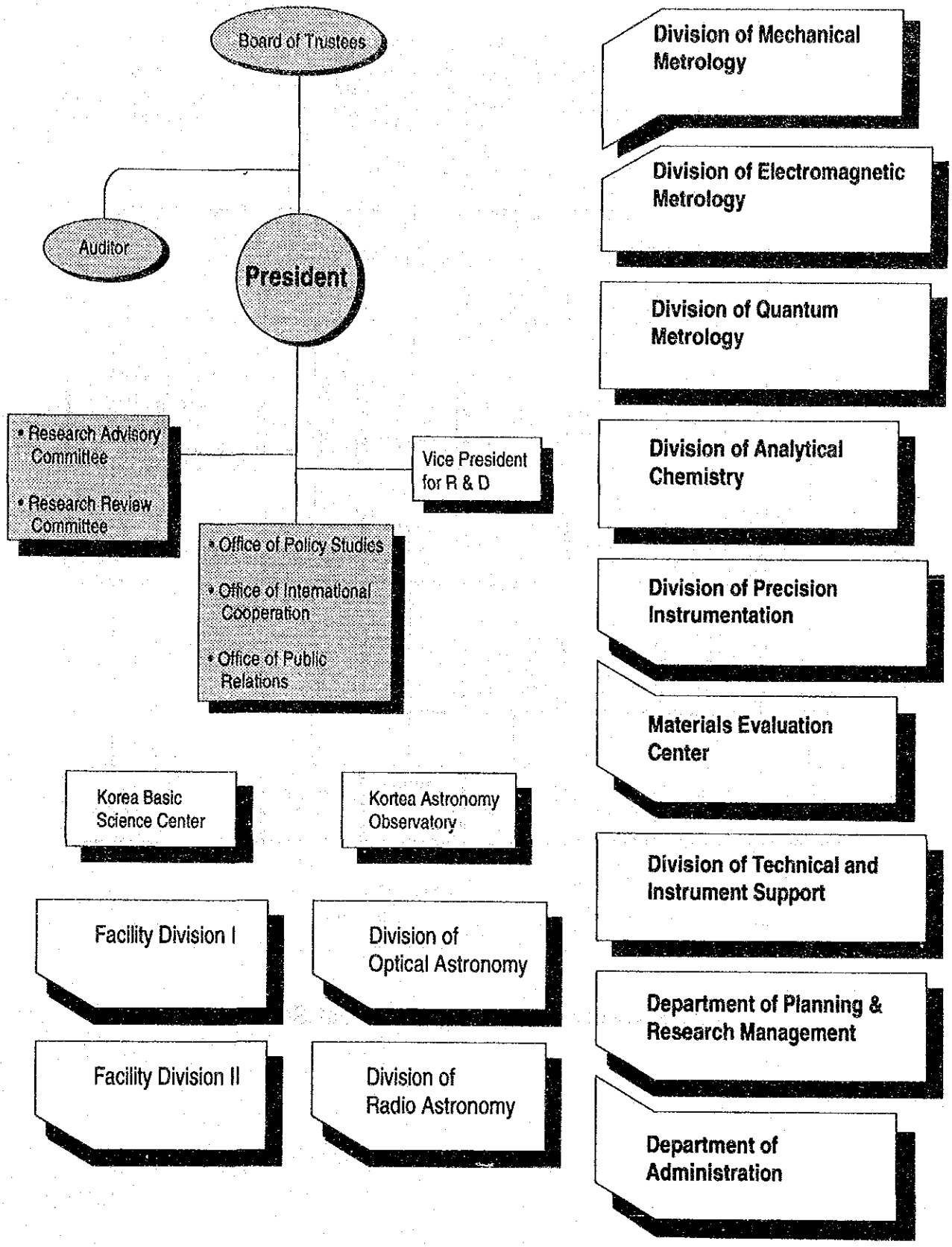

Fig. 2 Organization

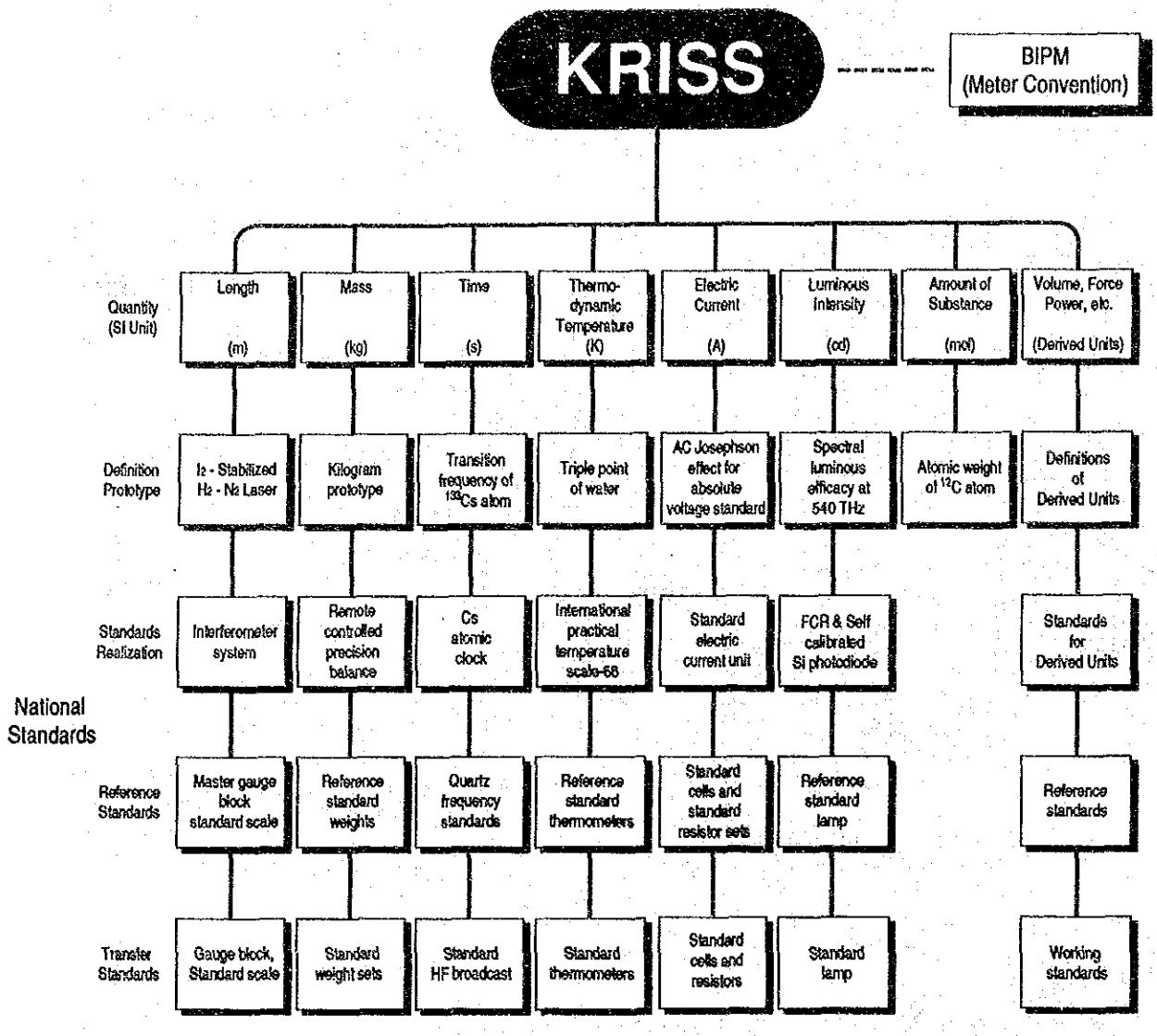

Fig. 3 Realization of Measurement Standards

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CHAPTER 1

INTRODUCTION

1.1 The objective of the DTI, the department for enterprise, is to work with business to promote best practice and within Government to create a climate that stimulates enterprise and reduces red tape. Business flourishes in a competitive and open economy and the Department aims to secure this at home and abroad. A system of measurement in which all users can have confidence is an essential part of the climate which business needs. Reliable measurement assists customers to purchase goods with confidence. It helps companies to compete for business on a fair basis and to understand the customer's requirement. It helps to improve the quality of products. DTI's objectives also include promoting the growth of international trade and working towards a single market within the European Community. Measurement needs to be an international language, clearly understood worldwide, so that trade can flow and wealth can be created whilst also ensuring that customers are afforded a fair level of protection.

1.2 Measurement also supports many other activities of Government, from defence procurement to health care, from revenue collection to environmental monitoring. Without accurate measurement aircraft could not fly safely, it would not be possible to diagnose or treat illnesses appropriately, the quality of food and drinking water could not be monitored and the workplace would be less safe. It is impossible to quantify precisely the amount of economic activity concerned with or dependent upon measurement in the UK, but the existence of a modern society without the ability to measure is unthinkable.

1.3 That everybody should have confidence in the accuracy of the measurements they make is of paramount importance. In the UK it is the National Measurement System (NMS) which underpins this confidence. The NMS, whose structure is described in Chapter 2, provides a coherent, formal system which ensures that measurements can be made on a consistent basis throughout the country. It is closely co-ordinated with the measurement systems of our major trading partners in Europe and elsewhere. The Government believes that the NMS is an essential national resource, a fine example of co-operation between Government and the private sector to provide a service which is of benefit to the whole community.

1.4 The NMS works well, but it needs to respond to new opportunities. The completion of the European Community's single market by the end of 1992 will have a profound effect upon the UK. This White Paper sets out, in chapter 3, measures which are intended to contribute to the development of a more co-ordinated system of measurement in Europe. As society becomes more technically sophisticated and industry more aware of the importance of quality, so new demands for measurement standards and calibration facilities arise. Chapters 4 and 5 describe ways in which the resources of Government and industry can be used together to meet these demands. Each has its role to play and benefits from the other's involvement. Particular issues and challenges in the areas of legal metrology and analytical measurements are addressed in Chapters 6 and 7.

1.5 In total the White Paper aims to give a clear statement of Government policy across the whole of the National Measurement System and to set the framework for its development into the 21st century. In doing so, it should also help to bring about greater public awareness of the NMS and of its value to industry, society and the economy.

CHAPTER 2

THE STRUCTURE OF THE NMS AND ITS IMPORTANCE TO THE UK

Structure of the NMS

2.1 The NMS is the technical and organisational infrastructure which ensures a consistent and internationally recognised basis for measurement in the UK. It has two central objectives:

i. To enable individuals and organisations in the UK to make measurements competently and accurately and to demonstrate the validity of such measurements

ii To co-ordinate the UK's measurement system with the measurement systems of other countries.

Much of the NMS framework and the work associated with maintaining it rests with its users. The Government and a number of specialist organisations provide the necessary co-ordination and regulation together with a range of services which form the core of the system.

2.2 At the heart of the NMS lie physical *measurement standards*[1] which are realised in accordance with the internationally recognised definitions of the International System of Units or SI. Seven *base units*[2] form the cornerstone of the SI. There are numerous further units, known as *derived units*, which are defined in terms of one or more of the base units. Imperial units used in the UK for the measurement of length and mass are defined in the Weights and Measures Act 1985 and in subordinate regulations in terms of their metric (SI) counterparts. For example, one yard is equivalent to 0.9144 metre.

2.3 For each *unit of measurement* disseminated through the NMS there is a *primary standard* recognised as the UK *national standard*. This is linked by means of comparison ("calibration") through an unbroken chain of *reference standards* to the *working standards* for day-to-day use. Measurement standards provide the basis for accurate and consistent measurement in many different areas. This ability to relate an individual measurement back via successive calibrations to the national standard using recognised measurement techniques and methods is known as "traceability" and is the principle on which the integrity of the NMS is founded.

2.4 The National Physical Laboratory (NPL), a DTI research establishment, plays a central role in the organisational structure of the NMS. Its principal task is to develop and disseminate national measurement standards and the majority of its resources are devoted to this. As the UK's primary centre of metrological expertise, NPL is also required to designate the national standards for those units held at other locations in the UK and to make this information readily available to users of the

[1]Definitions of metrological terms are given in the International Vocabulary of Metrology published by the International Standards Organisation and in British Standard BS 5233:1986. Definitions of the terms in italics in this paper, reproduced from BS 5233:1986, are in the glossary on page 23.

[2]The seven base units are the metre (length), the kilogram (mass), the second (time), the ampere (electric current), the Kelvin (thermodynamic temperature), the mole (amount of substance) and the candela (luminous intensity).

NMS. For example, the national measurement standards for flow measurement, which are of particular importance to the oil, gas and water industries, are concentrated in the specialist facilities of the National Engineering Laboratory (NEL). Under a collaborative agreement between 17 European countries (see paras 3.5 – 3.9 on EUROMET) it is envisaged that an increasing number of reference standards will be traceable to primary standards held at national laboratories in other countries. Reciprocal arrangements of this type, some involving the UK, have now been concluded, and it is expected that others will follow.

2.5 Calibration and testing laboratories, particularly those which have been accredited by the National Measurement Accreditation Service (NAMAS), play a vital part in the NMS. NAMAS accredited laboratories, some 90 per cent of which are in the private sector, provide a service to a wide range of customers in British industry and they constitute the main channel for the dissemination of measurement standards. As well as its role in the dissemination of measurement standards, NAMAS accreditation also covers a broad spectrum of testing activities from chemical analysis to environmental testing and from software to safety appliance testing. Accreditation is a sound indicator of a laboratory's competence to perform specified types of calibration or testing work.

2.6 The focus of the *legal metrology* sector (primarily concerned with the determination of weight or quantity for trading purposes) is the National Weights and Measures Laboratory (NWML). Under the provisions of the Weights and Measures Act (1985) NWML, which forms part of DTI, holds reference standards for mass, length and capacity which are used for calibrating the standards maintained by local authority Trading Standards Departments (TSDs). To underline the important part played by legal metrology in the NMS, the testing and calibration facilities of NWML are being progressively accredited by NAMAS. (Legal metrology is discussed in greater detail in chapter 6.)

2.7 The legal units of measurement used in the construction and use of measuring instruments and in the indication of quantity for economic, public health, public safety or administrative purposes are set out in the Units of Measurement Regulations 1986 (SI 1986/1082) which implement the 1979 Units of Measurement Directive (80/181/EEC), as amended. The European Commission has made proposals to amend this Directive which would allow the continued use of the pint for the sale of draught beer and cider and for milk in returnable containers; the mile for road transport purposes; the acre for land measurement; and the troy ounce for bullion dealing. The proposals would also allow the use, until 1999, of the fathom, therm, the pint and fluid ounce for the sale of drinks (other than milk) in returnable bottles, the gill for dispensing spirits and the pound and ounce for over-the-counter sales of goods sold loose from bulk. The use of all other non metric units would be phased out by the end of 1994. The Government believes these proposals provide adequate transitional periods to enable business to adapt in an orderly manner without incurring freedom to operate efficiently in the Single Market. The proposed time-table will also allow consumers to become used to the new measurements. The Government is committed to ensuring that information on metric units is widely available to business and the general public.

2.8 The analytical measurement system, which allows the determination of the chemical composition of a material, is related to the physical measurement standards through a hierarchy of analytical methods

supported by *reference materials* of known composition. The main focus for analytical measurement within Government is the Laboratory of the Government Chemist (LGC) – a DTI research establishment. The Secretary of State for Trade and Industry has a statutory responsibility for analytical measurement through the legal obligations placed upon the Government Chemist by a number of Acts of Parliament. At present the Government Chemist has formally defined functions under twenty-two Acts of Parliament. These define explicit or implicit obligations where the Government Chemist may be called upon to exercise a Referee Function[1], act as Authorised or Approved Analyst, or to act as an Analyst Designated by Departmental Instruction. The Government believes that this role is an essential component of statutory analytical measurement in the UK and will, from time to time, amend the duties placed upon the Government Chemist to reflect changes in the needs of Government. There are also specialised services throughout Government Departments and the system relies heavily on the collaborative efforts of the users themselves. (Proposals for the future of analytical measurement are set out in Chapter 7.)

The Importance of the NMS to the UK

2.9 Who uses the NMS? The short answer is that, directly or indirectly, we all do. Each measurement made is expressed in terms of a unit, and the standards for these units form the core of the NMS. In many cases of day-to-day measurement the accuracy required is modest and the user need not be unduly concerned with the links back to these measurement standards. However, the role of the NMS is no less important for the fact that its influence goes largely unseen, and the implicit confidence felt by the public in the many measurements they make in daily life is perhaps a testimony to its effectiveness.

2.10 For many groups, however, traceable measurement, where the formal links back to the NMS are clearly demonstrable, assumes considerable importance.The existence of a comprehensive measurement infrastructure is a precondition for the competitiveness of a modern industrialised economy. These links between the NMS and competitiveness are most clearly seen in the context of three areas of Government concern: (i) the facilitation of free and open trade, (ii) encouraging innovation and the spread of new technology and (iii) the promotion of quality.

Trade

2.11 Agreement on measurement is essential for the conduct of international trade. For example, a metre in London must be accepted as equal not only to a metre in Glasgow but also to a metre in Brussels, Bonn or Beijing. Where agreement exists, transactions can be carried out across national frontiers on a uniform and equitable basis. In the absence of agreement, trade is likely to be impeded.

2.12 For over 100 years a framework for intergovernmental agreement on the uniformity of physical measurements has been provided by the Metre Convention of 1875. All major industrialised nations are signatories to the agreement. Through its constituent institutions, the General Conference on Weights and Measures (CGPM) and the International Bureau of Weights and Measures (BIPM), it provides a forum for

[1]Certain Acts require the division of prosecution samples into three parts; in the event of a dispute regarding the analysis the Court may require the Government Chemist to analyse the third portion and provide a certificate.

multilateral discussion and agreement on all aspects of physical measurement. The CGPM has responsibility for the promulgation of SI which has gained acceptance worldwide as the basis for measurement in scientific, industrial and many other branches of human activity. It also directs the programme of work carried out by BIPM in collaboration with national laboratories to enhance worldwide uniformity and precision of measurement. The Government endorses this approach to ensuring a common basis for measurement, which proceeds by means of consensus and collaborative effort, and believes it has proved successful in its central objective of minimising the barriers to trade arising from the definition of units of measurement and their realisation.

2.13 In addition to the international agreements on the units of measurement the UK has sought agreements in the areas of calibration and testing. Mutual recognition agreements between NAMAS and accreditation organisations overseas can contribute to the elimination of technical barriers to UK goods in the European Community and other markets. Such agreements aim to ensure that a NAMAS certificate will be recognised as equivalent to a certificate issued by an accredited laboratory in the other country, thus removing the need for retesting or recalibration. The Government welcomes progress from bilateral to multilateral mutual recognition agreements such as that recently signed between six national calibration services in Western Europe (see paragraph 3.4). It looks forward to such agreements covering as many as possible of the national testing and calibration services of our major trading partners. Such agreements assist business when they are well known and their provisions understood. The Government, therefore, intends that more effort should be devoted to publicising, monitoring and ensuring their effectiveness.

2.14 In many countries the measurement infrastructure is at an early stage of development. The UK has been involved in assisting a number of such countries through the provision of expertise and services. RESOURCE, an organisation sponsored jointly by DTI and the British Standards Institution (BSI) , was launched in April 1987 to establish and co-ordinate co-operation in a number of areas including standards, measurement, testing and accreditation.

Innovation

2.15 Measurement standards and associated measurement methods and techniques are of considerable importance in the innovatory process. In areas such as electronic materials, optics, ultra-high precision machining and ceramics where measurements of unprecedented accuracy are required, the absence of adequate measurement standards and methods can pose a significant barrier to innovation. As well as links to state-of-the-art technology, measurement standards also assist those undertaking basic research in academic institutions. The Government is committed to ensuring that industry has access to the new measurement standards and associated technology which are developed in its own research establishments.

2.16 DTI's innovation policy set out in the 1988 White Paper "DTI – the department for Enterprise" (Cm 278) aims to encourage companies to increase their investment in R&D and to collaborate on the research which is necessary before commercial applications can be developed. The Government's commitment to encourage and finance collaborative research in the field of measurement is illustrated by its support for two programmes under the LINK initiative for pre-competitive but industrially relevant research, one on nanotechnology – the subject of

manufacturing and measuring to tolerances between about 1 and 100 nanometres – and the other on industrial measurement systems.

Quality

2.17 The 1982 White Paper "Standards, Quality and International Competitiveness" (Cmnd 8621) set out "the Government's determination to enhance the status of standards and quality assurance in the UK in order to increase the efficiency of British industry and thereby strengthen its international competitiveness". It stressed the importance of a more systematic approach to quality, which has been increasingly recognised by industry. Government has encouraged companies to demonstrate their quality achievements by obtaining certification to the national standard for quality systems BS 5750 (equivalent to EN 29000 and ISO 9002 at the European and international levels), and has assisted the expanding range of certification schemes operating in the UK.

2.18 One of the determinants of quality is the ability to confidently and consistently make measurements to the required accuracy. Measurement standards and associated measuring techniques provided the basis for attaining the desired levels of precision in the design, manufacture and testing of products. Proper attention to the principles of metrology and their application in the workplace is an essential element in the management of quality. Specification standards, such as the voluntary, approved standards prepared and published in the UK by the British Standards Institution (BSI) and by European and International standards bodies[1] also play an important role in achieving product quality. Reference to measurement will be included in the detail of some of these and accurate measurement will be needed in using others. In both cases traceability to national measurement standards is necessary as part of the management of quality.

2.19 Considerable progress has been made since 1982 in creating greater awareness of the measurement services available to industry to assist in the drive for quality. The role of NAMAS has been central to this process. The Government has sought to integrate NAMAS more closely into the formal mechanisms for quality assurance in the UK. Agreements between NAMAS and certain certification bodies (BSI.QAS and Lloyds Register Quality Assurance Ltd) have clarified the relationship between these organisations and their responsibilities in the area of laboratory accreditation. They also drew attention to the benefits which NAMAS accreditation offers to companies seeking assessment to BS 5750/ISO9000. It is intended that these should set the pattern for similar agreements with other third party quality systems assessment organisations.

2.20 The role of NAMAS has also been given formal recognition by the National Accreditation Council for Certification Bodies (NACCB). NACCB was set up in 1985 with the objective of enhancing the status and authority of UK certification bodies by ensuring rigorous and consistent standards in this area. It also aims to encourage the development of internationally harmonised accreditation arrangements for certification bodies. NACCB criteria, which have been drawn up in the context of recognised European and international criteria, specify that NAMAS accredited testing facilities, or facilities which meet the same standard, should be used by all product certification and product approval bodies seeking NACCB recognition.

[1]European Committee for Standardisation (CEN), European Committee for Electrotechnical Standardisation (CENELEC), International Organisation for Standardisation (ISO), International Electrotechnical Committee (IEC) and the European Telecommunications Standards Institute (ETSI).

2.21 The Government welcomes these developments which bring greater recognition to the importance of competence in measurement and testing as part of a company's approach to quality. They are important contributions to better co-ordination between the NMS and the quality infrastructures in the UK.

CHAPTER 3

EUROPE

3.1 The objective of a single European market by the end of 1992 has major implications for the measurement infrastructure throughout the European Community. To create a single market embracing twelve countries will require a high level of confidence in the measurement capability of all the EC states. An agreed approach will be needed to overcome the barriers to trade caused by retesting and recertification as products pass between Member States. At the level of national measurement standards there is also the need, as 1992 approaches, for greater co-ordination and collaboration between the measurement systems and practice of individual Member States. The following paragraphs give details of three ways in which the Government intends to pursue this objective, a European Calibration and Testing Policy, "EUROMET", and through the European Community programme for research and technical development.

European Testing and Calibration Policy

3.2 The formulation of a European policy on testing and calibration is vital to the completion of the single European market. Requirements for the re-testing of products as they cross national frontiers are time-consuming and frequently costly to industry. To remedy this, measures are necessary to help generate mutual confidence between Member States in their partners' testing and calibration arrangements. This forms part of a broader strategy to eliminate technical barriers to trade in Europe resulting from differences in national practice on specification standards, certification and testing.

3.3 The Government believes that national laboratory accreditation schemes such as NAMAS offer an effective means of ensuring uniform level of laboratory competence across Europe without imposing unnecessary additional burdens on industry. NAMAS is recognised internationally as a leader among accreditation schemes for testing and calibration laboratories and has provided an influential model for similar schemes being established in other European countries. Formal mutual recognition agreements now exist between NAMAS and a number of its counterparts in other Member States recognising the equivalence of test and/or calibration certificates issued by accredited laboratories (see paragraph 2.13).

3.4 The UK has also participated actively in negotiations leading to the formulation of European specifications for testing laboratories and accreditation bodies now published as the EN 45000 series of documents. These documents set out guidelines to be followed in the operation and assessment of testing laboratories and for the organisation of accreditation schemes which should facilitate the establishment of laboratory accreditation in those Member States where there is currently no national scheme. Conformance to these specifications could then form the basis for a comprehensive network of mutual recognition agreements within the Community which the Government regards as a valuable contribution to the elimination of barriers to Community trade. A multilateral mutual recognition agreement exists between those national calibration laboratory accreditation services which form the Western European Calibration Co-operation (WECC) and which meet the requirements of the EN 45000

series. The agreement recognises the equivalence of the calibration certificates issued by the laboratories belonging to the national services and commits WECC Members to promoting the wide acceptance of such certificates in their own countries. At present the agreement covers the national services of the UK, France, Federal Republic of Germany, Italy, The Netherlands and Sweden but can be extended to other EC and EFTA countries.

EUROMET

3.5 The UK, with France and West Germany, launched an initiative for European collaboration on measurement in 1986. This led to the signing of the EUROMET Memorandum of Understanding which came into force on 1 January 1988. Membership of EUROMET is open to national metrology institutes, that is the organisations principally responsible for national measurement standards, of the countries belonging to the European Community and EFTA. With the exception of Iceland all have joined. The European Commission is also a member.

3.6 The objective of EUROMET is to promote the co-ordination of metrological activities and services with the purpose of achieving higher efficiency. Within the existing decentralised structure based on national metrology institutes, EUROMET will seek to optimise the utilisation of resources and services. It will work to improve measurement services in Europe and ensure that, along with national facilities developed through EUROMET collaboration, they are accessible to all members.

3.7 Three main types of collaborative activity are envisaged through EUROMET:

(i) Common Measurement Standards

EUROMET offers its members the possibility of maintaining measurement standards on a common basis. Under this arrangement one national laboratory could hold the primary standard and provide access to it for other members. Where the UK participates in such arrangements with overseas laboratories it is intended that the primary standard should be formally recognised as the UK national standard for traceability purposes.

(ii) Facilities

From time to time investment in major specialist facilities for measurement standards work can involve considerable expenditure. Through EUROMET, organisations considering major capital investment programmes can explore the possibility of shared provision.

(iii) Research

EUROMET provides for the establishment of co-ordinated research programmes which may be undertaken at a single site or progressed concurrently at a number of laboratories. EUROMET will also encourage the sharing of results and information arising from national research projects between members.

3.8 The UK is playing an active role in the development of EUROMET. The Government believes that collaboration can help to reinforce the existing strengths of the UK's own measurement system whilst allowing improved access to European facilities and expertise in other areas. Collaboration depends, however, on the ability to reciprocate, and the Government recognises that a strong overall national measurement capability is essential if the UK is to derive full advantage from

EUROMET. Collaboration through EUROMET should also enhance the total European measurement capability and encourage the growth of greater mutual confidence among European countries. In this way EUROMET can make an important contribution to the development of systematic, fully co-ordinated measurement arrangements across Western Europe.

3.9 A proposal to establish an agreement for European collaboration in the area of analytical measurement is outlined in Chapter 7.

European Community Programmes

3.10 Within the European Communities Framework Programme for Research and Technology Development it is the Community Bureau of Reference (BCR) that is most concerned with the national measurement systems in Member States. The objective of the programme is to improve the reliability of chemical analysis and physical measurement so as to achieve agreement of results throughout the Community. In the field of chemical analysis BCR supports an extensive collaborative programme, particularly for the certification of natural matrix reference materials. It has also organised intercomparisons of measurement standards between Member States, aiming to identify and eliminate systematic errors in their realisation and dissemination. The Commission, through BCR, is a member of EUROMET and it is intended that the work of these two programmes complement each other. Similarly it is hoped that BCR will participate fully in the proposed European collaboration on analytical measurements (see paragraph 7.9).

3.11 Increasingly, the BCR programme is supporting collaborative projects aimed at solving problems found in implementing the specifications used for the testing of products in different Member States. These projects frequently involve the participation of industry as well as government laboratories and this trend is welcomed. The Government considers that the work of BCR makes a valuable contribution to the closer alignment of measurement standards and practices across Europe and would like to see this continue in support of establishing the single European market. It welcomes the suggestion that BCR has a role to play in support of the European Community certification and testing policy and believes that future priorities should include work to resolve technical problems which hinder the mutual recognition of the results of testing and analyses. Such assistance would need to extend wider than the production of reference materials and the conduct of intercomparisons.

CHAPTER 4

THE ROLE OF GOVERNMENT IN THE NMS

4.1 The Government has the ultimate responsibility for the integrity and efficient functioning of the NMS and in the last financial year (1988/89) DTI spent over £26 million in support of this. In addition it has a direct interest in ensuring the validity of measurement data which it uses or, as a result of legislation, requires of others. The purpose of this section is to set out the Government's view of its future involvement in the NMS both as a provider and user of its services. Five main areas are covered: the NMS in support of Government functions, the role of the Secretary of State for Trade and Industry, the future role of DTI Research Establishments, the funding of national measurement standards and the Government's support for laboratory accreditation.

The NMS in Support of Government Functions

4.2 A wide range of regulations, both domestic and European, makes specific provision to ensure the validity of measurements on which they depend. Such provisions include traceability of calibrations to national standards, the use of approved measurement procedures and the use of approved laboratories. For example, altimeters in civil aircraft must be calibrated in accordance with regulations drawn up under the Civil Aviation Act 1982 – an essential measure for passenger safety. Similarly some regulations made under the Food and Agriculture Acts require the use of statutory or approved analytical measurement methods with LGC specified as the referee analyst. In framing regulations and guidance under domestic and European health and safety legislation, traceability to national standards or NAMAS accreditation is specified by the Health and Safety Exective on a "deemed to satisfy" basis wherever appropriate. Indeed, NAMAS is playing an increasingly important part generally assisting in the implementation of EC Directives by the UK where validated measurements and tests are called for – from cosmetics to the quality of drinking water, and from electromagnetic compatibility to acoustic noise emissions from earth-moving machinery. Its role can be expected to continue to grow as further Directives are approved.

4.3 Government Departments are also dependent on the NMS in a great diversity of functions not covered by regulation. Audiometric testing in NHS hospitals relies on accurately calibrated equipment traceable to national measurement standards. MoD's defence procurement policy specifies that contractors should be able to demonstrate quality control; this includes a requirement for measurements to be traceable to national standards and MoD suppliers are expected to make use of NAMAS accredited testing and laboratory services. A number of Departments, including MAFF, MoD, DoH and DoE, have also sought NAMAS accreditation for their own in-house laboratory facilities.

The Role of the Secretary of State for Trade and Industry

4.4 Supervision of the NMS is exercised on behalf of the Secretary of State by the DTI. Existing statutory recognition for the Secretary of State's role is derived principally from the Weights and Measures Act 1985. Part 1 of this act requires the Secretary of State to maintain measurement standards for length, mass and capacity. These provisions

have remained largely unchanged since the turn of the century and have failed to keep in step with the evolution of the NMS in the UK.

4.5 The Government has already announced its intention to introduce changes to existing weights and measures legislation in order to implement the reforms outlined in Cmnd 9850 ("Metrological Control of Equipment for Use for Trade: The Government Response to the Report of the Eden Committee"). This would provide a suitable opportunity to amend the duty placed on the Secretary of State in order to reflect advances in measurement practice and to bring it more closely into line with other countries, particularly the UK's partners in the European Community. It is intended that the Secretary of State should be given a duty to maintain national measurement standards for the SI base units of measurement, and a power to maintain derived units. The duty will be framed to allow the Secretary of State to maintain these units in collaboration with overseas countries where he sees fit. The Secretary of State will further be required to compare measurement standards submitted by any person in the UK with the national standards of base units when there is no other reasonable means of calibration.

The Future Role of DTI Research Establishments

4.6 As the Prime Minister announced on 18 February 1988, the Government has accepted the main recommendations in a report by the Efficiency Unit: "Improving Management in Government: the Next Steps". As a result, a number of the executive functions of Government will be carried out by units designated as "agencies" within Departments. The objective of this programme is to make further improvements in efficiency by giving managers greater flexibility. Responsibility for the day-to-day operations of each agency will be delegated to a Chief Executive who will be responsible for management within a framework of policy objectives and resources.

4.7 The bulk of research, development and promotion of dissemination in support of the NMS is currently carried out in the DTI research establishments, principally NPL (including NAMAS). Proposals to introduce significant changes to the structure of these establishments were announced on 7 June 1988. Following a review of their activities, it was decided that they should concentrate on work required by Government for statutory, regulatory or policy reasons. Work done in support of the NMS falls within this definition. It was decided that NPL, LGC and the Warren Spring Laboratory (WSL), as well as NWML, would remain within Government but, subject to the establishment of appropriate framework agreements, become separate Executive Agencies within the Department of Trade and Industry. NWML and WSL became Executive Agencies in April 1989. It is proposed that LGC will be given this status later in 1989 and NPL during 1990. The National Engineering Laboratory (NEL) at East Kilbride provides the flow measurement standards of the NMS. In May 1989 the Secretary of State for Trade and Industry announced that the Laboratory would be converted into a limited company whose shares would initially be held by Government, but which could later be sold. Suitable arrangements will be made for the continuation of the flow measurement work.

Funding of Work on National Measurement Standards

4.8 The bulk of funding for the development and maintenance of measurement standards comes from general taxation. The Government believes that this should continue to be the case. And, as at present, it does not intend to seek to recover these costs through

the fees charged for calibrations, recognising that such a policy would be likely to both discourage potential users of standards and set UK companies at a disadvantage *vis-a-vis* overseas competitors.

4.9 The central justification for public funding lies in the nature of measurement standards themselves. Since a measurement standard will typically be used by a very wide range of individuals and firms, the investment necessary to develop and maintain it will yield benefits which accrue to all. The private benefits to be obtained from committing funds to work on measurement standards are therefore generally overshadowed by the broader benefits they confer on the user community as a whole – a strong disincentive to investment by individual private firms. If left to itself, therefore, the private sector can be expected to devote fewer resources to the development of measurement standards than is desirable from the point of view of the economy as a whole.

4.10 Whilst the Government is satisfied that this constitutes reasonable grounds for public funding of work on national measurement standards, it recognises that criteria need to be established to determine the allocation of these resources. This is particularly important in respect of work which falls outside the statutory and regulatory areas outlined in paragraphs 4.2–4.5 where the onus is clearly on Government to ensure that measurement standards are available. Proposed programmes will therefore be assessed against a number of criteria designed to establish whether they are of benefit to the national economy and would not be carried out without public support. The following are likely to be relevant considerations:

- whether the work will have applications across a range of important industrial sectors
- whether the work will significantly improve UK competitiveness
- whether the work could form part of a collaborative programme with the UK's partners in Europe
- whether the work will lead to a measurement standard which is likely to be of use to a large number of firms, including small and medium-sized enterprises.

Government Support for Laboratory Accreditation

4.11 NAMAS is the national accreditation service for calibration and testing laboratories. There are currently over 700 accredited laboratories in the UK and the scheme is growing rapidly. Responsibility for the operation of NAMAS lies with its Executive which is located in, and forms part of, NPL. Government involvement plays an important part in establishing the credibility of NAMAS at home and abroad. It gives demonstrable evidence of the organisation's commercial impartiality and allows the UK to negotiate from a strong position with other Governments on the mutual recognition of accreditation schemes. NAMAS members have expressed strong support for continued Government participation in the running of the scheme.

4.12 It has already been noted that a number of developments, notably the Single Market Programme and proposals for an improved framework for analytical measurement, will call for increased activity by NAMAS and its expansion into new fields of accreditation. Anticipating these developments, the Government has taken steps to introduce greater

flexibility into the operation of NAMAS, placing it as from 1 April 1988 under a new financial regime based on net running cost control. This should allow the NAMAS Executive greater freedom in the recruitment of staff to match demand for accreditation. The Government will also encourage NAMAS to maximise the use of personnel from outside Government in the assessment of laboratories.

4.13 The Government is concerned that, as far as possible, firms throughout the UK should have ready access to NAMAS accredited facilities. Whilst recognising that accreditation must remain firmly based on a voluntary principle and that the spread of laboratories will often reflect the pattern of local industry, it wishes to encourage an increase in the number of accredited laboratories especially in areas such as Northern Ireland which are currently under-represented. In publicising its activities by means of seminars, paid publicity and exhibitions, NAMAS will in future place emphasis on extending its regional coverage.

4.14 The Government wishes to see NAMAS vigorously promoted as a unified scheme covering all areas of laboratory accreditation, whose functions are widely understood and appreciated both in the UK and abroad. A major advantage offered by the existence of a national laboratory accreditation scheme is the prospect of the elimination of multiple assessment requirements on businesses. As sponsor of the scheme the Government recognises that it has a special duty in giving a lead here. NAMAS has already been accorded wide recognition by Government Departments and nationalised industries in the framing of quality assurance requirements relative to procurement and regulatory policies. Furthermore, laboratory assessment schemes operated by Government Departments will, wherever appropriate, be brought within NAMAS. A target date of 31 December 1991 has been set for the achievement of this.

4.15 Running parallel with NAMAS is the Department of Health's Good Laboratory Practice (GLP) Compliance Monitoring Programme. This programme monitors the quality and integrity of (mainly) biological and toxicological data generated by UK laboratories, for submission to Government regulatory agencies at home and abroad, in support of the human health and environmental safety of chemicals. The GLP programme operates under a number of international agreements and plays an important role by providing assurances to regulatory agencies as to the quality of chemicals safety data, thereby facilitating international trade in pharmaceuticals, pesticides and industrial chemicals. There are currently 58 UK laboratories recognised as being in compliance with GLP requirements.

4.16 Consistent with its policy of reducing the burden on laboratories of satisfying the needs of different accreditation and monitoring programmes, an agreement has been reached between NAMAS and GLP. Under the agreement, provided that certain conditions are met, NAMAS accredited laboratories carrying out physical and chemical tests (including analytical measurement activities) can be recognised as being GLP compliant.

CHAPTER 5

ROLE OF ORGANISATIONS OUTSIDE GOVERNMENT IN THE NMS

5.1 The Government recognises that private sector and other organisations play an important role in providing many of the measurement services which constitute the NMS. It believes, however, that wider involvement of outside organisations should be encouraged, particularly in activities such as the development of national measurement standards which have traditionally been regarded as the preserve of Government. Three main areas are foreseen for the greater involvement of the private sector; in providing external advice to DTI on the NMS, through competitive tendering for work on national measurement standards and through collaborative projects on industrial measurement. The Government believes that the measures in these areas outlined below will permit more effective targeting and enhanced efficiency in the use of public funds whilst attracting new resources and expertise into the NMS.

External Advice to DTI on the NMS

5.2 The Government recognises that close liaison with users of the NMS is essential if resources are to be directed at areas of measurement where the requirements are greatest. The Standards, Quality and Measurement Advisory Committee (SQMAC) was established in January 1988 to ensure a coherent formal structure for advice to DTI on the broad objectives, balance and strategy for Departmental expenditure on metrology. The linkage of measurement with the areas of quality and specification standards ensures that the broader objectives of the NMS in underpinning the competitiveness of UK industry are not lost from sight in framing this advice. The composition of the Committee is representative of a broad spread of industrial interests as well as including members from universities and Government Departments.

Competitive Tendering for Work on National Measurement Standards

5.3 The Government believes that efficiency in the provision of services is most effectively promoted through competition. It intends to open the way to competition for the work it funds in support of the NMS wherever this is consistent with the maintenance of public confidence in the integrity and impartiality of the system. Competition already works successfully at the level of reference standards where laboratories compete for calibration business in many areas. For national measurement standards the position is more complex. The principle of traceability, on which the integrity of the NMS depends, requires a single national measurement standard. This need not, however, preclude competition from operating at the point where a decision is taken over who should develop and subsequently hold a national measurement standard.

5.4 The bulk of work on national measurement standards is currently assigned to NPL. It holds virtually all the national measurement standards and carries out the lion's share of the associated research and development work in-house. The Government recognises that in many instances this may lead to savings through economies of scope and scale and through facilitation of the interdisciplinary approach often necessary in work on measurement standards. It is conscious, however, that it has been difficult to put this to the test in the past, since competition has been restricted by the assumption that national standards should be developed

and operated exclusively by organisations within Government. This assumption will now be dropped.

5.5 Through the introduction of competitive tendering it will be possible to secure greater value for money from public funds devoted to work on measurement standards. The feasibility of competitive tendering is supported by the existence of considerable measurement expertise outside Government. There are a number of organisations outside Government with the interest and potential to develop and operate national standards if given the opportunity. These include Research and Technology Organisations (RTOs) and higher education institutions (HEIs). The Government will therefore in future look for appropriate opportunities to seek tenders from such organisations to develop and hold the national measurement standards of derived units, particularly in areas where NPL has not built up facilities or expertise of its own.

Collaborative Projects in Support of the NMS

5.6 In some cases industry may believe there is a pressing need for the development of a national measurement standard or other aspect of the NMS which is not currently part of a Government funded programme and for which there is no alternative available through European collaborative arrangements. The likelihood is that this would apply in areas where the benefits arising from the project would accrue to a very restricted user community. If, in these circumstances, DTI is approached by a group of organisations with a programme who are prepared to contribute towards its cost, the Government will consider giving support under the terms of DTI's Research and Technology Initiative. In appraising such requests it will look for the acceptance of the proposal among all the potential user community. The Government would not normally insist that a national standard developed in this way should ultimately be held or operated within Government if suitable alternative arrangements were available.

Supervision of National Measurement Standards held outside Government

5.7 Competitive tendering and collaborative projects are likely to lead to the future location of national measurement standards for a number of derived units outside the Government laboratories where they have traditionally been held. The Government recognises that adequate safeguards will be needed to ensure that the quality of these measurement standards is maintained, that access is available to all parties on a fair and reasonable basis and that international confidence in the integrity of the NMS is not prejudiced.

5.8 Three basic conditions would need to be satisfied by any organisation outside Government wishing to hold a national measurement standard:

i. the holder should be able to demonstrate the traceability of the measurement standard to the national measurement standards for the base units held at NPL or other laboratories approved by the Secretary of State for Trade and Industry.

ii. the holder should be willing to participate in international intercomparisons where appropriate.

iii. the holder should provide independent confirmation of its competence to perform calibrations against the national standard. (This condition would generally be met by means of NAMAS accreditation.)

Further, more detailed conditions would be drawn up, based on the requirements of the particular national measurement standard. DTI, in consultation with users, will establish appropriate mechanisms to monitor compliance with these conditions and to ensure that the holder does not abuse its position by unreasonably refusing or discouraging requests for calibrations. In the event of the measurement standard being maintained or operated in an unacceptable manner, DTI will withdraw recognition of it as the national standard and will seek alternative arrangements regarding traceability for the unit in question.

CHAPTER 6

LEGAL METROLOGY AND THE NMS

6.1 Legal metrology covers certain areas of measurement controlled by statute or regulation. In the UK the term is applied principally to the control of measuring equipment in use for trade, although in many countries, including a number of the UK's EC partners, the boundaries of legal metrology are drawn far wider. The main legal requirements for measurement are set out in the Weights and Measures Act 1985, and associated secondary legislation. Controls over the metering of gas and electricity are contained in the Gas Act 1986 and the Electricity Supply (Meters) Act 1936, both of which are administered by the Department of Energy.

6.2 In 1986 the Government reviewed arrangements for the metrological control of trade equipment. In Cmnd 9850 ("Metrological Control of Equipment for Use for Trade: The Government Response to the Report of the Eden Committee") it reaffirmed its commitment to fair trading whilst ensuring that burdens of legal control sit as lightly as possible on business. Among the recommendations accepted by the Government was the introduction of a voluntary scheme to allow manufacturers, installers and repairers of weighing and measuring equipment to verify and stamp equipment; this is seen as an important deregulatory measure.

6.3 The Government recognises the major part played by local authority Trading Standards Officers (TSOs) in the enforcement of weights and measures legislation and the verification and inspection of measuring equipment. They are specifically trained and qualified (through the Diploma in Trading Standards) in a range of consumer-related activities and already fulfil a multiple role in the surveillance of manufacturers and traders. So far as weights and measures legislation is concerned, this is likely to be a changing role in the 1990s with increased emphasis on quality assurance and on meeting agreed criteria for certification and testing. The Government has recognised these developments by providing funding for training TSOs in quality assurance and by encouraging Trading Standards Departments (TSDs) to seek NAMAS accreditation when appropriate. In these ways TSOs are keeping abreast of progress in metrological control and preparing the way for compliance with the relevant European standards.

6.4 A number of TSDs have already obtained NAMAS accreditation, particularly for the calibration of mass and length standards, and the Government hopes that more TSDs will appreciate the value of accreditation as a means of generating increased confidence in their measurement and testing laboratories. It is expected that the wider market for their services thus generated will offset the resource costs of obtaining accreditation. Furthermore, a proposed amendment to the Weights and Measures Act will remove the need for multiple traceability of standards held by local authorities with NAMAS accreditation.

6.5 Developments in Europe leading to the completion of the single European market will have a considerable impact on legal metrology in the UK. The Government welcomes proposals for European Directives specifying performance requirements for measuring instruments in order to permit their free circulation within the Community. In negotiating

measuring instrument Directives, the UK will seek to balance the need to maintain confidence in accurate measurement against the importance of lightening the compliance burden on manufacturers and traders.

6.6 The Government welcomes proposals to include arrangements in Directives whereby manufacturers will be able to choose to make their own declarations of conformity without the need for 100 per cent testing by an inspection body (eg a TSD). These arrangements would mirror the proposed self-verification scheme in national regulations referred to in paragraph 6.2.

6.7 Under the measuring instrument Directives, designated bodies responsible for design approval and initial verification will be notified to the European Commission. These notified bodies will be expected to comply with the requirements in the relevant European standards.

6.8 NWML will also continue to play an active part in the International Organisation of Legal Metrology (OIML), of which the UK is a full member. The Government supports the work of the organisation and endorses its aim to encourage and facilitate worldwide trade in measuring instruments. It further believes that the UK should play a full part in the preparation of OIML International Recommendations. These are of particular importance as in many cases they will be adopted as European Standards to accompany future EC Directives and are also likely to form the basis of trade between the European Community and the rest of the world.

CHAPTER 7

ANALYTICAL MEASUREMENT AND THE NMS

7.1 The determination of the chemical composition of a material by analytical measurement has developed primarily to meet the needs of trade. Agreement on composition remains of crucial importance to commerce as many decisions taken in national or international trade depend on the compliance of goods with contractual or statutory requirements derived from chemical analysis. It is estimated that approximately 1000 million analytical measurements are carried out each year in the UK. Many of these measurements play a vital part not only in ensuring the quality of goods and commodities but also in the development of Government policy in areas as diverse as revenue collection, health and safety, environmental protection, agriculture and law enforcement.

The Need for an Analytical Measurement Initiative

7.2 The problem of the validity of analytical data – and the need for clear and unequivocal means to demonstrate that validity – has become increasingly apparent in recent years. The successful creation of the European single market in 1992 will have significant implications for the analytical measurement sector of the NMS. After 1992 the UK and other Member States will be required to accept each other's test data. However, present evidence suggests that there is frequently lack of agreement as to the validity of this data or even the methods which are best used to undertake a particular analysis. As well as representing a waste of effort and money this may also cause losses in trade.

7.3 The key to resolving these problems lies in analytical laboratories utilising a coherent quality control system, acceptable across both national boundaries and different fields of application, by which they can ensure the validity of their data and offer an independent demonstration of their capabilities to third parties. The remainder of this chapter sets out the way in which the Government intends to support the wider development of this approach.

The Way Forward in the United Kingdom

7.4 The Government believes that although the prime responsibility for determining and demonstrating the validity of analytical data rests with the analytical community more can be done to help them meet this requirement. LGC will therefore foster an improvement in analytical measurement within the UK, working in close collaboration with others, eg WSL in the environmental area. The Laboratories' programmes will be revised to devote a larger proportion of their current resources to work aimed at establishing the validity of analytical data. This will include promoting the adoption of analytical quality assurance programmes and the production of a comprehensive range of chemical standards and matrix reference materials, where specific needs for Government involvement are identified.

7.5 The Government believes that where practicable laboratories providing analytical measurements to third parties, particularly Government Departments, should seek some form of independent accreditation. The expansion of NAMAS to cope with demand in the analytical and other areas is described elsewhere in this White Paper. The

Government intends LGC to play a greater role in supporting the NAMAS Executive in developing accreditation in analytical measurement.

7.6 The Government recognises the special contribution to the development and validity of analytical measurement made by professional bodies and learned societies, both within the UK and internationally. For example, the Royal Society of Chemistry through its Analytical Division sponsors groups covering all aspects of analytical measurement. The Association of Public Analysts performs a particularly important role in support of analytical measurement for statutory requirements. The Government will continue to collaborate with these organisations in methods development, training and professional development of staff, and dissemination of information.

7.7 The Government notes that within the HEIs there are relatively few departments specialising in analytical measurement. A review is to be undertaken to ascertain whether the limited number of specialist departments are able to provide adequate numbers of trained analytical scientists to meet the demands of UK industry and Government. Previous studies have shown a shortage of trained metrologists available to industry and the provision of new courses has been supported by the Government.

The Way Forward in Europe

7.8 There is no single body responsible for European or international co-ordination of analytical measurement but ISO, the International Union of Pure and Applied Chemistry (IUPAC), and the Association of Official Analytical Chemists (AOAC) have played major parts in defining internationally agreed methods of analysis. Within Europe the Community's BCR Programme has fostered the production of a range of chemical reference materials. LGC and other organisations have made a substantial contribution to the acceptance of methods incorporated in the newly introduced harmonised system of Tariff Classification accepted by 108 countries.

7.9 The analytical measurement community works to improve accuracy by comparing and improving methods. The Government believes that this approach can provide a firm basis for the mutual acceptance of analytical data in 1992 and beyond and is providing new impetus and direction by seeking greater collaboration within Europe. LGC will, working with other relevant organisations, encourage the development of common analytical methods, a hierarchy of reference materials and a system of proficiency testing necessary to establish the acceptability of analytical measurement nationally and internationally. To facilitate this, the Government is consulting on a new network for European collaboration on analytical measurement enabling appropriate organisations to agree joint actions and to collaborate on development projects. This network of direct links between national centres of excellence in analytical measurement will reduce duplication of effort and increase efficiency. It will complement the activities of the BCR Programme in the field of chemical analysis.

GLOSSARY

Part 1 Principal Abbreviations

AOAC	Association of Official Analytical Chemists
BCR	Bureau Communautaire des Références (Community Bureau of Reference)
BIPM	Bureau International des Poids et Mesures (International Bureau of Weights and Measures)
BSI	British Standards Institute
BSI.QAS	British Standards Institute Quality Assurance Services
CEN	Comité Européen de Normalisation (European Committee for Standardisation)
CENELEC	Comité Européen de Normalisation Electrotechnique (European Committee for Electrotechnical Standardisation)
CGPM	Conference Générale des Poids et Mesures (General Conference on Weights and Measures)
EUROMET	an agreement under which European signatories co-operate in the development and provision of measurement standards and related services.
GLP	Good Laboratory Practice
HEI	Higher Education Institute
IEC	International Electrotechnical Committee
ISO	International Organisation for Standardisation
IUPAC	International Union of Pure and Applied Chemistry
LGC	Laboratory of the Government Chemist
NACCB	National Accreditation Council for Certification Bodies
NAMAS	National Measurement Accreditation Service
NEL	National Engineering Laboratory
NMS	National Measurement System
NPL	National Physical Laboratory
NWML	National Weights and Measures Laboratory
OIML	Organisation Internationale de Metrologie Légale (International Organisation of Legal Metrology)

RTO	Research and Technology Organisation
SI	Système International (d'Unités) (International System of Units). The coherent system of units adopted and recommended by the General Conference on Weights and Measures.
SQMAC	DTI Standards, Quality and Measurement Advisory Committee
TSD	Trading Standards Department
TSO	Trading Standards Officer
WSL	Warren Spring Laboratory

Part II Terms used in Metrology (taken from BS 5233)

base unit (of measurement) – a unit of measurement of a base quantity in a given system of quantities.

base quantity – one of the quantities which, in a system of quantities, are conventionally accepted as independent of each other.

derived unit (of measurement) – a unit of measurement of a derived quantity in a given system of quantities.

legal metrology – that part of metrology which treats units of measurement, methods of measurement, and of measuring instruments, in relation to the mandatory technical and legal requirements which have the object of ensuring a public guarantee from the point of view of the security and of the appropriate accuracy of measurements.

measurement standard; etalon – a material measure, measuring instrument or system intended to define, realise, conserve or reproduce a unit or one or more known values of a quantity in order to transmit them to other measuring instruments by comparison. (The term 'etalon' is now often used to avoid confusion between measurement standards, which are physical in nature, and purely documentary standards, such as BS 5233, BS 5781, etc.)

national standard – a standard recognised by an official national decision as the basis for fixing the value, in a country, of all other standards of the quantity concerned.

primary standard – a standard which has the highest metrological qualities in a specified field. Note: The concept of primary standard is equally valid for base units and for derived units.

reference standard – a standard, generally of the highest metrological quality available at a given location, from which measurements made at that location are derived.

reference material – a material or substance one or more properties of which are sufficiently well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials.

working standard – a standard which, usually calibrated against a reference standard, is used routinely to calibrate or check material measures or measuring instruments.

unit (of measurement) – a specific quantity, adopted by convention, used to express quantitatively quantities which have the same dimension.

Printed by Her Majesty's Stationery Office
Dd. 0503216 7/89 C25 3188771