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UNIDO ASSISTANCE TO THE BRAZILIAN STANDARDIZATION PROGRAMME

SEVENTH REPORT COVERING PERIOD

1 July to 30 December 1971

by Edmund Layton (Australia)
Standards Engineer & Project Manager Designate

283

Ministério da Indústria e do Comércio

INSTITUTO NACIONAL DE PESOS E MEDIDAS

INPM

RESTRICTED

Praça Mauá, 7-10º

Rio de Janeiro,-GB

BRASIL

FOR UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

U N I D O

UNIDO ASSISTANCE TO THE BRAZILIAN STANDARDIZATION PROGRAMME

by

Edmund LAYTON (Australia)

UNIDO Standards Engineer and Project Manager Designate

SEVENTH REPORT covering period from 1st July 1971 to 31st December 1971.

SUMMARY

Preparations were made for large scale, long term project "Standardization in Brazil" implementation. Objectives were specified and anquiries concerning feasibility and execution, possibilities were answered. The project was prepared for submission to the next UNDP Governing Council Meeting to take place in January 1972. The project was approved for submission by the Brazilian Government without any further ammendments. Its feasibility and bases were also examined by a UNDP Survey Mission.

1. PROJECT ACTIVITIES

1.1 Brief description of activities for period.

During this period, the large scale, long term project, submitted on 30 June 1971, was considered by the Brazilian Government authorities for submission for the UNDP Governing Council Meeting to take place in January 1972. The Brazilian Government accepted the project and awarded it high priority, towards the middle of September 1971. So that UNDP could include the proposal into the next Governing Council Meeting, Mr.D.Lovejoy (UNDP, New York), was sent to Rio to assess the project. My project proposal was for a 5 years duration with two phases of 3 and 2 years respectively. The project was submitted to Governing Council Meeting Agenda as a 3 years project with a reassessment after this period to determine its 2nd phase.

I prepared "extra muraly" a paper for presentation at the UNIDO Workshop on Standardization in Latin American Countries which took place end of September beginning of October 1971. The paper was as quite a lot of follow up action resulted with requests for additional documentation and information with reference to standardization in the fields of weights and measures from practically all the participants, especially from Panama, Mexico, Uruguay, Peru and others.

On the return journey from Chile, the Argentinian Instituto Nacional de Tecnologia Industrial (INTI) was visited for the purpose to survey their facilities in industrial, applied and scientific metrology with possible co-operation and exchange of Brazilian and Argentinian personnel in future collaboration between the INTI and the INPM. 2 officers of INPM followed up these possibilities, but no results of discussions between the INPM and INTI were communicated to me. The visit took place in the latter part of November 1971.

On 3rd December, interagency discussions took place between representatives of the Inter-American Bank (one of the aid giving agencies in the project "Standardization in Brazil") and myself, accompanied by the Assistant Resident Representative (Programmes) for the purpose of effecting co-operation and liaison at the field level. The representatives of the Inter-American Bank had previous discussions with the Diretor Geral Substituto, Dr. Armenio Lobo da Cunha Filho, without my presence, although I prepared a lot of

Relevant documentation for the perusal of the mission while visiting INPM. From my discussions held with them, it was obvious that U.N. experts can provide much useful documentation and information which would considerably help in the determination of merit of projects submitted to the Bank, especially were the Bank resources form an important part of the resources for the UNDP assisted project.

I will be taking part as special guest at the next Brazilian National Weights and Measures convention to be held in Salvador in the second half of December 1971.

The following documents were prepared by me as part of reports or memoranda : "Proposal concerning the metrological requirements of industry, of services, of existing technologies and in the marketing of products" (Portuguese translation available)
"Organization of a planning programme"
"How to manage improvements and extensions of services at INPM"
"The Aims and Functions of the Brazilian National Standards Laboratory"
"The Brazilian National Standards Laboratory Project" (All the above also available in Portuguese translation)
" Proposed areas of the Brazilian National Standards Laboratory by divisions and sections"
Due to unforseen circunstances and pressure of work periodic reports are being compiled with delay.

1.2 <u>Original terms of reference with respect to Job Description</u>

The Job Description, which was the basis for my first appointment with UNIDO in February 1969, stated that I should assist the Commission of National Development (now council) with the formulation of standards specifications in the mechanical, electrical and electronic field

In my first interview with a group of members of the Ministry of Industry and Commerce my terms of reference were altered in so far as to take up my mission with the INPM and assist the Director General of this Institute with standardization related to weights and meassures and applied and legal metrology in general, and pressure and length metrology in particular. The subsequent extensions, following Brazilian request for my continuance in this mission stressed the change of the terms of reference to the point that I should assist the Director General (who was to be my counterpart) in formulating the request for a large - scale, long term project on Standardization in Brazil from the point of view of INPM, I did this with little, from the part -

of INPM and its officers.

2. PROJECT EFFECTIVENESS

2.1 Response to advice and recommendations:

Advice and recommandations during my tenure of mission were taken and incorporated in a number of documents which the Director Geral of INPM prepared and edited in order to obtain various changes in the legal and administrative - structure of INPM and its network of branch organizations. The main two documents, were this occurred are "Preliminary Studies for the Metrology Centre- Centro Nacional de Metrologia, estudos preliminares "March 1971 and "Relatório do grupo instituido pela Portaria INPM nº 32/71 - Report of the working group under regulation 32/71" of July 1971. The former served as the document to earmark an Interamerican Bank Loan for the project "Standardization in Brasil" while the latter was to serve as a basic document for the administrative and legal re-organization of INPM and as a basic background information of the - state of INPM to consulting firms to be appointed in Brazil for the planning of the National Standards Laboratory. Separately, specification data for laboratory areas, climatization of laboratories and equipment requirements were compiled on an "ad hoc" - basis to serve as possible bidding data for contractors. In most cases, reference of UNDP assistence in all the above mentioned, was kept at a minimum. If advice was perhaps contrary to expectations, it was given little or no hearing.

2.2 Collaboration of homologues (counterpart support). My present official counterpart is Dr. Armenio Lobo da Cunha Filho, Diretor Geral Substituto, who has little time available to discuss matters with me as he seems to be overburdened with - need for re-organization of the structure of INPM and with the administration of 15 Branch Organizations in the Brazilian states. No counterpart substitute was assigned to me and my technical co-operation is carried out in the form of consulting - engineer mainly, by production of memoranda and reports with minimum of discussions. I have been assigned, since May 1971, the services of a part-time translator for English into Portuguese, and this helped a lot as there is hardy anybody in the INPM who is sufficiently proficient in English. I learned Portuguese in my own spare time and have attained a reasonable - proficiency in the language. Dr. Armenio works full-time. He is a physicist of good calibre by academic and practical -

training and has very good leadership potential besides having a genuine interest in his and the INPM work. The Diretor Geral, Dr. Moacir Reis, is at present on study leave attending the Escola Superior de Guerra (Brazilian work College)

2. PROJECT EFFECTIVENESS

2.1 a) The tecnical working conditions

Office space: I have a small office to myself which is at present rather overcrowded with my reference library. I have a typewriter, a desk, a large table and shelves to my disposal. The office is not confortable but can be considered as satisfying basic needs. I do not have any internal or external telephone in my office.

Travel: I get picked up in the morning at 7.30 a.m. In the afternoon a car is made available only if conditions of service permit.

Secretarial services: There are some secretarial services. I can get English typing done with great difficulties, but it has to be managed. The method, which I adopted, is that any English typing done by the INPM typist is confined to reports and papers and thus done on stencil. Stencils can be corrected without adding any additional mistakes. Almost all other English correspondence is done by myself.

Mail : There is quite a bit of what is termed "semi-official correspondence" which consists of letters which are connected with the activities of the mission but are addressed to me - e.g. - request for documentation on INPM service by someone in another country. I adopted the policy of asking for the documentation, - which is given to me, and transmitting the documentation via the UNDP Office in the respective country to the enquirer. The request originated usually from a standards body or bureaux in an other L.A. country.

Translation: Since May 1971, a part-time translator and assistant was made available to me who proved to be very competent and interested in his job. He cannot however be considered as the counterpart substitute.

Travel outside Rio In view that the project embraces the whole of Brazil with special emphasis on São Paulo. I should be able to travel in order to investigate on the spot conditions and - resources for the project. Unfortunately, last year and this - year. I had no opportunity to go there and discuss matters - with the São Paulo personnel were sidetracked.

2.2 Transfer of knowhow

When I came to Brazil in February 1969, the objectives and the working programme of the INPM and its network were not clear.

My main contribution during all my mission were two key documents, which prepared sometime ago. These were "Survey of existing - weights and measures services existing in Brazil."June 1970" and "Planning the Instituto Nacional de pesos e Medidas - list of metrology section and detailed list of proposed services of examinations and of areas of standardizations". The findings of these documents were eagerly accepted and formed the key documents of the project "Standardization in Brazil" and all INPM action, planning, programming and legislative drafts for change of administrative, legal and technical status. Specifications on laboratory planning, on industrial services, on standardization programmes were and are all based on theabove mentioned documents. - While a counterpart was really not trained, it could be noted that the INPM gained purpose, selfconfidence, objectives for the future and motivation to change to keep up with and provide within their capacity services of infrastructure. The INPM became aware of their important rôle in the community both as service to commerce, industry, education, technology, science, public health and safety and as the protector of the consumer. In broad goal my missions was very successful although there could have been even more done in particular fields.

2.3 I feel, that the need for specialized know how transfer has been provided in the project proposal "Standardization in Brazil". Some details of the methods and the programmes of training can be found in my papers, listed under.

1.1 the copies of which have been submitted both to the UNDP office in Rio and to UNIDO in Vienna for comment and as advance report of activities for the reporting period. During my home leave, earlier this year, I had the opportunity to locate some potencial candidates for technical co-operation within the above mentioned proposal.

2.4 My specialized agency has been providing me not very frequently with comments to my technical reports and directly or through the UNIDO Field Adviser with other documentation and - information. I feel that the publications of UNIDO, especially the periodic ones, should be available to me in two or three copies, so that I can keep one as a reference copy and install a routing system of the others for information of INPM and São Paulo staff. After routing, the copies of UNIDO or other publications can be kept in the INPM or IPEM - São Paulo Library.

2.5. <u>Working relations with others experts</u>. From the beginning of taking up my mission in Brazil, I advocated contact with - other experts in the field. The INPM issued instruction to all its staff in the 15 states of Brazil to co-operate in any possible way with U.N. experts. Whenever an expert was posted in the - Ministry of Commerce and Industry, I kept close contact with him to our mutual benefit. The getting together with experts, at -

least those in Rio and São Paulo, should be fostered as a monthly or 3 monthly event with UNDP support. I do participate in development but find that there seems to be little time to discuss any the meetings of the Society for International Development problems on individual level. I maintain quite an extensive correspondence with my parent Laboratory in Sydney in order to be up-to-date with development, with the weights and measures organization in Great Britain, with the National Bureau of Standards in Washington and with a number of individuals in the field, - besides belonging to professional societies. I became, upon request of the INPM, a member (socio contribuinte) of the Clube de Engenharia in Rio in order to keep in touch with progress and the Brazilian scene. There is and must be an intense need for co-operation among international and other experts. Most progress is achieved through co-operation and team work. Development is not the writing of surveys and reports of optimistic oratory but solid, enthusiastic, technical work and planning where the expert is expected to give his knowledge, his insight into the local conditions and his sympathy and understanding for the shortcomings.

3. LIVING CONDITIONS

If one accepts a UN mission appointment, one has to take into account that things in the host country are different than at home. I feel however that housing and conditions in appartments are not very satisfactory in relation to the price one has to pay for them in Rio, Perhaps, both the Brazilian authorities and the UNDP could assist a little more with housing and with the initial setting up in the new country. Health services in Rio depends on the location. I feel that public and taxi transportation seem adequate although very costly. Transportation in Rio are quite good and that the Brazilian Government Counterpart agency should provide within their means at least the same transport facilities they provide to their own senior staff.

Language: Portuguese is not easy. For sucess of longer term mission it is essential.

4. Project PERSPECTIVE

4.1. I do not expect that my counterparts are able to carry forward the tasks to which I was rendering my assistance. For this reason, a large scale, long term project "Standardization in Brazil" was elaborated. The project aims in providing the necessary assistance on a broad front as required by the rapid industrial and commercial development of Brazil. On my part,

I stated not only all the present shortcomings but also the successes on the mission hoping that by considering both, an evaluation of future progress and past achievements can be made.

I feel sure that by applying common sense, tact, initiative and imagination and by holding fast to the ideals of the United Nations, we can motivate our Brazilian colleagues to cooperate with the necessary enthusiasm and motivation to achieve the objectives of our missions. A little more support from UNDP in informing the Brazilian Government authorities of their obligations under UN assistence agreements would strengthen our chances to succeed in the field. Very often, it occurs, that the expert is considered a senior official of the Brazilian authority instead of as an expert on UN mission.

E.Layton

MEMORANDUM (for reference only of the Director General of INPM).

Preliminary study by E. LAYTON, UNIDO Standards Engineer. August 1971

Subject: Proposal concerning the metrological requirements of industry, of services, of existing technologies and in the marketing of products.

Note: 1) Some items mentioned should be considered in co-operation with the respective technological institutes existing in the country. A major part of documentation should be available at the Associação Brasileira de Normas Técnicas (ABNT) consisting of standard specifications of the International Organization for Standardization (ISO), the International Electrotechnical Commission (IEC) and their member countries.

2) A co-operation in aspects mentioned in this document with the ABNT would be very useful.

Proposal:

The metrological standard specification requirements and testing requirements of Brazil should be investigated from the point of view of all developing and existing industries, services and technologies.

Technical aspects:

Materials, processes, tools, machines and measuring equipment.

Consumer aspects:

Selection (including comparative quality), standards conformity, functional testing and measurements bearing on function, operation, servicing, maintenance and safety of products or Services.

The main industries to be covered are:

Ceramic industries

Ceramic materials, types, nature, uses, limitions;

Ceramic materials versus other materials in products;

Standards of quality in ceramic products and functional requirements

Brazilian products versus foreing products.

Ceramical Industries

Ceramic materials, types, nature, uses limitations;

Ceramic materials versus other materials in products;

Standards of quality in ceramic products and functional requirements;

Brazilian products vereus foreing products;

Ceramic processes, principles techniques.

Chemical Industries

Principles and practice of battery manufacture and services;

Principles and practice of electroplating;

Principles and practice of manufacture of photographic materials;

Paint formulas and paint qualities;

Selection of adhesives;

Effects of solvents on paints;

Strength of concrete;

Uses and limitations of plastics;

Legislative controls on chemicals;

Principles and practics of olloying and compounding.

Food industries

Farm machinery, mechanisms and operations in safety;

Principles and practice of refrigeration,

Principles and practices of storing agricultural products;

Measuring of quantity and quality of agricultural products;

Principles and practices for food preservation;

Safety of appliances and specification of controls;

Standards for industrial food production.

Graphic arts and industries

Engineering drawing, materials and standardspecification ralating to pictorial representation for the purpose of production;

Standards for materials, tools, machines etc in drawing;

Relation_ships between drawing and planning,

Principles of basic printing processes;

Standards on book publication,

Standards on type face and materials.

Measures of quality in printingand in standards of suitable paper;

Standards in documentation and library requiremente.

Leather industries

The manufacture of leather from skin, tanning chemistry, standarda and regulations for quality and quantity determinatione;

Manufacture of leather articles;

Testing of Physical and chemical propertiee of leather;

Specifications for leather cutting dies:

Identification of leather by type, quality and quantity;

Metal Industries

Specification for qualitative and quantitative determination of metals;

Specification for metal testing and identification;

Specifications and testing metal forming and cutting processes in production and for consumer utilization:

Quality standards in metals and metal productø of Brasilian manufac ture;

Identification of metals - Specificatione;

Shapes and sizes for commerce and industry-standard specifications;

Paper Industries

Specifications for types of pulp and chemical treatment;

Physical and chemical testing of paper and pulp;

Specificatione for grades and kinds of paper;

Specification for paper sizes and paper rticles;

Types and usea of plastic and impregnated papers, specifications;

Plastics Industries

Specifications for types and characteristics of plastics;
Physical and chemical testing of Plastics;
Quality testing of plastics and plastic articles;
Testing of plastic finishes for various materials;
Specifications for machinery used in the plastics industry;

Rubber Industries

Specification of synthetic and natural rubbers;
Specifications for chemical and physical testing of rubber;
Specifications for rubber articles used by industry and in commerce;
Specifications for the proper use of rubber articles;

Textile Industries

Pattern design specification for weaving, specifications for natural and synthetic threads;
Specifications for operation of textile machinery;
Specifications for textile quality and quantity testing;
Identification of textile qualities;
Standards for clothing and safety clothing;
Physical and chemical testing of yarns, cloth,etc;
Physical and chemical testing of materials used in textile manufacture.

Tools and machine industries

Specifications for tools shape, sizes, materials and quality;
Kinds and properties of metals used for tool constructions;
Specifications for safety and operations of electric control circuits;
Specifications for hydraulic and pneumatic circuits;
Metrology of machine tools and acceptance testing;
Properties of materials for machining processes;
Quality of tools and machine tools, machinability and cutability testing of Brazilian and imported materials;
Specifications for workshops safety and conduct;
Specifications for jig, tools, fixtures and accessories;
Inspection procedures;
Quality assurance and control.

Wood Industries

Specifications for wood types, uses, limitations, and identifications;
Testing properties of wood;
Specifications for the wood industries and for machine tools used;
Specifications for wood products and wood laminates;
Specifications and testing of wood products for quality;
Treatment of wood and wood finishes, specifications and testing.

Construction Industries

Specification for framed structures in various materials;
Specifications for heating and ventilating of structures;
Finishes and paints, specifications for applications and criteria for re-applications
Specifications for architectural and building drawings
Grades, sizes and standards of building materials;
Specifications for testing properties of materials and constructions;
Marks of quality in buildings;
Safety regulations on buildings.
Lifts and scaffolding regulations and functional testing

Power Industries

Specification for internal combustion engines, testing etc,
Specification for electric motors, for turbines, for jet engines;
Hydraulic machinery specifications
Testing and specifications of lubricants;
Specifications for accessories;
Regulations for selection of engines
Materials and product testing;
Various methods of testing power systems;
Safety regulations and qualifications for operator personnel;

Transportation Industries Airways

Aircraft nomenclature specification;
Aircraft operation, engine and airframe inspection, testing,
Aircraft and aircraft engine servicing;
Governmental regulation for safety;

Specifications for types of aircraft,

Control of materials and products used in aircraft, functional tes - ting regulations.

Qualifications, licensing of service personnel;

Meteorology services, controls and aerodrome regulations.

Transportation - conveyors

Specifications for industrial installation of conveyors, operation and servicing, testing for safety;

Pipe lines for long distance conveying-specifications;

Control systems in conveyors systems;

Materials and services specifications for conveyors in general,

Safety regulation for use of escalators, and other public conveyors;

Safety regulations for hoists, winches, lifts and pneumatic conveyor equipment;

Controls and control mechanism testing and safety regulations,

Fire precaution regulations.

Transportation Highways and Highway vehicles

Engineering aspects of automobile safety and specifications relating to testing performance,

Design specifications and testing of highway materials and highway construction

Nomenclature of automobiles and spare parts and testing of function;

Safety operation and safety tests;

Surveying and surveying instrument verifications;

Traffic engineering specifications and testing

Safety specifications for road traffic;

Illumination regulation and testing of vehicles and street illumination;

Transportation-Railways

Specification for railway powerplant, principles of operation, testing, standard nomenclature,

Railway automatic signals and testing;

Specifications for railway construction and materials,

Specifications for materials used in the fabrication of mechanical -

engineering components and units (e.g. engines, rolling stock, etc,). Safety regulations for railway traffic and operational testing of equipment, , both in the mechanical and electrical fields.

Electronic Industries

Electronic specification for testing and measurements functions of electronic components, servicing and testing

Specifications for electronic instruments, radio, television, telephones, etc.

Specifications for testing electronic controls on which safety and technological processes depend,

Specifications for applications of electronics in communications;

Special aspects of naval communications;

Special aspects of aircraft communications;

Special aspects of telecommunications,

Special aspects of space communications;

Technical qualification of service personnel using electronics;

The testing of electronic components;

Electric and electronic standards;

Quality testing and marking of electronic components

International co-operation in standards for electronic components;

International co-operation in electronics,

International arrangements on testing and specifications for electronic equipment in various spheres of activity,

Legislative and governmental regulations on electronics.

Application of electronic components in automation

Industrial research and metrological research

Relationship of industry, technology, commerce and services to standardization and metrology in general

Research and metrology, the need to be able to measure and provide accurate measuring services

Metrological regulations and legislation;

Economic values of metrology and standards in testing and product control for quality and function.

Unification, simplification and specification in standards and in the field of metrology.

Assistance to planning and statistical services by the use of metrological techniques and metrological concepts;

The implementation of metrication in industry, commerce, science and technology;

Social studies of relationships between industrial growth, metrology and social progress

Nature and fields of metrological research and creation of primary standards deduced for natural law;

Assistance and consultation on measurement and testing problems to industry and government agencies;

Identification of type of metrological or testing services needed;

Creation of a national, Brazilian pool of "know how" in the metrological and testing fields

Metrological Assistance in pilot projects and in industrial research

Co-operation with private and institutional research both in testing and in metrology;

Assistance in certification marking or product quality assurance for home consumption and export trade;

Co-operation with international organizations in metrology and material testing, quality control and statistics;

Library and documention service for metrology, product and material testing and quality assurance and control;

Register of Testing and product control laboratories;

Assessment of testing and metrological facilities;

Organizational plans for regional and national services in metrology and material (product) testing

Formation of functional committees for collaboration between government and private sectors.

E.L/MJS.

To: Director Geral of INPM.

From: Edmund Layton Date-June 1971

M E M O R A N D U M

SUBJECT: ORGANIZATION OF A PLANNING PROGRAMME

The size of the country requires a relatively high degree of decentralization. INPM has to be able to devote it - self to the needs and interests of the metrological service of Brazil as a whole. It should delegate the "routine repetitive situations" to the state IPEMs and concentrate in the work more on the "non-routine situations".

From the point of view of the INPM, the state IPEMs - must be capable of independent action in themselves and deal with some simpler "non-routine situations" before refering them to the INPM which in many cases is a long distance away.

Certain specialization may be necessary at particular IPEMs to meet local, specialized needs.

Thus, each IPEM requires its own individuality to match the needs of the particular state and should have some rela - tively independent command of some of its basic functions.

The INPM with its IPEMs must be both, centralized and decentralized.

As a result of UNDP and West German aids, the activi - ties of the INPM and of the IPEMs will be more diversified.

For the trainess of metrological "know how", there is the need to master the technical specialty and for the IPEM directors and higher staff of INPM and IPEMs there is the need to master principles of administration and organization toge - ther with a comprehensive technical "know-how".

There is the need, that new techniques are always ins- tructed to at least two people so that these people can work in teams. This step improves morale and productivity besides creating the situation where the newly learned can be better absorbed through collaboration and mutual discussion. It also

provides them with identity and goals. All IPEM and INPM staff should be capable to rotate to different types of work at short intervals.

In order to introduce to the public new techiniques of measurements available at INPM and IPEMs, the space offered in the journal "Industria & Produtividade" should be used for notices and regulations. The journal contains a section "Documentação & Informação" which is higly suitable for dissemination of news items about the activities of the INPM and its delegated IPEMs.

Organizationally, the INPM has to provide for planning, organization, motivation, co-ordination and control and as a result of these activities the tasks of INPM will be effectively accomplished.

Poor organization would result in a lot of waste motions and in very expensive overlap in work. It is necessary to investigate this because an investigation will usually reveal a surprising amount of duplicated effort in almost all sections of the work of INPM and its delegated IPEMs.

By proper division of labour, consistent delegation, and clear cut job definition or duty statements, the organization siphons off the routine duties and makes them the responsibility of lower rated positions. This frees executives and especially the Director of INPM (or the directors of IPEMs) so that they can devote most of their energies to planning and programming the work of their sections and co-ordinating their efforts with other functions of the metrological service as a whole. Otherwise, expansion and diversification cannot proceed farther than the organization structure permits, and INPM has plans for further growth and diversification which are being worked out.

Properly conceived, the organization structure of INPM and of its delegated IPEMs will demand creative results from creative people and will drain routine and repetitive work to supporting positions.

By establishing clear-cut accountability, it will provide recognition for the professional and the specialist in terms of their achievements.

The organization of INPM must at first identify the work that must be accomplished to attain the stated objectives, it must also group this work in logically related and balanced portions. Next, it must define and delegate responsability and authority to carry certain works out in the state IPEMs. As a final step, relationships have to be established to facilitate harmonious teamwork within the whole metrological services net work. This can be achieved with assistance from UNIDO, from the Western Germany Aid agreement, and other national, bilateral and international resources.

EL/MJS.

How to manage improvements and extension of services of INPM

by Edmund Layton, UNIDO Standards Engineer

Introduction

There are two ways to improve and extend weights and measures services. These are:

1) By increasing existing activities and promoting marginal activities;
2) By implementing a small and firmly based program into a dynamic program with assured effectiveness and long term survival in a certain critical area by specialists. If possible, training should embrace as many Weights & Measures Organizations as possible provided the specialty applies to them.

The first requirement of any program is to identify potential users and clients and to understand their needs. This is essential in order to determine the ultimate size of the program, areas where assistance is critically needed and the types of services which should be provided at the outset. It is also necessary to determine the measure to be taken to make the program feasible and possible.

Many of the data required are being compiled by the Instituto Brasileiro de Geografia e Estatística (IBGE), by other state and federal authorities and by evaluation of statistical data and requests for service received within the Weights and Measures Administration Network. These data are being analyzed and evaluated for planning of extension of existing services and for introducing new services. The present staff should be familiarized with collecting of relevant data affecting the Weights and Measures Administration as a whole and be competent to evaluate such data which serve as basis for central as well as regional decision making.

Data to be provided have to be more complete, more reliable, more pertinent and presented in a more efficient, timely and co-ordinated manner.

Human resources development - Objective and tool for programme.

The development of human resources is both a major objective and a means of obtaining the objectives of the programme.

In all training it is necessary to arrive at an understanding of basic principles involved in the services and of basic needs required from the service.

Some general programme guidelines

1) Staff selection,

2) design of content of training programme,

3) devising opportunities for advancement,

4) programming staff incentives,

5) selecting suitable firms (or entrepreneurs) for technical assistance in metrology, quality control and inspection practices together with on-site verification of measuring means and

6) designing content of programmes for training and for technical assistance to industry, to private and public laboratories including those of educational institutions.

When dealing with private industry it is necessary to treat production, marketing, financial management, standardization in all spheres of management. Personnel practices have to be included together with legal requirements as well as quality and function requirements which are based on metrology and metrological inspection services.

In all cases, it is necessary to motivate personnel by proper briefing concerning the objectives to be achieved.

The following is the basic outline:

Follow each basic principle which is new, by demonstration in actual working conditions to obtain realistic operating experience or at least realistic approximation of the real in-service conditions.

How should training programmes be organized?

In order that each new principle can be closely followed

by actual operating experience or (realistic approximation of operating experience) it is necessary to organize:

1) Fairly short training programmes focused on upgrading the capabilities of the operating staff by one or two steps at the time, or by teaching them just one thing at the time with sufficient in-service training;

2) Fairly long and continuous training programmes which accentuate small increments of knowledge or skill over a period of a year or even several years. This is mainly designed for high quality training, under in-service conditions, with a programme of seminars and training workshops;

3) A programme which is composed of case studies in going industrial concerns or in operating industrial laboratories, inspection or quality control services where the trainees will be ultimately expected to advise, to evalute and to manage such situations in practice. This part is designed for supervisory personnel and the higher echelons of the weights and measures administration. This can be instructed in training workshops or management clinics.

The above (1,2 and 3) are mainly designed for personnel, which is already performing useful work in the weights and measures administration or in other metrological services. For new trainees, with little or no previous experience, normal full time or part time courses should be arranged in the METROLOGY AND INSTRUMENT TECHNOLOGY COLLEGE as planned in the project proposal "Standardization in Brazil".

Identifying new opportunities for the application of metrological services

It is difficult to identify new opportunities for metrological services where these are most needed.

In this, it is necessary to effect "linking". This means that where more metrological services are installed, catering for a larger circle of industrial activity, members of lesser developed weightsand measures administrations should be assigned for practice. Thus, they will the recognize their needs for

metrology in their own proper areas on their return from their practical education.

The interchange of personnel in metrological services from well developed areas to lesserdeveloped areas and vice versa would greatly increase the efficiency and the holding together of the service. It would foster the so called "Esprit de corps", so important in the success of any service and in the motivation of its members.

When identifying opportunities for metrological services, all available information on industry, commerce and agriculture and supporting services should be obtained from federal agencies (e.g. the Instituto Brasileiro de Geografia e Estatística - IBGE) and the state and regional agencies (e.g. the Secretariat of the state and the regional agencies as the Sudene, Sudam etc).

It is necessary to discern the level of specialists required. One has to be able to use highly specialised persons effectively as these are very costly.

More attention has to be given to research in agriculture concerning metrological needs and especially to the agro-industries which may have many unidentified metrological problems. This applies especially to the lesser industrialized regions.

Technical assistance

Technical assistance consist chiefly of supplying technical know-how, by the receiving country, to be able to perform tasks that are expected of them.

Technical assistance for metrological services should focus on quality control. Functional reliability quality assurance (each with its specific meaning) technical assistance is very expensive. Quality control is an important metrological function. Technical assistance should be reserved to critical areas with high priority of growth and development. This may be difficult as at the same time a great variety of areas present themselves where technical assistance should be given on a priority basis. One should concentrate on those

areas involving the maximum reward for the minimum input or effort with reference to technical knowledge, skills, and equipment. It is better to concentrate on a few common aspect to all industries than only on one industry in particular. Material processing and material handling are such general spheres which occur in all manufacturing and processing industries. So do safety and public health. In practically all industries, material handling and material processing will be subject to some metrological control upon which quality and functional control will depend. The need for legal metrological services as to counting, measuring and weighing will also become apparent. Always concentrate of important bottleneck areas as these may solve not only problems in one sector but over a range of sectors.

To achieve the right balance requires a broad understanding of needs. Thus, surveys are an important preliminary step. Never allow too great and too wide a dispersion of advisory - efforts. Resist pressure from interested groups or even from government circles. Explain the case and concern realistically in terms of actual and immediate future potentialities of the service and within the objectives of the Weights and Measures Administration.

Role of Economic Investigations

(The word "economic" is used here in the widest possible significance thus:

1) relating or concerned with economics;
2) financially sound or reasonably profitable;
3) useful in the production of wealth,
4) necessary in the promotion of prosperity;
5) taking place without waste;
6) taking into consideration theories of supply and demand).

The key role of economic investigation is:

to evolve,
to improve and
to adapt to changing needs.

The also serve to sharpen critical and analytical capabilities and provide and excellent training in:

measuring,
estimating,
cross-checking,
and weighing the reliability of findings.

These are all important qualities by which staff can be evaluated as to the efficiency with which they carry out their practical activity. Economic investigations, stimulate performance, furnish information, point to development possibilities, identify bottlenecks, show ways and test means for meeting particular needs or overcoming particular obstacles.

Economic investigations are valuable tools for educating staff by providing a close approximation of actual industrial experience and insight into difficult-to-obtain information needed for managerial decisions.

In all economic investigations, there are always two broad fields to be handled-material processing and material - handling. All these are subject to measuring, estimating , crosschecking and weighing the reliability of findings.

Economic Investigations and Analyses in relation to Weights & Measures Service and to Standardization

1) Organization and analyses of basic data reletting to industry and industrial growth as far as they concern the Weights and Measures Administration and related standardization in the present and in the foreseeable future.

2) Analyses of the effectiveness of Weights and Measures extension of services programmes and their monitoring respectively, checking their efficacy under service conditions.

3) Market and other economic surveys to ascertain the need of metrological legislation especially in prepacked merchandise.

4) Techno-economic surveys of firms, institutional laboratories (private or public) within a sector of work.

If even the minimum quality of performance is to be achieved, inexperienced staff must have close professional guidance and close professional supervision of senior as well as well as subordinate staff.

The rapidity with which new services can be instituted depends to a large measure on the number of professional research advisors, on proficient and well trained local professional staff and on how well the instruction programme has been carried out.

New services should be designed in such a manner that they become as soon as possible income producing both for the Weights and Measures Branch Organizations as well as for the Instituto Nacional de Pesos e Medidas. Some services will not immediatly generate income but their value to the service is fundamental, and the results of such services may not be immediatly perceptible. This would apply to consulting services and project preparation in the field of pre-packaging, in quality control assistance and in setting up inspection systems. Also all assistance given to educational institutions or schemes will not yield immediate income, if any income at all.

Overseas training programmes

Carefully selected training needs can be provided by overseas training programs which are arranged by various agencies within the United Nations Family of Organizations as well as on bilateral bases. An eight weeks programme of training, based on US practice costs about US $ 4 000 which includes tuition, books, housing, board and transportation to and from Brazil. Subsequent courses may cost less as about one quarter of the initial fee represents expenses involved in setting up the programme.

Transportation also account for about 1/4 of costs, it may be advisable to consider the possibility of bringing a team of instructors or faculty members to Brazil. This would benefit a larger number of trainees at one time.

How can present training programmes be improved?

1) There is a need to devise methods and criteria on how to evaluate achievements of trainees and how to devise incentives to

stimulate the best performance level on the part of the students and the instructors.

2) It is necessary to bring in a lot of local case material and promote the discussion of actual in-service cases for soluctions.

3) A case should be studied from at least two different types of criteria.

This can be done by two groups presenting the same case from two different points of view before an unbiased audience presided by the instructor. Such arrangements would bring a lot of interest of all the participants and be of great educational value. This will provide a basis for absorbing what is to be learnt under most favourable learning conditions.

4) Trainees should be thought efficient ways of performing surveys to economic survey techniques. Gathering information on economics, on industrial operations, on markets and finance, on how plants operate their metrological, quality control and inspection services etc.

5) Trainees should be aware of the methods of cost accounting and of methods of cost analysis as pertaining to the wide scope of the weights and measures administration. They should also be aware of so called "value analysis" techniques as applied to metrological services in the wide sense of the meaning.

6) There should be an advance list of all training programmes to be offered a year ahead so that arrangements can be made for trainees and instructors alike, both for training to be effected in Brazil and for training to be received overseas.

7) It is also necessary to provide training programmes for a narrow sector. For example, only all the necessary information on balances, or on pressure gauges or on petrol station pumps etc. These courses should be of short duration and in several stages each stage augmenting the previous knowledge by a definite step. Every increase in knowledge or skill should be accompanied by increased promotion opportunities at the most appropriate moment especially if followed by a period of succes full execution of duties.

The Role of University and other higher training abroad

University training abroad provides primarely background in learning processes and building up abstract knowledge of basic technologies. The value of such training would be limited unless the universities concerned (or the related institutions) can be induced to create specially designed programmes.

Such programmes can be a highly valuable supplement to local training programmes. Arrangements should have a continuous flow of students for a period of about five years or more.

Using available resources

The Weights and Measures Administration (in order to strengthen its own operation) should seek the co-operation of private consultantes, private and public laboratories and laboratory and production staff in industry, commerce and agricultu re and in any services which or may only be remotely linked to metrology. This measure can be put into action at once by instructing the Weights and Measures Branch Organizations to conduct a survey with the assistance of the local state secretariats (e.g. commerce and industry, education, finance etc). Compiling such a "directory", will discover a lot of national know-how and save on importing technical experts where these are already in the country. Preparations to survey private and public laboratories are in progress.

In using available resources, and important agent in listing national know-how will be the trade an industrial associations. Especially in Brazil, co-operation of the Confederação Nacional de Industria and of various others should be sought. It is important to awaken interest in the national metrology system in the trade and in professional associations as well as in the Ministry of Planning and Coordination. The INPM can be an important factor in planning the use of national resources and know-how.

A large amount of technological processing is directly dependent upon basic metrological services such as counting, measuring and weighing.

As the complexity of the task of technical assistance

will increase, the identification and use of all available domestic resources is an economic must.

Using available resources will contribute to efficiency and profitability of undertaking.

How can one increase the dynamic impact of a technical co-operation project.

The main prospect of achieving more progress has to be sought in implementing small improvements continuously with adequate staff and instrumentation. This will assure good participation of the staff and will also achieve the necessary motivation. Each improvement in the service should be given adequate publicity and for this reason all branch organizations should be encouraged to report any improvements in the service or any extension of the service. These should then be prominently mentioned in a staff publication. The staff publication should be available to a large circle of users of metrological services and should be available to every federal and state department directly or remotely interested in metrology and all the associated services. All the trade associations should be circulated. The need for giving the public an adequate say in the information vehicle (e.g. Bulletim Informativ) cannot be overstressed. It is also important that this information vehicle be handled with professional staff as to editing and public relations work as well as to adequate technical information services.

The extension of services will gradually assume greater intensity. This will result in a greater and wider programme for activities and services. The demands and strains will increase, quite often, disproportunately. Forces to intensify the efforts will have to be put into action. The immediate impact upon the community will establish firmer foundations of the service through a record of positive achievements of a service to the public and to the nation. Much benefit will then be derived from relatively small actions spread simultaneously over the whole national territory.

Limitation of the present Level of Effort

It is very difficult to meet programmes effectively under conditions which exist in developing countries. To meet even the minimum requirements of the programme, the staff must have an unusual combination of professional skills and professional experience as well as good judgement.

However, the experience and training of staff, which is at present installed, is very uneven. Some are exceptionally well qualified in all respects, while others are only partially prepared for the complex responsibilities they will be called upon to shoulder and to undertake.

Many of the staff are young which sometimes places them under a handicap of lack of experience when confronted with extensive public relations or dealing with uncommon service conditions.

It is most important that existing staff will have time, opportunity, motivation and financial security (relatively free from personal as well as material problems) in order to fulfill the tasks on a fulltime basis.

Staff is at present receiving valuable training in basic legal metrology and metrological administration. They also have to be trained (at least some of them) in costing, cost analysis, accounting control, market analysis, techno-economic surveys, and experience in material processing and material handling with reference to metrological services.

Provision must be made to make more staff available as they are needed.

Staff turnover should be reduced as far as possible by provision in the service of such conditions as are conducive to make people realize that they are wanted, that they have reasonable career possibilities and adequate financial rewards for their services. Pride in good work and motivation regarding the needs of their services in the overall development plan of the nation should be encouraged.

Some warnings

Staff should not be put under pressure to perform services for which they are not adequate. This can be either because

their number is limited or because they lack in training or experience. Such action would result in deterioration of the work and in discouragement of participants. The resulting criticism may give rise to disappointments and damage the programme permanently.

Staff should be informed about developments in all regions of the service as to content and scope and also about happenings in their field which occur abroad. This will act as an incentive, as a stimulus to action by appealing to their self interest.

Every psychological and educational device should be be used to obtain more intensive effort from staff in the execution of their duties. Each one should know what (as far as possible accurately) is expected of him or her, by means of a job description or duty statement. Institutional arrangement should be so designed that each one feels part of the institution and will do its best to ensure adequate quality, continuity and effective performance of the services required by organisation or offered to the outside public.

Eng. Edmund Lupton

October 1971

EL/EJS.

THE AIMS AND FUNCTIONS OF THE BRAZILIAN NATIONAL STANDARDS LABORATORY

by Edmund Layton, UNIDO Standards Engineer

INTRODUCTION

The main functions of a National Standards Laboratory are to strengthen and advance science and technology and to facilitate their effective application for the public benefit. Scientific and applied metrology are both an instrument of government and a primary resource for the scientific and technological endeavours of the country. As metrology (or the science of measurements) enters into practically every scientific and technological activity, the National Standards Laboratory makes many very important contributions to the body of scientific and engineering know-how. The most significant impact of the National Standards Laboratory lies in the fact that it maintains the national measurement standards and produces adequate measurement standards for the use of the public. This facilitaties the advance of science and technology and its wise use by the society. Under the word "public", producers and consumers are meant.

THE PROMOTIONS OF THE LABORATORY

The National Standards Laboratory promotes:

1) More accurate, meaningful, compatible and reproducible measurements and technical data for science and engineering;

2) More effective use of applied science and technology by industry and government;

3) More equity in trade and commerce in a competitive market for consumers and sellers;

4) More effective scientific test methods and measurement standards for protecting the public from

hazards of health and safety.

NATIONAL AND INTERNATIONAL LINKS

It is the National Standards Laboratory's constant concern to improve the fundamental basis of accuracy and compatibility in physical measurements based on the hiarchy of standards represented by basic, derived and supplementary units of measurement of the Système Internacional d'Unitées, the "SI System".

Another main function of the Laboratory is the maintenance of links with the Bureau International des Poids et Mésures (BIPM) and intercompare its national reference standards of measurements with the international ones kept at the Bureau. At the same time, standards are kept compatible with national standards bureaux or laboratories in other countries. This assists greatly in promoting interchangeability not only on a national but also on an international scale.

Since most applied metrology can be legal metrology, the Laboratory maintains close relations with the Organization Internationale de Métrologie Legale (OIML).

THE HIARCHY OF STANDARDS

The Laboratory is also responsible to give high priority to link the apex of the national measurements (or the national reference standards) to the every day needs of technical and scientific measurements occuring throughout the country in science, technology, industry, commerce, education, public health and safety. This is done by means of the hiarchy of standards in accordance with definite steps in accuracy. The usual hiarchy of standards consists of reference, calibration, inspection and working standards. It incorporates results of scientific research in the metrology of products and services manufactured in the country and assists in pure and applied science, in improving the techniques of investigations, of research, of measurements and in testing.

The Laboratory provides the superior scientific and

practical basis of measurements from which all other measurements in science, technology, industry, commerce, public health and safety are derived and can be linked to measurements undertaken internationally and nationally. Each new advance in basic measuring capacity and capability is quickly taken over by science and technology and exploited for the benefit of the country and in the international field. The progress of development is directly linked to the progress at which the National Standards Laboratory grows and improves.

PRECISE MEASUREMENTS - A COMMUNITY SERVICE

Applications of precise measurements in science, technology, industry, public health and safety have increased so much in the past years that it is essential to have a single National Standards Laboratory to keep the national reference standards of measurements in a rapidly developing country like Brazil. It is also necessary that Applied Metrology branch laboratories are established. The standards of measurements of these laboratories being tied and traceable through the hierarchy of standards, directly, to the laboratory keeping the national reference standards - the National Standards Laboratory.

As the main measurement laboratory of the country, the National Standards Laboratory is moving in two distinct directions. These are:

1) - to improve the accuracy of measurements;

2) - to make improved measuring standards and techniques available to those who need them.

APPLIED AND SCIENTIFIC METROLOGY

Basic research to improve fundamental measurement standards may seem remote from the consumer. In actual fact, this research is essential to continued improvement of products, of metrological quality control of services and of research techniques used in science, technology, industry and commerce. An increasing amount of research results in science, in technology and in manufactured and other products owe their

existence in part to refinements in measuring techniques -and thus to applied and scientific metrology in general. These refinements can only be made possible by institutions like the National Standards Laboratory or institutions with similar aims in other countries. There is a variety of programs and pro - jects designed to make available modern improved measuring technology. Thus, applied metrology assists to do work for science, technology, industry and in the last and not least for the individual citizen.

THE LABORATORY AS KEEPER OF STANDARDS OF MEASUREMENTS

The National Standards Laboratory is the foundation of all measurements undertaken in practically all sectors of the activities of a country. The units of measurement of physical quantities in most general use today, are those of the Système International des Unités (the "SI" System) - as agreed among members of the Bureau International des Poids et Mésures some time ago.

The interrelation of physical units of the SI System will be understood from the enclosed table which shows the relationship of units used in mechanics to those of other physical units. The table is enclosed as Appendix 1. From it, it will be obvious that reference, calibration, inspection and working standards of all the listed units will have to be kept by the National Standards Laboratory.

A more complete outline of services planned is given in the enclosed "List of proposed services of examinations and areas of standardization" (Appendix 2).

CONCLUSION

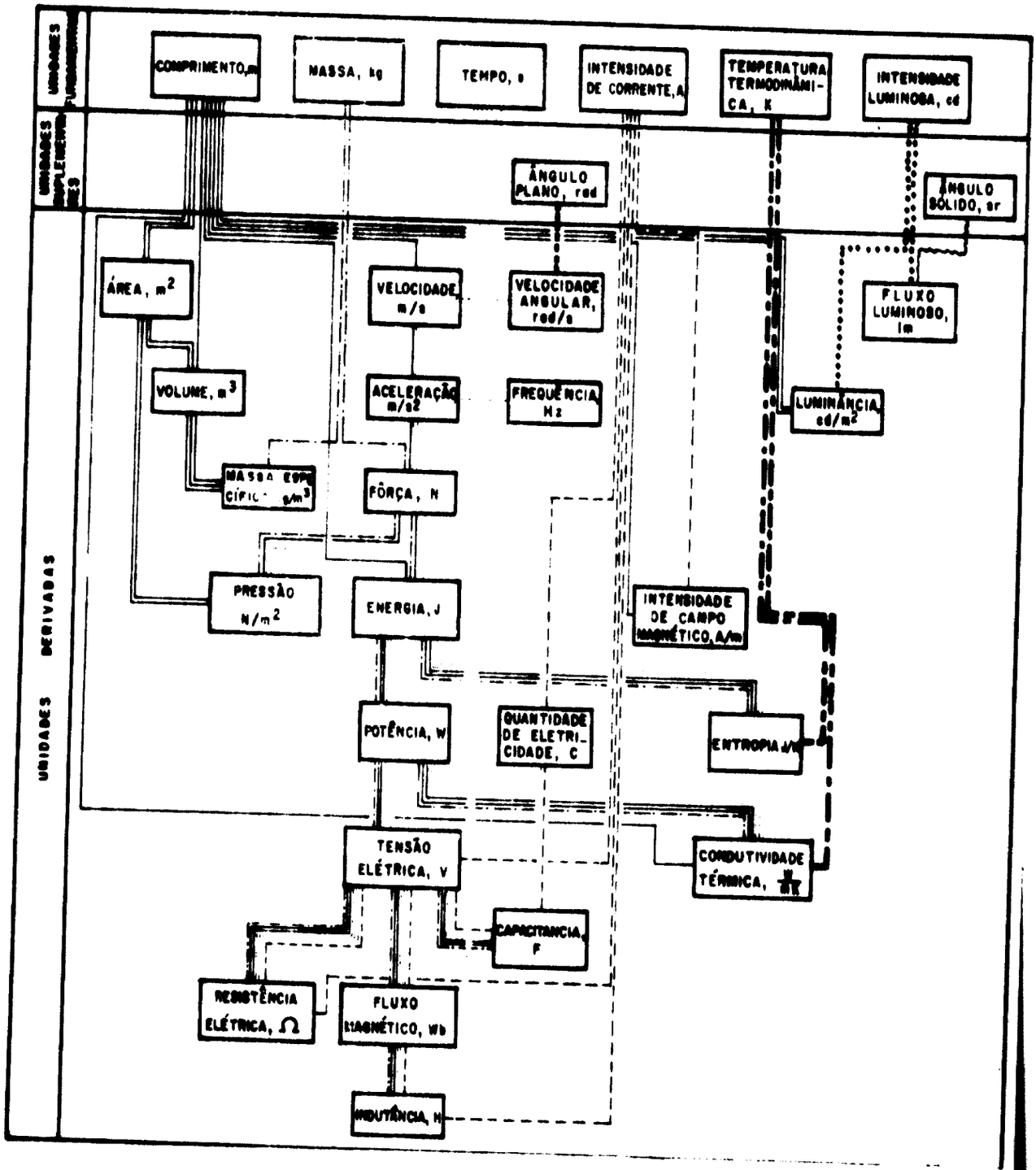
The expansion of precision measurement needs in scientific and technological research, in industry, commerce, education, public health and safety has grown out of all proportions. Brazil needs to meet this challenge with the utmost speed and efficiency using all available. resources.

With the Decree Law Nº 240 of 28 February 1967, the foundation of national policies on metrology and of a national measuring (weights and measures) service have been laid.

May 1971

MJS.

SISTEMA INTERNACIONAL DE UNIDADES



O Sistema Internacional de Unidades é o único sistema de unidades legal no Brasil.

O quadro acima mostra as correlações entre as unidades fundamentais, suplementares e derivadas. Estas unidades estão definidas no "Quadro Geral das Unidades de Medida", preparado pelo INSTITUTO NACIONAL DE PESOS E MEDIDAS e aprovado pelo Decreto nº 63 233, de 12-9-68 (Diário Oficial de 16-10-68).

INSTITUTO NACIONAL DE PESOS E MEDIDAS

ALGUMAS DEFINIÇÕES ÚTEIS DA METROLOGIA
(VIDE QUADRO DO SISTEMA INTERNACIONAL - SI)

1. GRANDEZA:
Característica quantitativa de um corpo, fenômeno ou processo físico. Ex.: comprimento, tempo, massa, temperatura

2. UNIDADE DE MEDIDA:
Valor da grandeza física tomado como base para a determinação quantitativa de grandezas da mesma espéie.

2.a - Unidade fundamental
Unidade cujo valor se determina independentemente dos valores de outras unidades. Ex.: metro, candela

2.b - Unidade suplementar
Unidade adimensional que suplementa as unidades fundamentais na definição das unidades derivadas.

2.c - Unidade derivada
Unidade cujo valor se determina em função dos valores das unidades fundamentais. Ex.: metro por segundo

2.d - Símbolo da unidade de medida
Sinal convencional que designa a unidade de medida.
Ex.: m (metro), s (segundo)

2.e - Dimensão de uma unidade de medida
Representação simbólica e característica das unidades de medida, mostrando sua interrelação das unidades fundamentais com as derivadas.

3. SISTEMA DE UNIDADES:
Conjunto de unidades de medida que abrangem todos ou a maior parte dos campos de medição.

3.a - Sistema Internacional de Unidades (SI)
Sistema de unidades de medida baseado em seis unidades fundamentais, adotado pelo Bureau Internacional de Pesos e Medidas.

4. MEDIÇÃO:
Operação ou conjunto de operações, efetuada com o auxílio de instrumentos, que visa determinar o valor numérico de uma grandeza.

4.a - Medição direta
Quando se efetua com o auxílio de uma medida ou aparelho destinado a essa grandeza. Ex.: medição da temperatura com o auxílio de um termômetro.

4.b - Medição indireta
Quando o seu resultado se obtém a partir de medições diretas de outras grandezas.
Ex.: medição de resistividade de um condutor com base nas medições de sua resistência, do comprimento e da área da sua seção transversal.

UGCW/ipp

INSTITUTO NACIONAL DE PESOS E MEDIDAS

Sistema Internacional de Unidades (SI)

GRANDEZA	DIMENSÃO	UNIDADES (SI)	SÍMBOLO
Unidades Fundamentais:			
Comprimento	L	metro	m
Massa	M	quilograma	kg
Tempo	T	segundo	s
Intensidade de corrente	I	ampère	A
Temperatura termodinâmica	O	kelvin	K
Intensidade luminosa	J	candela	cd
Unidades Suplementares (adimensionais):			
Ângulo plano	-	radiano	rad
Ângulo sólido	-	esterorradiano	sr
Unidades Derivadas:			
1. do comprimento (geométricas)			
Área	L^2	metro quadrado	m^2
Volume	L^3	metro cúbico	m^3
2. do comprimento, tempo e ângulo plano (cinemática)			
Velocidade	LT^{-1}	metro por segundo	m/s
Aceleração	LT^{-2}	metro por segundo ao quadrado	m/s^2
Velocidade angular	T^{-1}	radiano por segundo	rad/s
Freqüência	T^{-1}	hertz	Hz
3. do comprimento, tempo e massa (dinâmicas)			
Fôrça	LMT^{-2}	newton	N
Energia	L^2MT^{-2}	joule	J
Potência	L^2MT^{-3}	watt	W
Pressão	$L^{-1}MT^{-2}$	newton por metro quadrado	N/m^2
4. outras unidades derivadas			
Massa específica	ML^{-3}	quilograma por metro cúbico	kg/m^3
Quantidade de eletricidade	TI	coulomb	C
Tensão elétrica	$L^2MT^{-3}I^{-2}$	volt	V
Resistência elétrica	$L^{-2}MT^{-3}I^{-2}$	ohm	
Capacitância	$L^{-2}M^{-1}T^4I^2$	farad	F
Fluxo magnético	$L^2MT^{-2}I^{-1}$	weber	Wb
Indutância	$L^2MT^{-2}I^{-2}$	henry	H
Intensidade de campo magnético	$L^{-1}I$	ampère por metro	A/m
Fluxo luminoso	J	lúmen	lm
Luminância	$L^{-2}J$	candela por metro quadrado	cd/m^2

BRAZILIAN NATIONAL WEIGHTS AND MEASURES SERVICE NETWORK - DETAILED LIST OF PROPOSED SERVICES OF EXAMINATIONS AND OF AREAS OF STANDARDIZATION

1. MECHANICS

1.1 COMMERCIAL LENGTH & AREA - TAXIMETERS

(Measurement of length and area used for trade)

1.11 Commercial measures of length made of metal, hard wood or other approved material

1.12 Tapes woven or metallic and survey tapes in common use

1.13 Length measuring machines

1.13.1 Fabric Measuring Instruments & Machines

1.13.2 Cordage Measuring Instruments & Machines

1.13.3 Timber Measuring Instruments & Machines

1.13.4 Wire & Wire Netting Measuring Machines

1.13.5 Cable Measuring Machines

1.13.6 Miscellaneous Measuring Machines in Trade

1.14 Area measuring instruments (e.g. for leather)

1.14.1 Planimeters

1.14.2 Leather Measuring Instruments

1.14.3 Miscellaneous Area Measuring Instruments

1.15 Counting Machines

1.15.1 Counting Machines Used in Trade & Industry

1.15.2 Vending Machines

1.16 Taximeters and other measuring instruments used in motor vehicles

1.2 INDUSTRIAL AND SCIENTIFIC LENGTH METROLOGY

1.20 Maintenance of primary length standard

1.20.1 Wavelength with line standard comparator

1.20.2 Line standard with end standard comparator

1.20.3 Interferometry for length measurements

1.20.4 Linear & circular dividing laboratory

1.20.5 Block (slip) gauge comparator - reference & calibration

1.21 Engineers' Limit Gauges

1.21.1 Plain cylindricalPlug & Ring Gauges

1.21.2 Plain gap gauges, fixed & adjustable

1.21.3 Depth gauges

1.21.4 Tapered plug & ring gauges

1.21.5 Profile gauges

1.21.6 Position gauges & receiver gauges

1.21.7 Screw gauges

1.22 Engineers measuring tools and instruments

1.22.1 External Micrometers & Micrometer Setting Gauges

1.22.2 Micrometer heads

1.22.3 Internal micrometers & stick micrometers

1.22.4 Depth micrometers

1.22.5 Vernier callipers

1.22.6 Vernier height gauges

1.22.7 Surface plates

1.22.8 Toolmakers' flats & high precision surface plates

1.22.9 Optical flats

1.22.10 Straightedges

1.22.11 Engineers' squares

1.22.12 Engineers' Precision levels

1.22.13 Engineers' parallels

1.22.14 Dial gauges for linear measurement

1.22.15 Dial test indicators (lever type)

1.22.16 Feeler Gauges

1.22.17 Cast iron angle plates & box angle plates

1.22.18 Extensometers for proof stress determinations

1.22.19 Laboratory instruments

1.22.19.1 Vicat apparatus (cement)

1.22.19.2 Pensky Martens apparatus (petroleum)

1.22.19.3 Penetration needles (bitumen)

1.22.19.4 Thickness gauges for rubber, plastics etc.

1.22.19.5 Airflow nozzles & petrol jets

1.23. Jigs & fixtures, cutting tools & components

1.23.1 Examination of jigs & fixtures

1.23.2 Examination of single point cutting tools

1.23.3 Examination of multipoint cutting tools

1.23.4 Examination of laboratory moulds & dies

1.23.41 Cement cube moulds

1.23.42 Cement guide moulds

1.23.43 Vicat moulds (for Vicat apparatus)

1.23.44 Rubber specimen cutters

1.23.45 Miscellaneous cutters & moulds

1.23.5 Measurement of components

1.23.6 Measurement of components for quality control

1.23.7 Assessment for conformity to standards

1.23.8 Test sieves

1.24. Testing of machine tools

1.24.1 Geometric tests

1.24.11 Flatness of beds & tables

1.24.12 Straightness of Guideways

1.24.13 Alignments (Parallelism, Squareness, etc)

1.24.14 Accuracy of lead screws

1.24.15 Accuracy of gear drives

1.24.2 Dynamic (practical) tests

1.24.21 Performance tests

1.24.22 Deflection tests

1.25. Surface texture

1.25.1 Assessment of surface texture

1.25.2 Surface finish measuring instruments

1.25.3 Surface texture standards

1.26 Gears, Splines and Serrations

1.26.1 Machine cut gears - Helical & Straight Spur

1.26.2 Bevel gears (machine cut)

1.26.3 Gears for traction

1.26.4 Worm Gearing

1.26.5 Fine Pitch gears

1.26.6 Gears for turbines & similar Drives

1.26.7 Straight-Sided Splines & Serrations

1.26.8 Special types of gears

1.26.9 Gear cutting tools

1.26.10 Gauges & masters for gearings

1.27 Working Standards of Length & Angle

1.27.1 Line standards & precision linear scales

1.27.2 Surveying tapes-petroleum dip tapes

1.27.3 Precise levelling staffs

1.27.4 Slip (block) Gauges - inspection & working grade

1.27.5 Length (end) bars-block gauges above 100 mm

1.27.6 Cylindrical plug standards

1.27.7 Cylindrical Ring Standards

1.27.8 Roller gauges

1.27.9 Steel ball gauges

1.27.10 Combination angle gauges

1.27.11 Precision Polygons & Circular Scales

1.27.12 Thread Measuring Accessories

1.27.13 Precision Graticules, Stage Micrometers

1.27.14 Haemocytometer Counting Chamger

1.27.15 Screw pitch reference standards

1.27.16 Sine bars & sine tables

1.28 Precision Measuring Machines and Miscellaneous Measuring equipment

1.28.1 Length Measuring Machines

1.28.2 Screw Diameter Measuring Machines

1.28.3 Screw Pitch Measuring Machines

1.28.4 Precision Projection Apparatus

1.28.5 Auto-Collimators & Optical Length Measuring Instruments

1.28.6 Dividing Heads & Tables

1.28.7 Gear & Hob Measuring Equipment

1.28.8 Engineers Comparators (external Measurement)

1.28.9 Diamond Indenters for Hardness Testing Machines

1.28.10 Cryptometers (black & white)

1.28.11 Extensometers

1.28.12 Wet Film Thickness Gauge (wheel type)

1.28.13 Fineness of Grind Gauge

1.28.14 Taps & Dies

1.29 Engineering Design Analysis §

1.29.1 Drawing Practice

1.29.2 Gauging & Inspection Practice

1.29.3 Standards for Preferred Design Sizes In Linear & Angular Dimension

1.29.4 Fits

1.29.5 (Standard) Tolerances -Dimensions

1.29.6 (Standard) Tolerances - Geometry

1.29.7 Maching Processes, Surface finish, Effects of Tool Geometry on Dimension and Process Variability

1.29.8 Principles of Interchangeable Manufacture

1.29.9 Quality Assurance and Conformity With Standards Testing

1.29.10 Production Engineering Metrology

§ (Industrial Metrology Consulting Services)

1.3 Volume, Density & Flow

1.31 Examination of volumetric equipment

1.31.1 Measures of volume

1.31.2 Laboratory Glassware

1.31.3 Filling machines

1.31.4 Receptacles for the measurement of solids, earth, sand or ballast

1.31.5 Tanks and other receptacles

1.32 Determination of Density of Liquids & Solids

1.32.1 Density of liquids

1.32.2 Density of solids

1.33 Examination of Hydrometers

1.33.1 Density hydrometer

1.33.2 Specific gravity hydrometers

1.33.3 Brix hydrometers (sugar industry)

1.33.4 Proof spirit hydrometers

1.34 Measurement of Flow of Liquids & Gases (calibration of flow measuring devices)

1.34.1 Anemometers - (metereology)

1.34.2 Mechanical type meters

1.34.3 Differential type meters

1.34.4 Variable aperture type meters

1.34.5 Other flow measuring devices

1.34.6 Calibration of jets

1.35 Volumetric Meterological Instruments e.g. Rain Gauges

1.36 Determination of ship tonnage

1.4 Mass

1.41 Industrial Scales & Weighing Appliances

1.42 Commercial Balances

1.43 Precision Balances

1.44 Torsion Balances

1.45 Special Purpose Balances

1.45.1 Moisture Balances

1.45.2 Westphal Balances

1.45.3 Gas Density Balances

1.45.4 Yarn Balances

1.46 Commercial Weights

1.47 Precision Weights

1.48 Measure of Grain

1.49 Weighing of Components

1.5 Time, Velocity, Rotational Speed, & Acceleration

1.51 Time Interval

1.51.1 Precision Clocks

1.51.2 Interval Timers

1.51.3 Stopwatches

1.51.4 Chronograph Watches

1.51.5 Rating of "Time of Day" Watches

1.51.6 Marine & Surveying Chronometers

1.52 Velocity & Rotational Speed

1.53 Acceleration

1.6 Force, Hardness, Impact & Measurements of Strength of Materials and Mechanical Testing of Structures (Partly With INT)

1.61 Verification of Force Measuring Devices

1.61.1 Proving Rings & Load Measuring Rings

1.61.2 Proving Loops

1.61.3 Amsler Boxes

1.61.4 Electrical Load Cells

1.61.5 Proving Levers

1.61.6 Load Dynamometers

1.61.7 Cable Tension Meters

1.61.8 Draw Bar Dynamometer

1.61.9 Other Load Measuring Devices

1.62 Verification of Material Testing Machines

1.62.1 Tension & Compression Testing Machines

1.62.2 Universal Testing Machines Below 10t Capacity

1.62.3 Universal Testing Machines Above 10T capacity

1.62.4 Torsion Testing Machines & Torque Wrenches

1.62.5 Tension Torque Testing Machines

1.62.6 Biaxial Testing Machines

1.62.7 Triaxial Testing Machines

1.62.8 Other Stress Producing Machines (eg soils)

1.62.9 Fatigue Testing Machines

1.63 Verification of Haroness Testing Machines for Metals

1.63.1 Vickers Hardness Testing Machines

1.63.2 Rockwel Hardness Testing Machines

1.63.3 Brinell Hardness Testing Machines

1.63.4 Low Load Hardness Testing Machines

1.63.5 Micro Hardness Testing Machines

1.63.6 Other Types of Hardness Testing Machines

1.64 Hardnes Testing Instruments For Non-Metallic Materials

1.64.1 Dead-Weight Rubber Hardness Tester

1.64.2 Rubber Durometers

1.64.3 Hardness (softness) Instruments For Plastics

1.64.4 Micro Hardness Tester For Rubber

1.65 Impact Testing Machines For Metals And Non-Metallic Materials

1.65.1 Impact Testing Machines For Metals(IZOD & Charpy)

1.65.2 Impact Testing Machines for Plastics

1.65.3 Falling-Pendulum-Type Machines for Performing Puncture, Stiffness & Tearing Tests on Paper & Textiles

1.65.4 SpecialTypes of Machines

1.66 Other Testing Machines (Ductility, Folding, etc)

1.66.1 Ductility Testing Machine

1.66.2 Folding & Bend Tester

1.66.3 Other Types of Testing Machines

1.67 Standard Hardness Blocks for Metal & Rubber

1.67.1 Brinell Standard Hardness Test Blocks

1.67.2 Rockwell Standard Hardness Test Blocks

1.67.3 Vickers Standard Hardness Test Blocks

1.67.4 I.R.H.(Rubber) Standard Hardness Test Blocks

1.67.5 Special Standard Hardness Test Blocks

1.67.6 Examination of Brinell & Vickers Microscopes

1.68 Testing of Lifting Gear, Cranes & Hoists and Fasteners

1.68.1 Examination of Lifting Gear Testing Equipment

1.68.2 Approval of Patterns for Lifting Gear

1.68.21 Chain

1.68.22 Wire Rope

1.68.23 Steel for Wire Rope

1.68.24 Tension of Wire For Rope

1.68.25 Torsion of Wire for Rope

1.68.26 Tension Tests on Fittings

1.68.27 Bend & Reverse Bend Tests on Wire

1.68.3 Testing Passenger & Goods Elevators

1.68.4 Testing Cranes

1.68.5 Testing Hoists

1.68.6 Testing Fibre Rope & Cordage

1.68.7 Testing of Fasteners (Threaded, Riveted, Welded)

1.68.71 Threaded Fasteners

1.68.72 Riveted Fasteners

1.68.73 Welded Joints

1.68.74 Other Types

1.68.8 Testing of Scaffolding

1.69 Testing of Springs, Brakes & Energy Absorbing Devices

1.69.1 Verification of Spring Testers

1.69.2 Calibration of Springy

1.69.3 Verification of Braking Power Testers

1.69.4 Verification of Energi Absorbing Devices

1.7 PRESSURE

1.71 Dead Weight Testers

1.72 Pressure & Vacuum Gauges

1.72.1 Test Pressure Gauges

1.72.2 Compound Gauges

1.72.3 Oxygen Gauges

1.72.4 Pressure Vessel Tests

1.72.5 Vacuum Gauges

1.72.6 Other Pressure Measuring Devices

1.73 Barometers

1.73.1. Mercury Barometers

1.73.2 Aneroid Barometers

1.73.3. Manometers, Barographs

1.73.4 Special Instruments (eg micro barometers)

1.74 Verification of Sphygmomanomete

1.75 Testing Fired & Unfired Pressure Vessels

2.1 ELECTRICAL STANDARDS D.C.

(to be completed later)

2.11 Standard Cells

2.12 Resistors

2.13 Potential Dividers & Potentiometers

2.14 Bridges

2.15 Indicating & Recording Instruments

2.2 ELECTRICAL STANDARDS ET POWER FREQUENCY

2.2. Transformers (Details to Be Completed Later)

2.22 High Voltage (at later stage)

2.23 Indicating Instruments

2.23.1 A.C. Ammeters

2.23.2 A.C. Voltmeters

2.23.3 A.C. Wattmeters

2.23.4 Frequency Meters

2.23.5 Examination of Test Equipment

2.3 TIME & FREQUENCY (details to be completed later)

2.3. Frequency

2.32 Wave Meters

2.33 Counters & Time Interval Meters

2.34 Impedance Measurements

2.4 INDUCTANCE & CAPACITANCE

2.41 Inductors

2.42 Capacitors

2.5 ELECTRICITY METERS

2.51 Power Supply of Meters Pattern Approval

2.52 Electricity Meter Testing(for Electricity Supply Authorities)

2.53 Examination of Electricity Meter Testing Equipment

2.6 TESTS ON ELECTRICAL APPLIANCES & ACCESSORIES (Certification of safety) (Some Tests With INTI-INSTITUTO NACIONAL DE TECNOLOGIA DC

2.61 Tests on Conducting & Insulating Materials

2.62 Tests on Electron Tubes & Semi Conductors-Not Rectifiers

2.63 Tests on Power Rectifiers

2.64 Tests on Electronic & Telecommunication Equipment

2.65 Tests on Electrical Machines-Industrial

2.66 Tests on Circuit Switching & Rupturing Devices

2.67 Tests on Climatic & Durability Characteristics

2.68 Tests on Electrical Machines-Domestic

2.69 Examination of Various Testing Equipment

2.7 MAGNETISM & MAGNETIC PROPERTIES OF MATERIALS

(Details To Be Completed later)

2-71 Miscellaneous Magnetic Tests

3. H E A T

3.1 Temperature (Some items with INT)

3.11 Liquid-in-glass Thermometry

3.12 Dial Thermometers, Thermographs, Thermostats

3.12 Thermocouple Pyrometry

3.14 Optical Pyrometry

3.15 Radiation Pyrometry

3.16 Resistance Thermometry

3.17 Thermal Expansion

3.18 Thermal Conductivity

3.19 Installation Checking

3.2 VISCOSITY & SURFACE TENSION

3.2. Calibration of Viscometers

3.22 Viscosities of Liquids

3.23 Surface Tension Determination

3.3 HYGROMETRY

3.31 Psychrometer

3.32 Absorption Hygrometer

3.33 Hygrometers for Low Dew-Points

4. O P T I C S

4.1 Photometry (Photometric Units & Standards in co-operation with INT-at later stage)

4.11 Units of luminous Intensity & Flux

4.12 Units of Luminance & Illumination

4.13 Photometric Standards

4.14 Calibration of Standard Filament Lamps

4.15 Accurate Photometry of Discharge Lamps

4.16 Photoelectric Cells & Photometer

4.17 Lighting in Public Places & Factories

4.18 Lighting in Vehicles, Aircraft & Ships

4.2 Optical Properties of Materials (at later stage)

4.21 Refractive Indices of Solids & Liquids

4.22 PROPERTIES OF OPTICAL MATERIALS

4.22.1 Polarimetry & Colorimetry

4.23 Eye Hygiene

4.23.1 Welder's Glasses

4.23.2 Sun Glasses

4.23.3 Protective Devices for Eyes

4.24 Calibration of Optometric Equipment

4.3 Optical Instruments & Components (at later stage)

4.31 Laboratory Measuring Instruments

4.32 Camera Calibration (Photogrammetry)

5. A C U S T I C S (at later stage)

5.1 Testing of Acustical Equipment

5.11 Sound Level Meters

5.12 Ear Protectors

5.13 Hearing Aids

5.2 Physical Measurement of Sound (at later stage)

5.21 Sound Pressure

5.22 Vibrations

6. C H E M I C A L & B I O L O G I C A L S T A N D A R D S

(at later stage in co-operation with INT and other competent organizations)

7. A T O M I C & R A D I A T I O N S T A N D A R D S

(at later stage in co-operation with appropriate laboratory)

8. R E G I S T E R F O R P A T T E R N A P P R O V A L, A S S O C I A T E D L A B O R A T O R I E S A N D M A N U F A C T U R E R S A N D A G E N T S O F M E A S U R I N G I N S T R U M E N T. (at later stage)

8.1 Register of Approved Patterns

8.2 Register of Measuring Instrument Manufacturers & Agents

8.3 Register of Approved Metrology & Testing Laboratories

8.4 Register of Approved Commercial Labels and Trade Descriptions

8.5 Register of Approved Commercial Prepacking

9. METROLOGY OF MEALTH HAZARDS, SAFETY, ERGONOMICS AND RELATED STANDARDS (complete service at later stage in co-operation with other competent authorities)

9.1 Health Hazards - (Metrology of)

9.2 Safety Hazards - (Metrology of)

9.21 Fire Hazards

9.22 Electrical Hazards

9.23 Workshop Hazards

9.24 Hazards From Chemicals

9.25 Hazards in Operation of Chemical Plant

9.26 Hazards in Using Radioactive Substances

9.27 Hazards in Using Irradiating Substances

9.28 Hazards in Transportation

9.29 Hazards in Building & Civil Engineering Works

9.3 Ergonomics in Metrology

9.31 Ergonomics of Instrument Design

9.32 Ergonomics of Instrument Controls

9.33 Ergonomics of Metrology and Insrection

9.34 Anthropometry

10 LIBRARY, DOCUMENTATION, TRANSLATION & PUBLICITY

10.1 Metrology Library

10.2 Metrology Documentation Service

10.3 Metrology Publicity & Public Relations

10.4 Metrology Publication Service

10.5 Sale & Distribution of Publications

10.6 Translator

11. N A T O N A L A N D I N T E R N A T I O N A L L I A I S O N
(complete service at later stage)

11.1 Technical Co-operation with State Weights & Measures Organizations

11.2 Technical Co-operation with Associação Brasileira de Normas Técnicas

11.3 Technical Co-operation with Instituto Nacional de Tecnologia and Similar Organizations

11.4 Technical Co-operation with Brazilian Authorities

11.5 Technical Co-operation with OIML, ISO, IEC, and Other Foreign and International Organizations

11.6 Organization of Meetings and Conferences

12 M E T R O L O G Y A N D I N S T R U M E N T T E C H N O-
L O G Y C O L L E G E (complete Service at later stage)

12.1 Elementary Legal Metrology School

12.2 Advanced Legal Metrology School

12.3 Elementary Industrial Metrology School

12.4 Advanced Industrial Metrology School

12.5 Physical Instrument Technology School

12.6 Mechanical Instrument Technology School

12.7 Electrical Instrument Technology School

12.8 Electronic Instrument Technology School

12.9 Metrology Education Center

12.10 External and Correspondence Courses

12.11 Metrology Administration School

12.12 Metrological Museum

12.13 College Library

13. COMMON SERVICES - WORKSHOPS, DESIGN OFFICE AND LABORATORY ENGINEERS' OFFICE (COMPLETE SERVICE AT LATER STAGE)

13.1 Mechanical and Instrument Workshops

13.2 Electrical and Electronic Workshops

13.3 Glassblowers & OPTICAL WORKSHOPS

13.4 Mechanical Design Office

13.5 Electrical and Electronic Design Office

13.6 Laboratory Engineers Office

- 13.6.1 Mechanical Maintenance
- 13.6.2 Electrical Maintenance
- 13.6.3 Electronic Maintenance
- 13.6.4 Buildings and Furniture Maintenance
- 13.6.5 Fire Hazards Protection
- 13.6.6 Laboratory Safety
- 13.6.7 Cleaning Services
- 13.6.8 Plumbing Services
- 13.6.9 Air Conditioning

13.7 Central Laboratory Stores

13.8 Laboratory Receiving & Dispatch Office

13.9 Transportation Officer

14. COMPUTOR AND DATA PROCESSING

(complete service at later stage)

14.1 Computor Group

- 14.1.1 Programming
- 14.2.2 Computing and Date Processing

14.2 Metrology Statistics Group

14.3 Computor Programs Library

14.4 Technical records and Register of Certificates

14.5 Stores and Cost Accounting

14.6 Financial Accounting

THE BRAZILIAN NATIONAL STANDARDS LABORATORY PROJECT

"The Functions of the Divisional and Sectional Laboratories".

By Edmund Layton, UNIDO Standards Engineer attached to the Brazilian National Institute of Weights and Measures - Instituto Nacional de Pesos e Medidas - INPM in Rio de Janeiro.

INTRODUCTION

The existing services of the INPM and its Network of Branch Organizations, situated in 15 out of the 22 States forming the Federated Republic of Brazil and exercising metrological and weights and measures services in 18 States, are given in "Survey of Existing Weights and Measures Services - June 1970" (Appendix 1). A "list of metrology sections" - (Appendix 2), is enclosed which served as reference document when preparing the large scale, long term project "Standardization in Brazil" to be presented at the most convenient date to the Governing Council of U.N.D.P. after the Brazilian Government's request has been accepted and all formalities have been attended.

The following describes in broad outlines the provisions which are planned to be taken in accordance with existing Brazilian legislation and what main functions are planned to be assigned to divisional and sectional laboratories of the Brazilian National Standards Laboratory and to some Branch Applied Metrology and Industrial Services Laboratories to be attached to existing Branch Weights and Measures Organizations situated in some Brazilian States.

1. THE MECHANICS DIVISION LABORATORIES

These Laboratories will deal with measurements encountered in commerce, in industry, in scientific and applied engineering metrology used by science and technology, in the fields

of length, area, volume, angle, flow, linear, mass, linear and angular velocity, acceleration, simple time measurements, force, hardness and pressure.

1.1 Laboratory of the commercial length, area and taximeter section. These UNITS of measurements are used in all transactions in commerce were goods are sold on the basis of unit price per metre, per square metre or per cubic metre or by multiples and submultiples of these measures. An important part of a service to the consumer is the calibration of taximeters and the approval of taximeter patterns.

1.2 Laboratory of the section of scientific and industrial metrology of length and angle. This laboratoryforms the basis of all applied engineering length metrology. Besides containing the basic determination of the standard of length in terms of the internationally specified wavelengths of electro-magnetic radiation of kripton 86, it contains the standards of reference for calibration services of the means and standards of length measurements kept by other standards, testing and metrology laboratories and by industry. It also includes a laboratory for the establishment of a geodetic base, so that precise length measuring tapes and other surveying instruments can be verified. Industrial consulting services on length metrology, for the private and public sector are included.

1.3 The laboratory of the section for volume, density and flow measurements. This laboratory has been kept relatively large because of its immense importance upon the national economy. Measurements have to be taken of the volume, density and flow of liquids and gases and pattern approvals of flow and other meters devices for most various fluids have to be undertaken. The work of this section is of great value to the petroleum industry in all its ramifications.

1.4 The mass section laboratory controls, the standard of mass. This is not only the most important standard for commerce, as many transactions in business are based on this unit, but also many derived units of the "SI" system are linked to

2. ELECTRICITY AND ELECTRONICS DIVISION LABORATORIES

This group of laboratories handles the major part of maintenance of electrical and electronic standards and the associated calibration work. An important technological aspect of this division's work is the pattern approval of instruments used for measuring electrical power supplied to small medium and large consumers and the safety testing of electrical equipment used by industry and by individuals in the community.

2.1 The laboratory of the direct current electrical standards section is used extensively in science, basic and applied electrical technology and is necessary for an accurate calibration service of measuring instruments used in electrotechnology and electronics.

2.2 The laboratory of the section for alternating current electrical standards is used for most of the important power supply and distribution industry. A large part of the work, besides the maintenance of standards and the calibration of measuring instruments, is done on approval of patterns of measuring instruments for performance and public safety.

2.3 Time and frequency section laboratory. In recent years time and frequency measurements have risen to an importance never foreseen. The whole fundamentals of time measurements are strongly linked with frequency and these together form the basis of many measurements in telecommunications, radio and television. Navigational guidance for ships at sea and aircraft in flight is based upon accurate time and frequency measurements. Naturally, with the advent of the space age and space travel these measurements have further risen in importance.

2.4 Inductance and capacitance section laboratory.

Inductance and capacitance measurements are important for the determination of principal units used throughout electrical measurements. Their application in the electrical and electronic industries measurements cannot be overemphasized.

2.5 Laboratory for the section of pattern approval of electricity meters. Pattern approval and the calibration of electricity meters for other laboratories, for large electricity supply authorities and for the consumer plays an important part in the activity of the Laboratory.

2.6 Laboratory of the section for testing electrical appliances for safety. A special laboratory has been devoted to testing the function and safety of electrical apparatus and appliances. This is not only a service offered to industry but also in the interest of public safety and consumer protection.

A special small laboratory, for the testing of magnetic properties has been included in this section.

3. HEAT DIVISION LABORATORIES

This laboratory has been divided into two parts. One for measuring temperature by any possible method and associated physical units and one for measuring the viscosity and density of substances. The measurement of temperature in science, industry and technology is of utmost importance. Close liaison will be maintained with the Electricity Divisions. For the control of processes and phenomena, accurate temperature standards must be maintained for the whole temperature scale in practical use, ranging from extreme cold to extreme heat.

Many controls of products in technology, in agroindustries and in commerce are based on viscosity and density. These two types of measurements contribute considerably to determinations of product quality and functional suitability, for example: of mineral and vegetable oils for the most varied applications.

4. OPTICS DIVISION LABORATORY

The Laboratory for optics will be concerned with the maintenance of the photometric and colorimetric standards. It will also investigate the suitability of equipment used for the protection of sight and will generally assist in develop-

ping standards for suitable illumination, eyesight protection, and the calibration of optical instruments used in industry, science and technology. Equipment used by opticians will by calibrated and approved.

1.5 Acustics division laboratory. The number of acustical instruments used by the community is steadily increasing and facilities must be provided for the constructions of an anechoic chamber for the testing of acustical instruments and for metrological research in acustics in general. Standards of noise tolerance will be investigated and a calibration service and pattern approval of hearing aids and noise measuring equipment will be set up.

13. Workshops The nature of the work of the laboratory is such that it is impossible to buy all equipment ready made. Existing equipment has to be maintained by highly skilled personnel and special equipment has to be produced to cater for the demands of a National Standards Laboratory.

CONCLUSION

A detailed list of planned services and of units for which standards have to be established is enclosed as Appendix 3.

The areas of the various laboratories and some environmental specifications have been compiled and are attached as Appendix 4.

JUNE 1971

EL/MJS.

MINISTÉRIO DA INDÚSTRIA E DO COMÉRCIO
INSTITUTO NACIONAL DE PESOS E MEDIDAS

Praça Mauá,7
Rio de Janeiro - GB -Brasil

SURVEY OF EXISTING WEIGHTS AND MEASURES SERVICES-JUNE 1970

which are at present available in the Brazilian National Institute of Weights and Measures - Instituto Nacional de Pesos e Medidas (INPM) in Rio de Janeiro and in some Branch Institutes of Weights and Measures-Institutos de Pesos e Medidas - (IPEM), established in 15 out of 22 states of Brazil.

1. MECHANICS

1.1 Commercial length and area - taximeters

1.11 Commercial measures of length made of metal, hard wood or other approved material

1.12 Tapes woven or metallic and survey tapes in common use

1.16 Taximeters and other measuring devices used in motor vehicles.

1.2 - Industrial and scientific length metrology

(Services in process of installation only at the INPM).

1.21 Engineers Limit gauges

1.21.1 Plain cylindrical plug and ring gauges

1.21.2 Plain gap gages, fixed and adjustable

1.22 Engineers measuring tools and instruments

1.22.1 External Micrometers and micrometer setting gauges (up to 400 mm at present)

1.22.5 Vernier callipers

1.22.6 Vernier height gauges

1.22.14 Dial gauges for linear measurements

1.22.15 Dial test indicators

(National standards specifications for the above

listed instruments are being worked out and some of them have reached the final draft stage. The INPM is authorized under law to pass them as mandatory stan - dards after the period of public review has elapsed.)

1,3 - Volume, Density and flow

1,31 Examination of volumetric equipment

1.31.1 Measures of volume

1.31.2 Laboratory glassware (some items at INPM only)

1,32 Examination of density of liquids and solids

1.32.1 Density of liquids (limited range at INPM and some IPEMS)

1,33 Examination of hydrometers (limited range at INPM and at some IPEMS)

1.31.4 Receptacles for the measurement of solids , earth, sand and balast (at some IPEMs)

1.31 5 Tanks and other receptacles (at INPM)

1,34 Measurement of flow of liquids and gases (calibration of flow measuring devices)

1.34.2 Mechanical type meters

(This service includes verification of petrol station pump output and domestic and industrial water meter verification. Domestic water meter verification service is about to be introduced in some IPEMs while petrol station pump output, as measured by capacity containers, is executed in practically all branch institutes)..

1,4 M A S S

1,41 Industrial scales and weighing appliances

(This service available at INPM and most IPEMs , includes road and railway weighbridges using spe

cial mobile equipment. It also includes the verification of weighing appliances used in prepacking mer -- chandise)

1.42 Commercial balances

1.43 Precision Balances

1.46 Commercial weights

1.47 Precision weights

1.49 Weighing of components

(In view of the volume of work in this section, further service listing subdivision will be carried out later. Services available at all IPEMs.)

1.7 PRESSURE

1.72 Pressure and vacuum gauges

1.72.1 Test and other classes of pressure gauges

1.72.2 Compound gauges

1.72.5 Vacuum gauges

1.74 Verification of sphygmomanometers.

The services are available at INPM and appropriate standard specification have been drafted in preparation for public review. They will be introduced shortly in some of the IPEMs when equipment purchases will be completed.

2- ELECTRICITY AND MAGNETISM

2.1 Electrical standards D.C.

(At INPM only, in installation stage)

2.11 Standard Cells

2.12 Resistors

2.13 Potential dividers and potentiometers

2.15 Indicating and recording instruments

(This service needs to be subdivided further. At present, D.C. Wattmeters can be verified)

2.2 Electrical standards at power frequency

(At INPM only. in installation stage)

2.23. 1 A.C. Ammeters

2.23.2 A.C. Voltmeters

2.5 Electricity meters

2.51 Power supply electricity meter-pattern approval

(At INPM, only. This service is well established and works according to an INPM mandatory standard specification. Single phase and three phase meters can be tested. Brazil has a considerable home industry, but to satisfy demand, imports also a considerable number of meters from abroad)

2.52 Electricity meter testing for electricity supply authorities . This service is also available in states of Bahia and, in the initial stage, in Guanabara).

2.53 Examination of electricity meter testing equipment

(At INPM only, in installation stage)

3. H E A T

3.1 Temperature

3.11 Liquid-in-glass thermometry

(This service is available at the INPM and at some other NPEMs. It needs to be further subdivided to comprise clinical thermometers and specify various other forms of liquid-in-glass thermometers.)

/JFP.

INSTITUTO NACIONAL DE PESOS E MEDIDAS AND BRANCH IPEMs

Survey of Existing services related to the Weights and Measures Administration - June 1970

8. Register for pattern approval, associated laboratories and manufactures and agents of measuring instruments.

8.1 Register of approved patterns

(at INPM - centralized; for complete function, needs establishment of more extensive laboratory facilities)

8.2 Register of measuring instrument manufacturers and agents.

(In progress of being established under recent legislation)

8.4 Register of approved commercial labels and trade description

(In progress of being established under recent legislation)

8.5 Register of approved commercial prepacking

(In progress of being established under recent legislation)

10. Library, Documentation, translation and publicity

10.1 Metrology library.

(The INPM library needs building up but has basic material on shelves. Some other IPEMs have formed "library nuclei" e.g. São Paulo IPEM)

10.2 Metrology documentation service

INPM held recently a Metrology Documentation Exhibition at the Rio de Janeiro National Library and prepared for this purpose a detailed list of available documents and bibliographical references (Brazilian and foreign, available in Brazil). The library lacks many standard references.

10.4 Metrology publication service

(INPM has ample dupliciting facilities and an agreement for printing publications with Government Printer)

10.5 Sale and distribution of publications

(This is handled at present by the INPM Library and certain official publications ralating to the weights and measures service are available at all IPEMs).

10.6 Translator

(Is available at INPM on a part-time basis. A number of staff members can read foreign publications and some can speak well foreign languages).

11. National and international liaison

11.1 Technical co-operation with State Weights and Measures Organizations

(A Co-ordination section is at present established at INPM which executes also some statistical service on performance and finance of IPEMs).

11.2 Technical co-operation with Associação Brasileira de Normas Technicas

(Some staff members are also members of ABNT technical commitees, but needs to be greatly enlarged. There is no special section for this work and all communication is via the Office of the INPM Director).

11.3 Technical co-operation with the Instituto Nacional de Tecnologia and similar organizations.

11.4 Technical Co-operation with Brazilian Authorities

11.5 Technical Co-operation with OIML, ISO, IEC and other foreign and international organizations.

(Concerning 11.3, 11.4 and 11.5, all communications are made through the Office of the INPM Director. The co-operation with OIML, ISO and IEC needs to be greatly enlarged because all standard specification work, related to measures and measuring instruments is, under existing law, the competence of INPM and its executing network of state weights and measures organizations)

12 Metrology and instrument technology college

12.1 Elementary Legal metrology school is held at INPM and some IPEMs

12.3 Elementary Industrial Metrology School

(some preparation is being made for courses in elementary length metrology and pressure gauge verification)

13. Common services - workshops, design office and laboratory engineers' Office

13.1 Mechanical and instrument workshop

(Practically all IPEMs have some workshop facilities. The INPM workshop is small, but has experienced tradesmen including an electrician on the staff. The head of the workshop is also responsible for all INPM maintenance and transportation)

13.4 Mechanical design office

(INPM and IPEM São Paulo have a small drawing office)

13.7 Central laboratory store

13.8 Laboratory Receiving and Dispatch office

(These sections operate for all the state network at INPM as the central distributing authority for equipment and supplies)

14 Computor and data processing

There are small and modern desk calculating machines available for accounting and technical computations. In the beginning, co-operative arrangements can be made for computor time with Brazilian federal authorities having spare computor time available.

/JFP.

PLANNING THE INSTITUTO NACIONAL DE PESOS E MEDIDAS (INPM)

Lista das seções metrológicas - List of metrology sections

1. M E C H A N I C S

1.1. Commercial length, area and taximeters

1.2 Industrial and scientific Length Metrology (Engineering Metrology)

1.3 Volume, Density and Flow

1.4 Mass

1.5 Time, Velocity, Rotational Speed and Acceleration

1.6 Force, Hardness, Impact and Mechanical Testing of Materials & Structures

1.7 Pressure

2. E L E C T R I C I T Y, E L E C T R O N I C S & M A G N E T I S M

2.1. Electrical Standards - D.C.

2.2 Electrical Standards at Power Frequency

2.3 Time and Frequency

2.4 Inductance and Capacitance

2.5 Electricity Meters

2.6 Tests on Electrical Appliances and Accessories

2.7 Magnetism & Magnetic Properties of Materials

3. H E A T

3.1 Temperature

3.2 Viscosity and Surface Tension

3.3 Hygrometry

4. O P T I C S (A T L A T E R S T A G E)

4.1 Photometry

4-2 Optical Properties of Materials

4.3 Optical Instruments and Components

5. A C U S T I C S (AT LATER STAGE)

5.1 Testing of Acustical Equipment

5.2 Physical Measurement of Sound

6. C H E M I C A L & B I O L O G I C A L S T A N D A R D S

(at later stage)

7. ATOMIC & RADIATION STANDARDS

(at later stage in co-operation with competent organizations)

8. REGISTER FOR PATTERN APPROVAL, ASSOCIATED LABORATORIES AND MANUFACTURERS OR AGENTS OF MEASURING INSTRUMENTS (Complete service at later stage)

8.1 Register of Approved Patterns

8.2 Register of Measuring Instrument Manufacturers or Agents

8.3 Register of Approved Metrology and Testing Laboratories

8.4 Register of Approved Commercial Labels and Trade Descriptions

8.5 Register of Approved Commercial Prepackaging

9. METROLOGY OF HEALTH HAZARDS, SAFETY, ERGONOMICS AND RELATED STANDARDS (Complete service at later stage)

9.1 Health Hazards (Metrology of)

9.2 Safety Hazards (Metrology of)

9.3 Ergonomics in Metrology

10. LIBRARY, DOCUMENTATION, PUBLICITY AND TRANSLATIONS (Complete service at later stage)

10.1 Metrology Library

10.2 Metrology Documentation Service

10.3 Metrology Publicity & Public Relations

10.4 Metrology Publication Service

10.5 Sale and Distribution of Publications

10.6 Translator

11. NATIONAL AND INTERNATIONAL LIAISON (Complete service at later stage)

11.1 Technical Co-operation with State Weights & Measures Organizations

11.2 Technical Co-operation with Associação Brasileira de Normas Tecnicas

11.3 Technical Co-operation with Instituto Nacional de Tecnologia and similar Organizations in Brazil

11.4 Technical Co-operation with Brazilian Authorities

11.5 Technical Co-operation with OIML, ISO, IEC, and other Foreign and International Organizations

11.6 Organization of Meetings and Conferences

12. METROLOGY AND INSTRUMENT TECHNOLOGY COLLEGE

(Complete service at later stage)

12.1 Elementary Legal Metrology School

12.2 Advanced Legal Metrology School

12.3 Elementary Industrial Metrology School

12.4 Advanced Industrial Metrology School

12.5 Physical Instrument Technology

12.6 Mechanical Instrument Technology

12.7 Electrical Instrument Technology

12.8 Electronic Instrument Technology

12.9 Metrology Education Centre

12.10 External and Correspondence Courses

12.11 Metrology Administration School

12.12 Metrology Museum

12.13 College Library

13. COMMON SERVICES - WORKSHOPS, DESIGN OFFICES AND LABORATORY ENGINEERS OFFICE (Complete Service at later stage)

13.1 Mechanical and Instrument Workshops

13.2 Electrical and Electronic Workshops

13.3 Glassblowers and Optical Workshops

13.4 Mechanical Design Office

13.5 Electrical and Electronic Design Office

13.6 Laboratory Engineers Office

13.7 Central Laboratory Stores

13.8 Laboratory Receiving and Dispatch Office

13.9 Transportation Officer

14. COMPUTOR AND DATA PROCESSING (Complete service at later stage)

14.1 Computor Group

14.2 Metrology Statistics Group

14.3 Computor Programs Library

14.4 Technical records and Register of Certificates

14.5 Stores and Cost Accounting

14.6 Financial Accounting

BRAZILIAN NATIONAL WEIGHTS AND MEASURES SERVICE NETWORK - DETAILED LIST OF PROPOSED SERVICES OF EXAMINATIONS AND OF AREAS OF STANDARDIZATION

1. MECHANICS

1.1 COMMERCIAL LENGTH & AREA - TAXIMETERS

(Measurement of length and area used for trade)

1.11 Commercial measures of length made of metal, hard wood or other approved material

1.12 Tapes woven or metallic and survey tapes in common use

1.13 Length measuring machines

1.13.1 Fabric Measuring Instruments & Machines

1.13.2 Cordage Measuring Instruments & Machines

1.13.3 Timber Measuring Instruments & Machines

1.13.4 Wire & Wire Netting Measuring Machines

1.13.5 Cable Measuring Machines

1.13.6 Miscellaneous Measuring Machines in Trade

1.14 Area measuring instruments (e.g. for leather)

1.14.1 Planimeters

1.14.2 Leather Measuring Instruments

1.14.3 Miscellaneous Area Measuring Instruments

1.15 Counting Machines

1.15.1 Counting Machines Used in Trade & Industry

1.15.2 Vending Machines

1.16 Taximeters and other measuring instruments used in motor vehicles

1.2 INDUSTRIAL AND SCIENTIFIC LENGTH METROLOGY

1.20 Maintenance of primary length standard

1.20.1 Wavelength with line standard comparator

1.20.2 Line standard with end standard comparator

1.20.3 Interferometry for length measurements

1.20.4 Linear & circular dividing laboratory

1.20.5 Block (slip) gauge comparator - reference & calibration

1.21 Engineers' Limit Gauges

1.21.1 Plain cylindricalPlug & Ring Gauges

1.21.2 Plain gap gauges, fixed & adjustable

1.21.3 Depth gauges

1.21.4 Tapered plug & ring gauges

1.21.5 Profile gauges

1.21.6 Position gauges & receiver gauges

1.21.7 Screw gauges

1.22 Engineers measuring tools and instruments

1.22.1 External Micrometers & Micrometer Setting Gauges

1.22.2 Micrometer heads

1.22.3 Internal micrometers & stick micrometers

1.22.4 Depth micrometers

1.22.5 Vernier callipers

1.22.6 Vernier height gauges

1.22.7 Surface plates

1.22.8 Toolmakers' flats & high precision surface plates

1.22.9 Optical flats

1.22.10 Straightedges

1.22.11 Engineers' squares

1.22.12 Engineers' Precision levels

1.22.13 Engineers' parallels

1.22.14 Dial gauges for linear measurement

1.22.15 Dial test indicatores (lever type)

1.22.16 Feeler Gauges

1.22.17 Cast iron angle plates & box angle plates

1.22.18 Extensometers for proof stress determinations

1.22.19 Laboratory instruments

1.22.19.1 Vicat apparatus (cement)

1.22.19.2 Pensky Martens apparatus (petroleum)

1.22.19.3 Penetration needles (bitumen)

1.22.19.4 Thickness gauges for rubber, plastics etc.

1.22.19.5 Airflow nozzles & petrol jets

1.23. Jigs & fixtures, cutting tools & components

1.23.1 Examination of jigs & fixtures

1.23.2 Examination of single point cutting tools

1.23.3 Examination of multipoint cutting tools

1.23.4 Examination of laboratory moulds & dies

1.23.41 Cement cube moulds

1.23.42 Cement guide moulds

1.23.43 Vicat moulds (for Vicat apparatus)

1.23.44 Rubber specimen cutters

1.23.45 Miscellaneous cutters & moulds

1.23.5 Measurement of components

1.23.6 Measurement of components for quality control

1.23.7 Assessment for conformity to standards

1.23.8 Test sieves

1.24. Testing of machine tools

1.24.1 Geometric tests

1.24.11 Flatness of beds & tables

1.24.12 Straightness of Guideways

1.24.13 Alignments (Parallelism, Squareness, etc)

1.24.14 Accuracy of lead screws

1.24.15 Accuracy of gear drives

1.24.2 Dynamic (practical) tests

1.24.21 Performance tests

1.24.22 Deflection tests

1.25. Surface texture

1.25.1 Assessment of surface texture

1.25.2 Surface finish measuring instruments

1.25.3 Surface texture standards

1.26 Gears, Splines and Serrations

1.26.1 Machine cut gears - Helical & Straight Spur

1.26.2 Bevel gears (machine cut)

1.26.3 Gears for traction

1.26.4 Worm Gearing

1.26.5 Fine Pitch gears

1.26.6 Gears for turbines & similar Drives

1.26.7 Straight-Sided Splines & Serrations

1.26.8 Special types of gears

1.26.9 Gear cutting tools

1.26.10 Gauges & masters for gearings

1.27 Working Standards of Length & Angle

1.27.1 Line standards & precision linear scales

1.27.2 Surveying tapes-petroleum dip tapes

1.27.3 Precise levelling staffs

1.27.4 Slip (block) Gauges - inspection & working grade

1.27.5 Length (end) bars-block gauges above 100 mm

1.27.6 Cylindrical plug standards

1.27.7 Cylindrical Ring Standards

1.27.8 Roller gauges

1.27.9 Steel ball gauges

1.27.10 Combination angle gauges

1.27.11 Precision Polygons & Circular Scales

1.27.12 Thread Measuring Accessories

1.27.13 Precision Graticules, Stage Micrometers

1.27.14 Haemocytometer Counting Chamger

1.27.15 Screw pitch reference standards

1.27.16 Sine bars & sine tables

1.28 Precision Measuring Machines and Miscellaneous Measuring equipment

1.28.1 Length Measuring Machines

1.28.2 Screw Diameter Measuring Machines

1.28.3 Screw Pitch Measuring Machines

1.28.4 Precision Projection Apparatus

1.28.5 Auto-Collimators & Optical Length Measuring Instruments

1.28.6 Dividing Heads & Tables

1.28.7 Gear & Hob Measuring Equipment

1.28.8 Engineers Comparators (external Measurement)

1.28.9 Diamond Indenters for Hardness Testing Machines

1.28.10 Cryptometers (black & white)

1.28.11 Extensometers

1.28.12 Wet Film Thickness Gauge (wheel type)

1.28.13 Fineness of Grind Gauge

1.28.14 Taps & Dies

1.29 Engineering Design Analysis §

1.29.1 Drawing Practice

1.29.2 Gauging & Inspection Practice

1.29.3 Standards for Preferred Design Sizes In Linear & Angular Dimension

1.29.4 Fits

1.29.5 (Standard) Tolerances -Dimensions

1.29.6 (Standard) Tolerances - Geometry

1.29.7 Maching Processes, Surface finish, Effects of Tool Geometry on Dimension and Process Variability

1.29.8 Principles of Interchangeable Manufacture

1.29.9 Quality Assurance and Conformity With Standards Testing

1.29.10 Production Engineering Metrology

§ (Industrial Metrology Consulting Services)

1.3 Volume, Density & Flow

1.31 Examination of volumetric equipment

1.31.1 Measures of volume

1.31.2 Laboratory Glassware

1.31.3 Filling machines

1.31.4 Receptacles for the measurement of solids, earth, sand or ballast

1.31.5 Tanks and other receptacles

1.32 Determination of Density of Liquids & Solids

1.32.1 Density of liquids

1.32.2 Density of solids

1.33 Examination of Hydrometers

1.33.1 Density hydrometer

1.33.2 Specific gravity hydrometers

1.33.3 Brix hydrometers (sugar industry)

1.33.4 Proof spirit hydrometers

1.34 Measurement of Flow of Liquids & Gases (calibration of flow measuring devices)

1.34.1 Anemometers - (metereology)

1.34.2 Mechanical type meters

1.34.3 Differential type meters

1.34.4 Variable aperture type meters

1.34.5 Other flow measuring devices

1.34.6 Calibration of jets

1.35 Volumetric Meterological Instruments e.g. Rain Gauges

1.36 Determination of ship tonnage

1.4 Mass

1.41 Industrial Scales & Weighing Appliances

1.42 Commercial Balances

1.43 Precision Balances

1.44 Torsion Balances

1.45 Special Purpose Balances

1.45.1 Moisture Balances

1.45.2 Westphal Balances

1.45.3 Gas Density Balances

1.45.4 Yarn Balances

1.46 Commercial Weights

1.47 Precision Weights

1.48 Measure of Grain

1.49 Weighing of Components

1.5 Time, Velocity, Rotational Speed, & Acceleration

1:51 Time Interval

1.51.1 Precision Clocks

1:51.2 Interval Timers

1.51.3 Stopwatches

1.51.4 Chronograph Watches

1.51 5 Rating of "Time of Day" Watches

1.51.6 Marine & Surveying Chronometers

1.52 Velocity & Rotational Speed

1.53 Acceleration

1.6 Force, Hardness, Impact & Measurements of Strength of Materials and Mechanical Testing of Structures (Partly With INT)

1.61 Verification of Force Measuring Devices

1.61.1 Proving Rings & Load Measuring Rings

1.61.2 Proving Loops

1.61.3 Amsler Boxes

1.61.4 Electrical Load Cells

1.61.5 Proving Levers

1.61.6 Load Dynamometers

1.61.7 Cable Tension Meters

1.61.8 Draw Bar Dynamometer

1.61.9 Other Load Measuring Devices

1.62 Verification of Material Testing Machines

1.62.1 Tension & Compression Testing Machines

1.62.2 Universal Testing Machines Below 10T Capacity

1.62.3 Universal Testing Machines Above 10T capacity

1.62.4 Torsion Testing Machines & Torque Wrenches

1.62.5 Tension Torque Testing Machines

1.62.6 Biaxial Testing Machines

1.62.7 Triaxial Testing Machines

1.62.8 Other Stress Producing Machines (eg soils)

1.62.9 Fatigue Testing Machines

1.63 Verification of Haroness Testing Machines for Metals

1.63.1 Vickers Hardness Testing Machines

1.63.2 Rockwel Hardness Testing Machines

1.63.3 Brinell Hardness Testing Machines

1.63.4 Low Load Hardness Testing Machines

1.63.5 Micro Hardness Testing Machines

1.63.6 Other Types of Hardness Testing Machines

1.64 Hardnes Testing Instruments For Non-Metallic Materials

1.64.1 Dead-Weight Rubber Hardness Tester

1.64.2 Rubber Durometers

1.64.3 Hardness (softness) Instruments For Plastics

1.64.4 Micro Hardness Tester For Rubber

1.65 Impact Testing Machines For Metals And Mon-Metallic Materials

1.65.1 Impact Testing Machines For Metals(IZOD & Charpy)

1.65.2 Impact Testing Machines for Plastics

1.65.3 Falling-Pendulum-Type Machines for Performing Puncture, Stiffness & Tearing Tests on Paper & Textiles

1.65.4 SpecialTypes of Machines

1.66 Other Testing Machines (Ductility, Folding, etc)

1.66.1 Ductility Testing Machine

1.66.2 Folding & Bend Tester

1.66.3 Other Types of Testing Machines

1.67 Standard Hardness Blocks for Metal & Rubber

1.67.1 Brinell Standard Hardness Test Blocks

1.67.2 Rockwell Standard Hardness Test Blocks

1.67.3 Vickers Standard Hardness Test Blocks

1.67.4 I.R.H.(Rubber) Standard Hardness Test Blocks

1.67.5 Special Standard Hardness Test Blocks

1.67.6 Examination of Brinell & Vickers Microscopes

1.68 Testing of Lifting Gear, Cranes & Hoists and Fasteners

1.68.1 Examination of Lifting Gear Testing Equipment

1.68.2 Approval of Patterns for Lifting Gear

1.68.21 Chain

1.68.22 Wire Rope

1.68.23 Steel for Wire Rope

1.68.24 Tension of Wire For Rope

1.68.25 Torsion of Wire for Rope

1.68.26 Tension Tests on Fittings

1.68.27 Bend & Reverse Bend Tests on Wire

1.68.3 Testing Passenger & Goods Elevators

1.68.4 Testing Cranes

1.68.5 Testing Hoists

1.68.6 Testing Fibre Rope & Cordage

1.68.7 Testing of Fasteners (Threaded, Riveted, Welded)

1.68.71 Threaded Fasteners

1.68.72 Riveted Fasteners

1.68.73 Welded Joints

1.68.74 Other Types

1.68.8 Testing of Scaffolding

1.69 Testing of Springs, Brakes & Energy Absorbing Devices

1.69.1 Verification of Spring Testers

1.69.2 Calibration of Springy

1.69.3 Verification of Braking Power Testers

1.69.4 Verification of Energi Absorbing Devices

1.7 PRESSURE

1.71 Dead Weight Testers

1.72 Pressure & Vacuum Gauges

1.72.1 Test Pressure Gauges

1.72.2 Compound Gauges

1.72.3 Oxygen Gauges

1.72.4 Pressure Vessel Tests

1.72.5 Vacuum Gauges

1.72.6 Other Pressure Measuring Devices

1.73 Barometers

1.73.1. Mercury Barometers

1.73.2 Aneroid Barometers

1.73.3. Manometers, Barographs

1.73.4 Special Instruments (eg micro barometers)

1.74 Verification of Sphygmomanomete

1.75 Testing Fired & Unfired Pressure Vessels

2.1 ELECTRICAL STANDARDS D.C.

(to be completed later)

2.11 Standard Cells

2.12 Resistors

2.13 Potential Dividers & Potentiometers

2.14 Bridges

2.15 Indicating & Recording Instruments

2.2 ELECTRICAL STANDARDS ET POWER FREQUENCY

2.2. Transformers (Details to Be Completed Later)

2.22 High Voltage (at later stage)

2.23 Indicating Instruments

2.23.1 A.C. Ammeters

2.23.2 A.C. Voltmeters

2.23.3 A.C. Wattmeters

2.23.4 Frequency Meters

2.23.5 Examination of Test Equipment

2.3 TIME & FREQUENCY (details to be completed later)

2.3. Frequency

2.32 Wave Meters

2.33 Counters & Time Interval Meters

2.34 Impedance Measurements

2.4 INDUCTANCE & CAPACITANCE

2.41 Inductors

2.42 Capacitors

2.5 ELECTRICITY METERS

2.51 Power Supply of Meters Pattern Approval

2.52 Electricity Meter Testing(for Electricity Supply Authorities)

2.53 Examination of Electricity Meter Testing Equipment

2.6 TESTS ON ELECTRICAL APPLIANCES & ACCESSORIES (Certification of safety) (Some Tests With INT)-INSTITUTO NACIONAL DE TECNOLOGIA DC

2.61 Tests on Conducting & Insulating Materials

2.62 Tests on Electron Tubes & Semi Conductors-Not Rectifiers

2.63 Tests on Power Rectifiers

2.64 Tests on Electronic & Telecommunication Equipment

2.65 Tests on Electrical Machines-Industrial

2.66 Tests on Circuit Switching & Rupturing Devices

2.67 Tests on Climatic & Durability Characteristics

2.68 Tests on Electrical Machines-Domestic

2.69 Examination of Various Testing Equipment

2.7 MAGNETISM & MAGNETIC PROPERTIES OF MATERIALS

(Details To Be Completed Later)

2-71 Miscellaneous Magnetic Tests

3. H E A T

3.1 Temperature (Some items with INT)

3.11 Liquid-in-glass Thermometry

3.12 Dial Thermometers, Thermographs, Thermostats

3.12 Thermocouple Pyrometry

3.14 Optical Pyrometry

3.15 Radiation Pyrometry

3.16 Resistance Thermometry

3.17 Thermal Expansion

3.18 Thermal Conductivity

3.19 Installation Checking

3.2 VISCOSITY & SURFACE TENSION

3.2. Calibration of Viscometers

3.22 Viscosities of Liquids

3.23 Surface Tension Determination

3.3 HYGROMETRY

3.31 Psychrometer

3.32 Absorption Hygrometer

3.33 Hygrometers for Low Dew-Points

4. O P T I C S

4.1 Photometry (Photometric Units & Standards in co-operation with INT-at later stage)

4.11 Units of luminous Intensity & Flux

4.12 Units of Luminance & Illumination

4.13 Photometric Standards

4.14 Calibration of Standard Filament Lamps

4.15 Accurate Photometry of Discharge Lamps

4.16 Photoelectric Cells & Photometer

4.17 Lighting in Public Places & Factories

4.18 Lighting in Vehicles, Aircraft & Ships

4.2 Optical Properties of Materials (at later stage)

4.21 Refractive Indices of Solids & Liquids

4.22 PROPERTIES OF OPTICAL MATERIALS

4.22.1 Polarimetry & Colorimetry

4.23 Eye Hygiene

4.23.1 Welder's Glasses

4.23.2 Sun Glasses

4.23.3 Protective Devices for Eyes

4.24 Calibration of Optometric Equipment

4.3 Optical Instruments & Components (at later stage)

4.31 Laboratory Measuring Instruments

4.32 Camera Calibration (Photogrammetry)

5. A C U S T I C S (at later stage)

5.1 Testing of Acustical Equipment

5.11 Sound Level Meters

5.12 Ear Protectors

5.13 Hearing Aids

5.2 Physical Measurement of Sound (at later stage)

5.21 Sound Pressure

5.22 Vibrations

6. C H E M I C A L & B I O L O G I C A L S T A N D A R D S

(at later stage in co-operation with INT and other competent organizations)

7. A T O M I C & R A D I A T I O N S T A N D A R D S

(at later stage in co-operation with appropriate laboratory)

8. R E G I S T E R F O R P A T T E R N A P P R O V A L, A S S O C I A T E D L A B O R A T O R I E S A N D M A N U F A C T U R E R S A N D A G E N T S O F M E A S U R I N G I N S T R U M E N T. (at later stage)

8.1 Register of Approved Patterns

8.2 Register of Measuring Instrument Manufacturers & Agents

8.3 Register of Approved Metrology & Testing Laboratories

8.4 Register of Approved Commercial Labels and Trade Descriptions

8.5 Register of Approved Commercial Prepacking

9. METROLOGY OF MEALTH HAZARDS, SAFETY, ERGONOMICS AND RELATED STANDARDS (complete service at later stage in co-operation with other competent authorities)

9.1 Health Hazards - (Metrology of)

9.2 Safety Hazards - (Metrology of)

9.21 Fire Hazards

9.22 Electrical Hazards

9.23 Workshop Hazards

9.24 Hazards From Chemicals

9.25 Hazards in Operation of Chemical Plant

9.26 Hazards in Using Radioactive Substances

9.27 Hazards in Using Irradiating Substances

9.28 Hazards in Transportation

9.29 Hazards in Building & Civil Engineering Works

9.3 Ergonomics in Metrology

9.31 Ergonomics of Instrument Design

9.32 Ergonomics of Instrument Controls

9.33 Ergonomics of Metrology and Insrection

9.34 Anthropometry

10 LIBRARY, DOCUMENTATION, TRANSLATION & PUBLICITY

10.1 Metrology Library

10.2 Metrology Documentation Service

10.3 Metrology Publicity & Public Relations

10.4 Metrology Publication Service

10.5 Sale & Distribution of Publications

10.6 Translator

11. N A T O N A L A N D I N T E R N A T I O N A L L I A ISO N
(complete service at later stage)

11.1 Technical Co-operation with State Weights & Measures Organizations

11.2 Technical Co-operation with Associação Brasileira de Normas Technicas

11.3 Technical Co-operation with Instituto Nacional de Tecnologia and Similar Organizations

11.4 Technical Co-operation with Brazilian Authorities

11.5 Technical Co-operation with OIML, ISO, IEC, and Other Foreign and International Organizations

11.6 Organization of Meetings and Conferences

12 M E T R O L O G Y A N D I N S T R U M E N T T E C H N O-
L O G Y C O L L E G E (complete Service at later stage)

12.1 Elementary Legal Metrology School

12.2 Advanced Legal Metrology School

12.3 Elementary Industrial Metrology School

12.4 Advanced Industrial Metrology School

12.5 Physical Instrument Technology School

12.6 Mechanical Instrument Technology School

12.7 Electrical Instrument Technology School

12.8 Electronic Instrument Technology School

12.9 Metrology Education Center

12.10 External and Correspondence Courses

12.11 Metrology Administration School

12.12 Metrology Museum

12.13 College Library

13. COMMON SERVICES - WORKSHOPS, DESIGN OFFICE AND LABORATORY ENGINEERS' OFFICE (COMPLETE SERVICE AT LATER STAGE)

13.1 Mechanical and Instrument Workshops

13.2 Electrical and Electronic Workshops

13.3 Glassblowers & OPTICAL WORKSHOPS

13.4 Mechanical Design Office

13.5 Electrical and Electronic Design Office

13.6 Laboratory Engineers Office

- 13.6.1 Mechanical Maintenance
- 13.6.2 Electrical Maintenance
- 13.6.3 Electronic Maintenance
- 13.6.4 Buildings and Furniture Maintenance
- 13.6.5 Fire Hazards Protection
- 13.6.6 Laboratory Safety
- 13.6.7 Cleaning Services
- 13.6.8 Plumbing Services
- 13.6.9 Air Conditioning

13.7 Central Laboratory Stores

13.8 Laboratory Receiving & Dispatch Office

13.9 Transportation Officer

14. COMPUTOR AND DATA PROCESSING

(complete service at later stage)

14.1 Computor Group

- 14.1.1 Programming
- 14.2.2 Computing and Date Processing

14.2 Metrology Statistics Group

14.3 Computor Programs Library

14.4 Technical records and Register of Certificates

14.5 Stores and Cost Accounting

14.6 Financial Accounting

PROPOSED AREAS OF THE NATIONAL STANDARDS LABORATORY OF BRAZIL BY

DIVISIONS AND SECTIONS

DIVISIONAL LABORATORIES AND WORKSHOPS

	AREAS			UNITS m²
1 - MECHANICS	Laboratories	Offices	Circulation areas	Total
	1 530	700	300	2 700
2 - ELECTRICITY, ELECTRONICS AND MAGNETISM	680	300	100	1 200
3 - HEAT	370	210	120	700
4 - OPTICS	440	200	120	810
5 - ACUSTICS	70	40	20	130
Total of laboratories	3 090	1 450	660	5 900
18 - WORKSHOPS	440	280	120	810
SUM TOTAL	3 530	1 930	940	6 400

BRAZILIAN NATIONAL STANDARDS LABORATORY

DETAILS OF LABORATORY AREAS BY MAIN SECTIONS

UNIT: m^2

1 - MECHANICS DIVISION

1.1 - Commercial length, area and taximeters section	AREA 300
1.2 - Industrial and scientific length metrology section	AREA 440
1.3 - Volume, density and flow section	AREA 360
1.4 - Mass section	AREA 160
1.5 - Velocity, time, rotational speed and acceleration section	AREA 20
1.6 - Force, hardness and impact section	AREA 170
1.7 - Pressure	AREA 80

2 - ELECTRICITY, ELECTRONICS AND MAGNETISM DIVISION

2.1 - Electrical standards - D.C. section	AREA 120
2.2 - Electrical standards at power frequency section	AREA 200
2.3 - Time and frequency standards section	AREA 80
2.4 - Inductance and capacitance standards section	AREA 80
2.5 - Electricity meters section	AREA 60
2.6 - and 2.7 - Tests on electrical appliances and accessories section and Magnetism and magnetic properties of materials section	AREA 200

3 - HEAT DIVISION

3.1 - Temperature section — AREA 320

3.2 - Viscosity and surface tension and 3.3 - Hygrometry section — AREA 80

4 - OPTICS DIVISION

4.1 - Photometry section — AREA 230

4.2 - Optical properties of materials section — AREA 140

4.3 - Optical instruments and components section — AREA 70

5 - ACOUSTICS DIVISION

5.1 - Testing of acoustical equipment section — AREA 40

5.2 - Physical measurements of sound section — AREA 30

13 - WORKSHOPS AND COMMON SERVICES DIVISION

13.1- Mechanical and instrument workshops — AREA 260

13.2- Electricity and electronics workshops — AREA 180

13.3- Glassblowers and optical workshops — AREA 30

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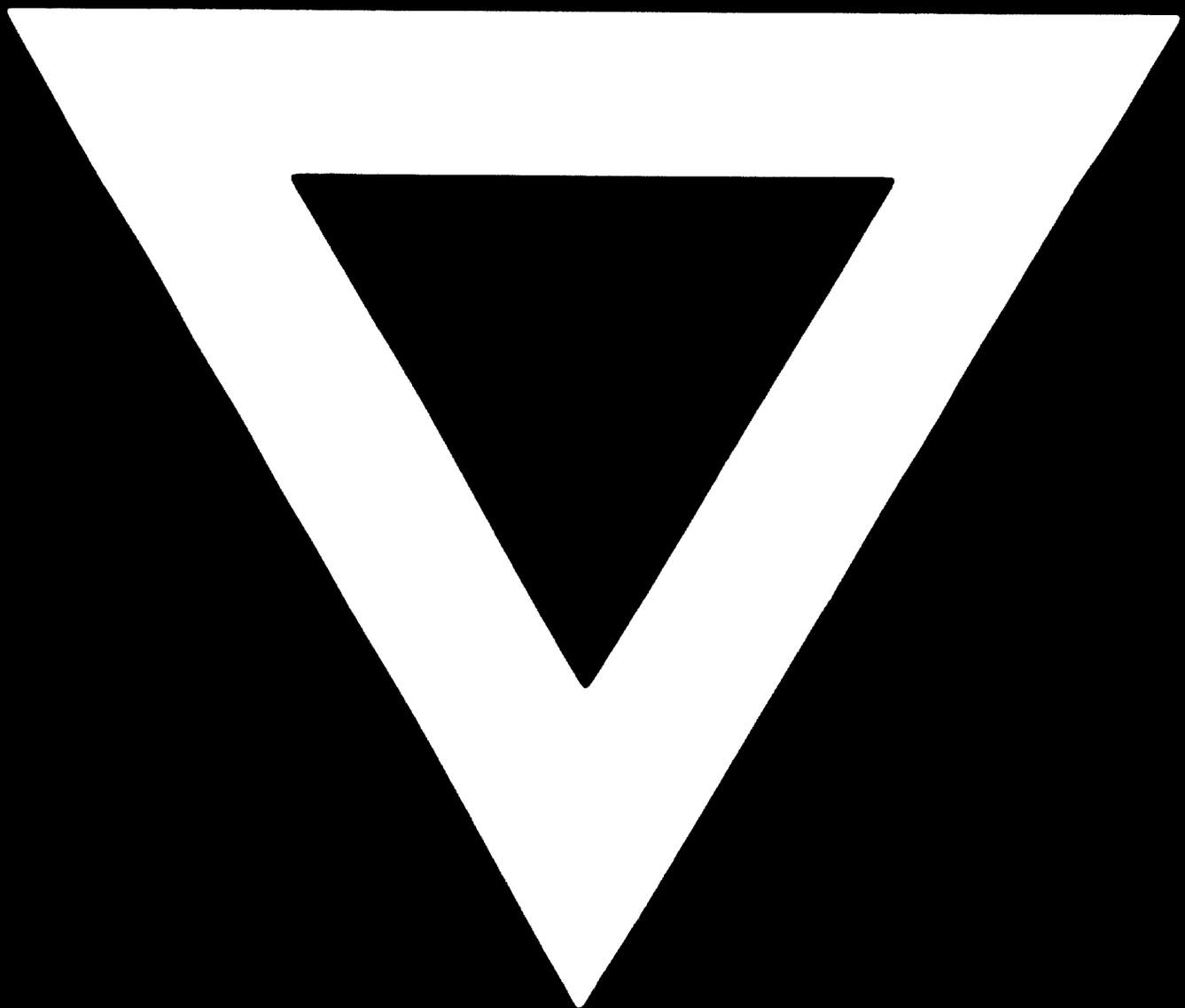

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