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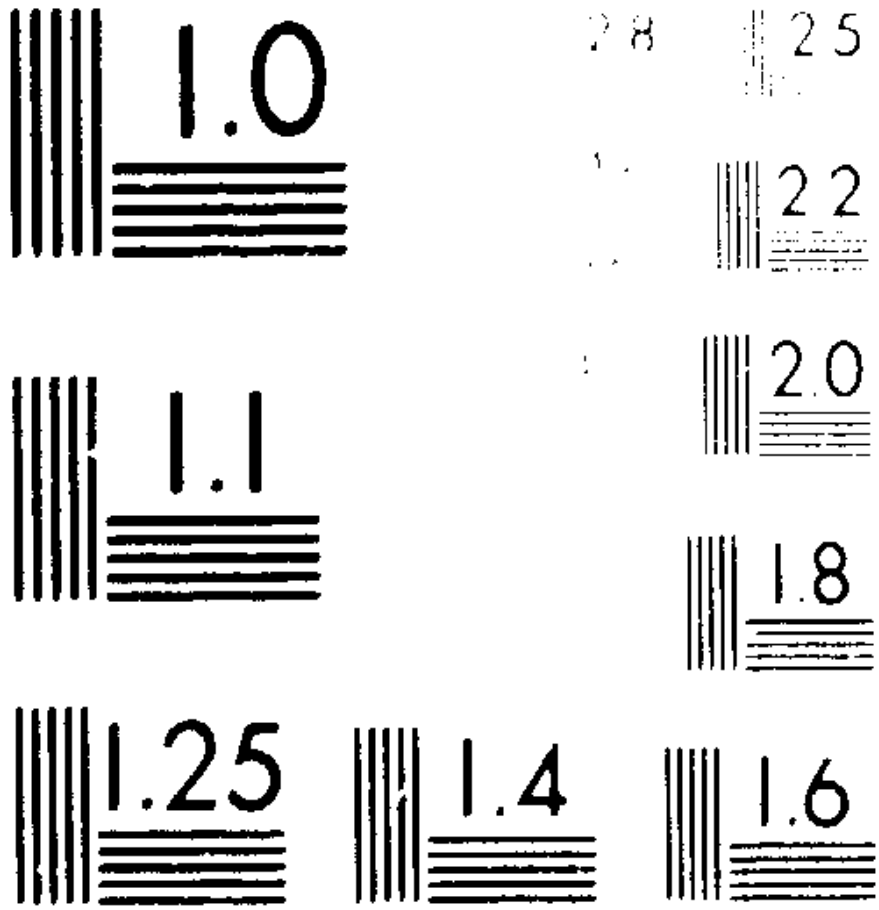
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January 1981
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INDUSTRIAL TECHNOLOGY, RESEARCH AND DEVELOPMENT CENTRES

DP/SYR/77/004

SYRIAN ARAB REPUBLIC

Technical report: Assistance in Establishing Engineering Laboratory Facilities in the Area of Mechanical Engineering*

Prepared for the Government of the Syrian Arab Republic
by the United Nations Industrial Development Organization,
executing agency for the United Nations Development Programme

Based on the work of F. ROPER, Mechanical Engineer

United Nations Industrial Development Organization
Vienna

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A C K N O W L E D G E M E N T S

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Thanks to Mr. Mohamed Hisham Sharafli the Director General and to all collaborators from ITRDC especially Mr. Kamal Sunbuli, Head of the Engineering Division, and Mr. Yasseen Thaljeh, Chief of the Mechanical Section, for all their assistance.

Thanks to the Engineers and Technicians of the Mechanical Section who, by their courtesy, kindness and good company, made the author's assignment in Syria such a pleasant one.

O

1. INTRODUCTION

(i) This report deals with the activities of Frederick Roper UNIDO Consultant for establishing laboratory facilities in the area of mechanical engineering. It covers the period of his assignment to the Industrial Testing, Research and Development Centre (I T R D C) between 8th November 1980 and 26th January 1981.

(ii) The Expert was assigned to the Project SYR/77/004 by Letter of Appointment Post DP/SYR/77/004/11-17/I/31.3.J dated 6th November 1980 with the Job Description as shown on Page 3.

(iii) The Expert s mission was from 3rd November 1980 to 2nd February 1981 during which time he was at the duty station, Damascus, S A R, from 8th November to 26th January.

JOB DESCRIPTION

16 June 1980

DP/SYR/77/004/11-17/I/31.3.J

Post title :Consultant for establishing engineering laboratory facilities in the area of mechanical engineering, with special emphasis on identification, selection and layout of facilities for non-destructive testing, strength of materials and metallographic studies.

Duration :Three months

Date required :September 1980

Duty Station :Damascus, with possible travel within the country.

Duties :The consultant will be a member of a professional team of international experts assigned to the Industrial Research and Development Centre and will work under the leadership of the Project Manager and in close co-operation with the appropriate local specialists. He will assist in creating facilities required to make the Centre capable of dealing with present and future tests which may have to be carried out in the area of mechanical engineering with special reference to non-destructive testing, welding, strength of materials and metallography, as relevant to Syrian industrial development. He will in particular:

1. Study the present and future needs of the Centre in the area of mechanical engineering as relevant to Syrian industrial development in this sector;

2. advise which existing facilities should be used and to what extent for tests in the area of mechanical engineering;

3. list the nature and type of new facilities needed and give technical specifications for purposes of equipment selection;

4. work out a layout for facilities with reference to new plans for the engineering block of laboratories and provide detailed guidance for installation and operation of equipment.

5. advise what facilities exist and should be built up at industry or plant level.

The expert will also be expected to prepare a final report, setting out the findings of his mission and his recommendations to the Government on further action which might be taken

Qualifications:		Qualified mechanical engineer with considerable experience in the establishment of laboratory facilities and with specialized knowledge in selecting equipment for mechanical engineering and layout of laboratory facilities.
Language	:	English. Arabic an asset.

2. The Basic Testing Requirements of Syrian Industry in the Area of Mechanical Engineering Laboratories

These are:

(i) Routine Tests

Tensile, compression, bending, impact, shear and hardness tests on materials and welded joints.
Proof tests and Bursting tests on small (unfired) pressure vessels such as domestic and commercial gas bottles.

(ii) Non-Routine Tests

X-ray and Ultrasonic tests on welds and castings.
Magnetic-particle and Dye-check examination for cracks and flaws in ferrous and non-ferrous items.

3. Equipment required by ITRDC to meet the basic testing needs of Industry

With exception of the apparatus required for hydraulic tests on pressure vessels, the basic items of equipment installed in the existing laboratories are adequate for conducting all of the tests prescribed in para 2 above. Appendix 1 of this report lists these basic items.
Appendix 2, A and B lists ADDITIONAL items of equipment in terms of brief specifications, source of supply, and the purpose for which they are to be used.

A shows the equipment recommended to improve the existing LABORATORY facilities at ITRDC.
B lists the equipment recommended to EXTEND ITRDC s testing services into the Industrial Field.

4. Proposed (New) Block of Engineering Laboratories

(i) The Mechanical Section will be provided with laboratories and offices covering a total area of 750 sq. meters located at the North end of a new engineering block to be built on the existing (ITRDC) grounds.

A Mechanical-testing laboratory, pressure-testing laboratory, Isotope storage and X-Ray laboratories, dark room and observation room, together with a store and two offices will be accommodated on the ground floor. A Non-Destructive testing laboratory, three laboratories for the heat treatment, preparation and microscopic examination of specimens, two offices and a W C is to be housed on the first floor.

A general outline of the new mechanical laboratories and recommendations for the installation and layout of equipment are shown in Appendix 3.

5. Testing Facilities existing at Industry or Plant Level (Ref. Job Description requirement 5)

A full assessment of the situation regarding Industry's testing facilities was beyond the capacity of the Expert with such a limited time at his disposal. However, information obtained at the Centre indicated that the heavier industries (steel plant, oil refinery, cement plant, etc.) and also some other Government Departments such as Syrian Airways and the Ministry of Roads, have equipment and expertise to cater for their day-to-day testing requirements. Equipment employed in Metallurgy, Radiography and other Non-destructive testing procedures is the most common in these areas.

During one of the Expert's visits to Adra, the Metal Construction Company's Technical Manager expressed strong views that testing and certification - particularly of finished products such as pressure-

vessels- should be carried out by an independent agency (viz ITRDC) in collaboration with some Government Authority (e.g. an Inspectorate of Boilers) which does not exist at present. The Expert agrees entirely with these views.

6. Other Activities - Difficulties, Conclusions, Recommendations

(i) Difficulties

Although the Expert has enjoyed a great deal of work satisfaction during the time of his Syrian assignment, several difficulties have been encountered, most of them minor ones - all of them compounded by the limited time (2-1/2 months) at his disposal.

The greatest difficulty arose from differences of opinion about the work plan prescribed by UNIDO, and the needs of the Centre as expressed by the counterparts.

According to 2.1 (Infrastructural Development) of the First Tripartite Review p. 24 and the Approved Project Work Plan Item No. 13, (and the Job Description) the task of the Expert was to assist "To Establish Laboratories covering Engineering Activities in the Mechanical Section".

Requests from the counterparts were concerned almost entirely with the transfer of technical know-how.

As a member of a UNIDO Team, the Expert agrees with the first evaluation. As an Engineer who remembers past experiences, he sympathises with the second

(ii) Other Activities

Whilst gathering information on the equipment requirements and layout of the new laboratories, the Expert maintained a close working relationship with members of the Mechanical staff. During the time of his assignment he - in collaboration with his working colleagues - designed, made and calibrated load - cells and the strain link shown in the Appendix of this report, and also held a colloquium on the Theory and Application of Strain Gauges for members of ITRDC staff. To conclude this exercise in industrial technology, a demonstration of its efficacy was made at a local steel factory by measuring the stress in the leaf-spring of a carrier when it was placed under load.

The transfer of information on strain gauge technique was chosen by the Expert for several reasons:- its wide application in the industrial field; its emphasis on the need for industrially - developing societies to bridge the gap between science, theory and industrial application, and - probably most important - that its practice would extend the Centre's services from the laboratories into the factories and field.

The primary objective in all these activities was to lead the local staff towards a point of proficiency where they were capable of carrying out the work by themselves so that the role of the Expert would be only a supportive one.

Given practice and encouragement, ITRDC Engineers now have the capacity to:

- Measure loads on metal presses in factories
- Determine stresses in structures (buildings, bridges, etc., under construction)
- Weigh-batch concrete constituents
- Record weights of scrap metal on a truck entering a steel mill
- Test finished components in a force frame etc., etc.

Informal talks on technical subjects were held with members of staff in their offices. Although quite superficial in character, they touched on subjects ranging from the compilation of test reports and presentation of test results to the constituents of materials and their behaviour under load.

The purpose of these talks were two-fold. To familiarize the staff with technical terms and philosophies, and to encourage the staff to speak English.

At the time of writing, plans have been initiated to test and report on welded joints made by the two welders at the Centre. This will be done in accordance with the appropriate standard for "Welders Acceptance Tests" and it is hoped to complete the exercise before the Expert leaves Damascus.

(iii) Conclusions

Considering the many difficulties encountered in the industrially-developing community, the Mechanical Section* has made commendable progress. Present indications are that its rate of development depends mainly upon:-

* Only the Mechanical Section lies within the Expert's Terms of Reference.

The rate at which quality control procedures are adopted as routine by Industry (The demand for technical services depends almost entirely upon this).

and

The rate at which the Section prepares to meet these demands of the future (which preparation - quite apart from the provision of buildings and equipment - depends strongly upon the efficacy of an intensive training programme).

Apart from minor accessories and those items listed in Appendix 2, the equipment now held in the Mechanical Section appears to be adequate to meet routine testing requirements over the next two or three years (If the demand for a non-routine test arises, special equipment would, of course, be required).

More transport is required to enable experts and counterparts to visit (and work at) factories.

(iv) Recommendations

That the Expert and Fellowship Component of the Project be increased.

That, for the duration of the Project, more emphasis be placed upon the "grass-roots" aspect of training as illustrated in this report.

APPENDIX I

MECHANICAL-TESTING LABORATORY

Universal (Hydraulic) Test Machine	-	100 T
Universal Test Machine (INSTRON)	-	10 T
Impact (IZOD and CHARPY) Testing Machine 'AVERY'	-	17 and 30 kgfm
Hardness Testing Machine, Brinell		
Hardness Testing Machine, Vickers, Rockwell and Brinell		

(Universal Machines are graduated in Metric units.
All machines were supplied with basic accessories)

NON-DESTRUCTIVE TESTING LABORATORIES

X-Ray Machine with facilities for
Development and Inspection of Film
Ultrasonic Testing Unit
Ultrasonic Thickness Measuring Apparatus
Magnetic Particle Testing Apparatus
Dye-check Equipment

METALLOGRAPHY LABORATORIES

Metallurgical Microscope M.F.2 complete with
Photographic apparatus
Polishing machines
Grinding machines
Electrolytic Polishing and Etching Apparatus
Specimen Mounting Press
Heat Treatment Furnace.

A. Additional Equipment Recommended for Mechanical Laboratories

Specification	Source	Purpose
Pressure Vessel Tester Amsler BP 717	Wolpert Schaffhausen	For conducting static and dynamic internal tests on domestic and commercial (unfired) pressure vessels, e.g. gas cylinders
Force Frame	To be fabricated at ITRDC from working drawings provided by the Department of Industrial & Scientific Research, New Zealand. (these drawings will be forwarded to ITRDC, via Vienna, by the Expert when he returns to New Zealand).	For testing components and finished products which cannot be accommodated in a test machine.
Hydraulic Pump Hand operated, high pressure. Complete with fittings to operate one 5000 kg hydraulic jack.	* Blackhawk Ltd. U.K. and CANADA ?	For use with Force Frame.
Portable Compressor complete with all fittings to operate TWO 10,000 kg hydraulic jacks in series	*Similar equipment was requested from UNIDO for CESME (DP/CHI/69/539 in November 1973. Please refer to records of Purchasing & Contracting Services, Vienna	
Hydraulic Jacks Double Acting (for tensile & compressive loading). 10,000 kg 2 OFF 5,000 kg 1 OFF		

B. Additional Equipment Recommended to extend the activities of the Centre into the Industrial Field

Specification	Source	Purpose
Static Strain Indicator Model SM-60D Switching and Balancing Box SS-12R Gauge Tester GT-7E	Kyowa Ltd. 3-8, Toronomon 2-Chome, Minato-Ku, Tokyo, Japan	To facilitate the practice of strain gauge techniques in order to:- Measure Residual Stress in pressure vessels. Weigh-batch concrete constituents. Weigh scrap metal entering a steel mill. Measure forces acting on buildings, bridges and structures during their construction. Conduct proof tests on chains, hooks, etc. Measure forces applied to components in the Force Frame. Calibrate Sheet metal presses for Industry. etc., etc.
Strain Gauges KFC-5-C1-11 20 Pkts of 10 gauges KFC-2-D4-11 2 Pkts of 10 gauges KC-70-A-11 (for concrete) 5 Pkts of 10 gauges	Kyowa Ltd. Japan	For strain gauge work.
Strain Gauge Cement PC - 12 Six 30g bottles		

Specification	Source	Purpose
Strain Gauge Terminals	Kyowa Ltd.	For strain gauge work
T-F13 40 sheets of 5 pieces T-P4 10 pieces T-F17 20 sheets of 5 pieces T-P6 20 pieces		
Moisture Proofer Type C-2 Microcrystalline Wax Two 500g Cans		

NOTE: Some Kyowa equipment is already held by ITRDC and for the sake of compatibility it is advisable to purchase the foregoing items from the same source.

APPENDIX 3

LAYOUT OF THE NEW MECHANICAL LABORATORIES

General Recommendations

(i) Environment

Ample facilities should be provided for the storage of accessories in all the laboratories. Bench type cupboards (some of them glass-fronted) should be located along the walls behind each test machine.

A number (say 12) of hardwood tables for use anywhere in the Mechanical Laboratories would be useful: These tables could be about 200 cm long, 100 cm wide and 100 cm high, of very solid construction (top about 50 cm thick, legs 10 cm square) and varnished. Laboratory stools are also needed.

Wall racks should be located close to the mechanical testing laboratory entrance to accommodate incoming and outgoing test items.

(ii)* General Services (Electricity, Water, Drainage and Compressed Air)

3-phase A C 220/380, 50 cps power is required for all the Mechanical Laboratories except the Dark Room, Microscope and Specimen Preparation Rooms and the Isotope storage laboratory where only single-phase power is needed.

Water supply and drainage are required for the Pressure-Vessel-Test Room and the Dark Room: they will also be needed in the Heat-Treatment, Specimen Preparation and Non-Destructive Testing laboratories.

A compressed air line would be useful for removing loose scale from the jaws of the 100T test machine.

* Power points and other services are marked on the ITRDC master plan. Additional points have been provided to meet with future requirements.

(iii) Installation and storage of machines and equipment

Concrete foundations, similar to those installed in the present mechanical testing laboratories, are necessary for the 100T machine and the Impact machine. Although not essential, some consideration could be given to the stability assured by concrete foundations for the Instron machine, the two Hardness machines and the Metallurgical microscope. No special arrangements need be made for the Pressure-Vessel-Tester.

To facilitate the installation of the 100T machine, a hand-operated chain block (purchased locally) could be bolted to the roof beam immediately above the foundation of this test machine. The chain block would later assist in the handling of heavy items (e.g. lifting gear) on test.

Storage facilities for Radioactive Isotopes is shown on the ground floor plan attached. This storage comprises 3 round holes 60 cm diameter and 60 cm deep set into the high density (150 lbs/cu.ft.) concrete floor. The holes are provided with 10 cm thick steel-reinforced-concrete lids. When housed in their lead-lined transport buckets, isotopes up to 20 curies would be adequately shielded if they were placed in these holes. However, the Expert DOES NOT RECOMMEND the acquisition of radioactive isotopes until, or unless, their need is demonstrated.

SHIELDING WILL BE REQUIRED in the ceilings above both the Isotope and the X-ray laboratories. This could be achieved either by providing a ceiling (concrete) thickness comparable to that of the walls surrounding the laboratories, or by lead sheeting.

A general outline of the Mechanical Laboratories with machine foundations drawn to scale is attached to this Appendix. A suitable layout of test machines is shown for the Mechanical-Testing-Laboratory. Equipment would be located as required in the other laboratories.

Cable INTEST

Ref

Date

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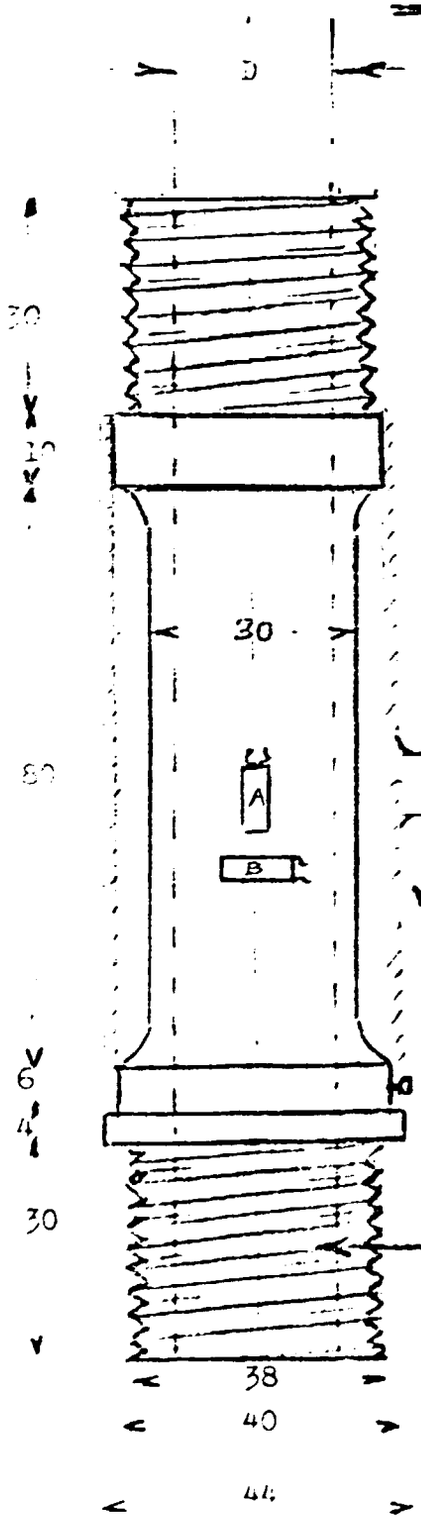
TENSION LINK



MATERIAL 0.5%C. Steel Bar 45 mm dia.
Heat - treated after machining
to UTS 20.000 Kg/cm²

DIMENSION D		CAPACITY		RATING	
inch	mm	lbs	Kg	Lbs	Kg
[illegible]	[illegible]	23.500	10 700	15 000	7 00
[illegible]	30	45 500	21 000	30 000	14 00
SOLID		80 500	37 500	55 000	25 00

Four strain gauges are mounted around t outer circumference of the bar; 2 on th side opposite to (A)&(B) shown,

(A) A_1 → Active

(B) B_1 → Earth / Compensating

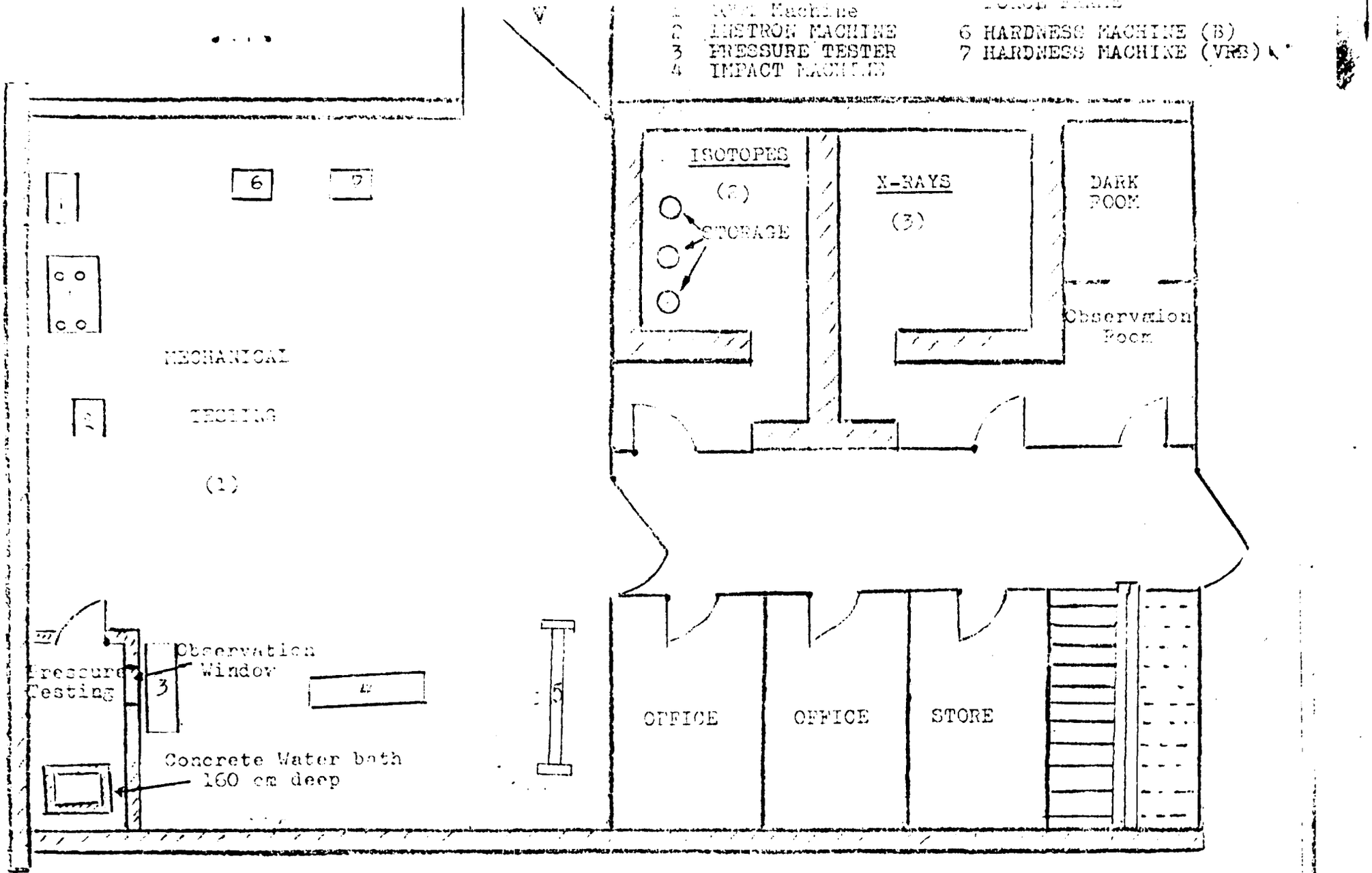
3 pin Socket

Thin-walled copper cylinder secured at one end with one screw (through collar). Both ends waterproofed with plastic compound.

Threaded to fit sockets on INSTRON Machi

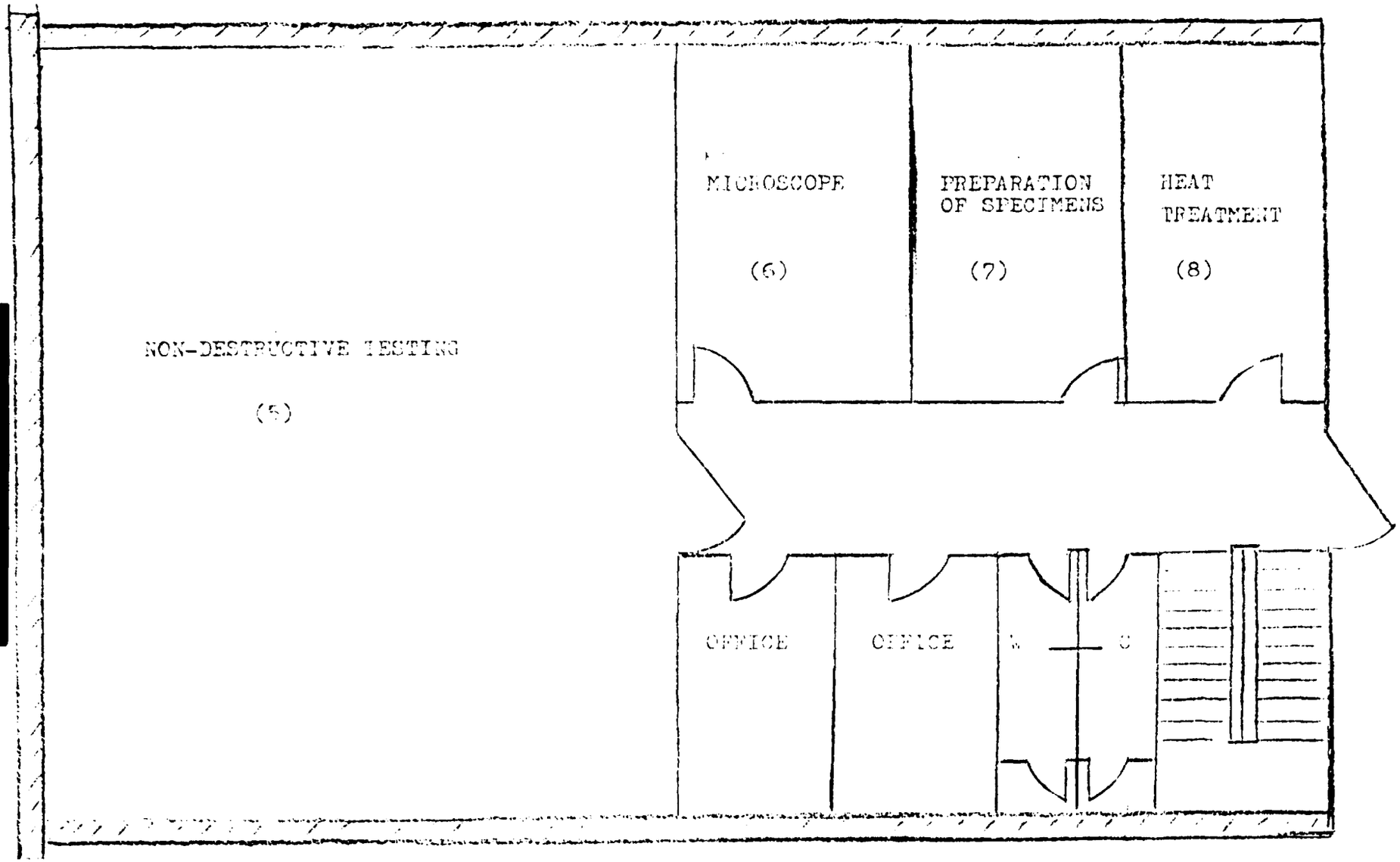
SCALE-FULL SIZE APPRO

FIG 1



MECHANICAL SECTION - GROUND FLOOR

Scale 1: 100 approx.



MECHANICAL SECTION - FIRST FLOOR

Scale 1 : 100 approx.