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INSTITUTE OF STANDARDS AND INDUSTRIAL RESEARCH

DP/IRA/69/534

IRAN

TERMINAL REPORT

Prepared for the Government of Iran by the
United Nations Industrial Development Organization,
executing agency for the
United Nations Development Programme

United Nations Industrial Development Organization

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United Nations Development Programme

INSTITUTE OF STANDARDS AND INDUSTRIAL RESEARCH, KARAJ

DP/IRA/69/534

IRAN

Project findings and recommendations

Prepared for the Government of Iran

by the United Nations Industrial Development Organization,

executing agency for the United Nations Development Programme

Based on the work of S.A. Thulin, chief technical adviser

United Nations Industrial Development Organization

Vienna, 1977

Explanatory notes

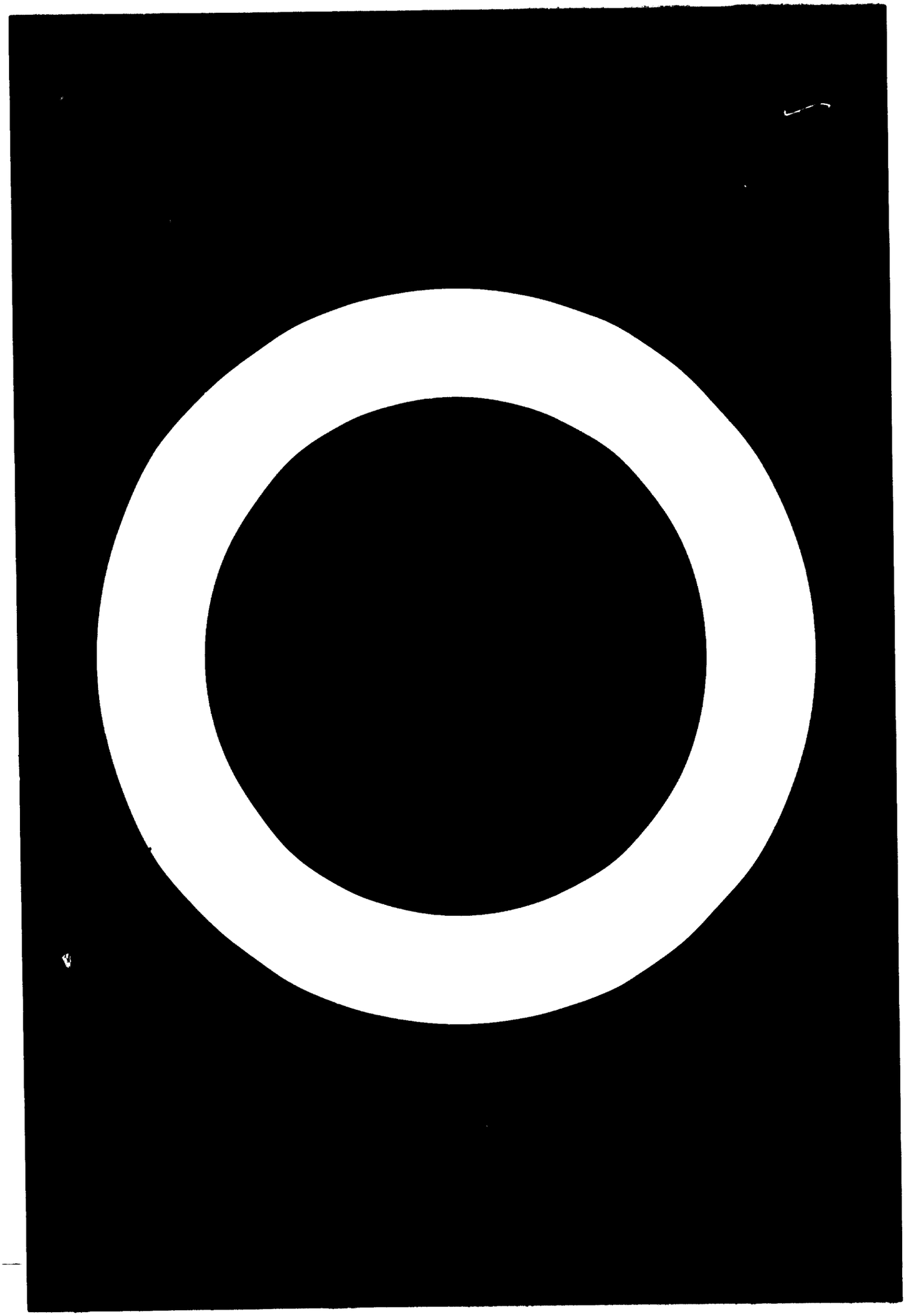
References to dollars ($) are to United Statee dollars.

Use of a hyphen between dates (e.g. 1970-1977) indicates the full period involved, including the beginning and end years.

References to tons are to metric tons.

The following abbreviations have been used in this report:

ISIRI	The Institute of Standards and Industrial Research of Iran
SI	International System of Units of Measurement



ABSTRACT

This report concerns UNDP/UNIDO/UNESCO assistance for the establishment of a Metrology and Testing Centre within the Institute of Standards and Industrial Research of Iran (DP/IRA/69/534). The project was executed during the period from July 1970 to July 1977.

The UNDP/UNIDO/UNESCO inputs were:

Experts	222 m-m
Equipment	$334,000
Fellowships	60 m-m

The purpose of the project was to create central calibration and testing facilities for Iran pertaining to weights and measures, and electrical and metallurgical materials.

The project has been fully completed according to the original plans, and facilities provided within the Centre should allow the handling of most of the current testing problems of Iranian industries and public services.

It is recommended that steps should be taken by the Government to increase the co-operation of the Centre with industries and public services with a view to making the present inputs more efficient.

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INTRODUCTION

A. Project background

The project was started by an exploratory mission to Iran in March and April 1965 by Professor Richard Vieweg. The Institute of Standards and Industrial Research of Iran (ISIRI) had been in operation since 1962 and had taken over the premises and activities of the Institute of Technology, a Point 4 aid programme (1957-1964) of the United States of America. The premises consisted of six laboratories built in 1959 in Karaj. These laboratories housed facilities for testing chemicals, foodstuffs, textiles, leather, ceramics and building materials, and electrical and mechanical appliances. ISIRI also took over provincial laboratories to form a network to control weights and measures and quality of products as well as classification of imports or exports.

There were no reliable measurement standards in Iran. As a result of Professor Vieweg's mission, ISIRI improved facilities for documentation, metrology, and electrical and mechanical testing. Documentation was handled by other projects and ISIRI made a separate request for assistance in creating a special central laboratory for metrology and testing of electrical and mechanical items. This was called the ISIRI Metrology Centre, but a more appropriate name would be the Metrology and Testing Centre as the work in these laboratories consists mainly of mechanical and electrical tests on manufactured materials and equipment.

On Professor Vieweg's recommendations ISIRI started building the Centre in May 1968; at the same time, a joint United Nations Industrial Development Organization/United Nations Educational, Scientific and Cultural Organization (UNIDO/UNESCO) mission arrived in Teheran to assist in the drafting of the Government's request.

The Government's request was approved by the United Nations Development Programme (UNDP) in January 1970. The executing agency was UNIDO, but three expert posts were sub-contracted to UNESCO: mass and length metrology, thermal metrology and photometry. A UNIDO expert in standardization prepared a draft plan of operation. A list of United Nations staff and fellowships are given in annexes I and II and an organizational plan for ISIRI is given in annex III.

The chief technical adviser stayed in Teheran from 24 May to 9 June 1970 to advise ISIRI consulting engineers on the installations to be made in the buildings.

He returned to the project in August 1970 and stayed there till July 1977. The Centre was opened in April 1972.

Estimated contributions are:

UNIDO	
Expert (man-months)	222
Equipment	$333,466
Fellowships (man-months)	60 (126 planned)
UNDP budget	$954,466
Government of Iran	
Counterpart staff (man-months)	2,500
Support staff (man-months)	1,700
Equipment	$1,100,000
Buildings	$1,180,000
Cash	$763,380

I. FINDINGS

The activities planned in 1965 have been largely carried out. However, the importance put on metrology has since then, for various reasons, decreased in favour of testing electrical and mechanical materials and equipment required by the rapid growth of industry.

The laboratories for testing building materials, mentioned in the first report, could not be incorporated into the Metrology Centre building and they remained on existing premises. However, their layout and equipment were improved by the assistance of a three-month mission in 1974 and 1975.

The assistance planned for glass-blowing or instrument repair was not continued.

The testing of electrical materials and appliances was incorporated with the electrical metrology of the project. This testing was handled by aid from the Federal Republic of Germany under the technical supervision of the chief technical adviser.

The heat and workshop divisions support the other divisions and therefore were incorporated as sections of the divisions of electricity and metallurgy respectively.

The activities of the project remain as listed in the first progress report of 31 January 1971, and are:

(a) Mechanical metrology (Central Laboratory for Weights and Measures);

(b) Electricity (including electrical metrology, time and frequency metrology, thermometry, photometry, and testing of electrical materials and appliances);

(c) Metallurgy (including destructive testing, metallography, foundry materials testing, workshops etc.);

(d) Testing of mechanical equipment (such as pressure containers, cooking appliances, automotive parts etc.), which is an important activity connected with metallurgy.

This latter testing has been only indirectly assisted by the project. A special test-house is to be constructed near the Metrology Centre to accommodate the increasing volume of such tests.

A leaflet on the project was issued in 1975 (annex IV).

basic dimensions as the other furniture. A special type of bench with an acid-resistant top and specially imported plastic sink was manufactured for the metallurgical sample preparation laboratory. Chairs have footrest rings to enable sitting work at both standardized heights. Various drawer and cupboard units can be included as required. The furniture was all made by a government-owned company, the quality of the manufacture was generally very good and the co-operation with the company engineers excellent.

Equipment

Equipment for metrology was ordered from the UNDP contribution and equipment for mechanical and electrical testing of equipment and materials according to standards was obtained by the Government (annex VII). Though there were some delays in the UNIDO deliveries at the beginning owing to a strict adherance to tender procedures, all the UNIDO equipment was available when the experts arrived.

Planning reports were carefully drawn up containing a description of the planned activities and a list of required equipment. These reports were based on the most recent trends in technology and were adapted to the immediate needs of Iran and to the limited budget. Expensive equipment was avoided as much as possible and a versatile type of instrument chosen whenever possible. Emphasis was on the quality of the basic physical reference standards (etalons) which were chosen so as to avoid the necessity for frequent recalibration abroad.

The various planning reports include ones for:

(a) The Divisions of Electricity (measuring instruments);

(b) The Division of Mechanical Metrology (Weights and Measures Central Laboratory);

(c) The heat section (thermometry);

(d) The photometry section.

The planning of the metallurgical testing division was done in 1971.

The planning of the equipment for electrical testing of cables, switches, plugs, lampholders, electrical household appliances etc. was done by a UNIDO consultant in 1972. The battery testing laboratory was designed by the chief technical adviser, who also assisted in the design of the workshops. The mechanical testing laboratories for pressure cookers, gas ranges, safety-glass, pressure vessels, regulators and valves were designed and installed by the counterpart engineers sometimes with the assistance of the chief technical adviser or other experts. Generally, however, this latter type of activity was not clearly specified in the Plan of Operation and had to be added when the testing of such items became compulsory. As

these types of tests are routine operations in accordance with the prescriptions of the standards it was not felt necessary to request expert assistance once the proper equipment had been bought or constructed at the Institute. The precision mechanical workshop was assisted by a UNIDO expert to manufacture test gear.

There were considerable delays in the delivery of other equipment owing to bad organization. Thus equipment typically remained from 6 to 20 months at customs before clearance. The water meter test installation planned in 1971 has still not been delivered. It is regrettable that reiterated suggestions for government equipment procurement through a funds in trust agreement with UNIDO were not taken. Such an agreement could have saved much time and effort.

Apart from the negative aspect related to the government procurements, installation and work on equipment within the Institute was, with few exceptions, very good and many of the laboratories were quickly completed.

Activities

Because of limited funds, equipment or laboratories provide for present needs and may prove insufficient as the facilities suggested have not yet been completed or personnel fully trained. So long as this is the case, it is not advisable to accept a large amount of precision work. However, governmental organizations and private enterprises will come to use the facilities to a larger extent. The Centre has been publicized through the press and television and a leaflet (annex IV) distributed. Great interest in calibration has been shown by some industries such as the factories making electricity meters, current transformers, cables etc. A large scheme for mechanical calibration was undertaken for the National Iranian Steel Mill and the aircraft industries. The latter, which have factory laboratories, have recently shown a great interest for calibration of secondary standards including electrical and electronic instrumentation. It is felt however that such schemes should be established on a regular basis by voluntary yearly contracts listing the type of services expected and the instruments to be checked or calibrated. Militating against this is the fact that fees have to be charged for such work. (As payment was not received from the National Iranian Steel Corporation, work on calibration of materials, testing machines and balances was interrupted.)

A. Project activities and results

Buildings

The project building consists of three interconnected three-storey wings (annexes V and VI). The original design allowed for two wings (blocks A and B) interconnected in a U-shape, but these premises could not house some of the mechanical testing machinery and block C was added, at the suggestion of the chief technical adviser, to include a machine-hall, an amphitheatre and laboratories for photometry and water-meter testings. Other minor modifications were made including the enlargement of stairs, construction of wall separations and a lift for heavy equipment. The building is of a very heavy concrete with brick walls and is adequate for metrology, and metallurgical and electrical testing as long as the area required for input and output storage of test objects is not too great.

The building is centrally air-conditioned but the heating system does not provide sufficient temperature stability; so several metrology rooms have been equipped with independent air-conditioning units. As the volume of mechanical testing of heating and refrigeration appliances, automotive parts etc. is expected to increase it is necessary to construct a special test-house outside the metrology building and money for this purpose has been allocated.

The building has a floor-space of 6,000 m^2; the available laboratory space is 4,000 m^2. There is comparatively little office space available for the staff and office desks are generally distributed in the laboratories. Some laboratories, especially in the weights and measures division are, unfortunately, still used as offices by administrative services which do not belong to the Metrology Centre. The archives for models of type-tested devices may also require additional space.

Furniture and installations

As the amounts of space, power, water etc. required for certain tests were not known, only connectable facilities (electricity, water, drains etc.) were installed and suitable vertical and horizontal channels provided for more important power installations. These arrangements proved economical and adaptable.

Modular furniture was used and laboratory benches were fitted to walls and window spacings; these benches can be adapted for work being done in either a standing or sitting position. The benches, which have a formica top and are fitted with an electrical connecting board comprising four earthed sockets, are used throughout the building. In the mechanical workshops, a heavier type of table is used with a steel top but with the [illegible]

Since compulsory testing was established, the laboratory units concerned have all been in full operation but the situation is special, as described below.

Mechanical Metrology Division

This Division, located in the basement of block A, is meant to be the central laboratory for weights and measures in Iran and at the same time provide services to industry in the testing of manometers, dynamometers, length gauges and certification of tensile and compression machines as well as hardness-measuring equipment.

So far, all the instruments tested have been submitted on a voluntary basis. However, most tests should involve the compulsory scheme including:

(a) Calibration of test equipment used by ISIRI field offices for district control of weights and measures and for quality control of manufactured items;

(b) Type testing of imported or locally manufactured weighing and mechanical measuring equipment.

The existing field offices for weights and measures are badly equipped and many of their facilities are run-down. Furthermore, there are not enough trained personnel especially for handling the verification of modern weighing equipment.

Several proposals were made to improve this situation. First, it was requested that a legal metrology expert review the situation of the local offices and provide a planning report to the authorities for a more effective weights and measures field inspection system which would in turn, make more use of the facilities at the Metrology Centre. The report of the expert was unfortunately delayed until he was about to leave.

Secondly, it was then hoped that by converting the assignment in instrument repair to weights and measures, which allowed the recruitment of an additional expert, it would be possible to train field inspectors, procure the necessary field-testing equipment and start the type-testing work at the Metrology Centre. A special training room with test benches was equipped in such a way that it could also be used for the type-testing of instruments. The equipment procurement for the field offices, which started upon the arrival of the second weights and measures expert, was however interrupted when the chief of division had to leave the Institute. Furthermore, there were no field inspectors employed to participate in the training and the whole programme was thus delayed.

Thirdly, a request, supported by the 1975 project review mission, was made to the Iranian Government Plan Organization for allocation of funds for the renovation of the field weights and measures services. The response is not yet known; it seems, however, that such funds will not be allocated at present. The impact of the Mechanical Metrology Division on the weights and measures in the country will thus still depend on the improvement of the field services, as was foreseen at the beginning of the project.

The second expert in weights and measures has been requested by the counterpart to participate in the design of new weights for Iran and to assist in the elaboration of the new laws and other decrees relative to the international system of units (SI) of measurement. The practical application of this system in Iran may extend the compulsory testing regime which is now supposed to be applied only for mass and length measures to a number of other units. Thus the future training of field inspectors for weights and measures should be much broader and consequently, the importance of the Metrology Centre as a base for the inspection work should further increase.

The training of the staff in precision weighing, calibration of force and pressure gauges and length measurements was all done by the chief technical adviser who wrote calibration manuals for these activities. He also supervised the routine work within these laboratories. Sometimes training in calibration took place in industries outside the Centre. In 1974, more than three weeks were spent at the National Iranian Steel Mill in Isfahan calibrating 50 balances and testing machines.

The premises of the Mechanical Metrology Division consist of:

Room 1 - calibration of measuring tapes up to 25 m (or more) by comparison to standard tapes

Room 3 - calibration of pressure gauges and dynamometers (and load cells)

Room 4 (primary balance room) - calibration of precision weights (500 kg weights used by the field service are calibrated in the machine hall)

Room 5 - training of field inspectors for weights and measures and type-testing of balances and weights

Room 6 - engineering metrology: dimensional measurements, calibration of end gauges and divided scales, and hardness and surface roughness machines

The staff in these laboratories comprises five engineers and one technician. At least two of the engineers are adequately trained for routine testing and calibration. The chief of the Division left in March 1974 and has not yet been replaced.

Electricity Division

This Division, located on the seoond floor of block A of the Metrology building, has two main activities: electrical metrology and electrical testing of materials and equipment.

Electrical metrology activities (rooms 204 and 206), are based on voluntary work requests, but also include [illegible] the instruments used for testing electrical materials. The electrical metrology activities (annex IV) have been planned and largely carried out by the chief technical adviser. Personnel in these laboratories has changed several times which is unfortunate as continuity is required in this work. The chief technical adviser has written a calibration manual on basic techniques for new personnel. In addition to routine calibration of the Institute's own instruments and of meters received from factories, a certain amount of high precision calibration has been made for aircraft laboratories.

Special training in the testing of electrical energy meters was provided by a UNIDO short-term consultant in May 1975. An expert in thermometry also assisted the electrical metrology laboratories and made a survey of the Institute's type-test facilities for energy meters.

Energy meters and instrument transformers are manufactured in Iran and routine calibration on a sampling basis is now being undertaken for such products.

The photometry laboratory (room 117), was planned by the chief technical adviser and installed with the assistance of the thermometry expert. A specialist was later recruited for training and supervision of the photometry work. He spent three months with the laboratory in 1975 and is supposed to return to the project for another period of three months in 1977. The photometry laboratory has been very active from the start as it is charged with the quality control of incandescent lamps manufactured in the country. It is planned to extend this control to fluorescent lamps but this will require additional equipment and it is uncertain when this will arrive. The [illegible] of standards in photometry consist of batches of incandescent lamps which have been calibrated at the Bureau international des poids et mesures (BIPM) and hand-carried to the project.

The thermometry laboratory (room 230) was also planned by the chief technical adviser. It has insufficient work but the thermometry expert is very experienced and has been useful for work in other laboratories. Recently, however, requests for calibration have been received and it is expected that medical thermometers will have to be checked on a routine basis, according to the existing Iranian standard.

The time and frequency laboratory (room 201) is being entirely equipped by the counterpart, assisted by a UNIDO expert. To make the services of this unit more available to outside customers, it is planned to transmit standard frequency and time signals in Iran with the co-operation of the National Iranian Radio and Television. The progress of this facility will depend on the arrival of government-ordered equipment. At present, one unit is operating in Karaj comprising a primary caesium beam oscillator and digital clock. This equipment was synchronized by flying it in full operation from Switzerland where the exact time was set to the atomic clocks of the Observatory of Neuchâtel.

The electrical testing of materials and appliances is the major activity of the electricity division. The planning of the laboratories and their equipment was done by a UNIDO consultant. As this planning had to be done after the building was finished, the various laboratories had to be distributed all over the building to make the best use of available space and facilities. Thus mechanical tests, such as vibration, are done in the machine-hall (room 18), and climatic tests of large appliances in room 120 where a walk-in climatic chamber with 16 m^3 volume has been installed. Life-testing of incandescent lamps takes place in room 116 adjacent to the photometry laboratory. Water-spray tests and long-duration tests of noisy appliances take place in room 14 in the basement where a special wet-room has been installed. The other main electrical testing laboratories are:

Room 208 - plugs, switches, sockets etc.
Room 214 - household appliances
Room 223 - cables and wires
Room 228 - storage batteries
Room 114 - lampholders (and, in future, fluorescent lamps)
Room 116 - incandescent lamps

More room space will be required when the testing activities expand; however, it is hoped that rooms can be taken over when mechanical testing moves to the test-house that is to be constructed. The electrical testing activities in most cases follow Iranian standards which have been made compulsory for the products listed above (except for household appliances which are still under consideration).

During the first phase these activities have been assisted by a Federal Republic of Germany bilateral expert for a total of one year in periods of from two to three months. Assistance has mainly consisted of advice in completing the equipment of the laboratories and the local manufacturing of test equipment. A UNIDO expert is now advising on the testing of the safety of household appliances which is expected to become compulsory soon. The testing includes both type-tests and tests of current production or imported goods by sampling procedures.

The staff of the Electricity Division comprises 15 engineers and technicians of which 5 engineers are engaged in metrology. Twelve local factories manufacture electrical materials and appliances which are subject to compulsory testing and about 5,000 samples per year are tested.

The assistance of experts from Verein Deutsche Elektroingenieure, an important electrical testing laboratory in the Federal Republic of Germany, has been most valuable in the establishment of these facilities in particular as the test equipment needed had to be specially designed to fit Iranian standards which are based, practically without modification, on standards of the Commision internationale de reglementation en veu de l'approbation de l'equipement electrique and the International Electro-Technical Commision (IEC).

Test schemes according to these standards have also been established by the experts, but all testing has been made from the beginning by the Iranian staff under the supervision of the chief of the division.

Metallurgy Division

This Division was originally planned by the UNIDO metallurgy expert to provide general service facilities for industries in Iran including both routine examinations of metals and industrial research projects (annex IV). In 1974 another project, the Metallurgical Research Centre of Iran (MRCI), was started. The laboratories at the Metrology Centre had, at that time, been in limited operation for practically two years. It was suggested that the metallurgy activities should be transferred to the new project but no suitable premises were available. The chief technical adviser, in full agreement with his counterpart and the expert, then advised that the facilities of the metrology project should be made available to MRCI staff for research projects and ISIRI should concentrate on metallurgical standards and their implementation. Such an agreement

was signed in April 1975 by the managing director of ISIRI and the designated director of MRCI, but no MRCI engineers came to work in the laboratories nor did they request testing of metals. The UNIDO expert who, during his second assignment, had spent part of his time at MRCI, was requested by UNDP to return full-time to the Metrology Centre, and work was resumed on standards. In spite of the efforts undertaken last year to issue standards for locally-manufactured steel and other metals, there is still a considerable amount of standardization to do concerning metal products manufactured in the country. The metallurgy laboratories of the project should have definite functions in testing local or imported metal products to standards.

Special research and development projects within metallurgy may be the work of other institutions and universities, but the official certification of metals to standards or otherwise should remain the duty of ISIRI. However, there has been a general lack of interest in this activity, and there is also a competitive situation among other laboratories within ISIRI which have monopolized the analysis of metals using obsolete or inaccurate chemical methods. The laboratories provided by the project are well installed with appropriate up-to-date equipment, the only lack being a spectrometric automatic analyser planned for several years ago but never produced in spite of the availability of funds. Another negative fact is that the staff is paid much less than elsewhere and tend to leave the Institute.

The metallurgy laboratories are located as follows (annex V):

Room 124 - metals preparation (cutting and rough grinding)
Room 125 - metallography
Room 129 - microscopy
Room 128 - photographic dark room
Room 130 - foundry materials
Room 18 - destructive testing (machine hall)
Room 126 - metals analysis (not installed, presently offices)

The very successful training and seminar activities in 1973 are described in the second report of the metallurgy expert and the last report summarizes the recommendations. Both reports contain extensive technical documentation for use by the counterpart.

During the training period in 1973, much interest was shown by various industries in the work and a considerable number of samples were received for tests. In 1975, another test scheme was undertaken by sampling locally-manufactured steel which could thus be officially evaluated as to structure and mechanical characteristics.

In 1973, there were six engineers and one technician but now there is only one engineer. The chief of the laboratory, who has a Ph.D and was trained in Finland during a one-year project fellowship, has left because of the general lack of interest shown by various authorities and the low salary.

The mechanical workshop has generally been listed in project documents as part of the Metallurgy Division. It is now under the responsibility of the chief of the Mechanical Testing Division (or Mechanical Industries Division) and serves all the laboratories in the Metrology Centre. This workshop was planned by the chief technical adviser and comprises:

Room 21 - precision workshop (milling machine, lathes)
Room 23 - workshop office and drawing tables
Room 25 - sheet metal and welding workshop
Room 30 - rough or medium mechanics' workshop

The special UNIDO machines were procured abroad by the counterpart for the precision workshop; other machines were bought on the local market. It took considerable time to obtain the necessary co-operation for the installation of the precision workshop. Finally, after some intermediate personnel were dismissed, things went much smoother and the precision workshop was put into full operation. The UNIDO expert in precision mechanics was patient and by the end of his stay did a lot of useful work. The counterpart technicians he trained however left before his departure, again on account of higher salaries in the private sector. At present, new untrained staff is employed. The new chief of the workshops is co-operative and competent.

Mechanical Testing Division

This Division is generally referred to in ISIRI documents as the Mechanical Industries Division. It is planned that the metallurgical laboratories should form a separate division, as described above, but this has not yet taken place and the metallurgical laboratories are under the general supervision of the chief of the Mechanical Industries Division.

Mechanical testing activities were, to a certain extent, taken into account in the original planning. However, emphasis was put mainly on the testing of materials as tests on equipment should take place at the respective industries. Provision was made for testing gas cylinders and pipes, as is the case in many materials testing institutes. A special test room was provided for this purpose and a high pressure pump procured from the UNIDO equipment allocation. However, the counterpart considered that the testing of other items, including gas ranges, pressure cookers, automobile parts, safety glass etc. and redistribution of the laboratories had to take place. The planned precision grinding workshop was thus postponed and a laboratory for testing valves and regulators was installed in its place. The machine hall, which should be partly used for calibrating gas meters and for non-destructive testing, was temporarily transformed into a laboratory for duration testing of gas ranges and gas cooking appliances. The testing of items, such as space heaters for gas or kerosene, water-heaters, brake linings, oil filters etc., is being considered, but the present building will not be able to cope with these activities because of lack of suitable space and necessary input-output storage requirements. In the standards for most of this equipment there are usually specified tests of metals which now are only partly executed because of lack of suitable analysis equipment in the metallurgical laboratories. The solution seems to be to first complete the metallurgical materials testing by analysis facilities and trained staff, and secondly, to construct a special test-house for the voluminous mechanical and thermal test objects. The two divisions, Mechanical Testing and Metallurgy, could thus better co-operate by either separating the materials or metals testing, which requires clean conditions, from the testing of various appliances which has to be done under normal operating conditions, or using special test benches, which are subject to storage and other handling problems.

At present the following laboratory facilities for mechanical testing are installed in the Metrology building:

Room 18 - testing of gas ranges (in a part of the machine hall)
Room 20 - pressure testing of containers (gas cylinders, pressure cookers)
Room 24 - testing of gas valves and regulators
Room 120 - testing of refrigerators. Installation not yet completed. This room is also used by the electricity division for climatic tests on voluminous items using a special walk-in cabinet separated from the refrigerator test enclosure.
Room 233 - testing of automobile safety glass

The testing of brake linings is already compulsory, but so far no suitable laboratory space has been found and the necessary test bench has not yet been delivered.

The chief technical adviser has assisted mainly in the installation, calibration and training concerning the destructive testing machines, an activity which normally comes under metallurgy but which is also required for testing of gas bottles and fire extinguishers. The expert in precision mechanics has also assisted in the manufacturing of test gear. In other respects, however, both planning and execution of the mechanical tests above have been fully initiated, executed and supervised by the counterpart engineers according to test schemes specified in the corresponding Iranian standards.

B. Project assessment

The project was carried out in accordance with the original plan of 1965. Since that date, there have been tremendous changes in Iran's economy and industry that could motivate a wide enlargement of the activities and facilities of the project.

Such an enlargement took place during the first phase of operation when a number of electrical and mechanical products were suddenly required to comply with compulsory standards thereby necessitating a great amount of laboratory and factory testing. It had been considered that only materials testing and certification of mechanical items should take place during the project and that electrical items should only be subject to safety tests, either on a voluntary or compulsory basis. The project could handle the electrical testing but the capacity for mechanical testing must be reconsidered especially if such testing is to be applied where not only safety is involved but also control of commercial quality. However, there has been, during the past year, a noticeable trend to limit the number of mechanical and electrical products subject to compulsory control.

The consequence of the emphasis on compulsory standards has been that little consideration has been given to voluntary control of measuring instruments or products, such as metals, for which practically no standards were set. During the last phase there has been a noticeable slow-down in the execution of safety requirements which it is hoped will be of short duration.

A successful metrology scheme in the country will require competent and adequately equipped field units. Field units exist and are claimed to do a considerable amount of checking of balances and weights; however, the technical quality of this testing is doubtful. Proper instruction

manuals and regulations for such testing must be issued and new technical personnel employed and trained as it is planned to extend the already compulsory weights, balances and dimensional measures to other instrumentation, according to the SI system of units. A progressive system should be adopted; steps in the right direction could have been taken during the last phase of the project. The chief technical adviser regrets that the assignments of the experts in weights and measures or legal metrology for a total period of three man-years have been rather wasted efforts. The training of field inspectors, and issuing of regulations and technical instructions, type-testing schemes etc. must thus be included in a large extension project which will probably take an additional five years or more to accomplish, and for which no funds have been allocated so far.

Fortunately, the project was able to execute some voluntary requests for calibration or other testing. These requests were generally made by industries or laboratories where expatriate collaborators specified such calibration schemes. Attempts to bring in more voluntary calibration and testing work were not sufficiently encouraged.

Contrary to expectations, experience has shown that the metrology facilities do not exceed Iran's requirements and the instrumentation must be completed to cope with requirements by local laboratories or industries that are presently building their own secondary standard laboratories.

II. CONCLUSIONS AND RECOMMENDATIONS

The facilities of the Metrology Centre are being used only partially. To improve this situation, the following recommendations are made for the three sectors that have been assisted by the UNDP:

A. Mechanical Metrology Division

It is essential for the operation that a technically competent leader be officially appointed for this Division. The engineer previously responsible left two years ago.

The facilities provided are only used for occasional voluntary control of measuring instruments for mass, length, force and pressure mainly at the request of aircraft companies, drilling enterprises and steel-works. The Institute should seek to extend this voluntary control to all local industries or institutes by proposing yearly service contracts according to an inventory made by each potential customer for those instruments or reference standards which are important to the quality of the production and the safety of the factory personnel or the product.

In the sector of compulsory operations only limited work has been done checking the working standards of the ISIRI field offices for weights and measures. The present reference standards (etalons) used in these field offices should be reviewed and in most cases replaced by new standards (etalons) from the Metrology Centre which should then make regular, at least yearly, checks of these measures. The central laboratories should also undertake type-testing of all measuring instruments produced in the country, and verify that imported instruments have been duly type-tested by official institutions abroad.

It is also essential that the field services for weights and measures be completely renovated in accordance with the 1976 review mission's recommendations and that the training facilities for specialists in weights and measures in the Metrology Centre be used.

Finally, the work of these laboratories will depend on follow-up action on the new commercial weights to be legally adopted and produced under governmental control, and also on the consequences of the new law for weights and measures to be adopted by parliament.

B. Electricity Division

It is important that this Division should have a technically competent and permanently assigned chief instead of the present temporary arrangements.

The electrical metrology laboratories which are now fully operating should be furnished with regular work through the same voluntary and compulsory schemes as for mechanical metrology.

The laboratories for electrical testing of materials should be completed for the testing of fluorescent lamps and household appliances. It is recommended, for reasons of human safety that this electrical testing be concentrated on compulsory testing and other performance quality control be limited to simple consumer items such as lamps, batteries etc. More elaborate capital goods, such as electrical and household appliances, should be made to follow compulsory safety regulations which should take into account the status of housing installations in Iran.

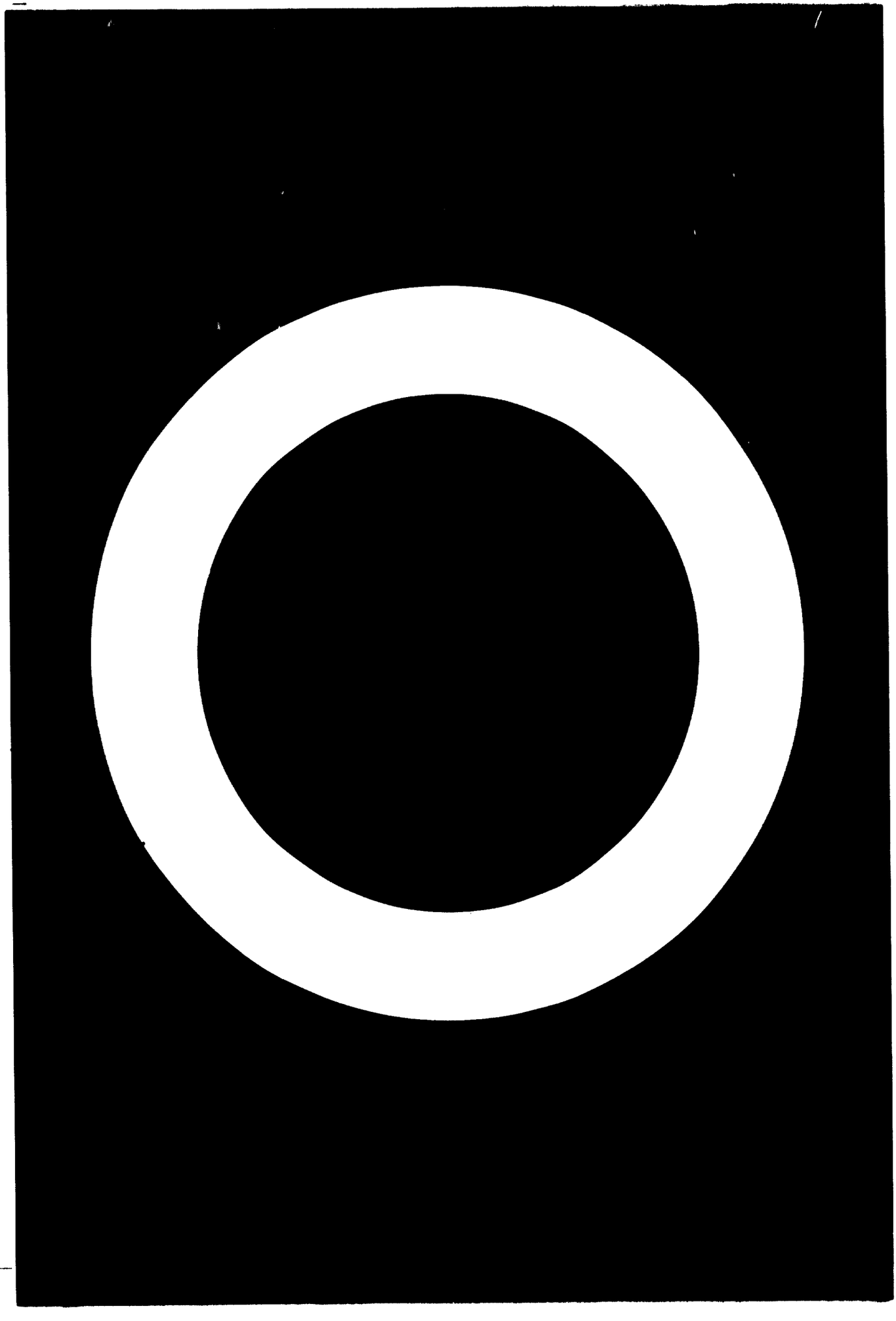
C. Metallurgy Division

Particular attention should be paid by the Government to the excellent facilities for testing metals and foundry materials, made available by the UNDP for the project, that only need to be completed by appropriate equipment for metals analysis.

Regular testing of the local production of steel and other metals should be established on the initiative of the Ministry of Industry and Mines and the activities of both standardization and testing of metals should be directly supervised by a competent body of this Ministry. The operation of the metallurgical laboratories should be made independent of the other mechanical testing activities of ISIRI.

The work on implementing local standards for metallurgical products, which has started but remains at a low level, should be intensified. This will automatically bring in work to the laboratory in addition to the routine testing of metals which should continue to flow in from industries that do not have sufficient laboratory facilities or who want to cross-check results.

It is recommended that the Ministry should also take financial steps to ensure that technically competent staff can be permanently assigned to the ISIRI laboratories.



Annex I

UNITED NATIONS STAFF

Post	Name	Country	Dates
Chief technical adviser and electrical metrology expert	S.A. Thulin	Sweden	July 1970-June 1977
Experts in:			
Mass and volume	R. Bedon	France	Feb. 1972-Dec. 1973
Metallurgy	P. Asanti	Finland	Oct. 1972-Sept. 1973
Metallurgy	P. Asanti	Finland	Oct. 1974-Aug. 1975
Thermal metrology	R.L. Closs	New Zealand	Dec. 1973-Jan. 1975
Precision mechanics	S. Gorkunov	USSR	Jan. 1974-June 1976
Legal metrology	Prem Prakash	India	Dec. 1974-Apr. 1976
Photometry	H. Terstiege	Federal Republic of Germany	May 1975-July 1975
Electronics (time and frequency)	C.J. Abom	Sweden	Sept. 1975-Aug. 1976
Testing electrical household appliances	R. Maier	Federal Republic of Germany	June 1976-May 1977
Consultants in:			
Electrical testing	H. Fuhr	Federal Republic of Germany	April 1971
Metallurgical testing	P. Asanti	Finland	Sept. 1971
Testing of building materials	A. Fabiszewski	Poland	Dec. 1974-Feb. 1975
Energy meter testing	M. Ruegger	Switzerland	May 1975
Planning of acoustical laboratories			

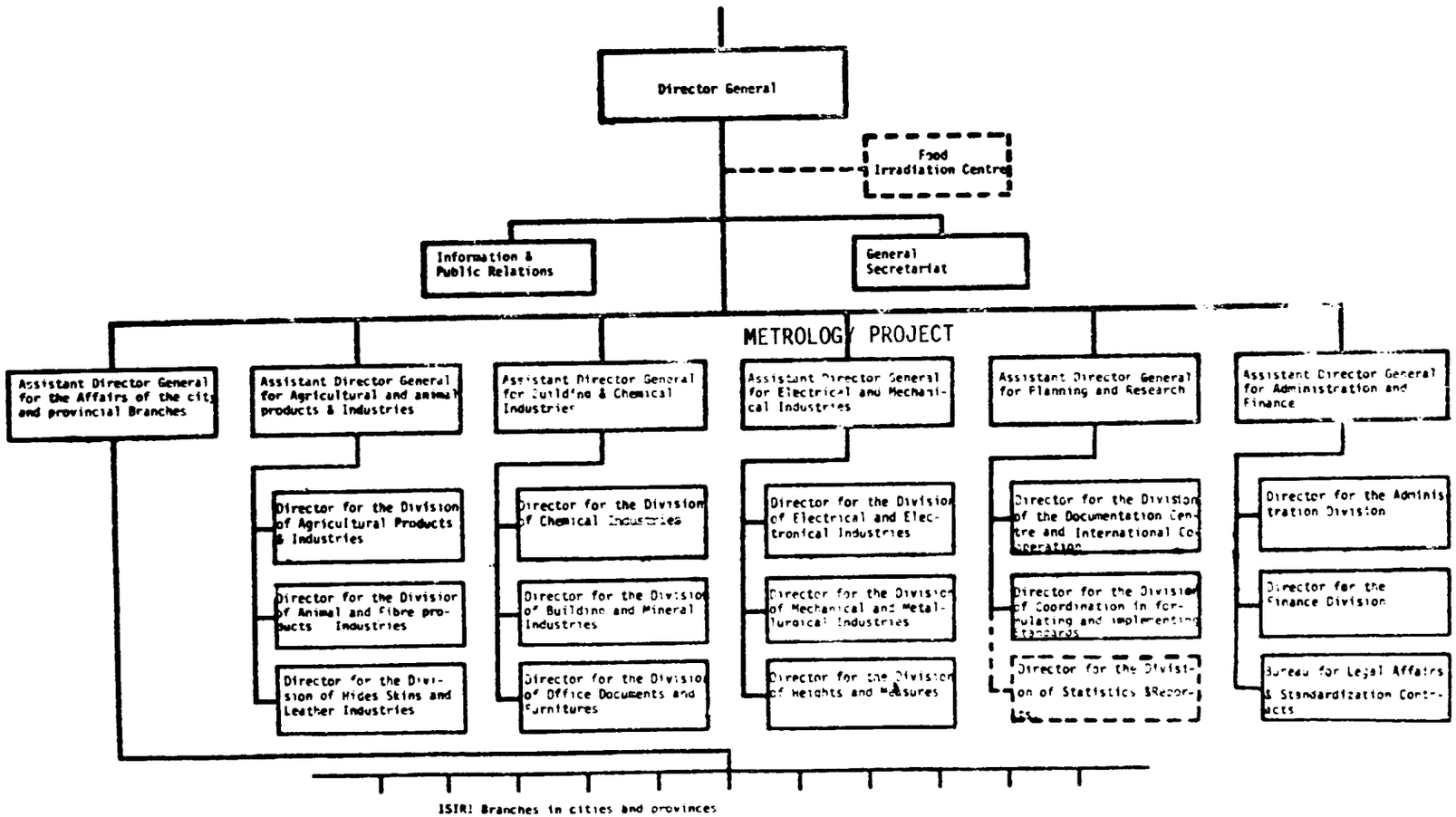
Annex II

FELLOWSHIPS

Post	Duration (months)	Name	Country of study	Dates
Metallurgy	12	Mehdi Tabassian	Finland	Oct. 1973-Sept. 1974
Time and frequency	6	M. Din-Pajuh	Federal Republic of Germany	Apr. 1975-Oct. 1975
Librarianship	12	F. Hazegh Djafari	USA and UK	Jan. 1976-Dec. 1976
Length metrology	6	Medhi Husseini	Federal Republic of Germany	Oct. 1976-Mar. 1977
Testing of automotive parts	3	M.M. Bagherzadeh	Federal Republic of Germany	Oct. 1976-Dec. 1976
Laboratory management	6	S.T. Khalilian	UK	Jan. 1977-July 1977
Photometry	6	Ardeshir Amini	Federal Republic of Germany	1977
Legal metrology	6	Ketabchi Haghighat		1977
Testing of automotive parts	3	Arsalan Balakhani	Federal Republic of Germany	1977

Note: The fellowship programme as originally planned had to be reduced owing to the unavailability of candidates who fulfilled government requirements and had a sufficient command of languages.

ORGANIZATIONAL CHART OF THE INSTITUTE OF STANDARDS AND INDUSTRIAL RESEARCH OF IRAN
MINISTRY OF INDUSTRIES AND MINES



Annex IV

THE ACTIVITIES OF THE METROLOGY CENTRE OF THE INSTITUTE OF STANDARDS AND INDUSTRIAL RESEARCH OF IRAN (ISIRI)

The Metrology Centre was established by the Institute of Standards and Industrial Research of Iran with financial support from the Iranian Government Plan Organization to include central laboratories for metrology and physical testing as a complement to previously existing laboratories located in Karaj, 40 km west of Teheran.

The Metrology Centre comprises the main technical services for conducting type approval, calibration and quality control of measuring instruments in Iran. It also acts as an approval and quality control services laboratory for other industrial products in the fields of mechanics and electricity. It furthermore assists in the establishment of Iranian national standard specifications for such products. By law such standards may be declared compulsory. The Metrology Centre also maintains the Iranian national physical reference standards(etalons).

The combined Metrology and Testing activities of the Metrology Centre make it possible for ISIRI to ascertain at any moment that correct values are obtained in various tests by using appropriate calibration methods of the test instrumentation. The Metrology Centre also calibrates instruments and test apparatus used in industries, universities or by other public and private institutions.

The establishment of the Metrology Centre has been assisted by the United Nations Development Programme through its executing agencies UNIDO and UNESCO.

The work of the Metrology Centre is distributed in four main divisions, each division with activity sections as shown below.

I. MECHANICAL METROLOGY DIVISION(Central Laboratory for Weights and Measures)

Section 1 Mass and force metrology
Section 2 Volume and fluid metrology *
Section 3 Dimensional metrology
Section 4 Thermometry
Section 5 Gas metrology*
Section 6 Training of metrology specialists for field work*

II. ELECTRICITY DIVISION

Section 1 Electrical physical standards and calibration
Section 2 Testing of electrical properties of materials
Section 3 Photometry and lamp testing
Section 4 Time and frequency standards and calibration
Section 5 Electrical workshop

III. METALLURGY DIVISION

Section 1 Destructive testing
Section 2 Non-destructive testing*
Section 3 Metallography and corrosion
Section 4 Foundry materials testing
Section 5 Analysis of metals(spectrophysical methods)*
Section 6 Mechanical workshop

IV. MECHANICAL INDUSTRIES DIVISION

Section 1 Pressure vessels
Section 2 Heating and cooking appliances
Section 3 Refrigeration appliances
Section 4 Automotive parts
Section 5 Various mechanical equipment

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* not yet in operation(June 1975)

Compulsory and voluntary quality control

A large part of the work at the Metrology Centre is constituted by laboratory tests and measurements for type approval of materials, equipment and instruments in accordance with Iranian national standard specifications, which whenever possible are based on corresponding international standards such as ISO or IEC.

The type approval procedure is followed by continuous field control at producers or importers including inspection on the spot and sampling for tests at the Metrology Centre when such tests cannot be executed in the field.

The type approval and continuous quality control is compulsory for a number of products and in other cases only voluntary for obtaining the ISIRI quality mark.

As examples of typical equipment subject to compulsory approval are in the electrical field:

electrical cables and wires for houses
switches,sockets and plugs for mains voltages
incandescent lamps and lampholders
storage batteries, etc.;

and in the mechanical field:

gas cylinders
gas cooking ranges
pressure cookers
valves and regulators for gas
safety glass
fire extinguishers
brake lining, etc.

Due to the expansion of testing in the mechanical field it is planned to construct a special mechanical TEST HOUSE adjacent to the Metrology Centre so as to be able to cope with the space requirements for voluminous equipment.

General calibration and testing services

Apart from the compulsory and voluntary testing schemes for specific products the Metrology Centre has been planned so as to be able to undertake a great number of types of calibration and materials testing activities for customers outside ISIRI.

These activities rely upon the use of certain physical reference standards(etalons) which have been chosen so as to correspond to the actual needs of the country.

The type of references used and the main calibration or testing equipment are included in the following summary of testing capabilities.

Mechanical metrology

Measured quantity or type of instrument	Physical reference and comparison instruments	Measuring range	Highest accuracy of certification
Weights and balances	1 kg stainless steel, BIPM calibrated		
	1000 kg drop-weight balance	500 kg	± 20 g
	25 kg free-swinging -"-	20 kg	10 mg
	5 kg free-swinging -"-	5 kg	1 mg
	200 g analytical -"-	200 g	0.1 mg
	20 g microbalance	20 g	0.01 mg
Length, divided tapes	Steel tapes 25 m, PTB certified	25 m	0.2 mm
divided scales	500 mm standard scale built-in to SIP 1 m measuring machine	1 m 500 mm	5 µm 1 µm
end gauges		1 m	5 µm
	Gauge blocks, PTB calibrated and SIP measuring machine	500 mm	2 µm
	Gauge blocks,PTB calibrated and electrical comparator	100 mm	0.2 µm

Measured quantity or type of instrument	Physical reference and comparison instruments	Measuring range	Highest accuracy of certification
Force,			
dynamometers	standard compression proving rings, PTB certified, hydralic comparators	3 MN to 100 N	± 0.1 %
testing machines	transportable dynamometers	3 MN to 100 N	0.2 %
manometers	dead-weight piston testers	1000 to 0.1 bar	0.1 %
Density of liquids	standard hydrometers	600 to 1800 kg/m^3	0.02 %
Thermometers	water triple point cells,		
	platinum resistance standard	-100 to -40 °C	0.1 K(degC)
	thermometers, resistance bridge	-40 to +200 °C	0.01 K
		+200 to +600 °C	0.2 K
	standard Pt-10%RhPt thermo-couples, potentiometer	+600 to 1100 °C	2 K
	tungsten ribbon lamps, NPL calibrated, optical pyrometer	+800 to 3000 °C	10 K
Electrical metrology			
Standard cells for emf	Batch of 10 saturated standard cells in thermostated enclosure calibrated to BIPM value	1.018... V	2.10^{-6}
Standard resistors	Three standard 10 kohm resistors, current comparator bridge	10^{-3} to 10^{7} ohm	10^{-5}
Capacitance	Two hermetically sealed 1000 pF standard capacitors, transformer ratio bridge	10^{-12} to 10^{-4} F	10^{-4}
Inductance	Impedance bridge, incremental inductance bridge	10^{-5} to 1000 H	0.2 %
DC volts	Potentiometer, volt box	10^{-3} to 10^{3} V	2.10^{-5}
AC volts(to 100 kHz)	Thermocouple AC/DC transfer	10^{-1} to 10^{3} V	2.10^{-4}
V-,A-, W-meters	Digital voltmeter, precision power supplies, standards etc		0.1 %
Watthourmeters	Electronic reference meter, threephase test bench	100 to 380 V 0.1 to 100 A	0.1 %
Instrument transformers	Current comparator test set, high voltage capacitance bridge (*)	0.1 to 2000 A 100 to 35 000 V	2.10^{-5} 5.10^{-5}
Frequency	Caesium beam oscillator	100 MHz to 0.1 Hz	10^{-11}
Luminous flux and luminous intensity	Standard lamps, BIPM certified	10 to 5000 lm 0.1 cd to 1000 cd	2 % 2 %

Electricai testing of properties

In addition to all the standard tests prescribed for electrical equipment according to Iranian or IEC regulations the Metrology Centre can with its equipment execute a great number of investigations and determination of properties of electric materials including high voltage tests, tracking tests on plastic materials, insulation resistance under various climatic conditions, break-down tests on insulation liquids, splash tests etc etc

Metallurgical examinations

The metallurgical laboratories have been planned so as to enable the following types of examinations usually included in foreign and national standard specifications:

Destructive testing:	Hardness, tensile, compression, bend and shear tests on bars, rods, pipes, tubes, sheets etc
	Impact testing according to Charpy and Izod
	Sheet metal testing, Erichsen cupping test(*)
Non-destructive testing(*):	Determination of surface and subsurface flaws, cavities, cracks and other defects in metals and alloys by ultrasonic, radiographic, dye penetrant and magnetic methods.
	Examinations of welded seams.
Metallographic testing:	Identification and interpretation of metallurgical structures, e.g. metallic phases, grain size, inclusions.
	Identification and measurement of thickness and porosity of deposited coatings.
	Photography of metallic structures.
	Corrosion tests under simulated environment in aerosol chamber. pH determinations.
Foundry materials testing:	Evaluation of molding and core sand properties. Evaluation of bentonite or other binder properties. High temperature testing of foundry sand. Microscopic examinations of foundry sand and coatings.
Analysis(*):	Spectrochemical analysis of metals and alloys and various other materials Induction combustion determination of carbon and sulphur.
Workshop:	Sampling and preparation of test specimens.

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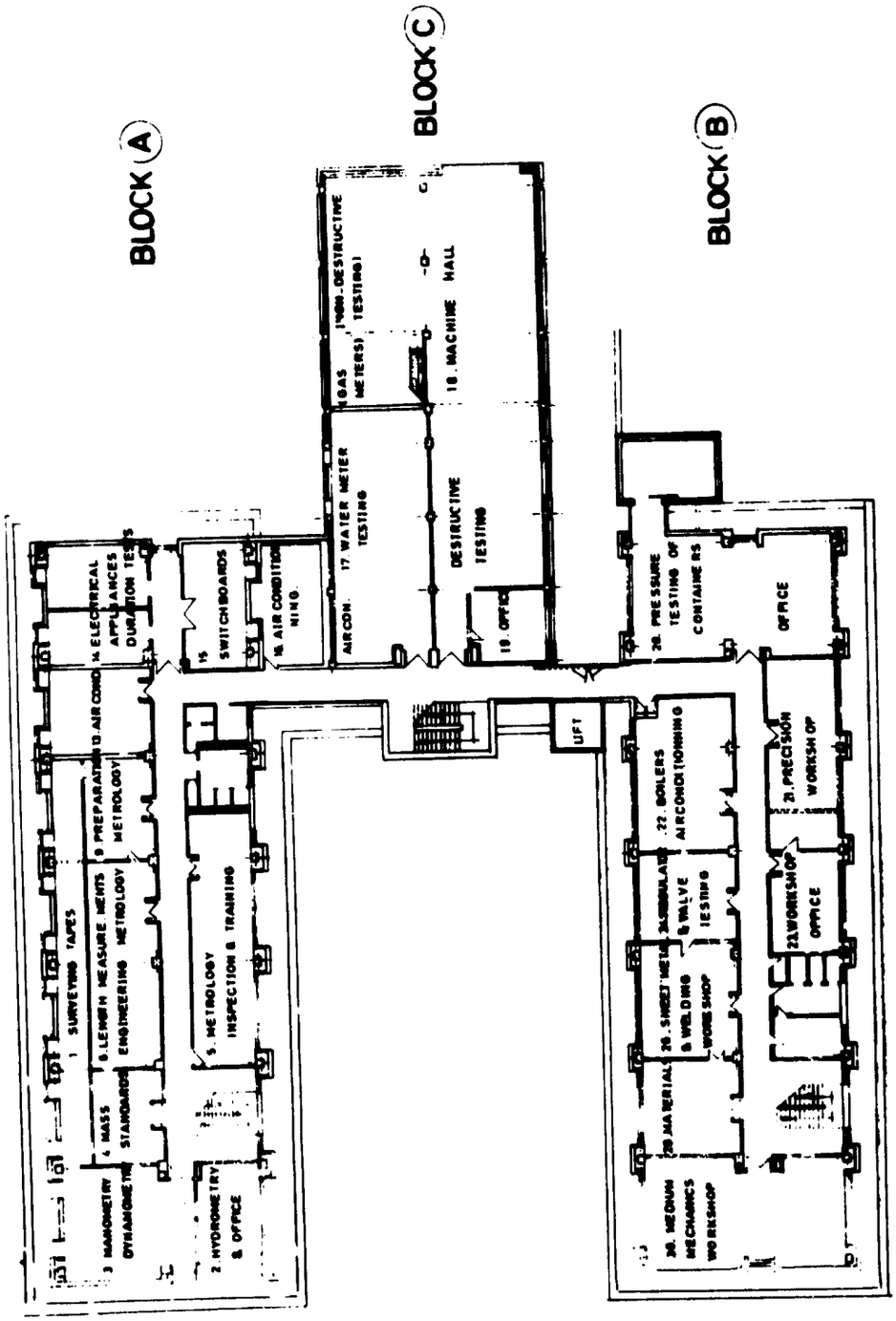
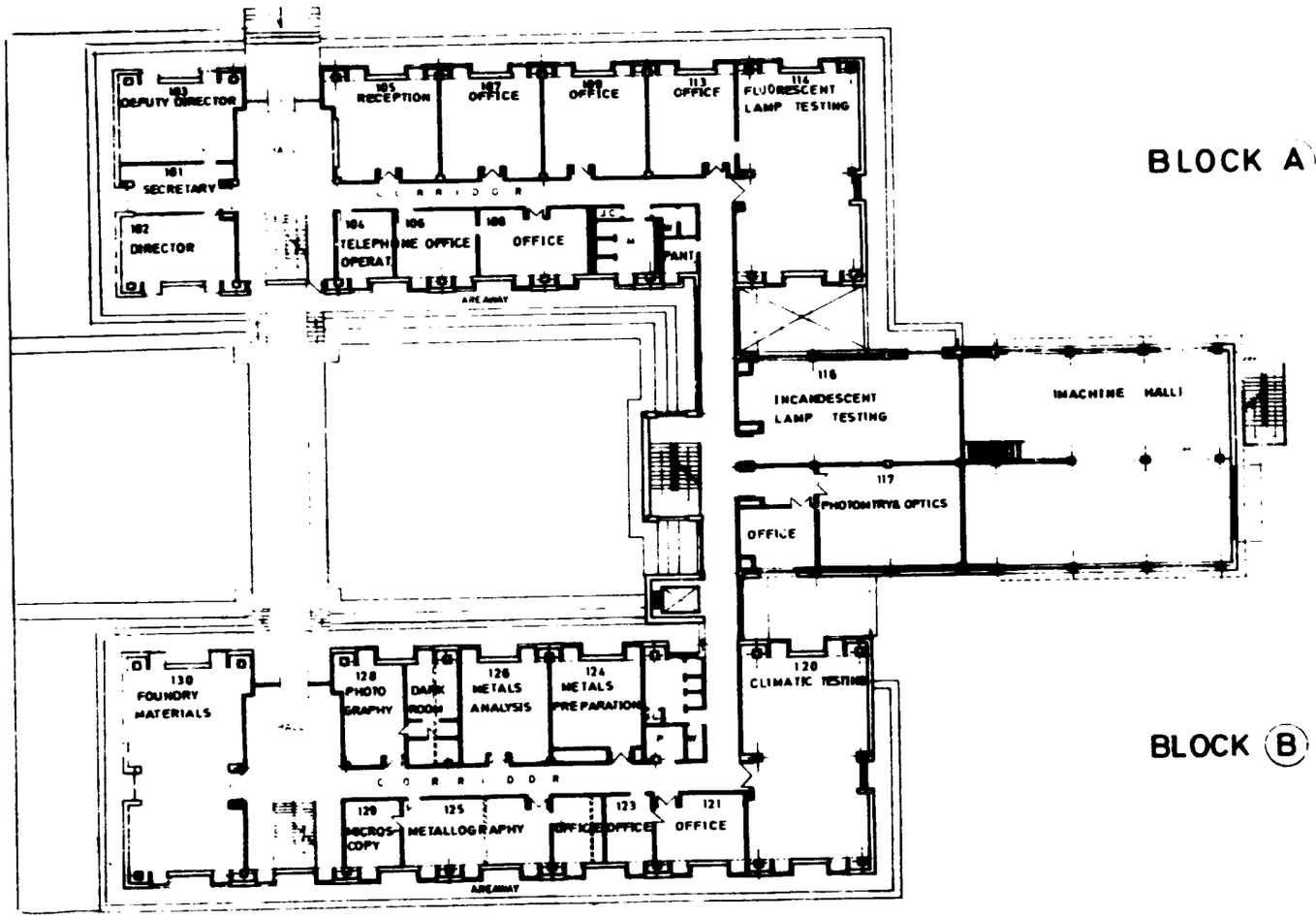
* not yet in operation(June 1975)

Annex V

PLANS OF THE METROLOGY CENTRE

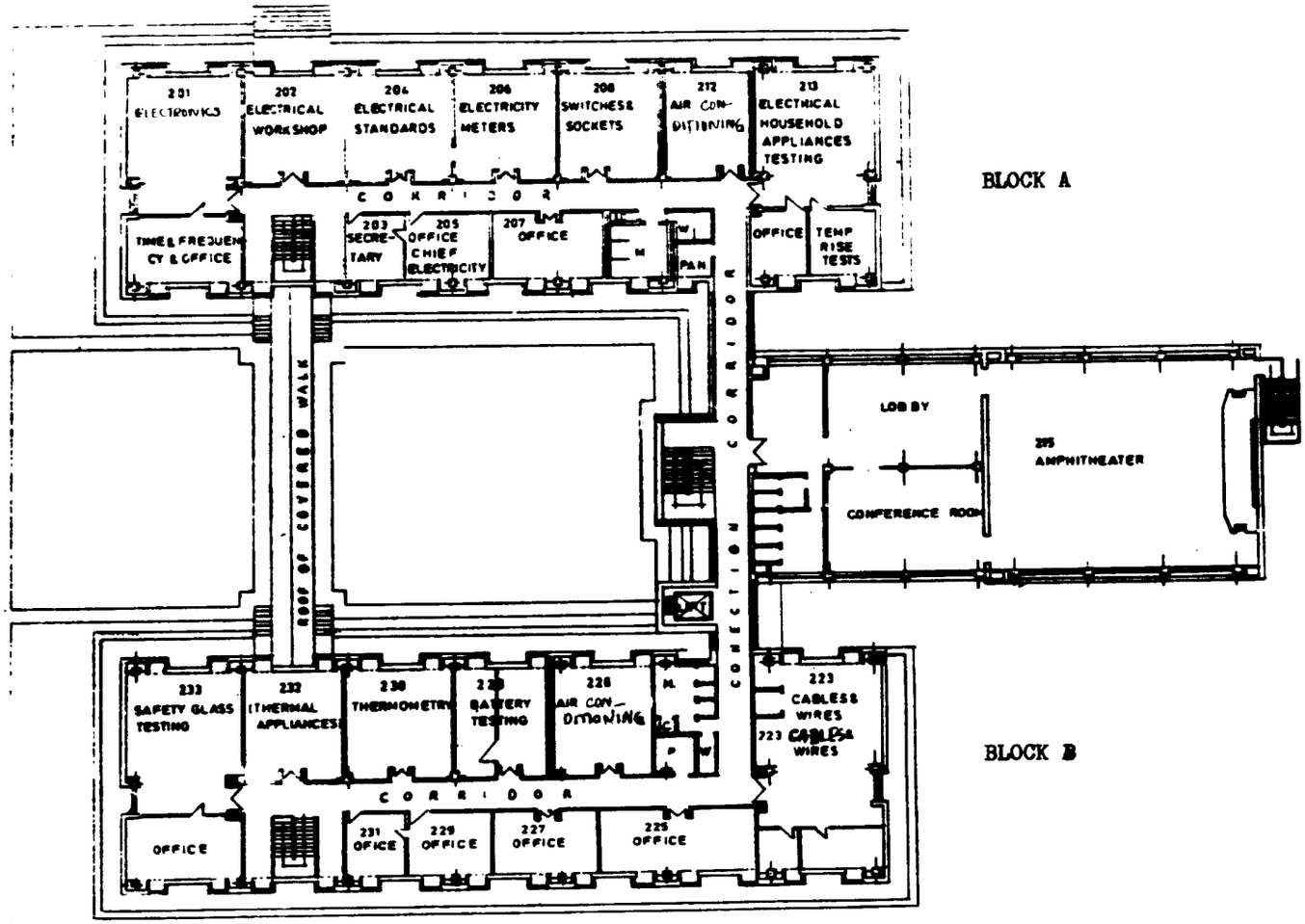


BASEMENT FLOOR PLAN
Scale 1:200



FIRST FLOOR PLAN

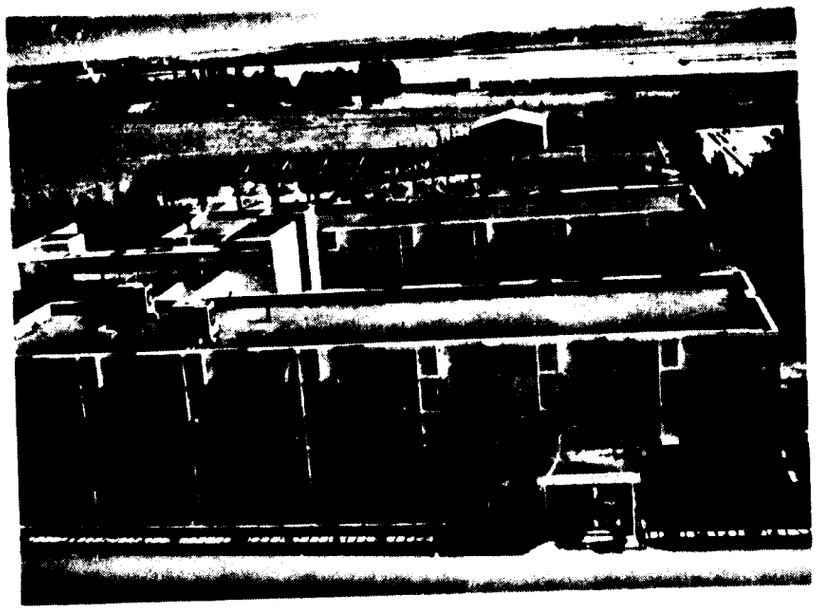
Scale 1:200



SECOND FLOOR PLAN

Annex VI

Photographs of the Metrology Centre



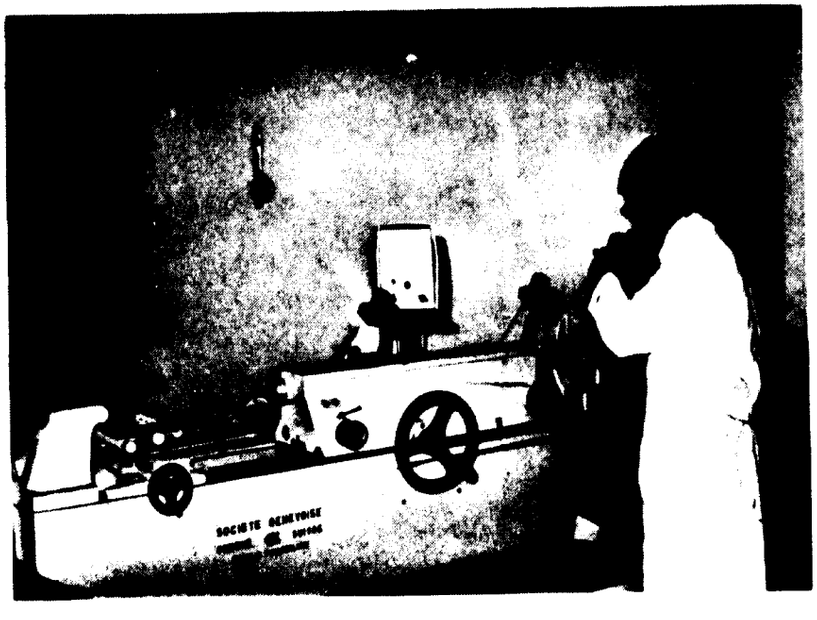
ISIRI Metrology Centre, general view

Amphitheatre for technical seminars

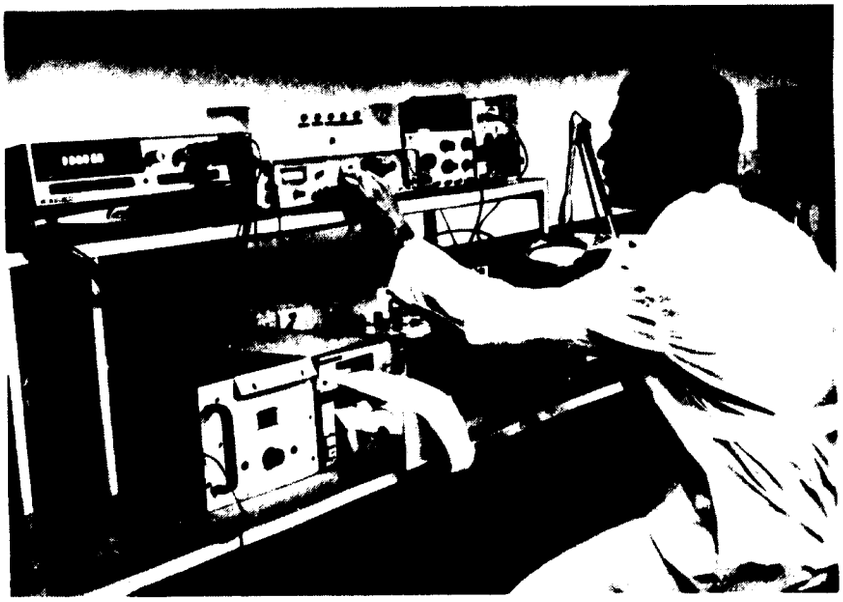
Mechanical metrology division, 25 kg
standardization balance

Mechanical metrology division, microbalances

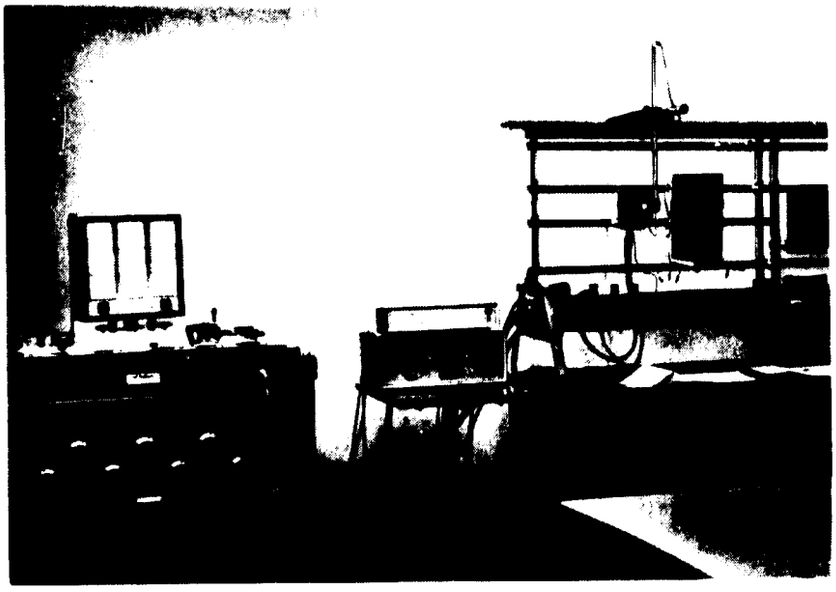
Mechanical metrology division, profile projector for measuring small parts



Mechanical metrology division, length measuring machine up to 1 metre, precision 1 micrometre

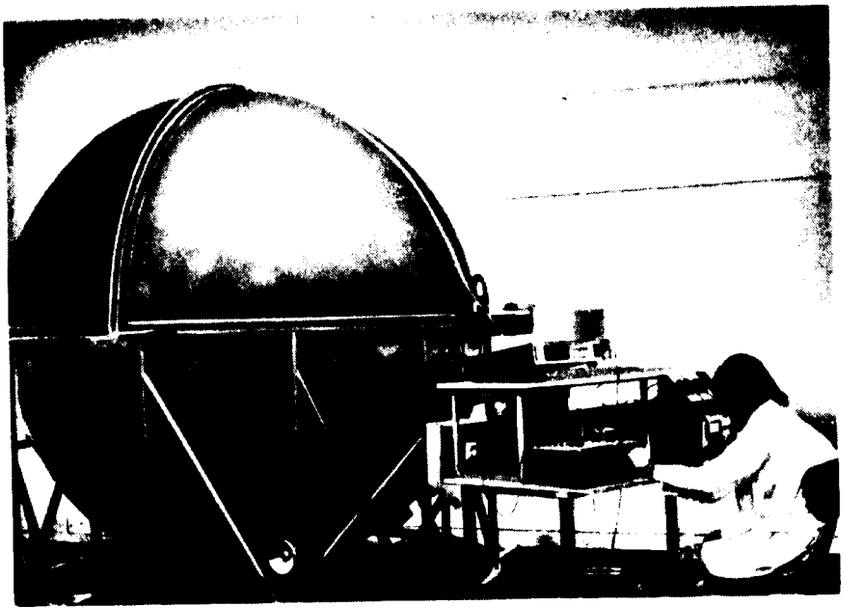


Electricity division, calibration of precision volt-, ampere- and watt--meters to basic physical standards



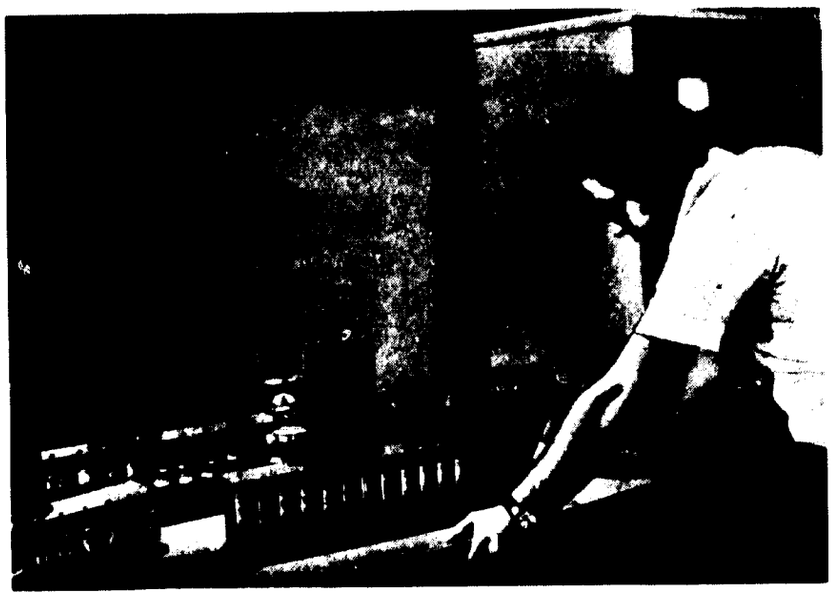
Electricity division, calibration of active and reactive energy meters using electronic reference meter

Thermometry, calibration of thermocouples

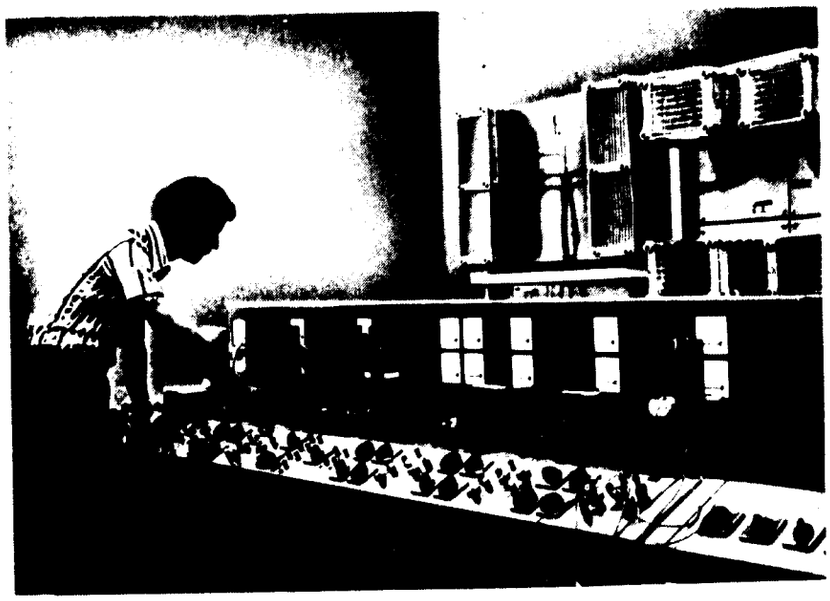


Photometry, determination of luminous flux of incandescent lamps using integrating sphere

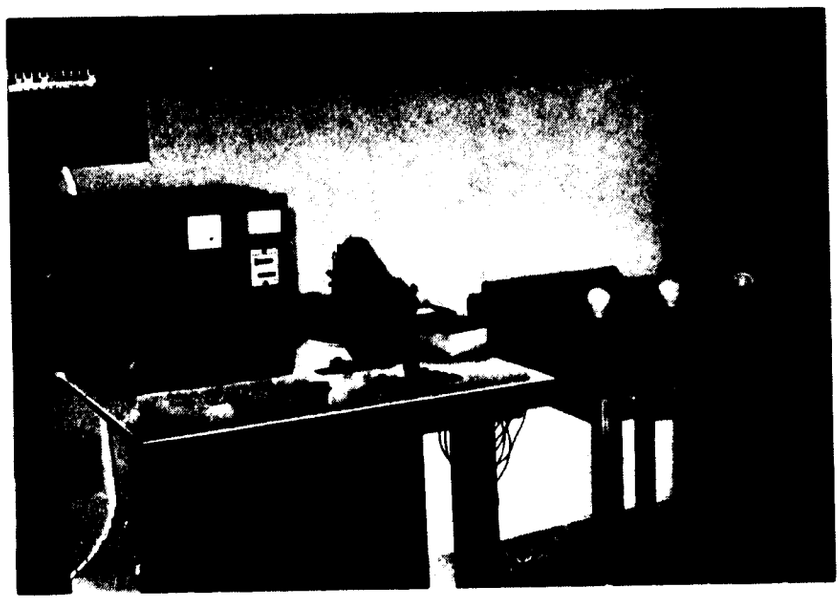
Electricity division, control desk for storage batteries testing



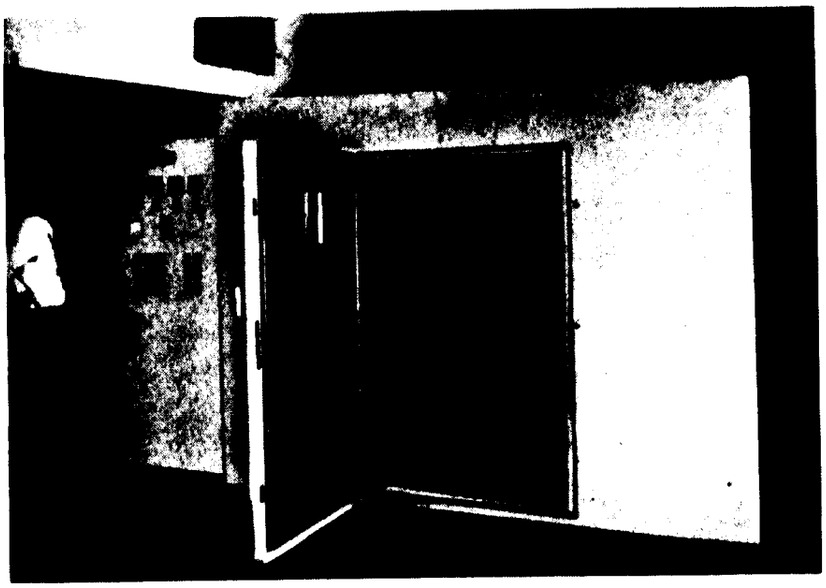
Electricity division, testing of dry batteries



Electricity division, life tests on switches, plugs and socket outlets



Electricity division, wear tests on lamp holders



Climatic chamber for environmental testing, volume 16 m^3,
temperature range from -20° to $+65^\circ$ C

General view of machine hall showing universal testing machines,
60 ton (0.6 MN) and 10 ton (0.1 MN), and 1000 kg
weigh-bridge for calibration of heavy weights

Metallurgy division, microscopy room with micro hardness-tester and universal metal microscopes

Metallurgy division, precision workshop and drawing office

Annex VII

INVENTORY OF EQUIPMENT IN THE INSTITUTE OF STANDARDS AND INDUSTRIAL RESEARCH OF IRAN

Mechanical Metrology Division, Metrology Centre

Force and pressure calibration room (Room 3), basement

Equipment room file	Equipment marked	Item	Manufacturer
1.	UN 0181 to UN 0188	Dynamometer, optical reading type MBO, 100 kp, 500 kp, 1.5 Mp 5 Mp, 20 Mp, 60 Mp, two microscopes	Wazau, Federal Republic of Germany
2.	UN 0189 to UN 0194	Dynamometer, dial indicator reading type MBM, 100 kp, 500 kp 1.5 Mp, 5 Mp, 20 Mp, 60 Mp, one accessory box UN 0194A	Wazau, Federal Republic of Germany
3.	UN 0195	Dynamometer, dial indicator reading type MBM, 300 Mp	Wazau, Federal Republic of Germany
4.	UN 0348 UN 0349	Force calibrating machine 13.5 Mp Force calibrating machine 67.5 Mp	Morehouse, USA
5.	UN 0239 to UN 0243	Manometer test equipment	Budenberg, U K
6.	UN 0534	Test manometers, 0-10 , 0-25 0-60, 0-160, 0-250, 0-600 kp/cm^2 (two of each)	OTA Industriegeraete, Federal Republic of Germany
7.	UN 0546 to UN 0549	Double laboratory pressure test gauges, 0-10, 0-25, 0-63 and 0-250 kp/cm^2 (one of each)	OTA Industriegeraete, Federal Republic of Germany

Balances room (Room 4), basement, Metrology Centre

Equipment room file	Equipment marked	Item	Manufacturer
1.	UN 002	Capacity standards 1 ml to 20 l, glass	Service des instruments de mesure, France
2.	UN 070	Top loading single pan balance 1200 g type P 1200 N	Mettler, Switzerland
3.	UN 071	Top loading balance 2000 g type P 2000 N	Mettler, Switzerland
4.	UN 072	Analytical balance 240 g type H311	Mettler, Switzerland
5.	UN 073	Analytical balance 240 g type H311	Mettler, Switzerland
6.	UN 0124	Glass containers for thermostats	Prolabo, France
7.	UN 0130	Two-pan balance 200 g type G41	Stanton, U K
8.	UN 0131	Weights, stainless steel, 10 mg to 100 g type SR1	Stanton, U K
9.	UN 0132	Microbalance 20 g type 1802	Sartorius, FRG
10.	UN 0133 UN 0134 UN 0135	Beamscales, Inspector's type 25 kg, 5 kg and 0.2 kg	Reverifications Ltd, U K
11.	UN 0136 UN 0137	Precision balance 25 kg Precision balance 5 kg	Reverifications Ltd, U K
12.	UN 0199	Brass cylindrical weights 1 mg to 20 kg	Reverifications Ltd, U K
13.	UN 0236	Platform balance 1000 kg with drop weight cabinet	BIW(Berliner Industrie-waagenfabrik), FRG
14.	UN 0237	Standard barometer type 20k	Fuess, Berlin, FRG
15.	UN 0316	Primary 1 kg standard stainless steel Ser No 71	Prolabo, France
16.	UN 0317	Analytical weights 1 mg to 100 g, Ser No 29750	Prolabo, France
17	UN 0318 to UN 0345	Hydrometers and liquid density measuring equipment including tensiometer for surface tension determinations	Prolabo, France

continued

Equipment room file	Equipment marked	Item	Manufacturer
18.	UN 0352 UN 0353	Brass rectangular weights 1 mg to 2 kg in leather boxes(two)	Reverifications Ltd, U K
19.	UN 0439	Damping pads for weighing tables	Mettler, Switzerland
20.	UN 0532 UN 0533	Stainless steel weights 1 mg to 20 kg ISIRI "B" Do. 1 g, 10 g, 100 g, 1 kg, 10 kg ISIRI "B"*	Oertling, U K
21.	UNESCO 681	Microbalance 20 g type M5	Mettler, Switzerland
22.	UNESCO 682	Analytical balance 160 g type H20T	Mettler, Switzerland
23.	UNESCO 683	Analytical balance 200 g type B5	Mettler, Switzerland
24.	UNESCO 684	Top loading balance 5 kg type P5	Mettler, Switzerland
25.	UNESCO 685	Top loading balance 1200 g type P1200	Mettler, Switzerland

Note: The last five items were supplied by a UNESCO technical assistance mission in 1968.

Engineering metrology laboratory, (Room 6), basement, Metrology Centre

Equipment room file	Equipment marking	Item	Manufacturer
1.	UN 039 to UN 041	Primary gauge block sets 1-100 mm, 200-500 mm, 1000 mm	Hommelwerke, FRG
2.	UN 042 UN 043	Gauge block mounting holders	Hommelwerke, FRG
3.	UN 044 UN 045	Interference lamp Optical flat	Hommelwerke, FRG
4.	UN 046 UN 047 UN 048	Divided scales(two), 500 mm Divided scales(two), 1000 mm Divided scales(two), 2000 mm	Hommelwerke, FRG
5.	UN 067	Profile projector type P 215	Hauser, Switzerland
6.	UN 0138 to UN 0143	Thermographs(six), 0-40°C	Lambrecht, FRG
7.	UN 0144 to UN 0149	Hygrographs(six)	Lambrecht, FRG
8.	UN 0150 to UN 0169	Hygrometers(twenty)	Lambrecht, FRG
9.	UN 0170 to UN 0173	Hygrometers(four), polymeter type	Lambrecht, FRG
10.	UN 0173A&B UN 0174-75	Whirling psycrometers(two) Aspiration psycrometers(two)	Lambrecht, FRG
11.	UN 0176	Cup anemometer 1.2 to 60 m/s	Lambrecht, FRG
12.	UN 0177	Barograph.	Lambracht, FRG
13.	UN 0238	Universal length measuring machine MUL- 1000	SIP, Switzerland
14.	UN 0261 to UN 0315	Engineering metrology equipment: calipers, micrometers, dial indicators, gauge block comparator	Carl Mahr, FRG
15	UN 0370 to UN 0390	Engineering metrology equipment: surface plates, micrometers, gauge block set, height micrometer	CE Johansson, Sweden

Electrical Metrology Laboratories, Metrology Centre

Second floor, (Room 204)

Equipment room file	Equipment marked	Item	Manufacturer
1.	UN 001	Electrometer type 610C	Keithley, USA
2.	UN 006-007	Hand tachometers(two)	Deuta-werke, FRG
3.	UN 008-009	Weston standard cells(two)	Tettex, Switzerland
4.	UN 010-011	Kelvin bridge & wire holder	Tettex, Switzerland
5.	UN 012-013	Slide wire bridges(two)	Tettex, Switzerland
6.	UN 014-023	Thermocouple switches	Croydon Instr., U.K.
7.	UN 024	Decade resistor type 1433	General Radio, USA
8.	UN 025-026	Decade capacitors type 1412	General Radio, USA
9.	UN 027	Stroboscope	General Radio, USA
10.	UN 028-030	Thermal transfer voltmeter	Holt, USA
11.	UN 031-032	Audio power amplifiers	Holt, USA
12.	UN 033-035	Memo oscilloscope type R5031	Tektronix, USA
13.	UN 036-038	Oscilloscope polaroid camera	Tektronix, USA
14.	UN 049-050	Multiscript recorders	Goerz, Austria
15.	UN 060-066	Verispot antivibratory galvanometers	SEFRAM, France
16.	UN 068	AC burden for current trfs	Tettex, Switzerland
17.	UN 087-091	Multizet multimeters	Siemens, FRG
18.	UN 092-095	Shunts 30 mV(four)	Siemens, FRG
19.	UN 096-097	Thermizet thermometers	Siemens, FRG
20.	UN 098-099	Millivoltmeters DC	Siemens, FRG

21.	UN 0100-0123	Time switches	Suevia, FRG
22.	UN 0126	Power supply 60 V 15 A B60-15	Oltronix, Sweden
23.	UN 0178	Digital multimeter type 7110	Systron-Donner, USA
24.	UN 0179	Digital printer type 5103	Systron-Donner, USA
25.	UN 0180	Digital counter-timer type 6150	Systron-Donner, USA
26.	UN 0196	Scale expander for Multiscript	Goerz, Austria
27.	UN 0200-0202	Three standard resistors 10 kohm	General Radio, USA
28.	UN 0203-0204	Two standard capacitors 1000 pF	General Radio, USA
29.	UN 0205-0206	Capacitance bridge type 1620AP	General Radio, USA
30.	UN 0207-0208	Impedance bridge type 1608A	General Radio, USA
31.	UN 0209	Light-spot watt-meter 0.5/1 A	Siemens, FRG
32.	UN 0210	Light-spot watt-meter 2.5/5 A	Siemens, FRG
33.	UN 0211-0212	Light-spot ammeter 3/6A & trf	Siemens, FRG
34.	UN 0213	Variable phase generator 203A	Hewlett-Packard, USA
35.	UN 0214	Function generator 3310A	Hewlett-Packard, USA
36.	UN 0215	AC voltmeter 403B	Hewlett-Packard, USA
37.	UN 0216-0217	DC power supply 32 V 30 A (two)	Oltronix, Sweden
38.	UN 0218-0220	DC power supply 32 V 10 A(three)	Oltronix, Sweden
39.	UN 0221	DC power supply 60 V 10 A	Oltronix, Sweden
40.	UN 0222-0227	Two potentiometric recorders, with two channels and accessories	Goerz, Austria

41.	UN 0228	XY graphic recorder	Goerz, Austria
42.	UN 0229-0232	Magnetic thickness gauges	Elektro-Physik, FRG
43.	UN 0233	Recording amperemeter 5 to 20 A	Esterline-Angus, USA
44.	UN 0234	Recording voltmeter 150 to 600 V	Esterline-Angus, USA
45.	UN 0235	Recording wattmeter 0-2 kW	Esterline-Angus, USA
46.	UN 0244	Primary standard cell enclosure type 9152/ 10 cells	Guildline, Canada
47.	UN 0245	Transvolt standard cell enclosure	Guildline, Canada
48.	UN 0246	Six-dial potentiometer 9160GD	Guildline, Canada
49.	UN 0247	Voltbox 1 to 1000 V type 9715	Guildline, Canada
50.	UN 0248	Six standard resistors 1, 10, 100 ohm, 1, 10, 100 kohm	Guildline, Canada
51.	UN 0249-0250	Two standard resistors 1 ohm 10W	Guildline, Canada
52.	UN 0251-0252	Two stndard resistors 0.1ohm50 W	Guildline, Canada
53.	UN 0253	Standard resistor 0.01 ohm 200 W	Guildline, Canada
54.	UN 0254	Multiple four terminal resistor	Guildline, Canada
55.	UN 0255	Current transformer test set	Guildline, Canada
56.	UN 0256	Voltage divider 10 kV	Fluke, USA
57.	UN 0257	Voltage standard type 335A	Fluke, USA
58.	UN 0258	High voltage DC supply type 415B	Fluke, USA
59.	UN 0259	DC power supply 500 V type 407D	Fluke, USA
60.	UN 0260	Differential rms voltmeter 931B	Fluke, USA

61.	UN 0350-0351	Electronic parts, tools	SIPE, France
62.	UN 0369	Spring impact hammer(to IEC spec)	Crater Controls, UK
63.	UN 0391-0395	Five Elavi3 multimeters	Hartmann & Braun, FRG
64.	UN 0396-0398	Three wattmeters type EBGW	Hartmann & Braun, FRG
65.	UN 0399-0402	Four amperemeters type EBFA	Hartmann & Braun, FRG
66.	UN 0403-0406	Four voltmeters type EBFV 300 V	Hartmann & Braun, FRG
67.	UN 0407-0409	Three milliamperemeters EBFA 600mA	Hartmann & Braun, FRG
68.	UN 0410-0412	Thrre voltmeters EBFV 30 V	Hartmann & Braun, FRG
69.	UN 0413	Clip-on amperemeter-voltmeter	Hartmann & Braun, FRG
70.	UN 0414-0415	Two INKAVI RLC-bridges	Hartmann & Braun, FRG
71.	UN 0416-0419	Four current transformers TiL05	Hartmann & Braun, FRG
72.	UN 0420-0422	Three current transformers EBTIV	Hartmann & Braun, FRG
73.	UN 0423	Multiple current transformer Ti53	Hartmann & Braun, FRG
74.	UN 0424-0426	Three Aracomp 6-point recorders	Hartmann & Braun, FRG
75.	UN 0440-0449	Ten program timers type KKB 40	SAIA, Switzerland
76.	UN 0450-0455	Six "Tempotac" timers	SAIA, Switzerland
77.	UN 0462	Adaptors for bridge UN 0205	General Radio, USA
78.	UN 0479	Wattmeter class 0.2 2.5/5 A	Goerz, Austria
79.	UN 0480	Current transformer 0.1 to 100 A	Goerz, Austria
80.	UN 0481	Amperemeter 0.2 to 5 A , 0.2 %	Goerz, Austria

81.	UN 0482	Voltmeter 75-15-300 V, 0.2 %	Goerz, Austria
82.	UN 0483	mA-meter-amperemeter 15mA-30 A	Goerz, Austria
83.	UN 0484-0485	Two millivoltmeter-voltmeters	Goerz, Austria
84.	UN 0486-0490	Four shunts 75-7.5-300-750 A	Goerz, Austria
85.	UN 0494	High voltage tester 50kV PGK50HB	Baur, Austria
86.	UN 0495-0498	Four reference ballasts for flourescent lamps 2x 20 W,2x40W	May & Christie, FRG
87.	UN 0499 UN 0500	Tracking test apparatus Hot mandrel test apparatus	Phys.Techn.Labor, FRG
88.	UN 0501	Insulation tester 5 kV PKG0.2-5	Moser-Glaser, Switzerland
89.	UN 0502-0503	Cosphimeter & voltage multiplier	Goerz, Austria
90.	UN 0505	Hour counters, impulse counters	Irion & Vosseler, FRG
91.	UN 0511-0513	Three "Tempotac" timers K0A3.e15	SAIA, Switzerland
92.	UN 0523	Oil tester 90 kV type PG090S-2	Baur, Austria
93.	UN 0527-0531	Gauges, test caps, steel balls for electrical testing (to CEE)	Physikalisch-Technisches Labor, FRG
94.	UN 0548	Resistance bridge type 9975, current comparator type	Guildline, Canada
96.	UN 0555	Precision oil bath for resistance measurements	Guideline, Canada

Photometry Laboratory, Metrology Centre

Basement (Room 117), (file in office next to Room 117)

Equipment room file	Equipment marked	Item	Manufacturer
1.	UN 0460	Stabilizer DC 300 V 5 A	Fontaine, France
2.	UN 0478	Optical parts	Spindler & Hoyer, FRG
3.	UN 0493	Optical bench	Bouty, France
4.	UN 0524	Standard incandescent lamps	Osram, FRG
5.	UN 0525	Integrating sphere 2.5 m	Schmidt & Haensch, FRG
6.	UN 0551	Spectral lamp	Spindler & Hoyer, FRG
7.	UN 0552	Optical filters	Jenaer Glaswerk, FRG
8.	UN 0553	Powder press for reflectance standards	Zeiss, FRG
9.	UN 0554	Digital photometer	
10.		Electrical instruments for lamp testing and photometry inventoried in the electrical metrology, Room 204, on loan to the photometry laboratory. (See files Room 204 for details, list of instruments in file No. 10, Room 117).	

Thermometry Laboratory, Metrology Centre

2nd floor, (Room 230), (file in room 230)

Equipment room file	Equipment marked	Item	Manufacturer
1.	UN 0354-0368	Thermocouple wire	Degussa, FRG
2.	UN 0456-0458	Thermometer bridge portable potentiometer	Cropico, U K
3.	UN 0459	DC stabilizer 50 V 20 A	Fontaine, France
4.	UN 0463-0468	Pyrometer lamps	General Electric, U K
5.	UN 0469-0474	Thermostates	Haake, FRG
6.	UN 0475-0477	Triple point cells	Spembly, U K
7.	UN 0491-0492	Calibration baths	Beopple, FRG
8.	UN 0504	Optical pyrometer	Leeds & Northrup, USA
9.	UN 0506-0508	Platinum resistance thermom.	Tinsley, U K
10.	UN 0509 UN 0510	Potentiometer type K-5 Millivolt potentiometer	Leeds & Northrup, USA
11.	UN 0514-0521	Thermocouple calibration furnace, three standard thermocouples	Johnsson-Matthey, U K
12.	UN 0522	Ice point reference cell	Mectron, U K

Metallurgy Division, Metrology Centre

First floor, (Rooms 124,125,129,130), (file in office room 125)

Equipment room file	Equipment marked	Item	Manufacturer
1.	UN 003	pH-meter	Beckman, USA
2.	UN 004	Portable hardness tester	Ernst, Switzerland
3.	UN 005	Microscope MeF 2	Reichert, Austria
4.	UN 051	Laboratory sifter	Fischer, Switzerland
5.	UN 052	Corrossion chamber	Huber, Switzerland
6.	UN 053	Microhardness tester	Zwick, FRG
7.	UN 054-059	Furnaces	Hereaus, FRG
8.	UN 069	Hydraulic pump 1000 at	Hausser, FRG
9.	UN 074-077	Grinding machine	Naxos, Sweden
10.	UN 078-086	Polishing equipment	Struers, Denmark
11.	UN 0215	Plastic sinks	Vulcathene, U K
12.	UN 0217	Strain-gauge amplifier	Automation-Peekel, Netherlands
13.	UN 0197-98	Stereomicroscope	American Optical, USA
14.	UN 0424-37	Sand testing equipment	Fischer, Switzerland
15.	UN 0438	Sand tester Permaran	Outokumpu, Finland
16.	UN 0461	Tensile tester 500 kp	Instron, U K

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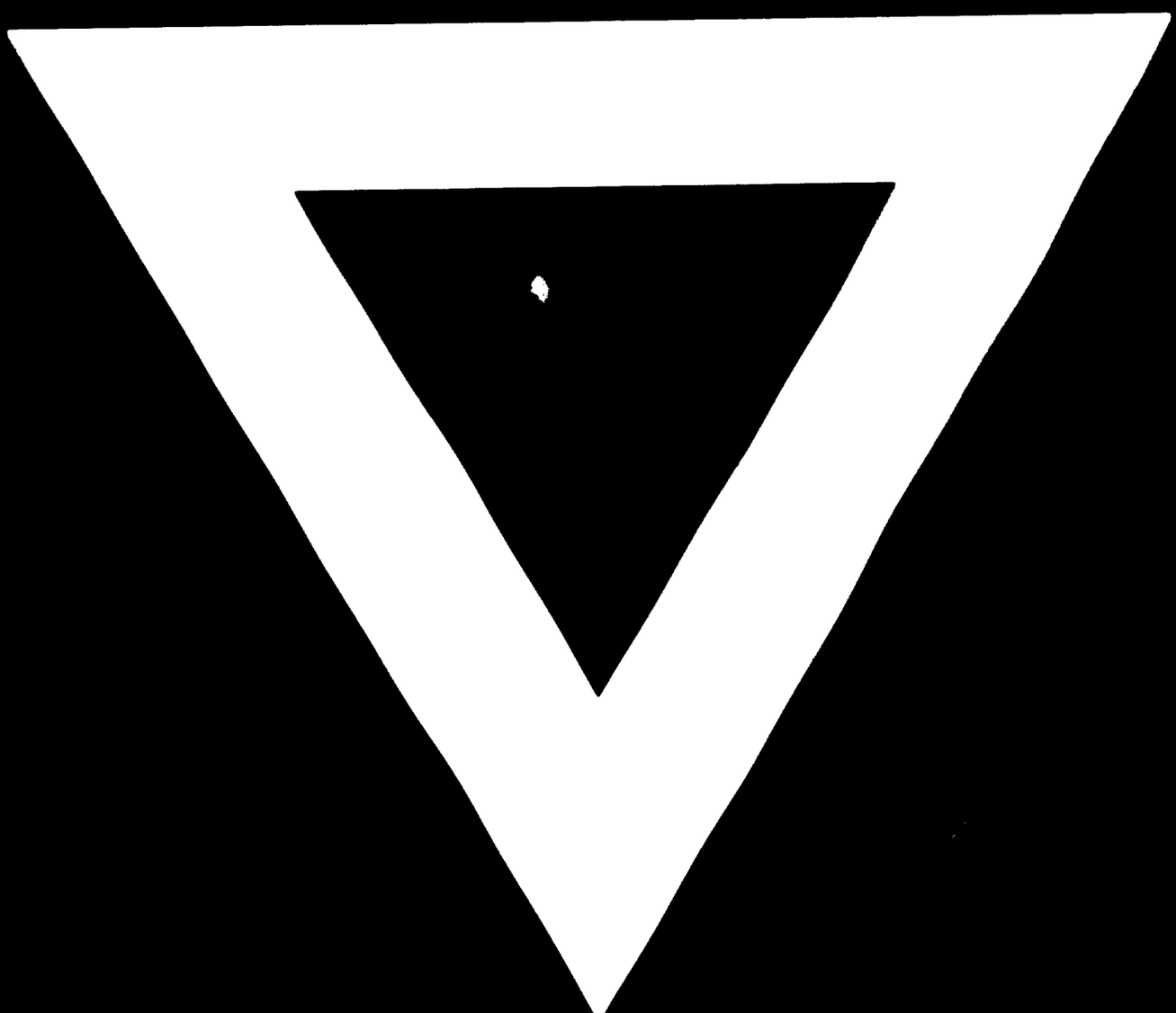

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