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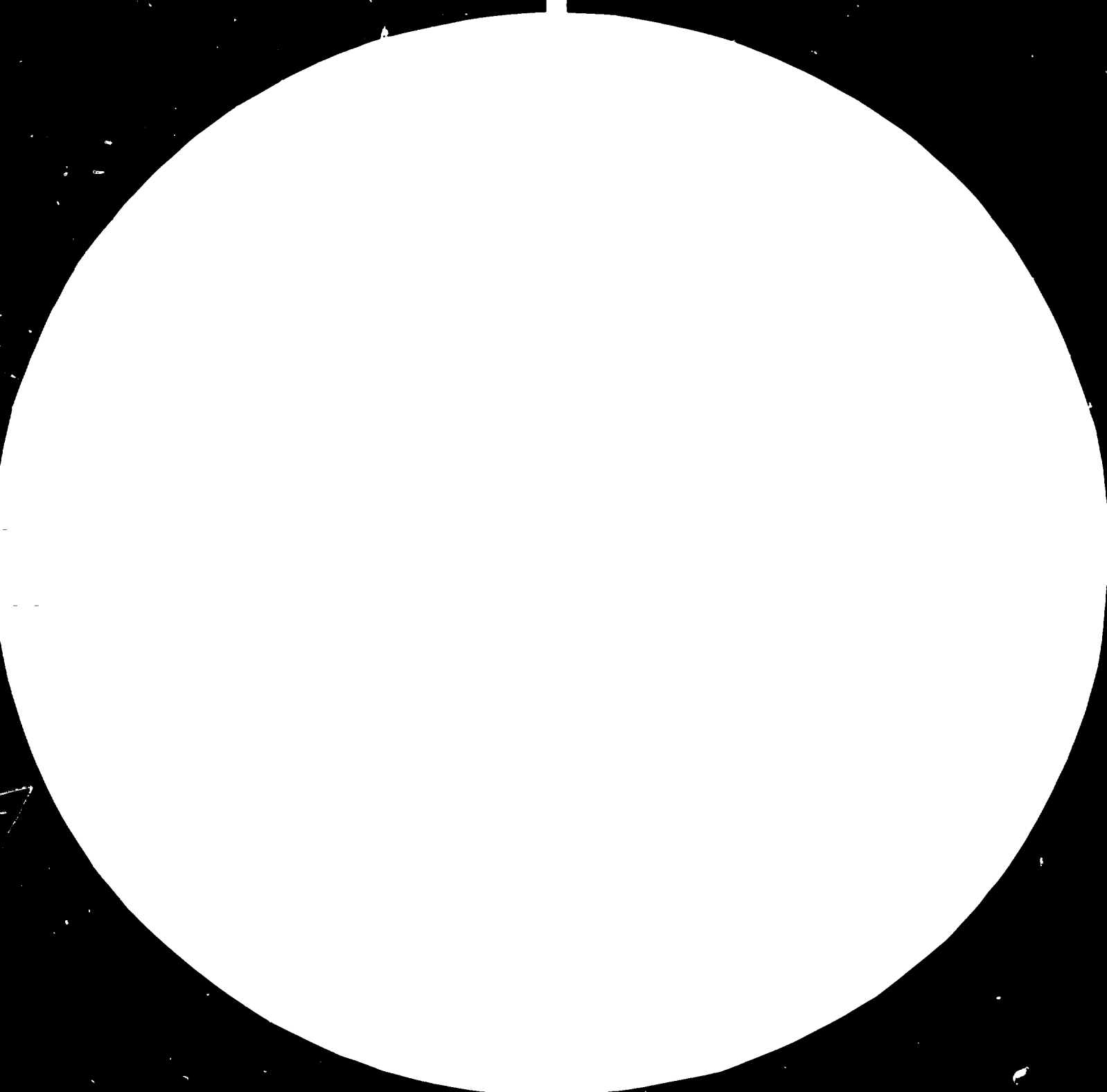

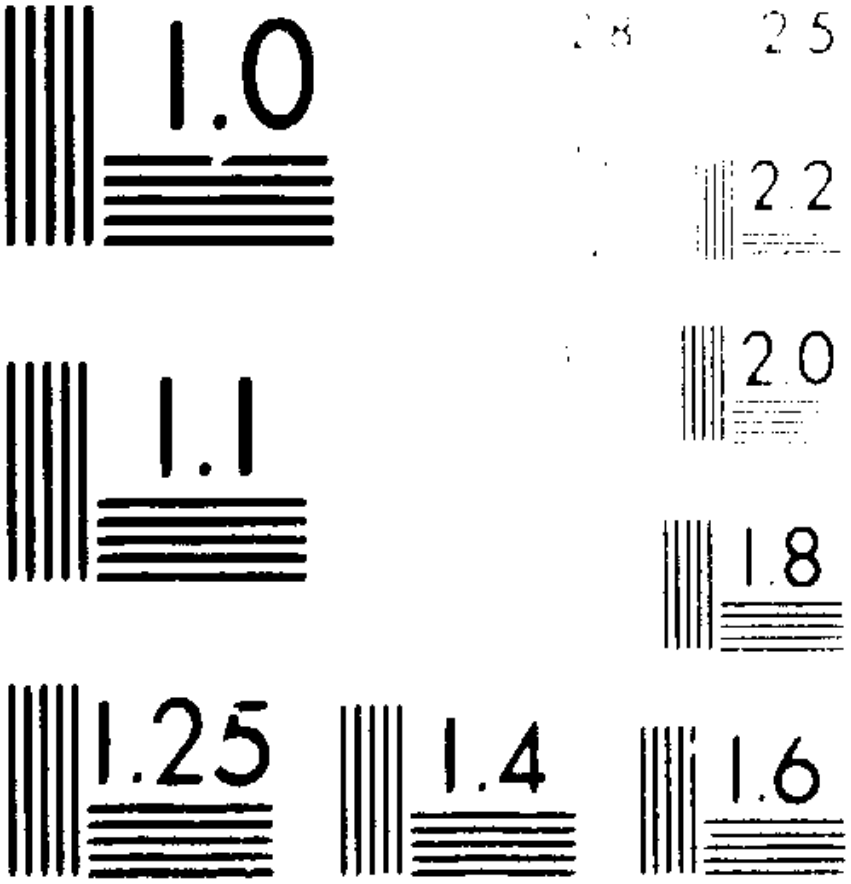
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FINAL REPORT ON A CONTRACT BETWEEN

THE UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION

and

THE CRANFIELD INSTITUTE OF TECHNOLOGY

for the provision of services relating to

ASSISTANCE TO THE ETHIOPIAN STANDARDS INSTITUTION IN THE ESTABLISHMENT OF A NATIONAL QUALITY CONTROL AND TESTING CENTRE IN ETHIOPIA

Project No. DP/ETH/75/010
Contract No. 77/108

A. J. Scarr

June 1978

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SUMMARY

This report contains an assessment of the requirements for establishing a Quality Control and Testing Centre for the Ethiopian Standards Institution. The laboratory facilities include provision for testing in the areas of Building and Civil Engineering, Mechanical Engineering, Electrical Engineering, Chemical Engineering and Textiles, Foodstuffs, Fertilizers etc. The overall cost of the project is estimated at US $1418 550; of this sum US $792 900 is required for equipment, US $ 486900 for experts and US $ 72000 for fellowship training. The project is scheduled to run for three years commencing in April 1979.

Consideration is also given to the requirements for establishing a National Metrology Centre in Ethiopia. Calibration facilities for the following fundamental units are included in the assessment - length, mass, volume, electrical units, time and temperature. These requirements have been dealt with separately as it is proposed that they do not form part of the UNIDO funded project.

CONTENTS

INTRODUCTION

The Ethiopian Standards Institution (ESI) was established in September 1970 and in 1972 Proclamation No. 300 provided the ESI with the power to:

- prepare compulsory as well as optional Ethiopian standards relating to practices, processes, materials, products and commodities in the field of commerce and industry and enforce the same.
- authorise the use of the Standards Mark to be affixed to materials, products and commodities which conform to Ethiopian Standards.
- certify important export materials, products and commodities which conform to Ethiopian Standards
- examine and test materials, products, commodities, practices and processes, and conduct any investigation or research that may be necessary.
- ensure by inspection and checking whether materials, products, commodities, practices and processes conform to Ethiopian Standards and
- fix, impose and collect fees for services rendered by the Institution.

Since that time and with assistance provided under UNIDO technical assistance project ID/OA 321 ETH/2 and UNIDO project ETH 081- A(ID) a total of 108 Ethiopian Standards (ES) have been printed, and are under implementation, 345 standards are ready for printing and over 760 are in the course of preparation. The range of subjects covered by these standards include Building and Civil Engineering, Mechanical Engineering, Chemical Engineering, Electrical Engineering, Foodstuffs, Drinking Water, Fertilizers, Textiles, etc.

The most pressing and urgent need now is for ESI to be able to test materials, products and commodities against these standards to ensure their conformity with the various detailed specifications.

The justification for providing facilities to enable this testing to be carried out may be summarised as follows:

(a) There will be an increasing need to be able to prove that products exported from Ethiopia meet requirements set in standard specifications.

(b) It is necessary to be able to test products imported into Ethiopia to ensure that they conform to requirements set in standard specifications.

(c) It is essential to be able to test products manufactured in Ethiopia for internal consumption, to ensure that consumers are protected against buying sub-standard or dangerous products.

(d) In order to strengthen the national standards preparation activity pursued by the Ethiopian Standards Institution, local technical data and test results should be made available to resolve essential technological and economic problems encountered in the formulation of Ethiopian Standards.

(e) It is essential that a National Quality Control Testing Centre be created to serve as a reference point in the introduction and operation of quality control methods at the enterprise level in the country.

(f) It is necessary that applied research for quality improvement be maintained in order to assist in the development and application of technologies aimed at improving quality and production efficiency.

The terms of reference for the consultancy agreement between UNIDO and the Cranfield Institute of Technology are contained in UNIDO Contract 77/108. Essentially the contract required the writer (A.J.Scarr) to

visit the ESI in Addis Ababa on a fact finding mission; this was followed by a period in the Home Office analysing the data collected and formulating the draft final report. A return visit to the ESI was made by the writer before preparing the final report.

Detailed discussions were held with all the senior members of staff within ESI and visits were arranged to the following Government Departments, Educational Establishments and industry:

Ethiopian Nutrition Institute
Central Laboratory and Research Institute
Addis Ababa Water and Sewerage Authority
Ethiopian Electric Light and Power Authority
Materials Testing Centre
Ministry of Mines, Water and Energy
Civil Aviation Authority (Ethiopian Airlines)
Faculty of Science, Addis Ababa University
Faculty of Technology, Addis Ababa University
Akaki Textile Mills
Ethiopian Sewing Thread Co.,
Girmanys Balance and Weights Manufacturing Co.,
National Consultants

The writer is very appreciative of the help given by the various members of these organisations.

The writer would also like to place on record his appreciation of the wholehearted and unstinted support given to him by the General Manager of ESI and the members of his staff during the fact finding mission. The value and effectiveness of this report is due in large measure to their efforts and enthusiasm.

The consultancy required an assessment to be made and recommendations formulated under the following headings:

(a) The experts, consultants and fellowships required
(b) The equipment requirements for the various laboratories
(c) A recommended programme of implementation for the UNIDO project
(d) The design of the new ESI laboratory facilities
(e) An assessment of the proposed organisational structure of the ESI

Each of these topics is dealt with in detail in the appropriate sections of this report and a 'Draft Project Document' is included as Appendix 1. In addition the writer was asked to assess the building and equipment requirements for establishing a National Metrology Centre (NMC) to be built within the ESI complex. These requirements have been dealt with separately in Appendix 4 as they do not form part of the proposed UNIDO funded project, although it is important to stress that the NMC will form an integral part of the overall ESI activities.

PROJECT PERSONNEL AND FELLOWSHIPS

It is recommended that a total of nine experts and consultants be assigned to the Project as follows:

(i) Project Manager
(ii) Expert on national quality control and certification marking schemes
(iii) Consultant in establishing and furnishing laboratories
(iv) Consultant on quality control and testing of building materials
(v) Consultant on quality control and testing of chemical products
(vi) Consultant on quality control and testing of electrical products
(vii) Consultant on quality control and testing of textile products
(viii) Consultant on quality control and testing of food and agricultural products
(ix) Consultant on equipment maintenance and servicing

In addition provision is made for twelve international fellowships of four months duration each.

The phasing of the experts, consultants and fellowships into an appropriate timescale is shown in Fig. 1. Detailed job descriptions may be found in the Draft Project Document, Appendix 1.

EQUIPMENT REQUIREMENTS

Detailed equipment requirements have been established for each of the activities in the Quality Control and Testing Centre. The information regarding equipment specifications and costs has been included in Appendix 2 and a list of the names and addresses of manufacturers who could supply this equipment may be found in Appendix 3.

It is recommended that the equipment purchased should conform to the following general requirements:

(a) register measurements in SI units

(b) wherever possible be self-calibrating (although it is recognised that the National Metrology Centre will have an important role to play in ensuring that the equipment used in the Quality Control and Testing Centre is regularly calibrated).

(c) wherever possible be provided with a digital readout and/or have provision for producing signals suitable for remote recording or print out.

(d) shall conform with the appropriate Ethiopian Standards Specifications.

When ordering equipment consideration should be given to the very real problem which exists in servicing and repairing the more sophisticated items. These problems will be eased if one manufacturer is chosen to supply a group of equipment which has identifiably similar characteristics, e.g. spectroscopic chemical analysis. Certain items of equipment required by ESI are in existence in other laboratories in Ethiopia, e.g. compression machine for testing concrete cubes, and it would be desirable for similar equipment to be ordered for this project.

The total cost of the equipment specified is US $792 900 and the breakdown of this total into various categories is included in Table 3 on page 8 .

PROJECT BUDGET

A detailed breakdown of the funding required for this project over the period 1979 to 1982 is contained in Tables 1, 2 and 3. Table 1 relates to the funding for experts and consultants; Table 2 relates to the cost of fellowship training and Table 3 provides detailed information on the equipment costs.

TABLE 1 PROJECT BUDGET

Experts & Consultants

Experts	TOTAL		1979		1980		1981		1982	
	m/m	US $	m/m	US $	m/m	US $	m/m	US $	m/m	US $
(i) Project Manager	36	170100	9	40500	12	57600	12	57600	3	14400
(ii) Expert on national quality control & certification marking schemes	24	115200			12	57600	12	57600		
(iii) Consultant in establishing and furnishing laboratories	6	28800			6	28800				
(iv) Consultant on quality control & testing of building materials	6	28800			3	14400	3	14400		
(v) Consultant on quality control & testing of chemical products	6	28800			3	14400	3	14400		
(vi) Consultant on quality control & testing of electrical products	6	28800			3	14400	3	14400		
(vii) Consultant on quality control & testing of textile products	6	28800			3	14400	3	14400		
(viii) Consultant on quality control & testing of agricultural & food products	6	28800			3	14400	3	14400		
(ix) Consultant on equipment maintenance & servicing	6	28800					6	28800		
TOTAL	102	486900	9	40500	45	216000	45	216000	3	14400

TABLE 2

PROJECT BUDGET

FELLOWSHIPS

		TOTAL		1980		1981	
		m/m	US$	m/m	US$	m/m	US$
(i)	Quality control & testing of building materials	8	12 000	2	3 000	6	9 000
(ii)	Quality control & testing of chemical products	8	12 000	2	3 000	6	9 000
(iii)	Quality control & testing of electrical products	8	12 000	2	3 000	6	9 000
(iv)	Quality control & testing of textiles	8	12 000	2	3 000	6	9 000
(v)	Quality control & testing of agricultural and food products	8	12 000	2	3 000	6	9 000
(vi)	Maintenance & servicing of mechanical equipment	4	6 000			4	6 000
(vii)	Maintenance & servicing of electrical equipment	4	6 000			4	6 000
	TOTAL	48	72 000	10	15 000	38	57 000

TABLE 3

PROJECT BUDGET

EQUIPMENT

	TOTAL	1979	1980
Building Materials & Mechanical Testing	243 600	100 000	143 600
Textiles & Leather Products Testing	110 200	50 000	60 200
Electrical Products Testing	42 600		42 600
Chemical Products Testing	216 600	100 00	116 600
Petroleum Products Testing	36 400		36 400
Maintenance & Servicing Workshop	107 900		107 900
Miscellaneous Equipment	35 600		35 600
Total US $	792 900	250 000	542 900

PRESENT STATUS OF GOVERNMENT FACILITIES

The ESI has been established since 1970 and has a total staff of 120 of whom 30 are qualified engineers and specialists. The Department of Technical Services is responsible for product testing against the appropriate ES and qualified members of staff are responsible for each product area. The senior members of the Department of Technical Services will act as counterparts to the UN experts and consultants and they will be available from the time the experts and consultants arrive.

At the present time the ESI is housed in a compound consisting of three buildings in the centre of Addis Ababa. However, the Government has provided land for the construction of the ESI complex including a materials testing laboratory, a biochemical laboratory and a maintenance and servicing workshop. The preliminary plans for these buildings have been reviewed as part of this consultancy and the recommended modifications are being incorporated into the final designs which the consultant architects will complete by October 1978. It is proposed to commence construction of the laboratory buildings during the first quarter of 1979 with the completion date scheduled for not later than September 1980.

The ESI has, at present, no testing facilities of its own but some testing experience has been gained by staff members by using facilities which are available in other organisations in Addis Ababa, e.g. Addis Ababa University, Ethiopian Nutrition Institute etc.

BUILDING REQUIREMENTS

The initial building layout and designs prepared by the local architects (National Consultants) have been reviewed and the suggested modifications and recommendations are discussed in detail under the separate headings of Material Testing Laboratory, Biochemical Laboratory and the Maintenance and Servicing Workshop. The National Metrology Centre is considered in detail in Appendix 4.

The overall layout of the site as proposed by the National Consultants is considered to be satisfactory. It must be emphasised, however, that in the writer's view it is essential for the whole site, i.e. Headquarters Building, Material Testing Laboratory, Biochemical Laboratory, Maintenance and Servicing Workshop and the National Metrology Centre be developed at the same time. The ESI would not be a viable organisation if the building programme was phased in any significant way, for example by building the laboratories first, followed at some later stage by the Headquarters Building.

Material Testing Laboratory

The overall layout for this laboratory is shown in Fig. 2. The total laboratory floor area is 1350 sq.m. There is likely to be a requirement for special foundations for the Hydraulically Operated Universal Testing Machine. The precise nature of these will depend on the particular machine chosen for the project and it is recommended that an area of 3m x 3m of the floor is left incomplete to simplify the building of the special foundations.

It will be necessary to provide the following services in the laboratory:

Electricity:	Single phase mains supply
Compressed air:	Dry compressed air at a pressure of 5 bars
Water:	Mains water supply

Separate air conditioning will be necessary in the Textile Testing Room to provide an environment of 20°C ± 1°C (temperature) and 65% ± 5% (relative humidity). The floor covering in the Textile Testing Room

and the Electrical Testing Room should be continuous welded PVC. It is suggested that laboratory furniture should comply with the general specifications indicated on page 12.

Biochemical Laboratory

The overall layout for this laboratory is shown in Fig. 3. The total laboratory floor area is 1300 sq.m.

It will be necessary to provide the following services in the laboratory:

Electricity:	Single phase mains supply
Water:	Mains water supply
Gases:	The following gases are used in connection with Atomic Absorption Spectrophotometry and Gas Chromatography - Acetylene, Nitrous Oxide, Argon, Hydrogen, Helium and Propane. (It should be noted that Copper and Acetylene react to produce explosive compounds. On no account should Copper tubing or fittings be exposed to Acetylene).

It is suggested that fume cupboards and laboratory furniture should comply with the general specification indicated on page 12. In addition it is necessary to have extraction apparatus mounted over the atomic absorption spectrophotometers. This is to:

(a) protect the operator from toxic fumes and vapours emitted from the flame

) keep the laboratory cool (the flame may generate as much as 3Kw of heat)

(c) protect the instrument itself from any corrosive vapours emitted from the flame

A suitable fume hood design is shown in Fig. 4. The hood should be mounted 150 to 230mm above the chimney of the spectrophotometer and a draught of at least 2800 litres/min should be provided. In view of

these extraction requirements, it is desirable to have this equipment situated against an external wall.

The floor covering in the Biochemical Laboratory should be continuous welded PVC.

Maintenance & Servicing Workshop

One of the important requirements for the long term viability and efficiency of the various laboratories within ESI, is the provision of adequately equipped workshop facilities. These, together with appropriately trained staff (note the provision of an expert and two fellowships) will ensure that the wide range of equipment used within the ESI is properly maintained and repaired. It will also be necessary from time to time, to manufacture test specimens, build test rigs and modify existing equipment. The facilities and expertise could be made available to other laboratories and establishments in Ethiopia when necessary.

The overall layout for the workshop is shown in Fig. 5. The total floor area is 625 sq.m.

Laboratory Furniture

The recommended dimensions for single sided work bench tops is 910mm high x 610mm deep and for double sided benching 910mm high x 1220mm deep. The recommended material for work bench tops is 25mm thick oiled teak or similar wood with a density of 0.64 to 0.80 g/cm^3, e.g. iroko. The exposed edges should be rounded at the top and throated on the underside. Where sinks are necessary, as in the wet chemical room, it is recommended that a stainless steel double drainer sink unit is placed at the end of the island fittings, as shown in Fig. 6.

Fume cupboards should be designed to use the stabilised extraction system as shown in Fig. 7. It is desirable that the air is extracted from each fume cupboard separately using a centrifugal fan. The recommended internal dimensions are 1200mm wide x 775mm deep x 1219mm high, with an access height of 830mm when the sash is fully raised.

To simplify air extraction, fume cupboards should be situated against external walls.

Handling Equipment

It is recommended that a fork lift truck be included in the equipment list as an alternative to installing overhead crane facilities in laboratories. The fork life truck offers a more flexible and cheaper solution to the handling requirements within ESI. However, it will be necessary to ensure that access into the various laboratories is on one level as it will not be possible for the fork lift truck to negotiate steps or kerb edges.

If the fork lift truck is made available as early in the project as possible, it will be of considerable use in installing equipment into the laboratories.

Organisational Structure

Detailed consideration has been given to the organisational structure and staffing requirements of the Quality Control and Testing Centre and its relationship to the National Metrology Centre within the Department of Technical Services. An organisational chart is shown in Fig. 8 which indicates the main organisational structure of ESI together with a detailed breakdown of the structure within the Department of Technical Services. It is recommended that the Materials Testing Laboratory and Biochemical Laboratory be combined organisationally to form a division within the Department of Technical Services and that the Reference Standards Laboratory and Calibration Laboratory would also form a Division. In the long term it may become necessary to separate the Materials Testing Laboratory and Biochemical Laboratory, as their work expands.

With reference to the staffing of the Quality Control and Testing Centre, it is suggested that the minimum staffing that would be required initially is as follows:-

(a) A Manager for the Centre. His duties will be mainly administrative and concerned with the efficient operation of the Centre. He will

be required to develop and maintain effective links with industry and will also be responsible for the efficient co-ordination of the Centre's activities with related activities within ESI.

(b) Section Heads for each of the main activities in the Centre, i.e. building materials, petroleum products, chemical products, electrical products, textile products, agricultural and food products, maintenance and servicing. Each Section Head will be responsible to the Manager of the Centre for the efficient operation of his particular area of specialisation. He must have a detailed knowledge of the test procedures required and of the equipment used in his section. He will ensure that the technical and clerical staff under his control operate efficiently, that suitable records are kept of all the test work undertaken and that future demands are anticipated and adequate provision made in terms of equipment and personnel.

(c) Technical staff for each of the main activities. These will be the people who undertake the detailed testing work in the Centre and each will be responsible to his appropriate Section Head. Each technician will be responsible for a range of tests and will have a detailed understanding of the test procedures and the operation of the equipment for which he is responsible. The irreducible minimum number of technical staff with which the Centre could operate is with one technician per product area. The total workload carried out in each product area will determine the number of technical staff which eventually need to be employed.

CONCLUSIONS

The information contained in this report will enable the Ethiopian Standards Institution to establish Quality Control and Testing Laboratories for the wide range of products which require testing.

The total UNDP funding required for the project is estimated to be US $1418500. Of this total US $ 486900 is required to provide 114 man months of expert and consultant assistance, US $ 72000 is required to provide 48 man months of fellowship training and US $792 900 is required for equipment.

The overall timescale for the project has been determined in conjunction with the proposed building programme for the Headquarters Building and the Laboratories. The project is scheduled to run for three years commencing in April 1979. A total of nine experts and consultants has been proposed together with provision for twelve fellowships. The detailed phasing of these activities into the overall timescale is shown in Fig. 1.

Detailed equipment lists have been prepared for the Quality Control and Testing Laboratory, the Biochemical Laboratory and the Maintenance and Servicing Workshop. Recommendations are included in the report on the overall size and layout of the various laboratories together with information on the services required in each laboratory and any special features that are necessary. This information should enable the local architects to proceed with preparing detailed plans for the ESI complex.

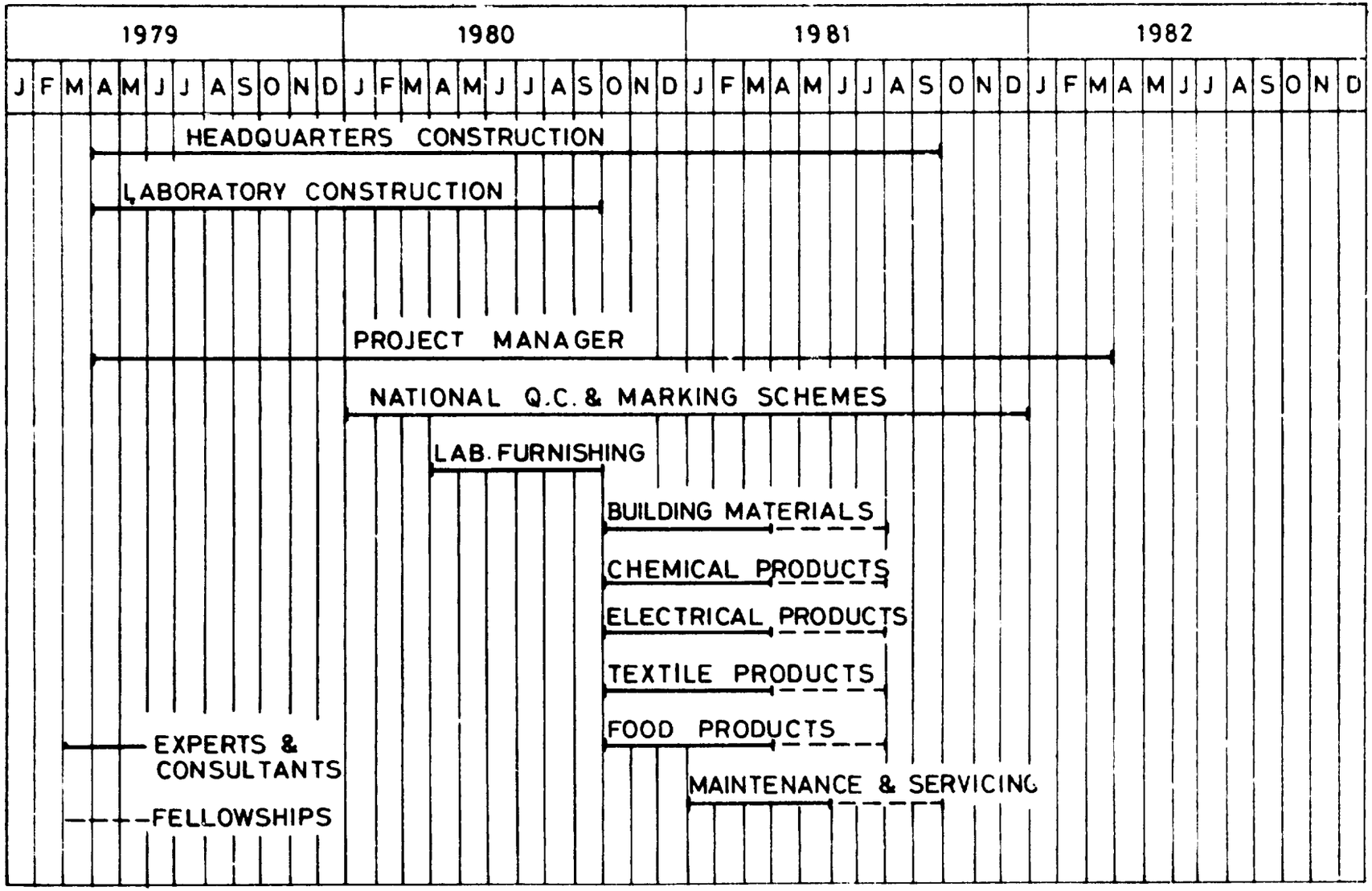


FIG. 1. PROJECT WORK PLAN

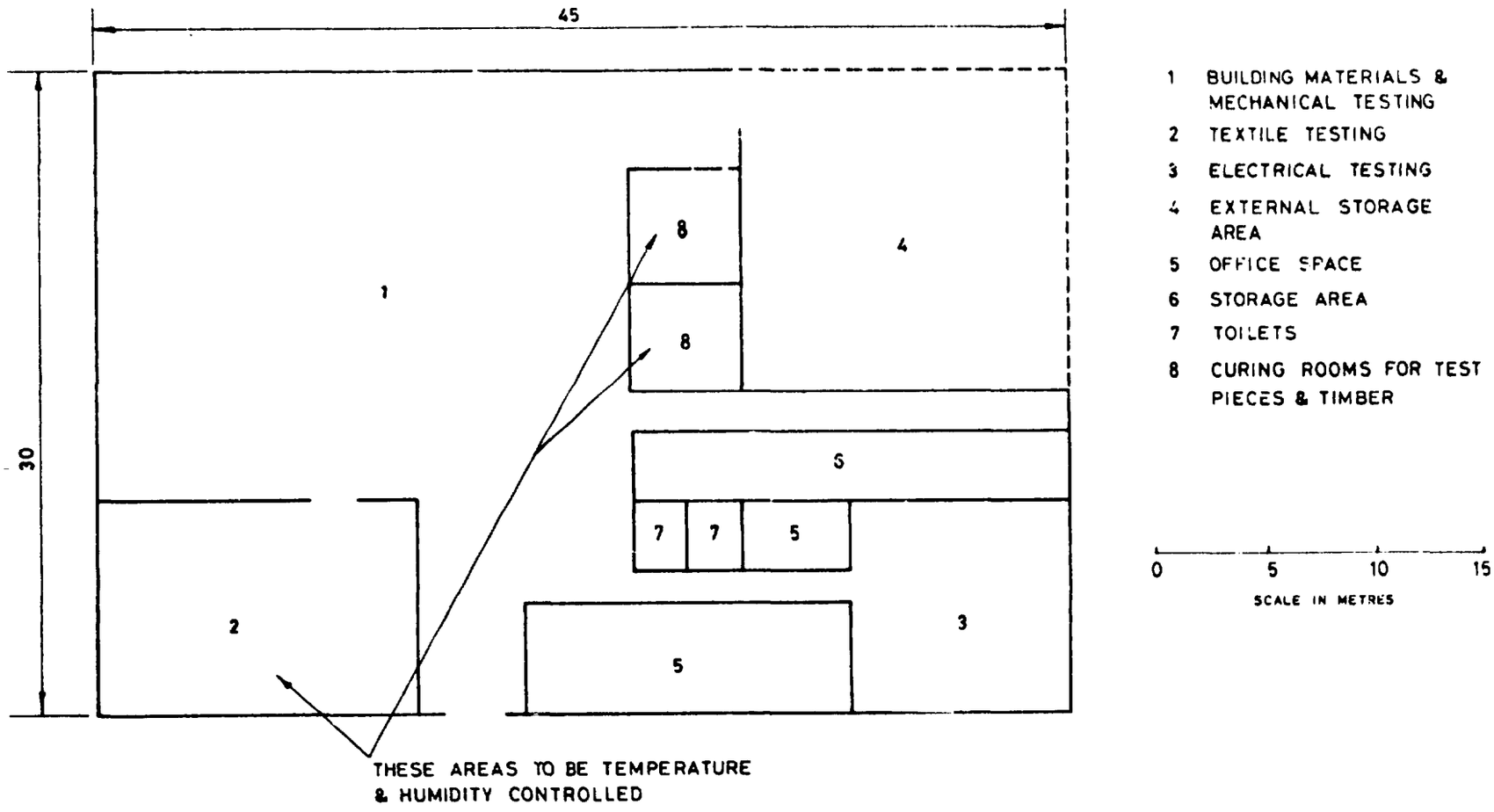
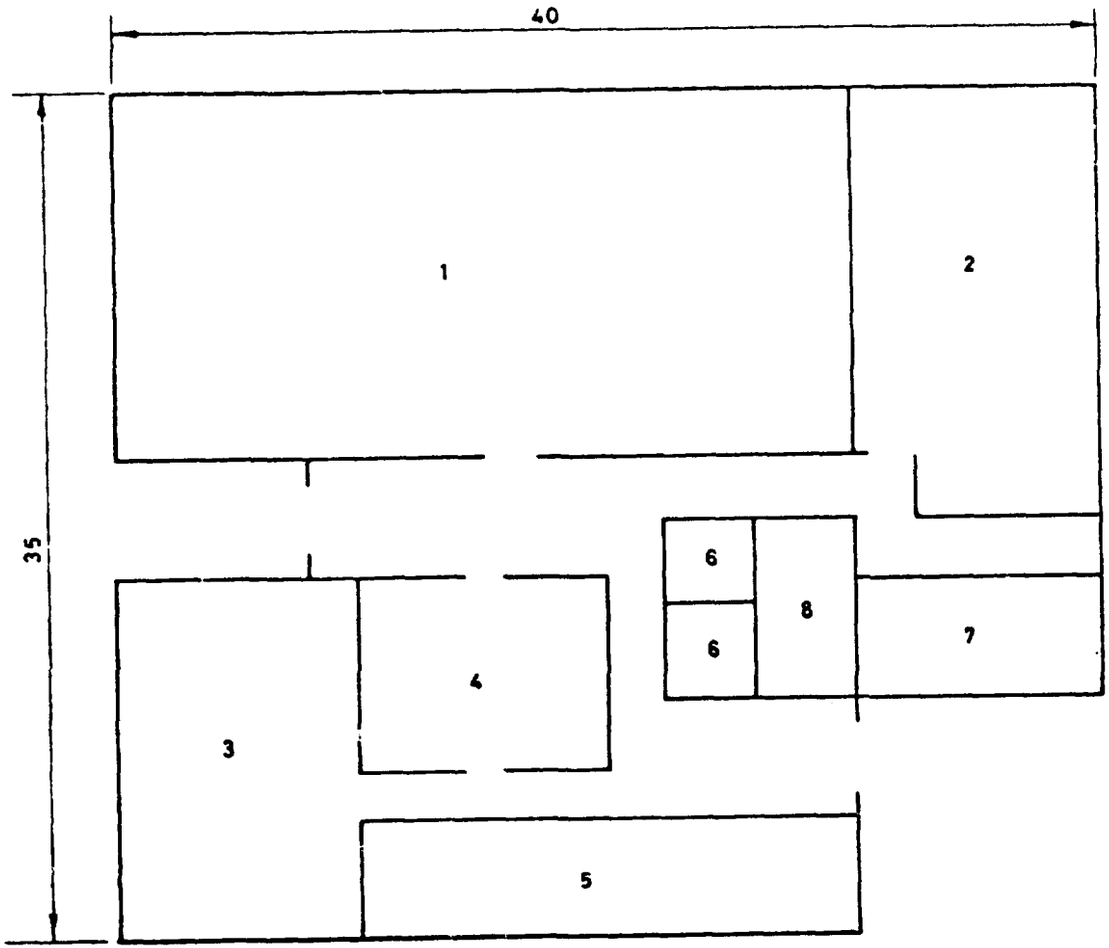


FIG.2. MATERIAL TESTING LABORATORY



1 CHEMICAL ANALYSIS
2 ANALYTICAL INSTRUMENTS
3 PETROLEUM TESTING
4 BALANCE ROOM
5 OFFICE SPACE
6 TOILETS
7 STORAGE AREA
8 COLD ROOM

0 5 10 15
SCALE IN METRES

FIG. 3. BIOCHEMICAL LABORATORY

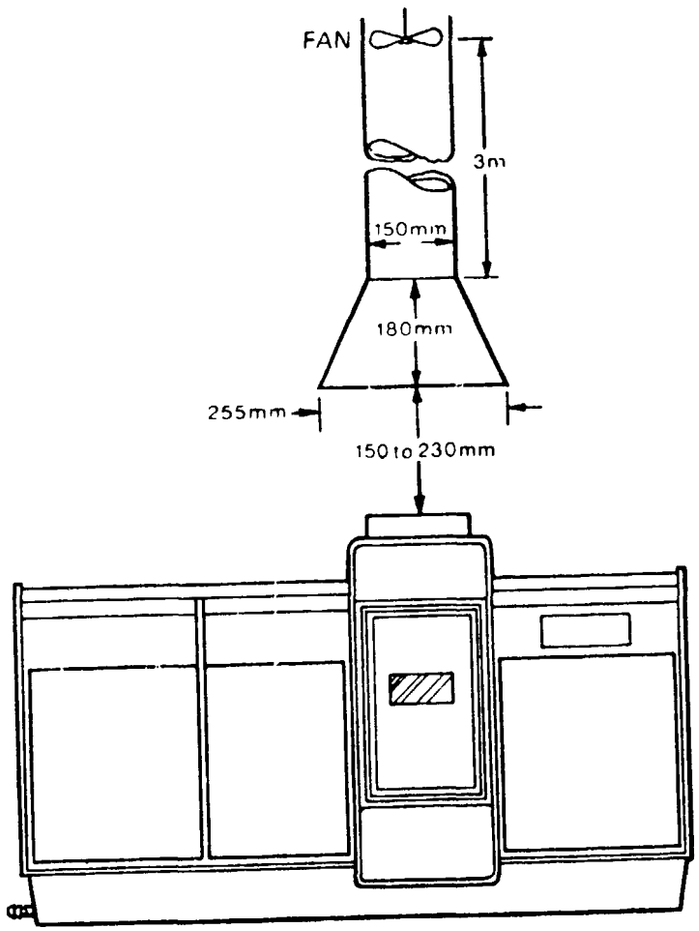
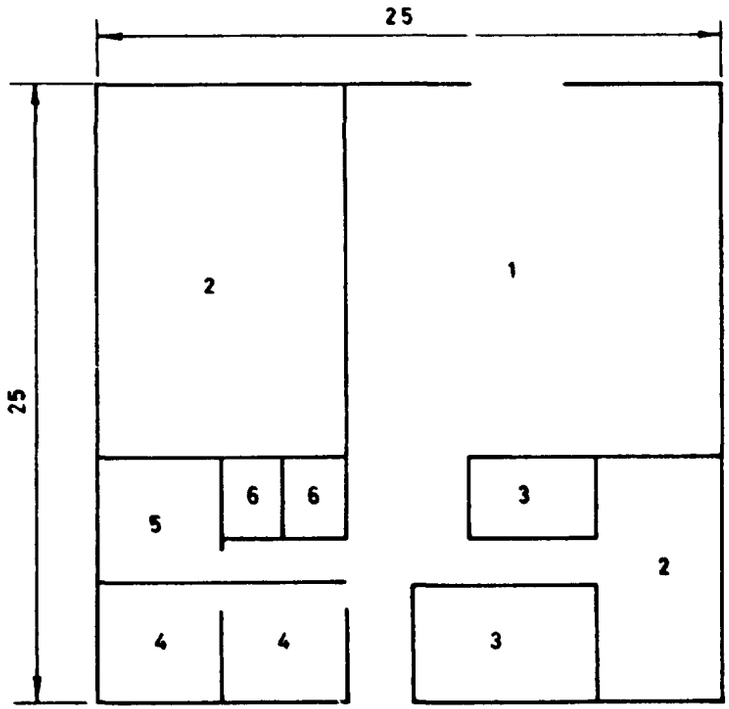


FIG. 4. FUME HOOD FOR USE WITH ATOMIC ABSORPTION SPECTRO PHOTOMETER



1 MAINTENANCE & SERVICING WORKSHOP
2 STORES
3 OFFICE SPACE
4 FIRST AID ROOM
5 SECURITY GUARDS
6 TOILETS

0 5 10 15
SCALE IN METRES

FIG.5. MAINTENANCE & SERVICING WORKSHOP

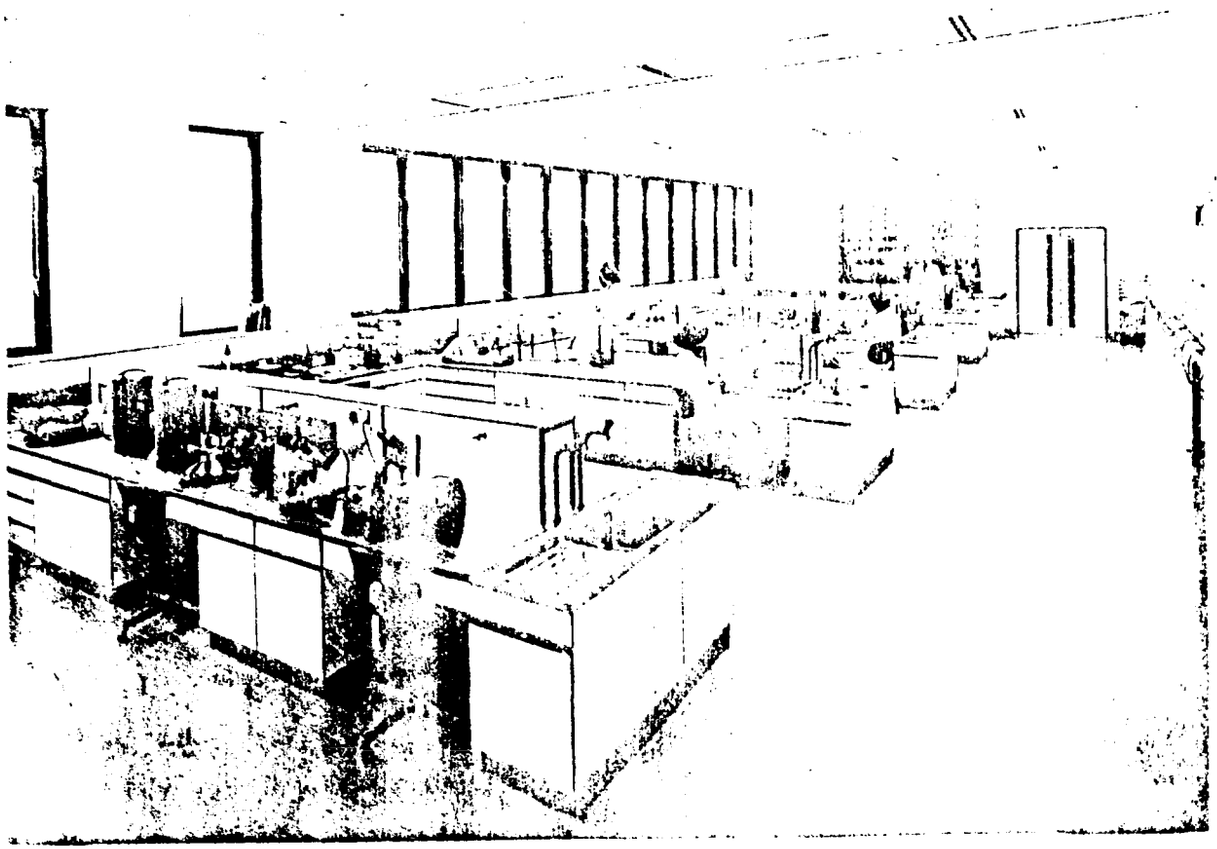


FIG. 6. ISLAND BENCHES WITH STAINLESS STEEL DOUBLE DRAINER SINK UNITS

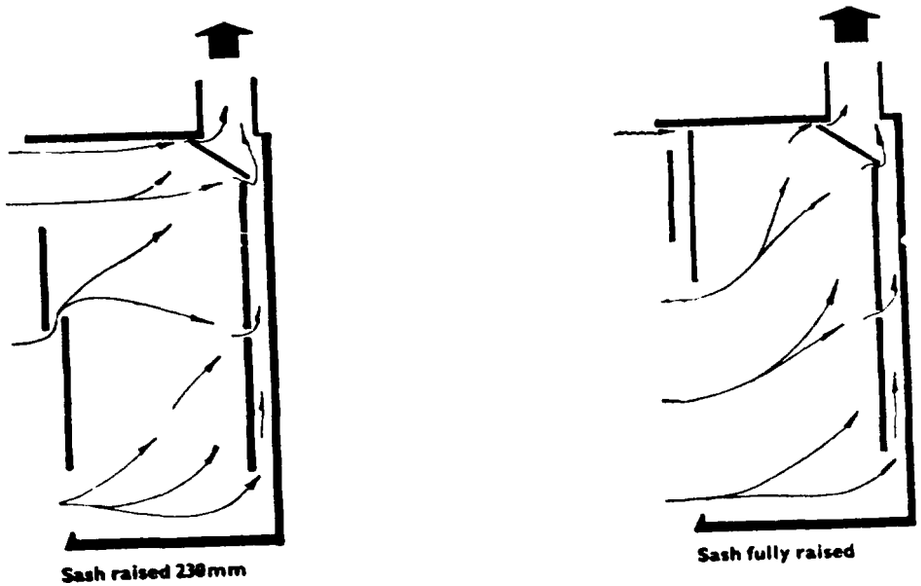


FIG. 7. FUME CUPBOARD WITH STABILISED EXTRACTION SYSTEM

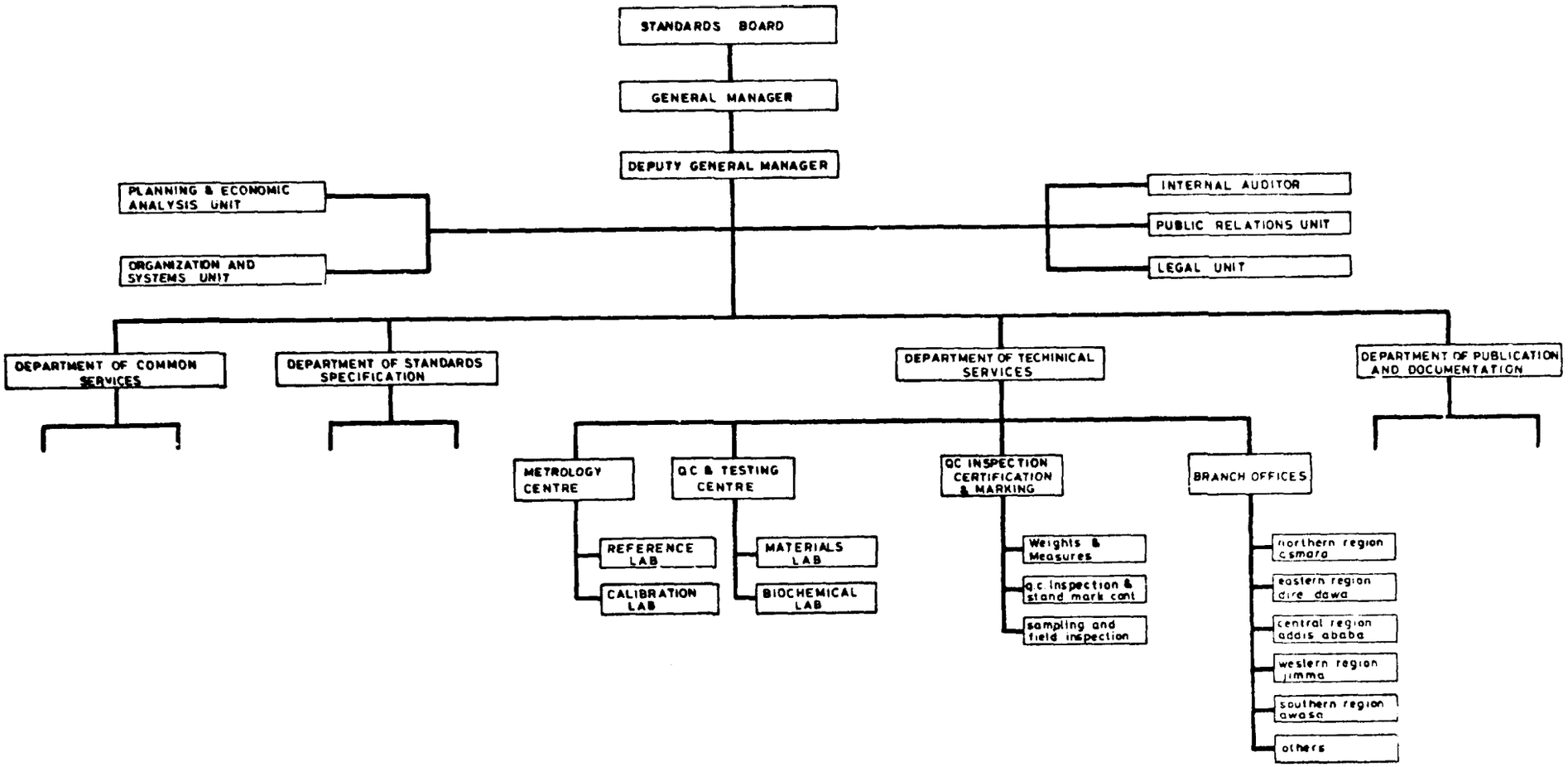


FIG.8. ORGANISATIONAL STRUCTURE

APPENDIX I

Draft Project Document

UNITED NATIONS DEVELOPMENT PROGRAMME

Project of the Government of

ETHIOPIA

(Country)

PROJECT DOCUMENT

Title: Assistance to Ethiopian Standards Institution

Number: Duration: 3 years

Primary function: Assistance in the establishment of a National Quality Control & Testing Centre

Secondary function:

Sector: (Govt. Class)_____(UNDP class. and code)_____

Sub-sector: (Govt.Class)_____ _____(UNDP class. and code)_____

Government Implementing Agency: Ethiopian Standards Institution

Executing Agency: United Nations Industrial Development Organisation (UNIDO)

Estimated starting date: (month, year) April 1979

Government inputs: _____(in kind) UNDP inputs: _____
(local currency) (US dollars)

_____(in cash)
(local currency)

Government Cost-Sharing: (if any)

_____
(US dollars or other freely convertible currency)

Signed: _____ Date: _____
on behalf of the Government

_____ Date: _____
on behalf of the Executing Agency

_____ Date: _____
on behalf of the United Nations Development Programme

PART I - LEGAL CONTEXT

This Project Document shall be the instrument referred to as such in Article 1, paragraph 1, of the Assistance Agreement between the Government of Ethiopia and the United Nations Development Programme, signed by the Parties on

The Government Implementing Agency shall, for the purposes of the Standard Basic Agreement, refer to the Government Co-operating Agency described in that Agreement.

PART II - THE PROJECT

A. Development Objectives

1. The establishment of the Quality Control Testing Centre is a basic prerequisite for the achievement of the objectives of the Ethiopian Standards Institution (ESI) in introducing standardization and quality control in the Ethiopian economy. The principal objective of the ESI is to meet the national interest by the stimulus which standardization and quality control impart to industrial development through the application of Ethiopian Standards in a number of different industrial fields, and the gradual establishment of a guide to nationally agreed industrial practice in order to render production units economical, enhance outputs of reliable quality levels and foster import substitution.

2. The establishment of the Centre shall furthermore achieve an important objective of the national standardization efforts regarding the promotion of the export capability of the country by defining, certifying and upgrading the quality levels of export items. Hence, the Quality Control Testing Centre would provide the capability of improving the quality of export oriented production in the light of international market requirements as well as help introduce a possible shift from the export of raw materials to that of semi-finished or finished products.

3. The Quality Control Testing Centre shall also be employed to strengthen the national standardization practice by gradually introducing modern quality control practices in manufacturing plants and integrating quality control and industrial research for quality control with the national standardization procedure. The Centre shall furthermore be the place where research and developmental testing for projects directed towards continuous improvement, adoption and development of indigenous and imported technology shall be undertaken.

B. Immediate Objectives

1. In order to reach the long-range objectives, some most important immediate objectives of the project should be fixed. The realisation of such immediate objectives will gradually lead to the achievement of the long-range objectives.

2. The main immediate objective is to establish testing laboratories under the Quality Control Testing Centre within the frame of the organisational structure of the Ethiopian Standards Institution by providing it with most necessary laboratory equipment. In such a way, the ESI will be enabled to undertake laboratory tests needed for the implementation of Ethiopian Standards, particularly those having compulsory status, concerning quality and other essential requirements for materials, products and commodities. By undertaking such tests, the Centre will be checking in its testing laboratories whether the quality of samples is in conformity with requirements such as physical and mechanical characteristics, chemical compositions, reliability, and safety specified in relevant Ethiopian Standards.

3. Only those producers and traders whose samples meet the specified requirements will be granted licences to use the Standards Mark on their materials and products. The Centre shall also be engaged in conducting all series of tests necessary at the time of periodic inspections to be undertaken during the validity of the licence.

4. Quality Control as one of the legal powers and tasks of the ESI may be introduced in the national economy of the country only by implementing the approved and published Ethiopian Standards concerning quality and other requirements and methods of sampling and testing on the basis of the provisions of the Standards Mark and Fees Regulations, and through relevant Quality Control and Certification Marking Schemes. For the accomplishment of this task, the provision of adequate testing equipment and facilities is the indispensable prerequisite for the successful operation of indicated schemes.

5. With regard to the preparation of Ethiopian Standards without which there cannot be any proper and systematic introduction of quality control, it should be mentioned that:

- during the working period 1971/72, a total of 110 Ethiopian Standards specifying such elements as types, dimensions, quality requirements, methods of sampling and testing, packing and marking have been finalized and issued in the following priority fields:

- Basic Standards including Weights and Measures	11
- Agricultural & Food Products	71
- Building and Civil Engineering	11
- Mechanical Engineering and Metallurgy	6
- Chemical Engineering	1
- Paper and Stationery	10
Total	110

6 Furthermore, additional groups of ES have been elaborated and finalized, i.e.

- Biological Standards	449 ES
- Engineering Standards	635 ES
	1104 ES

7. According to what is indicated in paras. 5 and 6 above, the present achievements are the following:

- 108 ES have been printed and published and they are already under implementation
- further 345 ES are approved by the Standards Board and they are being translated into Amharic gradually by priority groups for printing
- the remaining 761 finalized standards are in the stage of submission for approval by the Standards Board

8. Following a detailed survey and study of the different branches of the national economy a large number of standardization projects are envisaged to be undertaken and finalized in the future under the following three headings:

- basic and general standards
- biological standards
- engineering standards

COMPULSORY TESTS CONCERNING THE FIRST GROUP OF 108 PUBLISHED ES, PER ANNUM

Product	Types & Grades	No. of Factories	No. of Sample tests	No. of Testings
I	II	III	IV = II x III x 4	V
Edible Oils	1	30	120	120 x 23 = 2760
Oil Cakes	1	30	120	120 x 5 = 600
Solid Clay Bricks	4	12	192	192 x 7 = 1344
Hollow Clay Bricks & Beam Tiles	3	12	144	144 x 4 = 576
Cement	2	3	24	24 x 10 = 240
Hollow Concrete Blocks & Beam Tiles	3	8	96	96 x 3 = 288
Concrete Sewer Pipes	2	8	64	64 x 3 = 192
Asbestos Cement Flat Sheets	2	1	8	8 x 5 = 40
Asbestos Cement Pipes	3	1	12	12 x 5 = 60
Steel Sheets	4	2	32	32 x 2 = 64
Wires	1	2	8	8 x 3 = 24
Nails	18	2	144	144 x 2 = 288
Paper	2	1	8	8 x 3 = 24
Envelopes	6	6	144	144 x 2 = 288
Matches	1	1	4	4 x 9 = 36
Total	53	119	1120	6824

9. It is obvious that the number of Ethiopian Standards is already growing and that the preparation and publication of new groups of Ethiopian Standards covering different economic and industrial fields will be assured by the activity of the ESI with the aim of accomplishing the tasks and powers established in the legal acts of the Government and assigned to the ESI.

10. In order to show the volume of compulsory tests which will have to be made annually according to the first group of 108 Ethiopian Standards, a Table is enclosed indicating the number of testings by products. Taking into consideration the growing number of Ethiopian Standards every year, it is not difficult to realize the great activities which will have to be developed in the following years concerning laboratory tests of quality and other important requirements of products for which Ethiopian Standards are already issued or are under processing.

11. The Quality Control Testing Centre shall also be instrumental in providing pertinent research and test results necessary for the elaboration of certain national standards where basic local data and information are required for their finalization. Such an exercise shall make possible the integration of the national standardization procedure with quality control efforts in the light of prevailing national economic needs and physical requirements, thereby enabling the standardization process to grow root, in the indigenous soil.

C. Background and justification

1. The economy of Ethiopia is basically agricultural being followed by commerce and industry. Industrial development is a recent factor in the country's economy but is rapidly increasing in importance. While industry represents only a small percentage of the gross domestic product, it is growing at a high annual rate and is one of the fastest developing sectors. Moreover, Ethiopia's foreign trade also constitutes an important activity in order to meet foreign exchange requirements and, consequently, influence positively the rate of growth of the Ethiopian economy.

2. In such a stage of development, there was and is a need to organize activities aimed at the rationalization of production, improvement of productivity and quality of products, reduction of wastage and achievement of other benefits which may be attained through the introduction of standardization and quality control in the national economy.

3. Within the frame of the provisions of the Third Five Year Development Plan, 1968/69-1972/73, the Ethiopian Standards Institution (ESI) was established in September of 1970 by Order No. 64 of 1970. Later on Proclamation No. 300 of 1972 provided the ESI, among other things, with the power to:

- prepare compulsory as well as optional Ethiopian Standards relating to practices, processes, materials, products and commodities in the field of commerce and industry and enforce the same,
- authorize the use of the Standards Mark to be affixed to materials, products and commodities which conform to Ethiopian Standards,
- certify import and export materials, products and commodities which conform to Ethiopian Standards,
- examine and test materials, products, commodities, practices and processes, and conduct any investigation or research that may be necessary,
- ensure by inspection and checking whether materials, products, commodities, practices and processes conform to Ethiopian Standards, and
- fix, impose and collect fees for services rendered by the Institution.

4. The creation of the ESI was supported by UNIDO technical assistance project ID/OA 321 ETH/2/in 1968/69 and project UNIDO - ETH 081 - A (ID) in which an Adviser on Industrial Standardization was provided by UNIDO starting from May of 1970. The main objective of the project was to establish a National Standards Body for the preparation, publication and implementation of national standards and the centralization

of standardization and quality control methods throughout the country. It is to be noted that the said technical assistance project has been very successful indeed.

5. The first group of 108 Ethiopian Standards (ES) were printed and published during the working year 1973/74 relating to the fields of the International System (SI) of Units, Weights and Measures, Agriculture and Food Products, Building and Civil Engineering, Chemical Engineering, Paper and Stationery. The said standards were processed through different relevant Technical Committee and Sub-Committee meetings including public enquiries. The standards cover aspects of standardization such as terminology, type, dimensions, quality requirements, methods of sampling and testing, packing and marking. They relate to different materials and products designed for home market and export.

6. The implementation of the said standards is being conducted through Quality Control and the ESI Standards Mark Certification Scheme in order to certify the conformity of products with the requirements of relevant Ethiopian Standards, thus ensuring the quality of products intended for the home market and export. The legislative measures necessary for the creation of such National Schemes have already been concluded and the necessary Standards Mark and Fees Regulations issued on 21 May 1973 by Legal Notice No. 433 of 1973. In order to secure the implementation of the relevant provisions of the Regulations, the ESI will also be instrumental in the introduction of proper internal quality control schemes in factories and industries.

7. Testing laboratories and facilities are an indispensable element in the application of Ethiopian Standards through a national quality control programme. The ESI will require such testing facilities suitable to conduct relevant tests.

8. It is therefore proposed to request UNDP for assisting the Provisional Military Government of Socialist Ethiopia to strengthen the Ethiopian Standards Institution through a three-year project, in organizing, developing, managing and promoting within its organizational structure, a Quality Control Testing Centre by establishing national quality control testing facilities. The purpose is to improve the quality of goods

intended for the home and export markets, increase productivity and foster import substitution. This Centre, operating under the ESI, would assist and be instrumental in the successful implementation of the National Quality Control and Certification Marking Schemes as well as form the basis to functionally integrate quality control and industrial research for quality control with the national standardization procedure.

9. The project would also include assistance in organizing the training of national personnel in quality control schemes and testing laboratories, certification marking procedures and in the supply of quality control and testing equipment.

D. Outputs

The following outputs are expected to be produced during the project life:

1. Technical report on the product testing facilities developed as a result of the implementation of the project.

2. Technical report on the test procedures developed to satisfy existing Ethiopian Standards and on the research activities undertaken to assist in establishing new standards.

3. Technical report on the nature and extent of the liaison developed with local industry to assist them in manufacturing products of a satisfactory quality.

4. Technical report on the range and level of training achieved as a result of local and fellowship training.

E. Activities

It is expected that the following activities will be carried out during the project life:

1. Establishment of testing laboratory facilities for the following: building material products, electrical products, textile and leather products, chemical products, food and agricultural products.

2. Development of test procedures for the range of products indicated in Item 1.

3. Development of research facilities to assist in evolving new standards.

4. Establishment of liaison with industry to assist in improving the quality of locally manufactured products.

5. Development of servicing and maintenance facilities to ensure that the range of equipment used in the testing laboratories is maintained in a serviceable condition.

6. Training of local staff to ensure the long term operational efficiency of the testing laboratories.

F. Inputs

Description of Government inputs

1. Legislation

The ESI is, among other things, already empowered by Proclamation No. 300 of 1972 to:

- prepare compulsory and optional Ethiopian Standards relating to materials, products, commodities, practices and processes in the field of commerce and industry and enforce the same
- authorize the use of the ESI Standards Marks to be affixed to materials, products and commodities which conform to Ethiopian Standards
- certify import and export materials which conform to Ethiopian Standards
- examine and test materials, products and commodities and conduct any investigation or research that may be necessary
- ensure by inspection and checking whether materials, products, commodities, practices and processes conform to Ethiopian Standards
- fix, impose and collect fees for services rendered by the Institution

Moreover, the Standards Mark and Fees Regulations which establish the Standards Mark Certification Scheme have already been approved and issued.

2. Assignment of national staff

(a) The Department and Division Heads of ESI will be counterparts to the Project Manager and will be available for policy discussions, co-ordination and decisions on operational aspects of the project.

(b) The Head of the Quality Control, Inspection, Certification and Marking Division (and his staff for different industrial fields) will be available from the date of arrival of the expert.

(c) The Head of Quality Control Testing Centre will be available from the date of arrival of the consultant on the establishment and furnishing of laboratories.

(d) A Testing Officer for building materials laboratory unit will be available from the date of arrival of the consultant on quality control and testing of building materials.

(e) A Testing Officer for Chemical Products will be available from the date of arrival of the consultant on quality control and testing of chemical products.

(f) A Testing Officer for Electrical Products will be available from the date of the arrival of the consultant on quality control and testing of electrical products.

(g) A Testing Officer for textile raw materials and products will be available from the date of the arrival of the consultant of quality control and testing of textile products.

(h) A Testing Officer for agriculture and food products will be available from the date of arrival of the consultant on quality control and testing of agricultural and food products.

(i) The necessary secretarial and auxiliary staff will be made available from the time of arrival of individual experts and consultants.

3. Government-provided buildings, supplies and furniture

	Expendable equipment	Location	Delivery date	Cost US $
(a)	Office furniture (for experts, counterparts and secretarial staff)	Addis Ababa		10,000
(b)	Laboratory furniture	Addis Ababa		160,000
	Non-expendable equipment			
(a)	Studies and design	Addis Ababa	October 1976	50,000
(b)	Laboratory space and support facilities	Addis Ababa	September 1978	500,000
(c)	Operation and maintenance of equipment	Addis Ababa		25,000
(d)	Sundry, that is, transport, handling and other costs for equipment, water supply, electricity, telephones, travelling, contingencies etc.			75,000
			Total	820,000

Description of UNDP/UNIDO Inputs

It is recommended that the following international staff be assigned to the project:

(i) Project Manager

The Project Manager should have a science or engineering degree with experience in standardization at the national level; experience in managing a national standards body and participation in its work at the executive level; participation in all stages of standardization; knowledge and experience in international standardization. The project will be conducted under the Project Manager's general supervision. He will be responsible to the General Manager of the ESI for the overall operation of the project and for the direction and co-ordination of the work of experts under him in accordance with timing and details specified in the Work Plan. He will start in April 1979 for a period of three years. His duty station will be Addis Ababa.

(ii) Expert on National Quality Control and Certification Marking Schemes

The expert should have a science or engineering degree with experience and knowledge of the organization and operation of national quality control schemes and modern factory quality control, as well as in organization and operation of national certification marking schemes. He will have special responsibility to set up and apply systems and train local staff in operating the implementation of national standards for materials products and commodities in different economic industrial fields. He will start in January 1980 for a duration of two years and will work under the general supervision of the Project Manager and in close co-operation with the Heads of the Quality Control Testing Centre and of the QC Inspection, Certification and Marking Division. His duty station will be in Addis Ababa.

(iii) Consultant on Establishment and Furnishing of Laboratories

The consultant should have a science or engineering degree with experience in the establishment, organization and furnishing of laboratories concerned with quality control testing on the basis of

national standards. He will work under the general supervision of the Project Manager and in close coloperation with the Head of the Quality Control Testing Centre and the Heads of Laboratories concerned. He will have special responsibility in organizing and furnishing the laboratories and training the local staff in the operation of quality control laboratories. He will start in April 1980 for a period of six months. His duty station will be Addis Ababa.

(iv) Consultant on Quality Control and Testing of Building Materials

The expert should have an engineering degree preferably in civil engineering with knowledge and experience in performing all kinds of quality control and physical and mechanical laboratory tests and chemical analyses of building materials. He will work under the general supervision of the Project Manager and in close co-operation with the Testing Officer for building materials. His special responsibility will be the establishment and operation of systems and on-the-job training of local staff in performing quality control and tests of building materials on the basis of standard methods of test. He will start in October 1980 for a period of six months. His duty station will be Addis Ababa.

(v) Consultant on Quality Control and Testing of Chemical Products

The consultant should have a chemical, science or engineering degree with knowledge and experience in performing all kinds of quality control and laboratory analyses of chemical products. His special responsibility will be the establishment and operation of systems and on-the-job training of local staff in performing quality control and analyses of chemical products on the basis of standard methods of test. He will work under the general supervision of the Project Manager and in close co-operation with the Testing Officer for chemical products. He will start in October 1980 for a period of six months. His duty station will be Addis Ababa.

(vi) Consultant on Quality Control and Testing of Electrical Products

The consultant should have an engineering degree preferably in electrical engineering with knowledge and experience in performing all kinds of quality control and laboratory testing of electrical products. He will work under the general supervision of the Project Manager and in close co-operation with the Testing Officer for electrical products. His special responsibility will be the establishment and operation of systems and on-the-job training of local staff in performing quality control and testing of electrical products on the basis of standard methods of test. He will start in October 1980 for a period of six months. His duty station will be Addis Ababa.

(vii) Consultant on Quality Control and Testing of Textile Products

The consultant should have an engineering degree preferably in textile engineering with knowledge and experience in performing all kinds of quality control and laboratory testing of textile raw materials and products. He will work under the general supervision of the Project Manager and in close co-operation with the Testing Officer for textile products. His special responsibility will be the establishment and operation of systems and on-the-job training of local staff in performing quality control and testing of textile raw materials and products on the basis of standard methods of test. He will start in October 1980 for a period of six months. His duty station will be Addis Ababa.

(viii) Consultant on Quality Control and Testing of Agricultural and Food Products

The expert should have a science degree in agriculture with knowledge and experience in performing all kinds of quality control and laboratory testing and analyses of agricultural and food products. He will work under the general supervision of the Project Manager and in close co-operation with the Testing Officer for agricultural and food products. His special responsibility will be the establishment and operation of systems and on-the-job training of local staff in performing quality control and testing of agricultural and food products on the basis of standard methods of test. He will start in October 1980 for a period of six months. His duty station will be Addis Ababa.

(ix) Consultant on Equipment Maintenance and Servicing

The expert should have a science or engineering degree with experience in maintenance and servicing of a wide range of modern scientific equipment. He will work under the general supervision of the Project Manager and in close co-operation with the Head of the Quality Control Testing Centre and the Heads of the Laboratories. He will have special responsibility to train local staff in the maintenance and servicing of the range of equipment available within ESI and in the operation of the workshop facilities. He will start in January 1981 for a period of six months. His duty station will be Addis Ababa.

Fellowships

Twelve international fellowships are proposed of four months each for technical on-the-job training of local technical staff members at foreign National Standards Institutions or other establishments (including appropriate equipment manufacturers) in which relevant activities are well established and English spoken.

(i) Fellowship training for two people in the quality control and testing of building materials for four months each during the period October 1980 to July 1981.

(ii) Fellowship training for two people in the quality control and testing of chemical products for four months each during the period October 1980 to July 1981.

(iii) Fellowship training for two people in the quality control and testing of electrical products for four months during the period October 1980 to July 1981.

(iv) Fellowship training for two people in the quality control and testing of textiles for four months each during the period October 1980 to July 1981.

(v) Fellowship training for two people in the quality control and testing of agricultural and food products for four months each during the period October 1980 to July 1981.

(vi) Fellowship training in the maintenance and servicing of mechanical equipment for four months during the period January 1981 to October 1981.

(vii) Fellowship training in the maintenance and servicing of electrical and electronic equipment for four months during the period January 1981 to October 1981.

Equipment

Testing and ancillary equipment for the total amount of US dollars will be provided to the project under UNDP funds. Also a vehicle will be provided to the project for the cost not exceeding 4000 US dollars.

Contract Consultancy

A consultancy for up to 12 man months will be provided by the Cranfield Institute of Technology to provide advice and assistance to the project and responsibility for purchasing certain items of specialised equipment. The terms of reference for this consultancy are included as an Appendix to this Project Document.

G. Work Plan

1. Preparatory Activities to be carried out to ensure the timely implementation of the project	Location	Proposed duration and starting date
- The Government has already provided land in the outskirts of Addis Ababa, (approx. 90,000m^2). This plot of land is envisaged for the construction of laboratory offices, laboratory working space, conditioning rooms, ancillary spaces, workshop and general store with possible extensions, and open space (approx. 45,000m^2). The remaining land will be used as follows:	Addis Ababa	December 1975

	Location	Proposed duration and starting date
- for the construction of the ESI Headquarters building including open space (15,000m^2) at a later stage		
- for parking space (11,000m^2)		
- for other related purposes (19,000m^2)		
- The Government has already prepared preliminary plans which have been reviewed by the UNIDO consultant.		January 1976
- The Government will prepare the detailed working plans and other documents for the construction of the laboratories	Addis Ababa	To be finalised in October 1978
- The Government will arrange the completion of construction of buildings for the laboratories and support facilities	Addis Ababa	18 months April 1979 to September 1980
- The Government will appoint qualified staff as counterparts to the international experts as well as other necessary supporting technical, administrative and other staff		
- Detailed list of equipment is prepared by UNIDO consultant		
- UNIDO will take the necessary steps to order the equipment and have it delivered to the project		Commencing April 1979
- The Project Manager in close co-operation with the Government, will select qualified candidates for the fellowships of local staff for training abroad		January 1980

2. Peak Activities	Location	Proposed duration and starting date
- Strengthening of the ESI activities in all stages of standardization including co-ordination and supervision of the implementation of the project	Addis Ababa	36 months April 1979 to March 1982
- Organization and operation of national quality control and certification marking schemes and instructing local staff on introduction of up-to-date methods of factory quality control	Addis Ababa	24 months January 1980 to December 1981
- Operations concerning quality control and testing of building materials, including training of local staff	Addis Ababa	6 months October 1980 to March 1981
- Operations concerning quality control and testing of chemical products, including training of local staff	Addis Ababa	6 months October 1980 to March 1981
- Operations concerning quality control and testing of electrical products, including training of local staff	Addis Ababa	6 months October 1980 to March 1981
- Operations concerning quality control and testing of textile products including training of local staff	Addis Ababa	6 months October 1980 to March 1981

	Location	Proposed duration and starting date
- Operations concerning quality control and testing of agricultural and food products, including training of local staff	Addis Ababa	6 months October 1980 to March 1981
- Operations concerning the servicing and maintenance of laboratory equipment including training of local staff	Addis Ababa	6 months January 1981 to June 1981

3. Phasing-out Activities

- Training of local staff abroad in the special fields of operation indicated above		4 months each in the period April 1981 to September 1981

A detailed Work Plan for the implementation of the project will be prepared by the Project Manager assigned to the project in consultation with the General Manager of the Ethiopian Standards Institution. This will be done at the start of the project and brought forward periodically. The agreed Work Plan will be attached to the Project Document as Annex I and will be considered as part of that document.

A preliminary Work Plan in the form of a bar chart is given on page .

H. Preparation of the Framework for Effective Participation of National and International Staff in the Project

The activities necessary to produce the indicated outputs and achieve the Project's immediate objective will be carried out jointly by the national and international staff assigned to it. The respective roles of the national and international staff will be determined by their leaders, by mutual discussion and agreement, at the beginning of the Project, and set out in a Framework for Effective Participation of National and International Staff in the Project. The Framework, which will be attached to the

Project Document as an annex, will be reviewed from time to time. The respective roles of the national and international staff shall be in accordance with the established concept and specific purposes of technical co-operation.

I. Institutional Framework

1. The Government co-operating agency would be the Ethiopian Standards Institution (ESI), which was established by Order No. 64 of 1970 as an autonomous body of Ethiopian Government. The main and policy making organ of the ESI is the Standards Board consisting of representatives of six most interested Ministries, the University and the Chamber of Commerce as members with the Minister of Commerce, Industry and Tourism as the Chairman. The General Manager is responsible for the conduct of the activities of the Institution and is the head of the ESI Secretariat which consists of four operational Departments each having several Divisions. The standard proposals prepared by the ESI Secretariat are reviewed and processed by relevant Sub-Committees and Technical Committees representing different interests such as producers, consumers, Government departments, research bodies, traders etc. After public enquiries, all such processed standard proposals are finally submitted for approval by the Standards Board.

2. The ESI budget consists of an annual subsidy from the Government and fees collected for services rendered by the Institution. Such fees include charges to producers and traders for licences granted for the use of the Standards Mark on products which meet the requirements specified in relevant Ethiopian Standards within the frame of the Quality Control and Standards Mark Certification Schemes, as well as charges to traders for the inspection and verification of measuring instruments on the basis of Weights and Measures Proclamation No.208 of 1963 and relevant Regulations. The total number of personnel in the ESI is 120 of which about 30 are qualified engineers and specialists (several holding their Master's Degree from different foreign Universities). The Head Office of the Institution is presently housed in a compound consisting of three buildings located in the centre of Addis Ababa. Regional Branch Offices have been opened in Asmara, Massawa, Assab, Dire Dawa, Jima and Assawa.

3. The Quality Control Testing Centre will be incorporated in the organizational structure of the Ethiopian Standards Institution as a Division under the Department of Technical Services as shown in Annex I concerning Organization Chart. The Quality Control Testing Centre will be subdivided into sections and units each covering testing activities for individual industrial fields.

J. Prerequisites

1. The Government will provide the financial resources required to build the Quality Control and Testing Centre laboratories and provide the necessary services and facilities.

2. The Government will provide the financial resources required for the normal functioning of the Ethiopian Standards Institution and implementation of the approved programme of its activities.

3. The Government will secure the timely selection, preparation and release the national staff who need training under fellowships provision of the Project Document.

4. The Government will provide all the information to the members of the international staff assigned to the project which will be necessary for implementation of the project.

The Project Document will be signed by the Resident Representative on behalf of UNDP, and UNDP assistance to the Project will be provided, subject to UNDP receiving satisfaction that the pre-requisites listed above have been fulfilled, or are likely to be fulfilled. When anticipated fulfilment of one or more prerequisites fails to materialise, UNDP may, at its discretion, either suspend or terminate its assistance.

PART III

SCHEDULES OF MONITORING, EVALUATION & REPORTS

A. Tripartite Monitoring Reviews

The Project will be subject to periodic review in accordance with the policies and procedures established by UNDP for monitoring Project and Programme implementation.

B. Evaluation

The Project will be subject to evaluation, in accordance with the policies and procedures established for this purpose by UNDP. The organization, terms of reference and timing of the evaluation will be decided by consultation between the Government, UNDP and the Executing Agency concerned.

C. Progress and Terminal Reports

The Project Manager will produce his first Progress Report in a month after his assignment to the project. All the subsequent Progress Reports will be prepared after every six months of the Project implementation.

The Terminal Report of the Project will be prepared in accordance with the policies and procedures established by UNDP.

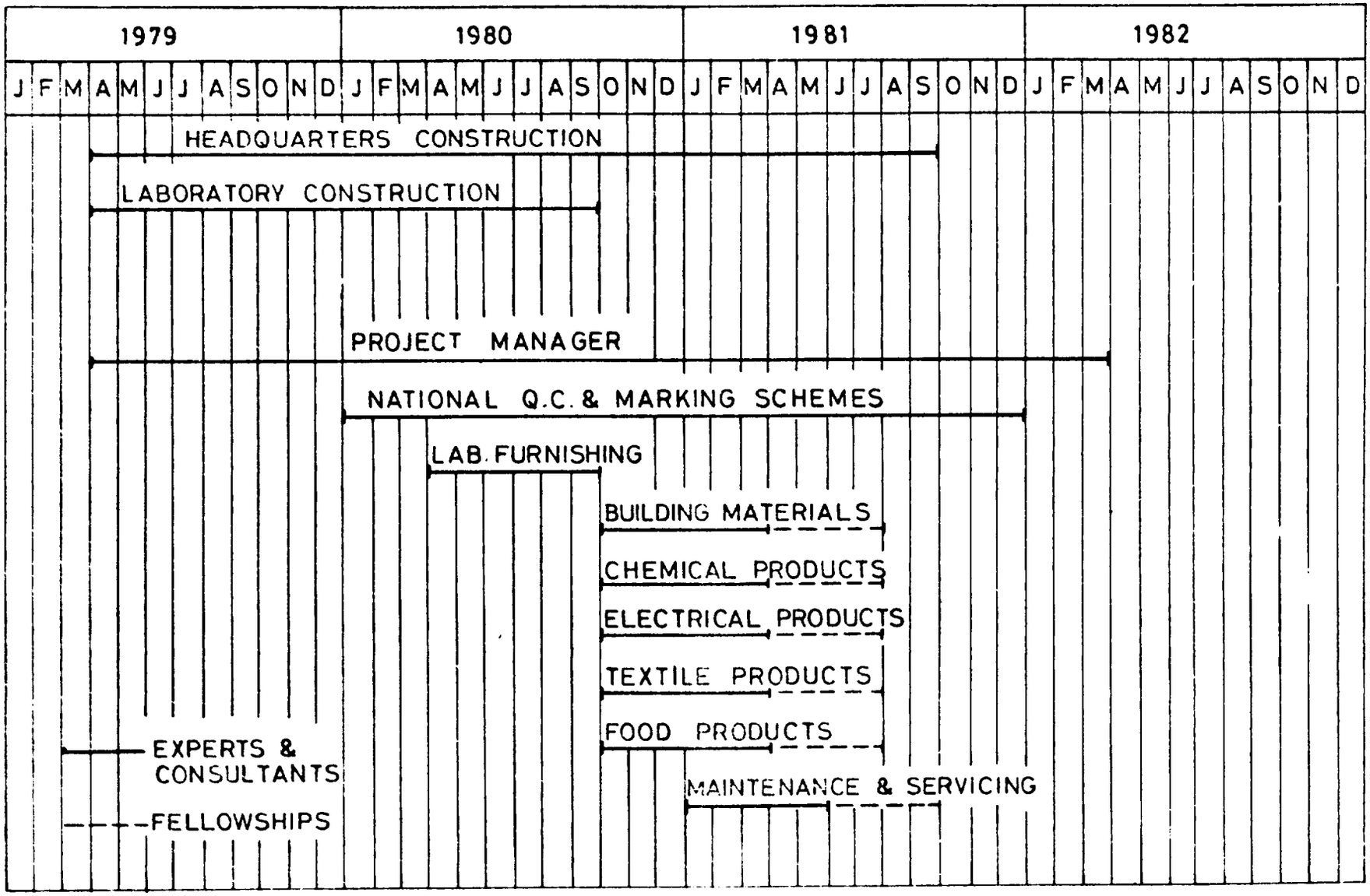


FIG. 1. PROJECT WORK PLAN

PROJECT BUDGET COVERING UNDP CONTRIBUTION
(in US dollars)

COUNTRY: Ethiopia

PROJECT No.

TITLE: Assistance to Ethiopian Standards Institution

		TOTAL		1979		1980		1981		1982	
		m/m	$	m/m	$	m/m	$	m/m	$	m/m	$
10.	PROJECT PERSONNEL										
	11 Experts										
	11.01 Project Manager			9		12		12		3	
	02 Expert on national quality control & certification marking schemes					12		12			
	03 Consultants					21		21			
	11.99 Sub-total	102	486 900	9	40 500	45	216 000	45	216 000	3	14 400
20.	SUBCONTRACT										
	21 Subcontracts	12	54 000	4	18 000	4	18 000	4	18 000		
	29 Component total	12	54 000	4	18 000	4	18 000	4	18000		
30.	TRAINING										
	31 Fellowships		72 000				15 000		57 000		
	39 Component total		72 000				15 000		57 000		

PROJECT BUDGET COVERING UNDP CONTRIBUTION
(in US dollars)

		TOTAL		1979		1980		1981		1982	
		m/m	$	m/m	$	m/m	$	m/m	$	m/m	$
40	EQUIPMENT										
	41 Equipment		792 900		250 000		542 900				
	49 Component total		792 900		250 000		542 900				
50	MISCELLANEOUS										
	51 Miscellaneous				6 000		3 000		3 000		750
	59 Component total		12 750		6 000		3 000		3 000		750
99	GRAND TOTAL		1418 550		314 500		794 900		294 000		15 150

PROJECT BUDGET COVERING GOVERNMENT CONTRIBUTION IN KIND
(in local currency)

COUNTRY: Ethiopia

PROJECT No.

TITLE: Assistance to Ethiopian Standards Institution

		TOTAL		1979		1980		1981		1982	
		m/m	Birr	m/m	Birr	m/m	Birr	m/m	Birr	m/m	Birr
10	PROJECT PERSONNEL										
	Counterpart to Project Manager	36		9		12		12		3	
	Counterpart to expert on national quality control & certification marking schemes	36		9		12		12		3	
	Counterparts to consultants	117				45		72			
	Support personnel	804		228		288		288			
	Component total	993	419 160	246	77 520	357	153 320	384	180 320	6	8 000
40	EQUIPMENT										
	41 Equipment		1420 000		800 000		620 000				
	Component total		1420 000		800 000		620 000				
50	MISCELLANEOUS										
	51 Miscellaneous		200 000		20 000		70 000		90 000		20 000
	Component total		200 000		20 000		70 000		90 000		20 000
	Grand total		2039 160		897 520		843 320		270 320		28 000

SUB-CONTRACTING TERMS OF REFERENCE

These terms of reference make provision for the services of the Cranfield Institute of Technology to be retained to provide advice and assistance to the Project and to accept responsibility for purchasing certain items of specialised equipment. It is recommended that up to 12 man months of consultancy is made available to provide the following services:

(a) Advice on detailed equipment specifications and suitable equipment manufacturers.

(b) Assistance in the analysis of equipment tenders.

(c) Advice to the Ethiopian Standards Institution on laboratory building plans, laboratory building services, e.g. environmental control requirements, specification of laboratory furniture and advice on suitable suppliers.

(d) Assistance in the recruitment of experts and consultants.

(e) Assistance in devising suitable Fellowship Training schemes, recommendations on suitable establishments and companies at which training could be undertaken.

(f) Accepting responsibility for the ordering of specialised equipment for which the normal international tendering procedure is not appropriate.

It is suggested that the following items of equipment, with a total value of approximately US$ 149 000, fall into this category:

Compression machine
Fineness and Maturity Tester
Fibre Length Machine
Moisture Testing Oven
Moisture Monitor
Light Fastness Tester
Colour Matching Cabinet
Three Bath Dyeing Machine

Warp Tension Meter
Pilling Tester
Finish Rub Fastness Tester
Lastometer
Snag Tester
Impact Scuff Tester
Wrinkleometer
Finish Heat Resistance Tester
Bottom Leather Water Penetration Machine
Soling Materials Abrasion Tester
Bottom Leather Grain Crack Tester
Atomic Absorption Spectrophotometer
Visible Spectrophotometer
Ultra violet Spectrophotometer
Infrared Spectrophotometer

APPENDIX 2

Detailed Equipment Specifications

BUILDING MATERIALS AND MECHANICAL TESTING

Cost US $

Static Universal Testing Machine

Maximum capacity 100kN (10 ton f.) Load cells to cover the tensile and compressive range 0.1N to 100kN. Full range of interchangeable jaws. Temperature cabinet to cover range -73°C to +315°C. Extensometers.
Typical manufacturers - Instron Ltd. Model 1195 — 40000

Hydraulically Operated Universal Testing Machine

Maximum capacity 1000kN (100 ton f). Accessories to include automatic stress/strain recorder, full range of jaws, extensometers, transverse tool for testing concrete beams.
Typical manufacturer - Avery Denison Ltd. Model 7104 — 60000

Impact Testing Machine

Machine to be suitable for Izod and Charpy tests. Complete with full range of accessories.
Typical manufacturer - Avery Denison Ltd. Model 6705 U — 7500

Hardness Testing Machine

Machine to be suitable for Vickers and Brinell tests. Maximum workpiece size 229mm length x 245mm diameter. Maximum test load 120kg f. Micrometer reading to 0.001mm. Microscope magnifications 70x and 350x.
Typical manufacturer - Avery Denison Ltd. Model 6406 — 5600

Compression Machine

2500 KN load frame. Maximum vertical clearance 330mm. Maximum width between columns 254mm. Platen diameter 310mm. Ram travel 63mm. Complete with control console, platens, 100kN flexural and transverse load frame, roller bearers and load pacing unit.
Typical manufacturer - Engineering Laboratory Equipment Ltd. Model EL32-70 — 18800

Cost US $

Aggregate Impact Value Apparatus

Trip action hammer release. Automatic counter. Complete with cylindrical measure and tamping rod.
Typical manufacturer - Engineering Laboratory Equipment Ltd.
Model EL42-400 700

Furnace

Internal dimensions 178mm x 153mm x 365mm. Maximum temperature 1200°C. Load rating 3.2kW.
Typical manufacturer - Engineering Laboratory Equipment Ltd.
Model EL46-216 1500

Compacting Factor Apparatus

Two conical hoppers with hinged trap door. Complete with cylindrical mould and compacting rod.
Typical manufacturer - Engineering Laboratory Equipment Ltd.
Model EL34-051 211

Vibro Consistometer

Comprising vibrating table, specimen pot, slump cone, graduated rod and plate.
Typical manufacturer - Engineering Laboratory Equipment Ltd.
Model EL34-030 1800

Air Entrainment Meter

Airtight container of $6dm^3$ capacity. Pressure gauge range up to $0.2MN/m^2$, graduations $0.005MN/m^2$. Air content gauge range up to 10%, graduations 0.1%.
Typical manufacturers - Engineering Laboratory Equipment Ltd.
Model EL34-322 600

Mixer

Capacity 56 dm^3. Mixing pan 635mm diameter x 330mm deep. Fitted with pan tipper.
Typical manufacturer - Engineering Laboratory Equipment Ltd.
Model EL34-351 3300

Cost US $

Weighing Machine

50Kg capacity counter platform scale. Accuracy 20g. Platform size 460mm x 305mm.
Typical manufacturer - Engineering Laboratory Equipment Ltd.
Model E22-850 500

Weighing Machine

25Kg capacity semi-automatic balance. Scale range 200g.
Sensitivity 1g. Complete with set of weights.
Typical manufacturer - Engineering Laboratory Equipment Ltd.
Model E22-500 1000

Top Pan Balance

1500g capacity top pan balance. Readability 0.01g.
Independent taring. Top Pan diameter 127mm.
Typical manufacturer - Oertling Ltd. Model 21TD 1300

Test Sieves

20 Standard test sieves with brass mesh or perforated plate.
Sieve diameter 200mm and 300mm. Aperture size ranging from 0.075mm up to 75.0mm. Complete with lids and receivers.
Typical manufacturer - Engineering Laboratory Equipment Ltd.
Model EL79 800

Sieve Shaker

To accept up to six 200mm dia. sieves or six 300mm dia. sieves.
Vibration frequency 300/min. Time switch 0-60 minutes.
Typical manufacturer - Engineering Laboratory Equipment Ltd.
Model EL80-015 1300

Drying Oven

Drying oven internal dimensions 600mm x 960mm x 430mm. Temperature range 40°C to 160°C. Temperature fluctuation ± 0.5°C.
Typical manufacturer - Engineering Laboratory Equipment Ltd.
Model EL22-011 1200

Cost US $

Vibrating Table

Table size 305mm x 610mm. Maximum load capacity 136Kg. Vibration amplitude 1.2mm peak to peak. Frequency 50 cycles/sec.
Typical manufacturer - Engineering Laboratory Equipment Ltd.
Model EL34-622 1400

Curing Tank

Internal dimensions 1630mm x 860mm x 510mm. Temperature control 20°C ± 1°C. Recirculation rate of pump 455 litres/hr. Complete with stand and racks.
Typical manufacturer - Engineering Laboratory Equipment Ltd.
Model EL34-660 1200

Moisture Conditioning Oven

Internal dimensions 680mm x 790mm x 790mm. Temperature range up to 60°C. Temperature fluctuation ± 0.1°C. Humidity range 0 to 95% RH.
Typical manufacturer - Engineering Laboratory Equipment Ltd.
Model EL36-153 3100

Los Angeles Abrasion Machine

Steel cylinder 711mm diameter x 508mm long. Rotational speed 30 rpm. Complete with abrasive charges.
Typical manufacturer - Engineering Laboratory Equipment Ltd.
Model EL42-530 3100

Rigdens Apparatus

For determination of particle size of cement. Comprising calibrated U tube, rubber aspirator, Rigden permeability cells. Complete with accessories.
Typical manufacturer - Engineering Laboratory Equipment Ltd.
Model EL38-050 500

Cost US $

Vicat Apparatus

Vicat frame complete with 10mm diameter plunger. Complete with needles and moulds.
Typical manufacturer - Engineering Laboratory Equipment Ltd.
Model EL38-201 200

Le Chatelier Water Bath

Water bath with temperature control to 20°C. Complete with mould and steam tank.
Typical manufacturer - Engineering Laboratory Equipment Ltd.
Model EL38-340 1500

Heat of Hydration Apparatus

Comprising dewar flask in lagged case, electric stirrer, filler funnel and Beckman type thermometer.
Typical manufacturer - Engineering Laboratory Equipment Ltd.
Model EL38-460 700

Penetrometer

Penetrometer fitted with automatic controller. Complete with penetration needles and water bath.
Typical manufacturer - Engineering Laboratory Equipment Ltd.
Model EL46-530 2500

Ductilometer

For testing four specimens. Thermostatically controlled water temperature. Drive carriage speed 5cm/min. Complete with thermometer and briquette mould.
Typical manufacturer - Engineering Laboratory Equipment Ltd.
Model EL46-260 2600

Loss on Heating Oven

Internal dimensions 350mm x 350mm x 350mm. Temperature controlled at 163°C ± 1°C. Platform rotation 6 rpm.
Typical manufacturer - Engineering Laboratory Equipment Ltd.
Model EL46-410 1300

	Cost US $
Cleveland Flash Cup Apparatus	
Comprising insulated test cup, electric heater, temperature controller, test flame assembly and thermometer. Typical manufacturer - Engineering Laboratory Equipment Ltd. Model EL46-330	1100
Sieving Extractor	
Comprising rocker box, sieves and clamping rods. Oscillation over 22^{o} at a frequency of 2 cyles/sec. Typical manufacturer - Engineering Laboratory Equipment Ltd. Model EL45-025	1700
Binder Recovery Apparatus	
Comprising boiling flask of 250ml capacity, hot water bath, vacuum reservoir of 2000ml capacity, vacuum pump and pressure gauge. Typical manufacturer - Engineering Laboratory Equipment Ltd. Model EL45-360	1500
Bench Mounted Mixer	
Capacity 11.4dm^3. Speed range 61 to 361 rpm. Motor rating 375W. Complete with stainless steel bowl and beaters. Typical manufacturer - Engineering Laboratory Equipment Ltd. Model EL45-560	2100
Pipe Testing Machine	
Pipe testing machine with maximum capacity of 1000 kN (100 ton f` Size range 300mm to 1800 bore. Maximum length 2600mm. Typical manufacturer - Engineering Laboratory Equipment Ltd	45600

	Cost US $
Flow Table	
Cast bronze flow table top complete with tripod, flow mould, baseplate and calipers.	600
Typical manufacturer - Engineering Laboratories Equipment Model EL38-600 Ltd	
Abrasion Machine	
For the abrasion testing of tiles etc. Variable speed rotating grinding surface. Adjustable load application.	3700
Typical manufacturer - Labotest	
Jolting Apparatus	
Vibrating platform complete with guard, time switch eccentric mechanism etc.	1900
Typical manufacturer - Engineering Laboratories Equipment Model EL39-020 Ltd	
Mortar Mixer	
Capacity 5.7 dm^3. Speed range 61 to 259 rpm. Motor rating 124W. Complete with stainless steel bowl, and beaters.	1400
Typical manufacturer - Engineering Laboratories Equipment Ltd Model EL23-620	
Miscellaneous Equipment including air conditioning units for curing rooms	20000

TEXTILE & LEATHER PRODUCTS

	Cost US $
X - Type Viscometer	
For the detection and measurement of the chemical degradation of cotton by measurement of its fluidity in cupramonium solution Typical manufacturer - Shirley Developments Ltd. Model SDL/14	1400
Yarn Hairiness Meter	
Length of hair detected 0 - 100mm. Sensitivity ranges 100, 200, 500 and 1000 hairs per metre. Complete with chart recorder and winder. Typical manufacturer - Shirley Developments Ltd. Model SDL/84	10500
Textiles Yarn Tachometer	
Measurement of yarn speed with four figure digital readout in metres/minute. Accuracy of tachometer one digit. Measuring time one second. Mains or battery operation. Typical manufacturer - Shirley Developments Ltd. Model SDL/91	3000
Fineness and Maturity Tester	
For the rapid testing of fineness and maturity, together with micronaire value. Typical manufacturer - Shirley Developments Ltd. Model SDL/89	7800
Rubbing Colourfastness Tester	
To test the fastness to rubbing of coloured materials. Test area 10cm x 2.5cm. Load on rubbing surface 445g/sq.cm. Peg diameter 2.5cm. Typical manufacturer - Shirley Developments Ltd. Model SDL/72	1100
Cyclic Bending Tester	
To test the stiffness, liveliness and bending behaviour of fabrics. Complete with template for fabric specimens and pendulum to cover the range 200 to 10000 dyn cm/cm Typical manufacturer - Shirley Developments Ltd. Model SDL/72	1100

	Cost US $
Yarn Friction Tester	
To measure the coefficient of friction of yarn as it runs round a test object.	
Typical manufacturer - Shirley Developments Ltd. Model SDL/55	1900
Cotton Fineness Meter	
Calibrated to give direct readout of micronaire value.	
Typical manufacturer - Shirley Developments Ltd. Model SDL/19	2600
Comb Sorter	
For sorting cotton fibres into staple lengths up to a maximum of 150mm.	
Typical manufacturer - Shirley Developments Ltd. Model SDL/9	1300
Nep Counting Templates	
For counting neps in yarn and cloth.	
Typical manufacturer - Shirley Developments Ltd. Model SDL/10	500
Crimp Tester	
For the measurement of yarn length at a known tension. Tension ranges 0 to 0.35g and 0 to 0.175g.	
Typical manufacturer - Shirley Developments Ltd. Model SDL/4	900
Stiffness Tester	
To measure stiffness, drape, handle and fullness of cloth.	
Typical manufacturer - Shirley Developments Ltd. Model SDL/3A	300
Pressley Tester	
For the determination of resistance of fibre bundles. Measuring range 10-44Kg. Testing length zero and 3mm.	
Typical manufacturer - J. H. Heal Ltd.	1700

	Cost US $
Fibre Length Machine	
For measurement of the length of individual fibres under controlled tension. Fitted with 2mm scale for cotton fibres. Typical manufacturer - J. H. Heal Ltd.	2100
Stereoscopic Microscope	
Magnification 10x, 15x, 20x and 40x. Facilities for oblique and transmitted light illumination. Typical manufacturer - Vickers Instruments. Model M69	600
Moisture Testing Oven	
Thermostatically controlled electrically heated over. Recommended working temperature 105°C. Balance capacity 310g, resolution 0.01g. Pan size 170mm diameter x 125mm deep. Typical manufacturer - J. H. Heal Ltd. Model 82	2500
Moisture Monitor	
For the indication of moisture content in percentage regain. Rechargeable battery operation. Percentage regain range 2.4 to 20.0. Typical manufacturer - J. H. Heal Ltd.	700
Roving Reel	
For the measurement of the length of rovings, slubbings and drawings. Drum circumference 1m. Drum width 300mm. Universal creel. Typical manufacturer - J. H. Heal Ltd. Model 54 APT	700
Yarn Examining Machine	
Motor driven yarn examining machine. Complete with black taper boards. Typical manufacturer - J. H. Heal Ltd.	1100

Cost US $

Twist Tester

For measuring twist using the straightened fibre method. Test lengths 0 to 250mm. Resettable counter to record 'S' or 'Z' twist. Complete with accessories.
Typical manufacturer - J. H. Heal Ltd. Model 71 — 600

Quadrant Twist Tester

For measuring twist using the twist contraction method. Test length 0 to 250mm. Resettable counter to record 'S' or 'Z' twist.
Typical manufacturer - J. H. Heal Ltd. Model 73M — 800

Universal Strength Tester

For tensile testing of yarn, hanks and fabrics. Ten measuring ranges from 0 - 480Kg to 0-1Kg. Accuracy $\pm$ 1% of full scale deflection. Speed of traverse 50 to 600mm/min. Complete with recorder, extension counter, yarn grips, hank grips, jaws for cloth specimens.
Typical manufacturer - J. H. Heal Ltd. Model 200SX — 8700

Fastran Count Balance

Balance to be supplied to indicate yarn count in the Tex count system.
Typical manufacturer - J. H. Heal Ltd. — 600

Wear and Abrasion Tester

For the comparison of the resistance of fabrics to abrasion. Four specimens tested simultaneously. Complete with 10m of abrasive cloth, 10 sets of felt pads, 10 sheets polyurethane foam, hand operated lever press and 38mm diameter cutter.
Typical manufacturer - J. H. Heal Ltd. Model 1103 — 2800

Cost US $

Wash Wheel

For the determination of colour fastness to washing at various temperatures and to dry cleaning. Machine to accommodate eight stainless steel test vessels 134mm long x 76mm diameter.
Typical manufacturer - J. H. Heal Ltd. Model 250 — 3200

Light Fastness Tester

For the determination of colour fastness to daylight and to artificial light. Complete with test cells, grey scales, MBTL lamps and MB/U lamps.
Typical manufacturer - J. H. Heal Ltd. Model 225 — 2900

Colour Matching Cabinet

Viewing cavity 700mm x 400mm x 400mm. Complete with full range of alternative light sources.
Typical manufacturer - J. H. Heal Ltd. Model XKNFUV/HM — 300

Wrap Reel

Motor driven wrap reel. Reeling speed 200 m/min. Provision for variable tension. Pre-set yarn length counter.
Typical manufacturer - J. H. Heal Ltd. — 1700

Three Bath Dyeing Machine

Temperature range independently variable in each bath up to 135°C. Complete with dye tubes of 82ml, 215ml and 750ml capacity.
Typical manufacturer - Roaches Engineering Ltd. — 6000

Warp Tension Meter

To measure the tension in warp yarns. Measuring ranges 0 to 25Kg and 0 to 50Kg.
Typical manufacturers - Thorn Bendix Ltd. — 400

	Cost US $
Balance	
Top pan balance. Capacity 1500g. Resolution 0.01g. Pan diameter 127mm. Typical manufacturer - Oertling Ltd. Model 21TD	1300
Thermohygrograph	
To measure ambient temperature and relative humidity. Spring driven drum rotation, with weekly rotation. Typical manufacturer - J. H. Heal Ltd.	300
Air Permeability Tester	
To measure the flow rate through a circular area of 5 sq.cm. Air flow ranges 0.05 - 0.5 cm^3/s to 30.0 - 350.0 cm^3/s. Pressure drop across specimen varied between 0 - 25mm water gauge. Typical manufacturer - Shirley Developments Ltd. Model SDL/21	5000
Thickness Gauge	
Range of pressures 20 - 2000 gm/cm^2. Area of presser foot 325mm^2. Range of thickness 0 - 25mm. Sensitivity 0.01mm. Typical manufacturer - Shirley Developments Ltd. Model SDL/94	1100
Pilling Tester	
Two wooden test boxes 250mm x 250mm x 250mm. Rotational speed 60 rev/min. Pre-set counter for number of revolutions. Typical manufacturer - J. H. Heal Ltd. Model 116/2	1200
Finish Rub Fastness Tester	
To measure the fastness of the finish of upper leather to rubbing under dry and wet conditions. Complete with Grey scales and felt pads.	1000
Typical manufacturer - Satra, Model STM102	

	Cost US $
Lastometer	
To measure the tendency of upper leather to crack or tear in lasting. Maximum load 80Kg. Distension measured to 0.01mm.	1400
Typical manufacturer - Satra, Model STD104	
Snag Tester	
To assess the resistance of leather to snagging and scratching in wear.	1900
Typical manufacturer - Satra, Model SRM108	
Upper Leather Waterproofness Tester	
To test the waterproofness of upper leather under conditions of flexing. Machine to accommodate up to three testpieces.	1800
Typical manufacturer - Satra, Model STM106	
Impact Scuff Tester	
To test upper leathers for their resistance to damage when struck a single glancing blow.	1900
Typical manufacturer - Satra, Model STD165	
Viewing Box	
To assess the severity of damage produced by the Impact Scuff Tester.	700
Typical manufacturer - Satra, Model STD166	
Wrinkleometer	
To assess the tendency of upper leather to form pleats or wrinkles where shortening occurs during lasting.	200
Typical manufacturer - Satra, Model STD119	
Permeability/Absorption Apparatus	
To measure the moisture permeability and absorption of leather under conditions which exist in practice.	1800
Typical manufacturer - Satra, Model STM175	

	Cost US $
Upper Leather Flexing Machine	
To measure the flexing endurance of light leathers and their surface finishes. Machine to be supplied with four stations.	1400
Typical manufacturer - Satra, Model STM407	
Finish Heat Resistance Tester	
To assess the effect of heat on the colour and appearance of the finish of leather.	700
Typical manufacturer - Satra, Model STM111	
Leather Shrinkage Temperature Determination	
To measure the shrinkage of leather in water at varying temperatures.	1200
Typical manufacturer - Satra, Model STD114	
Bottom Leather Water Penetration Machine	
To measure the water resistance of sole leather under dynamic test conditions.	2900
Typical manufacturer - Satra, Model STM131	
Soling Materials Abrasion Machine	
To test the abrasion resistance of soling and heeling materials.	4100
Typical manufacturer - Satra, Model STM140	
Bottom Leather Grain Crack Tester	
To determine the resistance of bottom leather to grain crack in a single bend.	500
Typical manufacturer - Satra, Model STD132	
Miscellaneous Equipment	
Including grey scales, piece glasses, sample cutter, stroboscobe, air conditioning unit etc.	10000

Cost US $

ELECTRICAL PRODUCTS

Universal Test Instrument for Electrical Domestic Appliances

Instrument to be capable of making earth conductor tests, insulation resistance measurement, leakage current measurements, continuity testing and resistance measurement.
Typical manufacturer - Siemens Ltd. Model M05743-A3 — 400

D.C. Micro Ammeter (Class 0.5)

Precision light spot instrument with moving coil movement. Measuring range 0.75 to 750μA.
Typical manufacturer - Siemens Ltd. Model M14817-A1 — 1200

Multimeter

AC and DC current and resistance measurement. AC current voltage 1.5, DC current voltage 1.5, Resistance 1.5. Number of measuring ranges 55.
Typical manufacturer - Siemans Ltd. Model M05819-A22 — 600

DC Micro Voltmeter (Class 0.5)

Precision light spot instrument with moving coil movement. Measuring range 0.3 to 300 mV.
Typical manufacturer - Siemans Ltd. Model M14817-A5 — 1200

Clip.on Voltammeter

For maximum 600 A. AC and 600 V AC. Measuring ranges 15, 60 and 600 A; 150, 300 and 600 V.
Typical manufacturer - Siemens Ltd. Model M05025-A203 — 600

Clip-on Wattmeter

For measurement of active power with single phase and three phase currents and reactive power with three phase currents. Measuring range 15A to 600A; 7.5, 30 and 300kW.
Typical manufacturer - Siemens Ltd. Model 05025-A204 — 600

Cost US $

Clip-on Power Factor Meter

For measurement of cos ϕ with three phase current and for determination of phase rotation and energy direction. Measuring range 15 to 1500A; 150 to 600V. Frequency range 40 to 60Hz.
Typical manufacturer - Siemens Ltd. Model M05025-A205 600

Insulation Tester with Magneto Generator

For measurement of consumer installations, for voltage measurement and for indication of current type and polarity.
Typical manufacturer - Siemens Ltd. Model C70241-A517-A1 600

Insulation Tester for Battery Operation

For measuring the insulation resistance of conductors, systems, machines etc. when they are not under voltage.
Typical manufacturer - Siemens Ltd. Model M05835-A2 1000

Power Measuring Set

For measurement in single phase and three wire systems with unbalanced load. Frequency range 15 to 65Hz.
Typical manufacturer - Siemens Ltd. Model M05839-A1 2800

Transformer Ratio Tester

For the measurement of the no-load ratio of power transformers. Measuring range of the no-load ratio 1 to 1011.
Typical manufacturer - Siements Ltd. Model M05833-A1 3800

R.L.C. Measuring Bridge

For percentage measurement of apparent resistances by comparison with external standards. Resistance range 0.1Ω to 110M Ω, Self inductive range 10μH to 1100 H. Capacitance range 10 pF to 1100μF.
Typical manufacturer - Siemens Ltd. Model M14565-A1 1400

Cost US $

High Voltage Testing Unit

Test voltage range 80 to 110 kV. For liquid and solid insulating materials. To be supplied with a full range of accessories.
Typical manufacturer - Siemens Ltd. Model M06843-A1 — 11000

Digital Timer

For measurement of working time of relays or the tripping time of switches. Range 0 to 99.99 seconds. Resolution 10ms.
Typical manufacturer - Siemens Ltd. Model M09005-A23-A1 — 400

Lightmeter

For measuring level of illumination in two ranges 0-500 lux and 0-2000 lux.
Typical manufacturer - Avo Ltd. Model LM4 — 700

AC/DC Breakdown, Leakage and Ionisation Tester

Testing voltage 0-4Kv and 0-12Kv. Breakdown periods from 1ms to 5ms indicated. Ionisation indication.
Typical manufacturer - Avo Ltd. Model RM215 L/2 — 2600

Calibration Generator

Three square wave output modes 10Hz to 1MHz. Amplitude calibration from 200μV to 100V.
Typical manufacturer - Tektronix Ltd. Model PG506 — 1700

Time Mark Generator

Marker outputs 1ns to 5s. Crystal frequency 1MHz, stability within 1 part in 10^5. External trigger output.
Typical manufacturer - Tektronix Ltd. Model TG501.

	Cost US $
Signal Generator	
Levelled variable output 250kHz to 250MHz. Digital readout of frequency. Amplitude range 5mV to 5.5V. Typical manufacturer - Tektronix Ltd. Model SG503	1400
Signal Generator	
Levelled variable output 245MHz to 1050MHz Frequency modulation capability. Amplitude range 0.5V to 4.0V. Typical manufacturer - Tektronix Ltd. Model SG504.	2200
Dual Beam Oscilloscope	
400 MHz bandwidth. Dual beam with full vertical cross over switching. 1GHz/division calibrated sweep. LGH2 direct access unit. Typical manufacturer - Tektronix Ltd. Model R7844.	2800
Miscellaneous Equipment	5000

CHEMICAL PRODUCTS

Cost US $

Automatic Adiabatic Bomb Calorimeter

For the determination of calorific value of coal, coke, petroleum products and biological materials. Capacity 300ml. Complete with console, bomb, bomb stand pressure gauge and full range of accessories.
Typical manufacturer - Gallenkamp & Co. Ltd. Model CBA-300 2200

Ballistic Bomb Calorimeter

For the determination of the calorific values of foods and animal feeds.
Typical manufacturer - Gallenkamp & Co. Ltd. Model CBB-330 1200

Centrifuge

General purpose laboratory centrifuge. Maximum capacity 1000ml. Speed up to 5000 rev/min. Timer 0-60 minutes. Complete with swing out heads and buckets.
Typical manufacturer - Gallenkamp & Co. Ltd. Model CFD-400 1600

Linear Scale Colorimeter

Instrument with linear optical density readout from digital display. Wavelength range 450 to 670nm. Digital readout range 0 - 1 x 0.01 o.d. Complete with filter discs and full range of accessories.
Typical manufacturer - Gallenkamp & Co. Ltd. Model COL-440 1000

Muffle Furnace

Temperature range up to 1100°C. Internal dimensions 100mm x 125mm x 150mm. Complete with indicating pyrometer and thermal fuse.
Typical manufacturer - Gallenkamp & Co. Ltd. Model FSE-250 500

Incubator

Temperature range 5°C above ambient to 100°C. Temperature variations $\pm$ 0.25°C. Internal dimensions 605mm x 505mm x 455mm.
Typical manufacturer - Gallenkamp & Co. Ltd. Model INC-750 800

	Cost US $
Kjeldahl Equipment	
Combined digestion and distillation assembly. Typical manufacturer - Gallenkamp & Co. Ltd. Model NKA-280	1600
Oven	
Fan convection. Maximum temperature 250°C. Stainless steel interior. Interior dimensions 605mm x 505mm x 455mm. Typical manufacturer - Gallenkamp & Co. Ltd. Model OVH-200	700
Humidity Oven	
Temperature range 0 to 100°C. Temperature variation ± 0.5°C. Humidity up to 95%. Internal dimensions 710mm x 810mm x 685mm. Typical manufacturer - Gallenkamp & Co. Ltd. Model OVR-400	4600
Refrigerator	
Capacity 395 litres. Shelf area 1.4m^2 Typical manufacturer - Gallenkamp & Co. Ltd. Model RFP-400	500
Low Temperature Cabinet	
Minimum operating temperature -70°C. Internal dimensions 1150mm x 460mm x 730mm. Typical manufacturer - Gallenkamp & Co. Ltd. Model RFP-800	3500
Flask Shaker	
To accept six 500ml flasks. Speed range 100 to 800 oscillations/ minute. Timer 0 - 20 minutes. Typical manufacturer - Gallenkamp & Co. Ltd. Model SGL-700	300
Water Still	
Electrically heated. Output 4.5 litres/hour. Typical manufacturer - Gallenkamp & Co. Ltd. Model WGS-370	300

	Cost US $
Analytical Balance	
80g capacity analytical balance. Readability 0.01mg Independent taring. Typical manufacturer - Oertling Ltd. Model R52.	1600
Analytical Balance	
160g capacity analytical balance. Readability 0.1mg. Independent taring. Typical manufacturer - Oertling Ltd. Model R41.	1200
Top Pan Balance	
200g capacity top pan balance. Readability 0.001g. Independent taring. Top pan diameter 83mm. Typical manufacturer - Oertling Ltd. Model 31TD.	1200
Top Pan Balance	
1500g capacity top pan balance. Readability 0.01g. Independent taring. Top pan diameter 127mm. Typical manufacturer - Oertling Ltd. Model 21TD.	1300
Microscope	
Modular design microscope with objective lens magnifications of x4, x10, x20, x40 and x100. Eyepiece magnification x10. Work stage of 170mm x 170mm with vernier scale adjustment reading to 0.1mm. Complete with photomicrographic outfit and full range of accessories. Typical manufacturer - Gallenkamp & Co. Ltd. Model MKU 350.	4300
Sterescopic Microscope	
Sterescopic zoom microscope with continuous magnification from x7 to x40. Facilities to provide magnification ranges from x3.5 to x160. Mounted on stand with rack and pinion focussing. Typical manufacturer - Gallenkamp & Co. Ltd. Model MLR 320	800

Cost US $

Glass ware

Full range of laboratory glassware including beakers, bottles, burettes, condensers, crucibles, glass cylinders, distillation columns, filters, flasks, funnels, hydrometers, pipettes etc. etc. 30000

Warburg Bath

Maximum temperature 60°C. Temperature fluctuation ± 0.01°C. Tank capacity 14 litres. Speed control 0 to 130 strokes/min. Complete with thermistor control and 13 standard manometer holders. Typical manufacturer - Gallenkamp & Co. Ltd. Model BLH-500 2600

Freeze Drying Apparatus

Comprising air cooled refrigerator compressor, stainless steel condenser chamber and eight port drum manifold. Heat extraction rate 180k cal/hour. Complete with vacuum pump and Pirani vacuum gauge.
Typical manufacturer - Gallenkamp & Co. Ltd. Model FMW-500 2400

Gas Analyser

For the determination of O_2, CO_2, CO, H_2 and CH_4. All glass parts mounted on panel. Complete with rheostat, mains transformer, burettes, mercury reservoir etc.
Typical manufacturer - Gallenkamp & Co. Ltd. Model GAS-730 1000

Automatic Melting, Boiling and Drop Point Apparatus

Temperature range -20 to 300°C. Heating and cooling rates 0.2 to 3°C/min. Recorder output 100mV into not less than 5 kΩ
Typical manufacturer - Gallenkamp & Co.Ltd. Model MFM-300 3100

Moisture Balance

375W tungsten filament lamp mounted over 150mm diameter stainless steel pan. Pre-set heating periods 0.5 to 60 minutes. Weighing system capacity 10g, sensitivity 0.01g.
Typical manufacturer - Gallenkamp & Co. Ltd. Model MRX-270 1000

Cost US $

Hydraulic Press

Self-contained with hand pump. Four column press. Total load 10000Kg. Platen size 150mm x 180mm. Maximum separation of platens 400mm. Hydraulic lift 150mm.
Typical manufacturer - Gallenkamp & Co. Ltd. Model PWS-350 1400

Refractometer

Determination of refractive index of substances between 1.300 to 1.700 with an accuracy of 0.00004. Thermometer range 0°C to 75°C. Complete with horizontal prism surface, water jackets and scale illuminator.
Typical manufacturer - Gallenkamp & Co. Ltd. Model RFA-400 1000

Titration Outfit

For automatic plotting of px or potentiometer curves and titrations to pre-set px or potential end points. Comprising burette drive module, burette module 10ml, electrode potential amplifier, rate and end point control module and potentiometric recorder.
Typical manufacturer - Gallenkamp & Co. Ltd. 10400

Viscometer Bath

Temperature range up to 250°C. Temperature fluctuation ± 0.025°C. Maximum power rating 1Kw. Tank capacity 7 litres. Complete with viscometers, viscometer holders and indicating thermometer.
Typical manufacturer - Gallenkamp & Co., Ltd. Model VHC-400 2500

Atomic Absorption Spectrophometer

Four individual lamp positions adjustable in vertical and horizontal planes. Current continuously adjustable 3 to 25 mA. Double beam optical system, Ebert monochromator with 1200 lines/mm diffraction grating, f/8 aperture and blazed at 250nm. Five fixed slits giving bandwidths of 0.2, 0.4, 0.8,

	Cost US $
1.6 and 4.0nm. Complete with full range of accessories. Typical manufacturer - Pye Unicam Ltd. Model SP2900	45800
Visible Spectrophotometer	
Digital display. Range 325 - 1000nm. Single beam grating spectrophotometer. Wavelength accuracy within 1nm. Complete with accessories. Typical manufacturer - Pye Unicam Ltd. Model SP6-300	3000
Ultraviolet Spectrophotometer	
Double beam grating spectrophotometer. Wavelength range 190nm to 800nm. Wavelength accuracy $\pm$ 0.5nm. Complete with colour measurement system including integrating spheroid and programmable calculator. Typical manufacturer - Pye Unicam Ltd. Model SP8-1000	26100
Infrared Spectrophotometer	
Double beam optics. Two grating monochromator. IR50 infrared detector. Wavelength range 400 to 4000 cm^{-1}. Scan times 3,6, 25 and 50. Complete with full range of accessories. Typical manufacturer - Pye Unicam Ltd. Model SP1100	16400
Gas Chromatograph	
Temperature programmed dual flame ionization detector. Injector temperature range 50°C to 400°C $\pm$ 1°C. Column oven temperature range 20°C above ambient to 400°C $\pm$ 0.12°C. Detector oven temperature range 60°C to 400°C continuously variable. Complete with full range of accessories. Typical manufacturer - Pye Unicam Ltd. Model GCD	9100
Liquid Chromatograph	
Comprising a separate solvent delivery system and variable wavelength UV detector. Maximum pressure 160 bar. Flow range 0 - 10ml/min. Deuterium lamp source, wavelength 190-380nm. Wavelength accuracy better than 2nm. Typical manufacturer - Pye Unicam Ltd. Model LC3	30600

Cost US $

pH Meter

Digital display. Range 0.00 to 19.99 pH. Reading accuracy 0.01 pH. Complete with electrode stand and holder, electrodes etc.

Typical manufacturer - Pye Unicam Ltd. Model PW 9410/30 1000

PETROLEUM PRODUCTS

Cost US $

Automatic Standard Distillation Apparatus

Temperature ranges 0 to 300°C and 0 to 400°C together with 5 narrow temperature ranges between 50 and 400°C. Complete with recorder, cooling outfit and full range of accessories.
Typical manufacturer - Gallenkamp & Co. Ltd. Model PED-230 — 10500

Determination of Sulphur Content

For the determination of sulphur by the Lamp method. Complete with 5 test unit assembly, glassware and synthetic air unit.
Typical manufacturer - Gallenkamp & Co. Ltd. Model PEM-200, PEM-220 and PEM-250 — 2600

Determination of Vapour Pressure

For the determination of vapour pressure by the Reid method. Complete with vapour pressure bomb and pressure gauges to cover the range 0 to 25 bar.
Typical manufacturer - Gallenkamp & Co. Ltd. Model PEM 430 and PEM-460 — 2100

Determination of Existent Gum in Fuels

For the determination of existent gum in fuels by jet evaporation. Five place heating block complete with pressure regulator and pressure gauge. Air pressure controlled at 155°C ± 5°C and steam superheater at 232°C ± 3°C.
Typical manufacturer - Gallenkamp & Co. Ltd. Model PEH-440 — 2400

Determination of Corrosiveness of Copper

Copper corrosion assembly comprising thermostatic waterbath with capacity for eight corrosion bombs. Complete with full range of accessories.
Typical manufacturer - Gallenkamp & Co. Ltd. Model PEB-770 and PEB-780 — 1000

Cost US $

Oxidation Stability Test

For the determination of the oxidation stability of aviation fuels by the Potential Residue method and of Motor Gasoline by the Induction Period method. Oxidation stability apparatus and accessories.
Typical manufacturer - Gallankamp & Co. Ltd. Model PEL-460 1500

Determination of Flash Point

For the determination of flash points by the Pensky-Martens closed cup method. Automatic testing apparatus with digital readout in ^{o}C. Complete with full range of accessories.
Typical manufacturer - Gallankamp & Co. Ltd. Model PEJ-200 and PEJ-230 3300

Determination of Water and Sediment

For determination of water content and sediment by the centrifuge method. Electrically driven centrifuge, maximum speed 1500 rev/min.
Typical manufacturer - Gallenkamp & Co. Ltd. Model PEM-750 500

Determination of Kinematic Viscosity

Canon-Fenske viscometers to cover range 0.4 to 16000 c st.
Viscometer bath with temperature range up to $120^{o}C$.
Typical manufacturer - Gallenkamp & Co. Ltd. Model VHB-670 and VHC-220 1400

Determination of Carbon Residue

Determination of carbon residue by Ramsbottom method. Heating block with accurate temperature control complete with accessories.
Typical manufacturer - Gallenkamp & Co. Ltd. Model PEB-350 2000

Determination of Penetration

Universal automatic penetrometer complete with needles and cones.
Typical manufacturer - Gallenkamp & Co. Ltd. Model PEL-610 800

	Cost US $
Saybolt Viscometer	
Two tube Saybolt Viscometer with temperature 21 to 100°C. Complete with full range of accessories. Typical manufacturer - Gallenkamp & Co. Ltd. Model PEM-510	1500
Colour Comparator	
For determining the colour of a wide range of petroleum products. Typical manufacturer - Gallenkamp & Co.Ltd. Model PEB-700	700
Cloud and Pour Point Baths	
Comprising cylindrical copper tank 230mm diameter x 165mm deep to take six standard test jars and thermometer. Typical manufacturer - Gallenkamp & Co. Ltd. Model PEB-570	200
Abel Apparatus	
For the determination of flash point by the Abel method. Complete with oil cup, heating vessel, test timing pendulum and thermometers. Typical manufacturer - Gallenkamp & Co. Ltd. Model PEH-600	600
Smoke Point Lamp	
Comprising lamp body with 50mm scale, micrometer adjusted candle socket and candle assembly. Typical manufacturer - Gallenkamp & Co. Ltd. Model PEL-860	300
Miscellaneous Equipment	5000

MAINTENANCE & SERVICING

Cost US $

Milling, Drilling and Boring Machine (Bridgeport Type)

Table size 1070mm x 220mm, longitudinal traverse 760mm, cross traverse 305mm, vertical traverse 405mm. 2 HP motor with infinitely variable speed of 50 to 3750 rpm. Accessories to include slotting attachment, right angle arbor support bracket, dividing head, rotary table, collets, arbors, swivel vice, clamps and equipment cabinet.
Typical manufacturer - Adcock Shipley Ltd. Model BR2J2 — 9500

Variable Speed Precision Lathe

Workpiece capacity 280mm diameter x 610mm long. Speed range 40 to 2500 rpm. Screw cutting facility. Taper turning attachment. Accessories to include 3 and 4 jaw chucks, face plate, drill chucks, three point steady.
Typical manufacturer - Clarkson Machine Tools (Smart & Brown) Ltd. Model 1024 VSI — 20000

Surface Grinder

Worktable capacity 200m x 610mm. Vertical movement of wheel head 280mm. Accessories to include wheel dressing equipment, coolant clarifier, magnetic chuck, compound sine table.
Typical manufacturer - Jones & Shipman Ltd. Model 1400 — 18000

Universal Cylindrical Grinder

Workpiece capacity 250mm diameter x 450mm long. Machine to be suitable for external and internal grinding. Machine to be fitted with a rise and fall swivelling wheelhead for tool and cutter grinding operations. Accessories to include internal grinding spindles for up to 50mm diameter, radial grinding attachment.
Typical manufacturer - Jones & Shipman Ltd. Model 1311 EIVR — 23500

	Cost US $
Heat Treatment Plant	
Equipment to include a heat treatment furnace with a workpiece capacity of 400mm x 200mm x 200mm, case hardening facilities, quenching baths.	15000
Bandsaw	
Throat 610mm. Height under guides 200mm. Table size 480 x 480mm. Ten speeds from 17 to 980 m/min. Motor horsepower 1.5	1900
Typical manufacturer - Startrite Machine Tool Co., Ltd. Model 24T10	
Miscellaneous Equipment	
Equipment to include guillotine, gas and electric welding equipment, etc.	10000
Miscellaneous Small Tools	
Equipment to include taps, dies, reamers, drills, rolling cutters, hand tools, inspection equipment.	10000

MISCELLANEOUS EQUIPMENT

	Cost US $
Fork Lift Truck	
Electrically operated, 2000Kg carrying capacity complete with batteries and charger. Fitted with pneumatic tyres, side shift control and crane attachment. Overall height with mast lowered 2160mm, overall length 3145mm, overall width 1145mm. Typical manufacturer - Lancer Boss Ltd. Model PE4P	20500
Duplicator	
Offset printing and duplicating machine. Maximum sheet size 297mm x 431mm. Printing area 264mm x 330mm. Paper magazine capacity 5000 sheets. Printing speed 5000 to 10000 copies per hour. Typical manufacturer - Addressograph-Multigraph Ltd. Model 1250 HS	9200
Offset Platemaker	
Exposure area 300mm x 450mm. 500 watt tungsten lamps light source. Exposure timer 0-10 seconds. Typical manufacturer - Agfa-Gevaert. Model 030	1100
Compressors	
Compressors to supply air at 7Kg/cm^2 pressure. Free air delivered 0.4m^3. Motor horsepower 4.5 Typical manufacturer - Broom & Wade Ltd.	4800

APPENDIX 3

Names and Addresses of Typical Manufacturers

ADCOCK SHIPLEY LTD.
P.O.Box 22,
Forest Road,
LEICESTER, England.

Alternatives

THE SELSON MACHINE TOOL CO. LTD.
Airfield Industrial Estate,
Cherry Garden Lane,
WHITE WALTHAM, England.

STAVELEY MACHINE TOOLS LTD.
Portland House,
Stag Place,
LONDON SW1E 5BU, England.

ADDRESSOGRAPH-MULTIGRAPH LTD.
P.O.Box 17,
Maylands Avenue,
HEMEL HEMPSTEAD,
Herts, England.

Alternative

GESTETNER LTD.
P.O. Box 466,
LONDON, England.

AGFA-GEVAERT LTD.
Brent House,
950 Great West Road,
BRENTFORD,
Middx. England.

ASTELL HEARSON LTD.
172 Brownhill Road,
LONDON SE6 5DL, England.

AVERY-DENISON LTD.
Moor Road,
LEEDS, England.

Alternatives

ZWICK & CO. K.G.
Werkstoffprufmaschinen,
D-7901 Einsingen ub Vöm,
W.Germany.

ROCKWELL LTD.
Sandy Lane,
Stourport on Severn,
Worcs. England.

CLARKSON MACHINE TOOLS
(Smart & Brown)Ltd.
Lon don Road,
BIGGLESWADE,
Beds. England.

Alternative

THE COLCHESTER LATHE CO. LTD
COLCHESTER,
Essex, England.

COVENTRY GAUGE LTD.
Park Avenue,
Madeley,
TELFORD, England.

Alternative

CARL MAHR
Plodinger Str 23-25,
73 Esslingen,
West Germany.

ENGINEERING LABORATORY EQUIPMENT LTD.
Eastman Way,
HEMEL HEMPSTEAD,
Herts. England.

Alternatives

MARUTO TESTING MACHINE CO.
15-4, 2 Chome,
Shirakawa, Koto-Ku,
Tokyo, Japan 135-91

LABOTEST
41 Avenue Albert-Bartholome,
Paris XV^{e}

FLUKE INTERNATIONAL CORPORATION,
Garnett Close,
WATFORD, England.

Alternatives

J.J. LLOYD INSTRUMENTS LTD.
Brook Avenue,
Warwash, SOUTHAMPTON.
England.

H. TINSLEY & CO. LTD.
Wernder Hall,
South Norwood,
LONDON SE25 5LA.
England.

GALLENKAMP & CO. LTD.
P.O.Box 290 Technico House,
Christopher Street,
LONDON EC2P 2ER, England.

Alternative

TOWSON & MERCER LTD.
Beddington Lane,
CROYDON, England.

HERBERT SIGMA LTD.
Spring Road,
LETCHWORTH, England.

Alternative

THOMAS MERCER LTD.
Eywood Road,
ST. ALBANS, England.

HEWLETT PACKARD LTD.
Winnersh,
WOKINGHAM,
Berks. England.

INSTRON LTD.
Coronation Road,
HIGH WYCOMBE,
Bucks. England.

Alternative

ZWICK & CO. KG
Werkstoff pruf maschinen
D-7901 Einsingen Ub Ulm,
W. Germany.

JAMES H. HEAL & CO. LTD
Richmond Works,
HALIFAX, England.

Alternatives

TEXTEST INCORPORATED
CH-8802 Kilchberg/Zurich,
Weinberger strasse 93,
Switzerland.

TEXTECHINO HERBERT STEIN KG,
405 Mouchengladbach 1,
Regentenstr. 37-39.
West Germany.

C.E.JOHANSSON
Eskilstuna,
SWEDEN

Alternatives

CARL MAHR,
Plochinger Str. 23-25
73 Esslingen,
W.Germany

T.I. COVENTRY GAUGE LTD.
Park Avenue,
Madeley,
TELFORD, England.

JONES & SHIPMAN LTD.
Narborough Road South,
LEICESTER, England.

Alternative

ELLIOT MACHINE TOOLS LTD.
Padholme Road,
PETERBOROUGH, England.

LANCER BOSS LTD.
LEIGHTON BUZZARD,
Bedfordshire, England.

Alternatives

LANSING BAGNELL LTD.
Kingsclere Road,
BASINGSTOKE,
Hants. England.

B.K.S. GESELLSCHAFT mbH.
562 Velbert,
W.Germany.

LAND PYROMETERS LTD
Wreakes Lane,
Dronfield,
SHEFFIELD, England.

Alternative

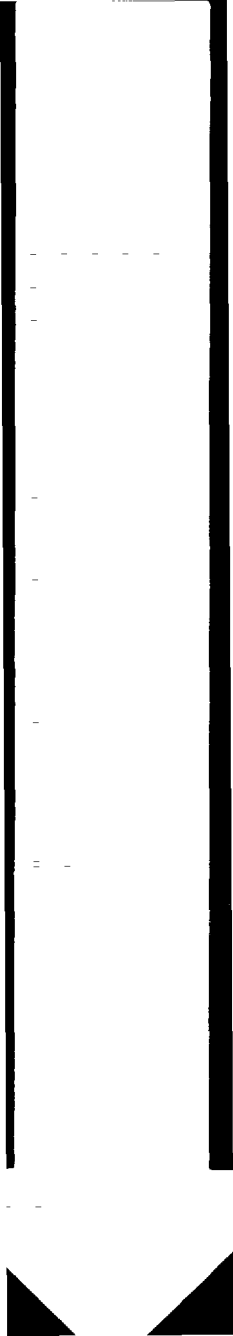
THE AMALGAMS CO. LTD.
Tinsley Park Road,
SHEFFIELD, England.

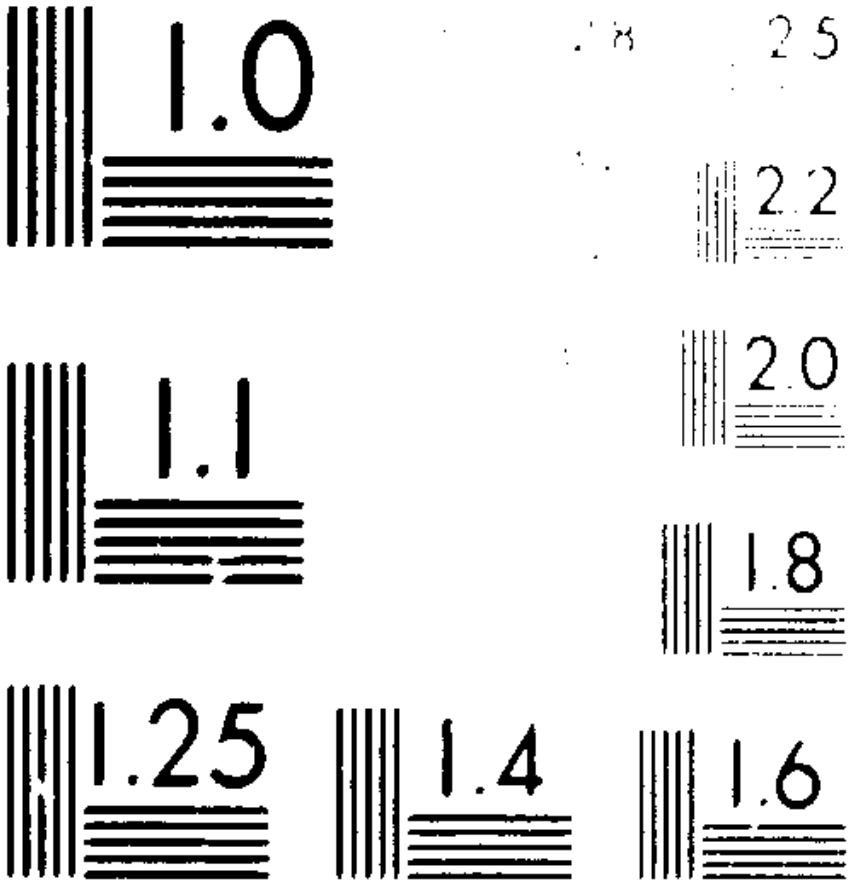
OBERTLING LTD.
Cray Valley Works,
St. Mary Cray,
ORPINGTON,
Kent, England.

Alternatives

METTLER GmbH,
Badinburger Hohl 67,
63 Giessen-Wieseck,
W. Germany.

SARTORIUS-WERKE GmbH
Weender Landstr. 96-102,
34 Gottingen,
W. Germany

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PYE UNICAM LTD.
York Street,
CAMBRIDGE, England.

Alternative

PERKIN ELMER,
916 Meridian Ave,
South Pasadena,
CALIFORNIA 91030, U.S.A.

RANK PRECISION INDUSTRIES
P.O.Box 36,
Guthlaxton Street,
LEICESTER, England.

Alternative

FERRANTI LTD.
Thornybank,
DALKEITH,
Midlothian, Scotland.

ROACHES ENGINEERING LTD.
Upper Hulme,
Nr. LEEK,
Staffs. England.

SHIRLEY DEVELOPMENTS LTD.
P.O.Box 6,
856 Wilmslow Road,
MANCHESTER, England.

Alternative

GOODBRAND & JEFFRIES,
Beaumont Road,
BANBURY, England.

SATRA,
Satra House,
Rockingham Road,
KETTERING,
Northants, England.

SIEMENS LTD.
Siemens House,
Eaton Bank,
CONGLETON,
Cheshire, England.

SIMMONS & HAWKER LTD.
Central Way,
Feltham,
Middx, England.

SOCIETE GENEVOISE D'INSTRUMENT DE PHYSIQUE
8 Rue des Vieux-Grenadiers,
1211 GENEVA, Switzerland.

Alternative

CARL ZEISS LTD.
Jena,
E. Germany

SULLIVAN LTD.
Archcliffe Road,
DOVER,
Kent, England.

Alternative

H. TINSLEY & CO. LTD.
Werndee Hall,
South Norwood,
LONDON SE25 5LA, England.

STARTRITE MACHINE TOOL CO. LTD.
69-71 Newington Causeway,
LONDON SE1 6BH, England.

Alternatives

DOALE CO. LTD.
12 Barton Rd,
Water Eaton Estate,
BLETCHLEY, England.

DEMURGER et CIE,
Roanne,
France

TEKTRONIX UK LTD.
Beaverton House,
P.O.Box 69,
HARPENDEN,
Herts. England.

Alternative

THE SOLARTRON ELECTRONIC GROUP LTD.
FARNBOROUGH,
Hants. England.

THORN BENDIX LTD.
Beech Avenue,
New Basford,
NOTTINGHAM, England.

VICKERS INSTRUMENTS
Haxby Road,
YORK, England.

WINDLEY BROS LTD.
Beach's Drive,
CHELMSFORD, England.

Alternative

WBJ ENGINEERING LTD.
Shepley Estate,
Audenshaw,
MANCHESTER, England.

APPENDIX 4

National Metrology Centre

The building and equipment requirements for the National Metrology Centre have been dealt with separately as they do not form part of the UNDP funded project. It is important to stress again, however, that the NMC does form an integral part of the ESI activities and separation of the NMC requirements into this Appendix is merely for convenience of reporting.

On reviewing the preliminary outline design for the NMC, it became apparent that a number of modifications would be required. These were mainly concerned with the provision of suitably controlled environmental conditions in the laboratory area. The decision of ESI to recommend that the NMC should be physically separated from the Headquarters Building is fully endorsed by the writer.

The proposed outline design for the NMC building is shown in Fig. 1. of this Appendix. The total floor area of the building is 1000 sq.m. of which 500 sq.m. is laboratory space under environmental control; 210 sq.m. is office space and the remainder is for miscellaneous items including loading and unloading, storage space, compressor room etc. The most vital part of the building is the environmentally controlled laboratory and it is proposed to construct this on the basis of "a building within a building". Close attention is required to the insulation of the inner laboratory building and this necessitates the use of air locks on the entrances, cavity walls, double glazing, insulated roof etc.

Two levels of environmental control are proposed; the smaller area which is controlled to 20°C ± ¼°C and 50% ± 5% relative humidity will house the Ethiopian National Standards for length, mass, volume, electrical units, temperature and frequency. The larger area controlled to 20°C ± 1°C and 50% ± 5% relative humidity will be used for the routine calibration of working standards and measuring equipment. It will be necessary to provide the following services in the laboratory:

Electricity:	Single phase mains supply
Compressed air:	Dry, compressed air at a pressure of 5 bars
Water:	Mains water supply

The level of illumination necessary at bench level is 500 to 1000 lux and this should be provided by fluorescent lighting to minimise the heat load. Arrangements should be made in ESI to ensure that the lighting remains switched on 24 hours a day as this helps to provide an even heat load in the laboratory and simplifies the problem of maintaining a constant temperature.

The floor covering should be continuous welded PVC and a suitable means of collecting dust from people's shoes, at the two air locks, should be provided.

It will be necessary to provide a shielded enclosure within the electrical/frequency section of the laboratory to provide attenuation in both the electric and magnetic modes from 1KHz to 45GHz. The provision of such an enclosure requires specialised skills and it is recommended that an enclosure of modular design with internal dimensions of 2438mm x 2438mm x 2438mm be obtained from a manufacturer such as Belling and Lee Ltd., Great Cambridge Road, Enfield, Middlesex, England.

The recommended major items of equipment for use in the various sections of the laboratory are listed under the appropriate headings.

LENGTH MEASUREMENT

Slip Gauges	Cost US $
One set of grade 00 metric slip gauges (1.0005mm to 100mm) One set of grade 00 inch slip gauges (0.1001 in to 4 in) Two sets of grade 1 metric slip gauges (1.0005mm to 100mm) One set of slip gauge accessories Typical manufacturer - C. E. Johansson	9000
Cylindrical Standards	
One set of metric cylindrical standards in size range 10mm diameter to 100mm diameter Typical manufacturer - Coventry Gauge Ltd.	1000
Ring Gauges	
One set of reference quality ring gauges in size range 10mm diameter to 100mm diameter Typical manufacturer - Coventry Gauge Ltd.	1300
Slip Gauge Interferometer	
Interferometer for the calibration of slip gauges in size ranges 0 - 100mm. Complete with monochromatic light source, platens, fractional coincidences slide rule, wavelength tables etc. Typical manufacturer - Rank Precision Industries	30000
High Magnification Comparator	
Vertical comparator for slip gauge calibration. Magnification 50 000:1. Resolution 0.00005mm. Capacity 150mm Typical manufacturer - Herbert Sigma Ltd.	3200

Universal Measuring Machine	Cost US $
Longitudinal travel 400mm. Transverse travel 200mm. Vertical travel 200mm. Digital readout on each axis to 0.0001mm. Complete with a full range of accessories for the measurement of plug and ring gauges, screw thread gauges, angular measurement etc.	
Typical manufacturer - Societe Genevoise Ltd. Model 422M	177000
Length Measuring Machine	
Length capacity 3000mm. Micrometer microscope reading to 0.0005mm. Complete with full range of accessories.	
Typical manufacturer - Societe Genevoise Ltd. Model MUL 3000	89000
Surface Table	
Black granite surface table complete with stand. Size 1800mm x 1200mm. Grade A.	
Typical manufacturer - Windley Bros. Ltd.	3000
Mechanical Comparators	
One vertical mechanical comparator. Workpiece capacity 300mm. Magnification 500:1. Complete with range of worktables and measuring contacts.	600
One vertical mechanical comparator. Workpiece capacity 150mm. Magnification 3000:1 complete with range of worktables and measuring contacts.	
Typical manufacturer - Herbert Sigma Ltd.	700
Optical Projector	
Workstage capacity 230mm x 630mm. Maximum travel 150mm x 300mm with digital readout to 0.002mm. Vertical screen 500mm diameter with angular reading to 1 minute. Optical magnification 10x, 50x, and 100x. Complete with surface illumination facilities, centres and vee supports.	
Typical manufacturer - Herbert Sigma Ltd.	17000

Optical Dividing Head	Cost US $
Optical dividing head with direct reading to 2 seconds of arc. Complete with baseplate, tailstock and collets. Typical manufacturer - Windley Bros. Ltd.	4900
Optical Rotary Table	
400mm diameter optical rotary table with direct reading to one second of arc. Complete with support base. Typical manufacturer - Windley Bros. Ltd.	3800
Roundness Measuring Machine	
Rotating table roundness measuring machine. Worktable diameter 200mm. Maximum workpiece load 9Kg. Maximum error or rotation 0.000075mm. Magnification 100:1 to 10 000:1 complete with polar recorder and accessories. Typical manufacturer - Rank Precision Industries.	20000
Surface Finish Measuring Machine	
Stylus type surface finish measuring machine. Vertical magnifications 1000:1 to 100000:1. Horizontal magnifications 20:1 to 100:1. Complete with chart recorder, meter readout of Ra value and full set of accessories. Typical manufacturer - Rank Precision Industries	12000
Electronic Level	
Battery operated electronic level. Resolution 2 seconds of arc. Range 50 seconds to 8 minutes of arc. Typical manufacturer - Rank Precision Industries	800
End Bars	
One set of grade 0 metric end bars plus accessories Typical manufacturer - Coventry Gauge Ltd	1800

Autocollimator	Cost US $
Microptic autocollimator with a range of 10 minutes of arc. Resolution 0.2 seconds. Complete with mounted reflector, 8 sided polygon, optical square. Typical manufacturer - Rank Precision Industries	4900
Electrical Transducers	
Unidirectional and bidirectional transducers. Readout unit with ranges 0 - 0.005mm to 0 - 0.5mm. Height transfer stand. Typical manufacturer - Herbert Sigma Ltd.	1000

MASS MEASUREMENT

Cost US $

100Kg Capacity Balance

Swinging pointer balance of 100Kg capacity. Sensitivity 50mg. 760mm phosphor bronze beam. Hardened tool steel knife edges on tungsten carbide planes.
Typical manufacturer - Oertling Ltd. Model A06. 10400

25Kg Capacity Balance

Reference balance of 25Kg capacity. Sensitivity 15mg. 610mm phosphor bronze beam. Hardened steel knife edges and planes. Flat, circular weighing pans 320mm diameter.
Typical manufacturer - Oertling Ltd. Model 0182. 4400

5Kg Capacity Balance

Reference balance of 5Kg capacity. Sensitivity 4mg. 254mm aluminium alloy beam. Agate knife edges on corundum planes. Flat, circular weighing pans 146mm diameter.
Typical manufacturer - Oertling Ltd. Model 0182. 2200

200g Capacity Balance

Reference balance of 200g capacity. Sensitivity 0.5mg 127mm aluminium alloy beam. Agate knife edges on corundum planes. Flat, circular weighing pans 70mm diameter.
Typical manufacturer - Oertling Ltd. Model 0181. 900

20g Capacity Balance

Reference balance of 20g capacity. Sensitivity 0.025mg. 127mm nickel-chromium alloy beam. Agate knife edges and planes. Flat, circular weighing pans 24mm diameter.
Typical manufacturer - Oertling Ltd. Model 0180. 1500

Cost US $

Set of Reference Weights

Set of 31 reference weights 50Kg to 1mg complying with OIML Class E2 requirements. Weights down to and including 10mg of stainless steel, weights below 10mg of aluminium. Weights contained in lined, mahogany case. Lifting forceps for smaller weights.
Typical manufacturer - Oertling Ltd. Model ST1. 3600

Set of Calibration Weights

Set of 30 calibration weights 50Kg to 1mg complying with OIML Class F1 requirements. Weights down to and including 10mg of stainless steel; weights below 10mg of aluminium. Weights contained in lined, mahogany case. Lifting forceps for smaller weights.
Typical manufacturer - Oertling Ltd. Model ST2. 2800

TEMPERATURE MEASUREMENT

Cost US $

Equipment for the calibration of Thermocouples:

(a) Thermocouple calibration furnace. Temperature range 20°C to 1600°C. Temperature uniformity ± 1°C over 200mm. Tube size 38mm diameter x 750mm long.

(b) Three standard rare metal thermocouples calibrated over the range 0 to 1600°C to an uncertainty of ± 2°K.

(c) Cold junction reference source. Reference temperature 0°C. Temperature stability ± 0.01°C.

(d) Digital volt meter. Range 0 - 10.000 mV to 0 - 1000.0V in six steps. Resolution 1μV on 10 mV range.

(e) Thermocouple selector switch. Insulation between studs 50 000 megohms at 500V. Switch resistance less than 0.001 ohm.
Typical manufacturer - Land Pyrometers Ltd. 11000

Visual (Optical) Pyrometer Calibration (Temperature range 800°C to 2650°C)

(a) Two low temperature black body lamps, calibrated over the range 800°C to 1700°C

(b) Two high temperature black body lamps, calibrated over the range 1600°C to 2650°C

(c) Optical bench. Length 1m. Carrier with horizontal and vertical adjustment

(d) Stabilised power supply

Cost US $

(e) Standard resistance 0.001 ohm rated at 20 amperes
Typical manufacturer - Land Pyrometers Ltd. 16000

Infra-red Thermometer Calibration

(a) Liquid Bath Calibration Source (water)
Temperature range 20°C to 100°C. Reproducibility
± ½°C. Heater power 2000 watts. Heating rate 5K/min.
Maximum bath capacity 10 litres.

(b) Liquid Bath Calibration Source (oil)
Temperature range 80°C to 200°C. Reproducibility
± ½°C. Heater power 2000 watts. Heating rate 5K/min.
Maximum bath capacity 10 litres.

(c) Hot plate Calibration Source
Temperature range 200°C to 600°C. Reproducibility
± 1°C. Plate dimensions 150mm x 150mm x 13mm.
Plate material oxidised heat resistant steel.

(d) Cylindrical Furnace Calibration Source
Temperature range 400°C to 1450°C. Reproducibility
± 1°C. Heater power 2300 watts. Heating rate 10K/min.
Target diameter 49mm.

(e) Optical Bench Assembly
Optical bench 500mm long complete with accessories.

(f) Digital Voltmeter
Ranges 0 - 10.000mV and 0 - 10000V in six steps.
Resolution 1μV on 10mV range.
Typical manufacturer - Land Pyrometers Ltd 13000

Cost US $

Mercury in Glass Thermometer Calibration

(a) Calibrating bath thermostatically controlled. Fitted with 0 to 200°C contact thermometer, electronic relay and stirrer assembly

(b) Range of reference thermometers and thermometer reader with adjustable focussing eyepiece

Typical manufacturer - Gallenkamp & Co. Ltd. 1200

VOLUME

	Cost US $
Burettes	
Automatic burettes to cover the range 5ml to 10 litres. Accuracy of calibration ± .01ml. Typical manufacturer - Astell Hearson Ltd. Model AM17 to 30	1000
Primary Volume Measure	
Capacities 20, 40, 60, 100 and 200 litres. Accuracy of calibration 0.1ml. Typical manufacturer - Simmons & Hawker Ltd	2300
Volumetric Prover Tank	
Capacity 500 litres. Complete with facilities for flow measurement. Typical manufacturers - Simmons & Hawker Ltd.	9500

ELECTRICAL UNITS

Cost US $

Voltage Standards

12 saturated standard cell enclosure. Temperature stability ± 0.01°C. Calibrated accuracy ± 1μV. Standby battery operation.
Typical manufacturer - Guildline Instruments Ltd. Model 9152/12 — 2900

Standard Resistors

Resistance values 1, 10, 100, 1k, 10k, 100k and 1 Meg ohm.
Accuracy 0.001%. Temperature coefficient less than 2pp/m/°C.
Power coefficient less than 2ppm/watt. Power rating 0.1 watt.
Typical manufacturer - Guildline Instruments Ltd. Model 9330 — 2600

Constant Temperature Oil Bath

Working volume 63cm x 38cm x 20cm. Temperature stability 0.001°C. Temperature gradients less than 0.001°C. Temperature adjustment range 0°C to 65°C.
Typical manufacturer - Guildline Instruments Ltd. Model 9730CR — 7100

Inductance Standards

Thirteen inductors in the range 1μH to 1H. Accuracy ± 0.01%. Temperature coefficient better than 5 ppm/°C. Stability better than 0.01%.
Typical manufacturer - Sullivan Ltd. Model R1900 — 5300

Capacitance Standards

Fixed value air capacitors value 100pF and 1000pF. Accuracy 0.05pF. Frequency limit 700kHz. Power factor less than 0.00002 at 1KHz.
Typical manufacturer - Sullivan Ltd. Model C1101 — 1500

DC Voltage Generator

Output voltage 0 to 1111.1110 VDC. Output current 0 to 50 ma.
Voltage ranges 10, 100 and 1000. Absolute accuracy 0.0002%.
Overcurrent and overvoltage protection. Remote sensing.
Typical manufacturer - Fluke International Corpn. Model 335A — 7100

Cost US $

Reference Divider

Input voltage ranging from 1.1 to 1100. Output voltages ranging from 0.1 to 1100. Division ratio accuracy 0.001%. Over-voltage protection to 2kV. Standard cell reference output.
Typical manufacturer - Fluke International Corpn. Model 750A. 3100

Kelvin-Varley Voltage Divider

Input rating 1100V. Input power rating 1w. Resolution 0.1 ppm. Absolute linearity ± 0.1ppm. Self calibration.
Typical manufacturer - Fluke International Corpn. Model 720A. 4000

Lead Compensator

Maximum resistance ratio 4000:1. Resolution of resistance compensation 0.1 milliohms. Maximum allowable lead resistance 150 milliohms. Maximum divider voltage 1500.
Typical manufacturer - Fluke International Corpn. Model 721A. 1100

D.C.Reference Standard

Output voltage range up to 10V. Transfer accuracy 2ppm. Absolute accuracy for one year 30ppm. Short circuit output protection. Mains and battery operation.
Typical manufacturer - Fluke International Corpn. Model 731B. 1200

Null Detector

Input resistance 10 to 100 meg ohms. Voltage range 1μV to 1000V. Input isolation 10^{12} ohms.
Typical manufacturer - Fluke International Corpn. Model 845AR. 1500

Voltage/Current Calibrator

Output voltage 0 to 50 and 0 to 5. Output current 0 to 2 amps. Calibration accuracy ± 0.01%. Resolution 100μV on 50V range, 10μV on 5 V range.
Typical manufacturer - Fluke International Corpn. Model 382A. 4200

Cost US $

High Voltage Power Supply

Output voltage 0 to 10 000. Output current 0 to 10 milliamps. Load regulation 0.001%. Resolution 5mV. Ripple less than 1mV. RMS.
Typical manufacturer - Fluke International Corpn. Model 410B. 2000

Voltage Divider

Maximum input voltage 10 000. Input resistance 10 megohms. Division ratios 1000:1 and 10000:1. Stability of division ratio ± 0.01%.
Typical manufacturer - Fluke International Corpn. Model 80E-10. 700

Transfer Standard

0.01% AC/DC transfer accuracy. Voltage ranges 0.5 to 1000. Frequency range 5 cps to 1MC. Input impedance 180 ohms/volt of input. Polarity reversal switch. Self-contained rechargeable nickel-cadmium cells.
Typical manufacturer - Fluke International Corpn. Model 540B. 3200

Current Shunts

Current ratings for shunts 10 to 500 milliamps and 1 to 20 amps. Accuracy 0.01%.
Typical manufacturer - Fluke International Corpn. Model A40. 3500

Thermal Converters

Frequency range 5Hz to 50MHz. Accuracy of calibration ± 0.05%. Input impedance 200 ohms/volt. Output voltage 7 millivolts. Output resistance 8 ohms. Reversal error less than 0.025%.
Typical manufacturer - Fluke International Corpn. Model A55. 4300

Cost US $

Precision AC Calibrator

Voltage range 1mV to 1000V. Frequency range 10Hz to 1.2MHz.
Resolution ± 0.005%. Phase lock input. Quadrature output.
Typical manufacturer - Fluke International Corpn. Model 5200A and 5215A — 12400

True RMS Differential Voltmeter

Input voltage range 0.01 to 1100. Input frequency range 10Hz to 1MHz. Accuracy ± 0.05%.
Typical manufacturer - Fluke International Corpn. Model 931B. — 3100

High Precision dc Resistance Bridge

Seven measurement ranges covering 0-11.1111 M ohms.
Overall accuracy 0.003%. Discrimination down to 2 ppm
Internal resistance standards. — 4500

Typical manufacturer - J.J.Lloyd Instruments Ltd

FREQUENCY

Cost US $

Cesium Beam Frequency Standard

Cesium 133 atomic beam primary frequency standard. Accuracy $\pm$ 7 x 10^{-12}. Sinusoidal outputs 5MHz, 1MHz and 100KHz. Output voltage 1V rms into 50 ohms. Complete with degausser, clock display and standby power supply.

Typical manufacturer - Hewlett Packard Ltd. Model 5061 A — 24900

Electronic Counter

Direct counting and totalizing capability to 4GHz. Time interval range 2ns to 20000s. Gate time range 50ns to 1000s. Eleven digit LED display. Complete with full range of accessories.

Typical manufacturer - Hewlett Packard Ltd. Model 5345 A — 7900

VLF Receiver/Comparator

Frequency coverage 8 to 31.9 kHz. Receiver sensitivity 10 nanovolt at 50 ohm antenna input terminal. Calibration accuracy $\pm$ 1 x 10^{-11}. Complete with whip antenna.

Typical manufacturer - Fluke International Corpn. Model 207-5 — 5600

Distribution Amplifier

Twelve output channels. Frequencies accepted 100kHz, 1MHz and 5MHz. Input level 0.5 to 5.0 MHz. Input level 0.5 to 5.0 volts rms. Input impedance 50 ohms. Stability 1 x 10^{-11}.

Typical manufacturer - Fluke International Corpn. Model 203A — 3100

DERIVED UNITS

Cost US $

Pressure Gauge Testing

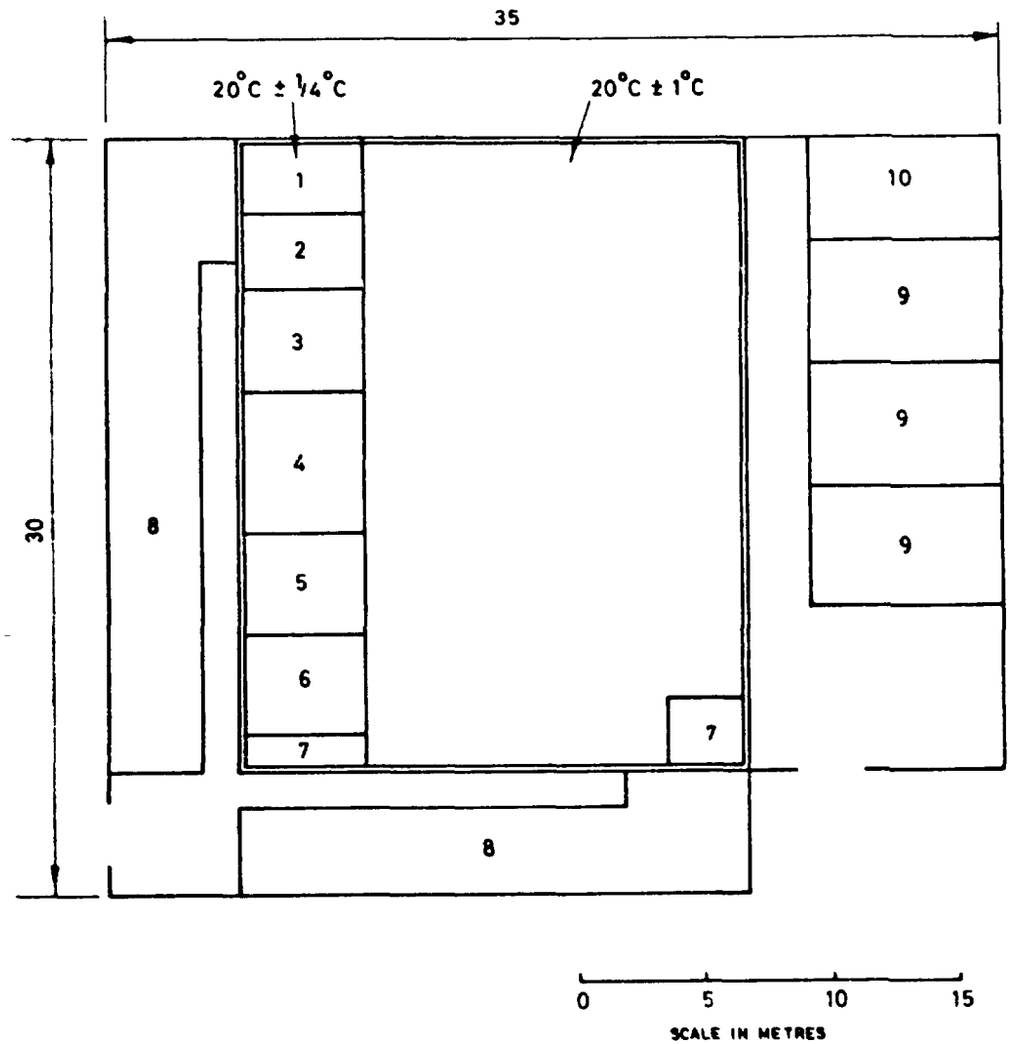
Equipment for testing a range of pressure gauges for pressures up to 20 bar.

Typical manufacturer - Engineering Laboratory Equipment Ltd — 5000

Proving Rings

Set of proving rings for the calibration of tensile and compressive testing machines. Repeatability within 0.2% Capacity up to 500kN. — 14000

Typical manufacturer - Engineering Laboratory Equipment Ltd



ENVIRONMENTALLY CONTROLLED AREA SHOWN THUS.

CAVITY BRICK WALLS

NO EXTERNAL WINDOWS

INTERNAL WINDOWS DOUBLE GLAZED

CEILING HEIGHT 3m WITH 150mm LAYER OF INSULATION MATERIAL ABOVE

INTERNAL PARTITIONING TO CEILING HT TO SEPARATE THE TWO TEMPERATURE CONTROLLED AREAS

1 TEMPERATURE
2 FREQUENCY
3 ELECTRICAL UNITS
4 LENGTH
5 VOLUME
6 MASS
7 AIR LOCKS
8 OFFICES
9 STORAGE AREA
10 COMPRESSOR & AIR CONDITIONING PLANT

FIG .1. NATIONAL METROLOGY CENTRE