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UNITED NATIONS INDUSTRIAL
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STRENGTHENING OF THE IRAQI ORGANIZATION FOR

STANDARDS*

TF/IRQ/77/003

IRAQ

1(CR) Technical report: Mechanical testing of materials and goods

Prepared for the Government of Iraq by the
United Nations Industrial Development Organization

Based on the work of Frederick Roper, expert in mechanical testing

*This report has been reproduced without formal editing.

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CONTENTS

1. OBJECTIVES

The objectives of this mission (first part) are:

1.1 To assist the Project Manager and his National Counterpart to assess the present and future requirements in the field of mechanical testing of materials and goods.

1.2 To plan, organise and equip, in the light of the previous assessment the sections of Mechanical Testing and Mechanical Workshop.

1.3 To advise on the training of counterparts.

2. ASSESSMENT OF THE PRESENT SITUATION

2.1 Locally-manufactured Products. As it was not possible for IOS to arrange visits to Iraqi enterprises during the time of the Expert's assignment, a limited assessment of Industry's present and future needs in the field of mechanical testing was made from information provided by the Project Manager Dr. Ahmed Geneidy.

From this information, a list of locally-manufactured products together with a brief description of their test requirements in accordance with ISO and equivalent standards, has been compiled. The equipment needed to carry out such tests is listed alongside them (ref. Appendix A of this report).

2.2 Working Environment

The testing laboratories, which are part of the building complex for the Iraqi Organization for Standardization, compare favourably with most of the Centres which the Expert has observed in other countries.
They are spacious, centrally air-conditioned and pleasantly situated in grounds occupied by the University and Research Institutes.

The expert RECOMMENDS that:

(a) All mechanical testing of materials and goods be carried out on the ground floor.

(b) Rooms 128 and 129 (ref Ground Floor Plan) be used to accommodate all (bought) testing machines and equipment specified in Appendix B attached - i.e. Universal Test Machines, Impact Machine, Hardness Machines etc..... Also, that the concrete floors of these two rooms be sealed (preferably with vinyl tiles) to prevent damage to equipment caused by dust . Also, that bench-type cupboards be built around most of the laboratory walls as detailed in 3.2 below.

(c) The Machine Hall (Room 123) be retained for tests on components or goods which entail the use, or generation of, agents normally foreign to a materials-testing laboratory - e.g. heat, water, gas, dust, noise, heavy weights etc.

(d) The Workshop be considered primarily as a service for the testing laboratories. (welding and light grinding operations may be necessary in moderation, but industrial processes, such as forging and electro-plating, seem to be quite inappropriate

3 EQUIPMENT

3.1 Workshop equipment and Layout. A list of machinery and equipment adequate for servicing the testing laboratories is shown in Appendix B. These items will be suitably placed in consideration of the facililies (power points etc.) already provided.

3.2 Laboratory equipment and Layout. The basic requirements for the establishment of mechanical testing facilities at the Iraqi Centre are listed in Appendix C . In addition to these testing machines, provision has been made for a Force Frame to accommodate components and finished goods (e.g. a bicycle) which do not fit easily into a standard

test machine. The force frame is basically a very versatile testing rig locally fabricated from 250mm steel I beams. It is used in conjunction with portable hydraulic jacks, load cells, and the special equipment listed as items 8-23 in Appendix C part C. A full set of working drawing of a frame used successfully in Auckland, New Zealand and Santiago, Chile has been given by the Expert to his counterparts.

Detailed plans for the layout of the machines in the laboratories will be presented separately, A brief summary of the present proposal, however, is that the main item - the 1000kN Universal Test Machine - should be located in Room 128 approximately 3½ metres from the middle of the West wall. The Impact Machine and the Multi - range Test Machine should also be located in this room.

All bench-type machines (Hardness, Wire-testing, Spring-testing, Fatigue etc.) should be located on bench-type cupboards distributed around the walls of Room 129.

Bench-type cupboards should be built around almost the entire length of the walls in both laboratories; about one third of their number being filted with shelves and glass-fronted doors, the remainder open, with drawers and shelves. Construction should preferably be of heavy hardwood and varnished.

The Force Frame (Which will be mounted on wheels) should be located in the Machine Hall (Room 123) but all equipment used in conjunction with it should be stored in Laboratory Room 129.

Regarding Room 120, previously designed for testing cylinders under pressure: This room appears to be ideally suited for the storage and use of radioactive materials employed in some aspects of non-destructive testing. To provide protection from ionising radiation, a wall could be built INSIDE, parallel to, and about 2 metres from, the open doorway. The wall should overlap the entrance by one metre on each side and be about 3 metres high.

It should be constructed of high-density concrete 250mm, thick. A light metal, sliding door (marked "Danger-Radiation") could then be used to close, the existing entrance.

The adjacent Room 122, which is already provided with drainage, could be used for testing pressure vessels to destruction.

3.3 The expert strongly supports the efforts previously made by the Project Manager to include the equipment component in the present Project in order to make use of UNIDO'S experience in purchase and contracting. Had this been possible, the procurement of equipment would have been more rapid and more adequately secured.

4. TRAINING

4.1 Counterparts. Mechanical Engineer Miran. Algiborey of the Iraqi Organization for Standardization has worked continuously with the Expert since the beginning of his assignment. Equipment specifications, testing requirements, laboratory layout, and the substance of this report have all been discussed with her and it is RECOMMENDED that she should be given the opportunity to observe the testing techniques practised by a comparable Organization in New Zealand (this applies particularly to the fabrication and use of the Force Frame).

The Expert has written to Dr. E.I. Robertson Director General of the NZ Department of Scientific and Industrial Research requesting approval for the placement of 3 fellowships for this project (Mechanical Testing, Non-destructive Testing and Engineering Metrology).

Counterparts from the expert's previous assignments in Singapore and Santiago have already received training in New Zealand and it is antic-

ipated that this expression of goodwill be gladly extended towards the Counterparts of Iraq.

ACKNOWLEDGEMENT

The Expert wishes to thank the Project Manager Dr. Ahmed Geneidy for all the help he has given him - Engineer Niran for her collaboration in the compilation of equipment specifications - and the Staff of IOS for the kindness and courtesy which they have shown to him.

APPENDIX A

LOCALLY - MANUFACTURED PRODUCTS

MANUFACTURED PRODUCT	STD.	MECH. TEST REQUIREMENT	LAPORATORY EQUPMENT REQUIRED.
MANHOLE COVERS	BS 497	SUPPORT IN FRAME, APPLY LOAD THROUGH 300mm. HARDWOOD BLOCK FACED WITH RUBBER.	UNIVERSAL TEST MACHINE.
PEDAL BICYCLES	A.S.1927-1973	SUPPORT IN FORCE FRAME APPLY LOADS AS REQUIRED ALTERNATIVELY, LOAD IN MULTIRANGE MACHINE	TESTING MACHINE AND FORCE FRAME WITH HYDRAULIC JACKS LOAD CELLS OR TRANSDUCER, SPRING WEIGHING APPARATUS
BOLTS, NUTS FASTENERS	ISO 898/1 ISO 898/IV ISOR898/II	TENSILE TESTS FOR PROOF STRENGTH	MULTI-RANGE TESTING MACHINE. EXTENSOMETER.
STEEL TUBES (WELDED OR SEAMLESS)	ISO 559 BS 3074	TENSILE TESTS ON SPECIMEN CUT FROM TUBE BEND AND FLATTENING TESTS ON WHOLE TUBE	MULTI-RANGE TESTING MACHINE UNIVERSAL TEST MACHINE.
STEEL BAR	FED. STANDARD 00152 (ARMY-ORD)	TENSILE, HARDNESS AND COLD BEND TESTS	UNIVERSAL TEST MACHINE. HARDNESS TESTER.
NAILS STEEL	BS 1202P+1	DIMENSIONS AND WEIGHT.	MICROMETER. SCALES
NAILS COPPER	BS 1202P+2	DIMENSIONS AND WEIGHT.	(BALANCE)
NAILS ALUMINIUM	BS 1202P+3	DIMENSIONS AND WEIGHT.	" "
NAILS, BRADS, STAPLES AND SPIKES WIRE, CUT and WROUGHT	FED. FF-N-105 A	TENSUE, HARDNESS, BENDING, TORSION, WRAPPING	MULTI-RANGE TEST MACHINE WIRE BEND TESTER WIRE TORSION TEST

MANUFACTURED PRODUCT	STD.	MECH.TEST TO REQUIREMENT	LABORATORY EQUIPMENT REQUIRED
TRACTOR (GENERAL PURPOSE)	FED STANDARD KKK-T-00642	GENERAL INSPECTION AND MEASUREMENT OF FORCE ON TOW BAR	STRAIN LINK OR DYNAMOMETER.
DOORS. METAL DOOR FRAMES	FED. SPEC. RR-D-575a	BEND. TENSILE. DIMENSIONS, INSPECTION	MULTI-RANGE TESTING MACHINE.
PIPE. STEEL SEAMLESS AND WELDED FOR ORDINARY USE	FED. SPEC. WW-P-406c	HYDROSTATIC TESTS INSPECTION THICKNESE OF PROTECTIVE COTTING MEASUREMENT-	CHEM. TESTS. VESSEL TESTING MACHINE.
WIRES. NICKEL AND N. ALLOYS FOR SPRINGS. BRASS WROUGHT ALUMINIUM AND A. ALLOYS	BS 3075 BS 2786 BS 1475	TENSION, BEND, TORSION, WRAPPING	MULTI-RANGE. TEST MACHINE. WIRE TESTING MACHINES,
SHEET AND PLATE NICKEL AND NICKEL ALLOYS	BS 3072 FED. SPEC QQ-S-766c	TENSILE (incl. proog-stress) HARDNESS	MULTI-RANGE TEST MACHINE. EXTENSOMETER HARDNESS MACHINE.
STRIP NICKEL AND NICKEL ALLOYS	BS 3073	AS FOR SHEET	AS FOR SHEET
STEEL PRODUCTS FOR PRESSURE PURPOSES. FORGINGS.	ISO 2604/I AND 2604/II	TENSILE. IMPACT (HYDRAULIC & NON-DESTRUCTIVE TESTS)	IMPACT MACHINE. MULTI-RANGE TEST MACHINE. Vessel testing Machine.

MANUFACTURED PRODUCT	STD.	MECH. TEST REQUIREMENT	LABORATORY EQUIPMENT REQUIRED
TRACTORS TESTING PROTE-CTIVE FRAMES	BS 4063	PERFORMANCE TESTS AND IMPACT BY 2000kG WEIGHT	TESTS COULD BE INOVATED IN MA CHINE HALL BUT PREFERABLY AT FACTORY
SPIRAL-WELD LINE PIPE	API Spec. 5LS	TENSILE, BEND, FLATTENING, & TRANSVERSE. TESTS	UNIVERSAL TEST MACHINE.
STEEL WIRE ROPES	IS 2266 BS 4048 pts. 1&2.	TENSION, BENDING AND TORSION OF SINGLE WIRES. TENSION ON COMPLETE ROPE	UNIVERSAL TEST MACHINE AND WIRE TESTING MACHINES.
S.S. CONE JOINT PIPE FITTINGS	BS 3581	HYDRAULIC TESTS	PRESSURE PUMP
STEEL PIPE FLANGES FOR PETROLEUM	BS 1560	HYDRAULIC TESTS	PRESSURE PUMP
ALUMINIUM DOORS AND WINDOWS	IS 1948 IS 1949	INSPECTION AND MEASUREMENT	

APPENDIX B

EQUIPMENT SPECIFICATIONS

FOR

MECHANICAL WORKSHOP

A. MACHINES.

Item No	Qty	Specifications.
1	1	PRECISION LATHE, for general precision work. Roundness accuracy Better than 2 microns (0.0001 in). Metric. Gap Bed Type. Distance between centres 1270mm (50 in). Height of centres 190mm (7½ in). Swing over bed 390mm (15 ¼in). Swing in gap 580mm (23 in). Spindle bore 54mm (2⅛ in). Number of spindle speeds 16. Range of spindle speeds 25-2000 r.p.m. Overall length of machine 2438mm (96 in). With standard equipment as follows:- Slotted toolblock .Driving plate. Centre Bush. Two No. 4 Morse Taper centres. 250mm 3 Jaw Chuck. Chuck Guard. Thread indicator. Electrical equipment for 3 phase 380 volts 50Hz A.C. supply. Coolant pump, tank and fittings. Splash quard. Set of spanners and keys. Installation, Instruction and Spare Parts Manuals 3 of each. Accuracy chart. Supplied with the optional accessory Machine Lighting.
2	1	PRECISION LATHE similar in all respects to Item 1 above except that the measuring Version is to be MIXED i.e. with English pitch leadscrew and dial graduations in

Item No	Qty	Specifications.
		millimeters . Required for the production of test specimens in accordance with appropriate standards and also for general precision work. In addition to the standard equipment supplied, the following optional accessories are required to facilitate the rapid production of test specimens:- Hydraulic Profiling Equipment. Capstan Equipment camprising 6 station hand operated inclined head capstan slide, with adjustable rotating stops and minimum working stroke to 203 mm (8in)bored to receive 25 mm or 1 in shank toolholders. Rear slotted Toolpost. Quick change Toolpost. Chucks and Collet Chucks Comprising additional 250mm dia. 3 jaw Chuck, 305mm dia 4 jaw Chuck and 1½ in. capacity Burnerd key-operated "Multisize" Collet Chuck. One 355mm (14 in) Faceplate and one 535mm (21 in) Faceplate. Machine lighting. No. 4 Morse Taper Centring Centre. English / Metric Dual Reading Dials. Universal magnetic base dial gauge.
3	1	RADIAL DRILL. For general drilling and boring operations in workshop. Drilling capacity 32mm (1¼ in) for steel and 40mm (1½ in) for cast iron. Boring capacity 50mm for steel and 60mm (2⅜ in) for cast iron. Drilling depth max. 180mm (7 in). Height adjustment — range of arm 610mm (24 in), throat of arm 1000mm (39⅜ in). Dimensions of base plate 1120 X 800mm (44⅛ x31½ in). Output of drilling motor 2HP. 8 adjustable spindle speeds 20-3000 r.p.m. 3 adjustable automatic feeds 0.05, 0.1 & 0.2mm/rev. Supplied with standard equipment i.e. electric equipment. (380 volts 3 phase current) limit switch, base plate, crank for jib adjustment, set of wrenches, key driver and Installation, Instruction and Spare Parts Manuals 3 of each. Also special equipment as follows:- Base table with coolant system and drawers for tools. Vise, threading attachment, quick change Chuck, Tap Holder, Reducing Sockets.

Item No	Qty	Specifications.
4	1	HACKSAWING MACHINE. for general workshop purposes. 2 speed (100 and 140 strokes p.m.). Hydraulicelly controlled with automatic cut-off. Circulating cooling system through pump and reservour with separating weir to prevent swarf entering pump. Capacity 250mm (10") gap. To be supplied with 25 H.S.S. blades in addition to the standard equipment.
5	1	BANDSAW. for straight and contour cutting filing and polishing of sheet & sections in metal. With infinitely variable speeds, Welder, grinder and shear capacity, Table traverse and Table tilt. Throat size 460mm (18 in) Height under Guides 200mm (7.8 in). Table size 480mm (18 in) square. To be supplied with the standard equipment and also the following accessories:- Circle-cutting Attachment, Contour cutting Attachment, Filing Attachment and Tile Bands, Polishing Attachment and Polishing Bands, Angled Roller Guides, Mechanical Feed and Contour Attachment, Universal Work-holding Kit, Spray Coolant Equipment. 3 copies each of Installation, Instruction and Spare Parts Manuals.
6	1	UNIVERSAL MILLING MACHINE. for general precision work and the production of test specimens. Table size 250 x 800mm (opprox 10in x 30 in). Working ranges :- Centre-to-centre distance from the horizontal spindle to the upper edge of the table, min. 38mm (1½ in) max. 480mm (17 in); Distance from the V spindle bottom edge to the upper edge of the table, min 10mm. (0.39 in), max 400mm (15 in). Spindle sizes:- Chucking Capacity 26mm (1.0 in), Milling Arbor 27mm (1.06 in), Tools in Taper Socket up to Morse 4. To be supplied with standard equipment also a range of milling cutters and tools necessary for general-purpose work.
7	1	BENCH DRILLING MACHINE, for general work up

Item No	Qty	Specifications.
		to 13mm (½ in) drill size.
8	1	SHAPING MACHINE for general shaping work. Length of stroke 550mm (22 in).
9	1	PEDESTAL GRINDING MACHINE to meet heavy-duty requirements. Wheel size 300x32x25mm (12 in) course and fine. Speed 1450 rpm. To be supplied with eyeshields, adjustable spark arrestors, tool rests, overload protection, and pedestal.
10	1	BENCH GRINDING MACHINE for light grinding work (e.g sharpeining drills). Wheel size 200mm (8 in) coarse and fine. Speed 2800rpm. To be supplied with eyeshields and tool rests.
11	1	UNIVERSAL TOOL AND CUTTER GRINDER, for sharpening tools and cutters (e.g. the tool required to cut the notch in an Impact Test specimen). To be supplied with tool-holding attachments.

B. HAND OPERATED EQUIPMENT

12	1	GUILLOTINE for cutting steel sheet up to 2000mm (6'6") size and 3mm (0.118 in) thick. Foot operated.
13	1	BENDING ROLLS MACHINE for rolling steel sheet up to 1200mm (4 ft) size and 4.5mm (0.177 in) thick. Hand operated
14	1	FOLDING AND BENDING MACHINE To take widths up to 1500mm (5 ft) and 2.5mm (o.1 in) thickness. Hand operated.

Item No	Qty	Specifications.
15	1	PLATE AND ROUND STEEL SHEARS for cutting flat and round steel lengths. Capacity- plate up to 8mm (0.3 in), rounds up to 20mm (0.8 in) Hand operated.
16	1	HYDRAULIC TOOL for straightening framework and for applying loads to structures on test. Capacity 15 ton. Boxed with a set of 22 accessories.
17	1	SURFACE TABLE. (CAST IRON) for marking out and precision measurement. Size approximately 600x900mm (24x36 in) To be supplied with stand and wooden cover.
18	1	PORTABLE WORK STAND WITH PIPE VISE. To hold pipes up to 50mm (2 in), and include bending holes for pipes 13-75mm ($\frac{1}{2}$-1$\frac{1}{2}$).
19	4	FITTERS PARALLEL VISE, BENCH TYPE. of drop forged steel. Jaw width 175mm (7 in), jaw opening 200mm (8 in).
20	1	PLUMBERS VISE BENCH TYPE. to hold pipes up to 100mm (4 in) dia. Law width 135mm (5 in), Clamping width 175mm (7 in).

C. HAND TOOLS

21	4	FITTERS TOOL KIT COMPLETE IN BOX.
22	2	PIPE WRENCH. 300mm (12 in).
23	1set	ADJUSTABLE SPANNERS 300mm (12 in) and 500mm (20 in)

Item No	Qty	Specifications.
24	1	SLEDGEHAMMER 2 KG.
25	1	ELECTRIC DRILL. Two speed. Large capacity to take 13mm ($\frac{1}{2}$ in) drill.
26	1	ELECTRIC DRILL with flexible drive Two speed Small capacity to take 10mm ($\frac{3}{8}$ in) drill
27	1	ISOLATING TRANSFORMER for use with electric hand Tools. 220v. 50Hz

D. MEASURING APPARATUS

28	2	MAGNETIC GAUGE BLOCK
29	1	VEE BLOCKS (SETS) 25mm, 50mm, 200mm.
30	2	DIAL GAUGE METRIC. 50mm travel
31	1	DIAL GAUGE METRIC 100mm Travel
32	1	STEEL RULE 200mm. Metric
33	1	TRAMMELS complete, to measure up to 2000mm (6'6")
34	1	PROTRACTOR for angular measurement. 200mm size (8 in)
35	1	VERNIER CALIPER. METRIC. length 500mm. (20 in)
36	1	VERNIER CALIPER 259mm (10 in)
37	2	MICROMETER METRIC. 25mm

Item No	Qty	Specifications.
38	1	MICROMETER ENGLISH 1.0 in.
39	1	MICROMETER METRIC. 50mm
40	1	MICROMETER METRIC 150mm. with gauge lengths
41	1	MICROMETER METRIC 100mm
42	2	FEELER GAUGES. Metric from 0.025mm

E. SMALL TOOLS

43	2sets	TWIST DRILLS for use with Radial Drill (Item 3) Complete range from 13mm ($\frac{1}{2}$ in) to 40mm ($1\frac{1}{2}$ in) with necessary taper sockets.
44	2 "	TWIST DRILLS for use with Bench Drill (Item 7) complete range Metric sizes up to 13mm
45	1 set	TWIST DRILLS. Complete range of Number sizes up to 13mm equivalent.
46	1 set	TWIST DRILLS Complete range English sizes $\frac{1}{16}$ - $\frac{1}{2}$ in.
		All Twist Drills to be supplied in holders.
47	3sets	CUTTING TOOLS FOR LATHES. Assortment of High-Speed-Steel and Tungsten-Carbide-tipped cutting tools
48	2 set	MILLING CUTTERS, Assortment of milling cutters for use in Universal Milling Machine.
49	2 "	CUTTING TOOLS FOR SHAPING MACHINE. Assortment of High Speed cutting Tools for shaping Machine.

Item No	Qty	Specifications.
50	1	SOLDERING IRON, Electric. Large
51	1	SOLDERING IRON Electric Small.
52	1 set	SMALL TOOLS for general workshop use. A complete set of small tools comprising spanners-open-ended, ring and box; pliers-all types, torsion wrench, etc. Metric. Boxed & mounted on peg board.

F. HEAT TREATMENT

53	1	SMALL HEAT TREATMENT FURNACE for conditioning test specimens if reguired. Automatic with gas curtain. Temp. up to 1500C. Dimensions approximately 500mm (20 in) deep, door opening 300mm (12 in) x 1500mm (6 in).

WORKSHOP FURNITURE.

Item No	Qty	Specifications
1	6	FITTERS' BENCHES. Braced wooden frame & Heavy top. Standard hight. Approximately 1800mm (6 ft) long.
2	3	STOOLS. for marking-out operations. Wood Approx 500mm (18 in) high.
3	6	TOOL STORAGE CUPBOARDS. Metal (preferably modular type),Lockable, front opening. Fitted with drawers and adjustable shelves. Dimensions approx 1800mm (6ft) high, 900mm (3 ft) wide and 600mm (2 ft) deep.
4		DEXION ANGLE SECTION. Totel 250metres supplied in 50 three metre lengths and 50 two metre lengths, together with supply of nuts and bolts (about 300) and a Dexion Cutting Tool. For fabricating racks and shelves (e.g. for metal storage) in workshop.

APPENDIX C

EQUIPMENT SPECIFICATIONS FOR
MECHANICAL TESTING LABORATORY.

A. HEAVY MACHINES

Item No.	Qty	Specification
1	1	UNIVERSAL TESTING MACHINE. 1000KN (100 Ton) capacity. for tension, compression and bending tests. Grade AI accuracy according to ISOR 147 . ISOR 376 and BS 1610. Maximum Height not more than 3 meters. At least four load ranges. Maximum strain rate about 500mm (20in) per minute. Hydraulic load application with independent weighing system. Specimen accommodation within the order of 600mm (24in) for tension tests and 600mm (24in) for compression. To be supplied with all standard equipment including Transverse Table about 1000x400mm (40x16 in), and Grips for Tensile Tests. A Complete range of grips for accommodating both round and flat specimens.
	1 set	Holders and Adaptors for Headed Specimens.
	1 set	Holders and Adaptors for Screwed Specimens.
		Compression Plates.
	1	Hardened steel lower compression platens with Packing Stool.
	1	Hardened steel upper compression platens
	1	Hardened steel upper compression platen Spherically Seated.
		Transverse Bearers.
	1 set	Set of knee and 18 dogs for cast iron. Set of upper and lower bearers for use with 1000mm (40in.) table for flexural tests on 100 and 150mm section beams to ISO 1920 and BS 1881 pt.4, and also for centre point transverse tests.
		Cold Bend Tackle.
		Set of cold bend tackle with 4 formers 19,22, 25 and 32mm radius, and 76mm dia. rollers

Item No	Qty	Specification
		adjustable from 76 to 273mm centres.
		Shear Apparatus.
	1 set	Set of Die and Box to take 3 sizes of round specimens in double shear 10,15 and 20mm. diameter.
	1 set	Set of Punching and Cupping Tools.
	1	Lindley (or similar) Extensometer for extension measurement on 50mm gauge length, up to 16mm diameter or Thickness and up to 19mm width. Complete with 3 sizes of Wire Grips covering wires from 0.4mm to 7.5mm. diameter,
	1	Electric Vibrator for use with extensometer.
	1	Autographic Recorder.
	1	Electrically-operated Load Pacer.
	1	Crosshead Rate Pacer up to 250mm per minute
	1	Strain Rate Indicator.
	1 set	Transducers for use with Autographic Recorder.
2	1	MULTI-RANGE TESTING MACHINE for routine work. Accuracy in accordance with ISOR 147 and ISOR 376. Capacity 250kN (25tons) Up to six load ranges siutable for tension compression, bending and transverse tests. Supplied with all standard equipment including complete sets of grips, platens and supports for tension, compression, bending and transverse tests.
		Also the following special equipment:
	1 set	Two special shackles with split rings (for tests on short shouldered bars. Minimum distance between shoulders 20mm., Max. diameter at neck 10mm)
	1 set	Two special shackles with spherical supports and split rings. (for tests on short shouldered bars.

Item No	Qty	Specification
		Minimum Distance between shoulders 55mm, diameter at neck 16mm.).
	1 set	Two Holders to suit ISO 82 specification for tensile test specimens (for round bars with threaded ends).
	1 set	Two Holders to suit ISO 82 specification for tensile tests on standard size shouldered bars.
	1 set	Two Helically-Grooved Drums to take wire ropes up to 10mm diameter.
	1 set	Two Split-socket Gripping Boxes and Split Mould for casting sockets on to wire ropes up to 18mm. diameter.
	1	One additional beam with two special supports for making transverse tests on leaf springs.
	1	One Shearing Arrangement,(one set of shear rings for round bars and one set for rectangular bars, for shear tests on round and rectangular bars).
	1	One Shearing Tool and one set of shear rings for shear tests on wires up to 10mm. diameter .
	1	Recording Electronic Extensometer with load magnifications of 5, 25, 100 and 500x.
3	1	IMPACT TESTING MACHINE combined IZOD and CHARPY. for impact tests in accordance with ISOR 148, ISO 83 and BS 131. To be supplied with the following accessories:
	1	Wedges to secure Izod and Charpy specimen grips.
	2	Vee-notch Milling Cutter. 1 in Bore
	2	U-notch Milling Cutter 1 in bore.
	1	Pendulum Release Mechanism-Izod position.
	1	Pendulum Release Mechanism-Charpy position.
	1	150 J Tup and Striker (Izod).
	1	300 J Tup and Striker (Charpy).

Item No	Qty	Specification
	1	Vice Assembly for standard 10mm. square specimens.
	2	Test Piece Positioning Gauge.
	1	Support Anvil for 10mm, square and 10x7.5, 10x5 and 10x2.5mm. rectangular specimens.
	1	Tongs for insertion and centralising test piece.
	2	Striker Centralising Gauge.
	1	150 J. Tup and Striker (Charpy).
	1	Tension Impact Test Tools.
4	1	UNIVERSAL SHEET AND STRIP TESTING MACHINE for physical tests on sheet metal
		Accessories to include:
	1	Punch in Testing Head.
	1	Hydraulic Cup Ejector.
	1	Erichsen Deep-drawing Tool.
	1	First filling of Hydraulic Oil.

B. BENCH TYPE MACHINES.

5	1	DYNAMIC FATIGUE-TESTING MACHINE. for fatigue testing small specimens in torsion and bending in accordance with ISO 1352. Capacity about 30Nm (300kgf. cm.) Bench Mounted. with standard equipment and the following accessories:
	1 set	Set of Grips for bend tests on round specimens.
	1 set	Set of Grips for combined and torsion tests on round specimens.
6	1	ROCKWELL HARDNESS TESTING MACHINE. for hardness testing in accordance with ISOR 80 and BS 891. Complete with standard equipment as follows:

Item No	Qty	Specification
	1	Diamond Cone Indenter.
	1	Ball Indenter with twelve spare balls.
	1	Flat Anvil about 63mm diameter.
	1	Spot Anvil with raised centre.
	1	Two Vee Anvils for specimens 4-13mm diameter. and 11-32mm. diameter.
	1	Three Calibrated Blocks (for B. Scale, Hard C Scale and Soft C Scale).
		Also, the following extras:
	1	Spare Diamand Cone Indenter.
	1 set	Ball Indenters 1.5mm., 3.1mm., 6.3mm. and 12.7mm.
	1	Case of five standard hardnes test blocks for indirect verification to ISOR 1024, ISO 80 and BS 891.
	1 set	Replacement Standard hardness test blocks: 65-59HRC, 55-35HRC, 30-20HRC, 10C-80HRB and 60-40HRB.
	1	Flat Work Table about 200mm (8 in) diameter.
7	1	BRINELL and VICKERS HARDNESS MACHINE. accuracy to ISOR 156, ISOR 146 and BS 240. A combined Brinell / Vickers Machine with the following features: Automatic Magnification and Projection of impression - Built - in Microscope and digital Micrometer- Measurement of impression without removing specimen - Rotatable Screen allowing for measurement of two diagonals of pyramid (Vickers) impression- Pre-set Loading System.
		To be supplied with standard equipment and the following extras:
	1	Table, about 200mm (8 in) diameter.
	1	Adjustable work rest.
	1	Ball-seated Platen about 100mm (4 in) diameter.

Item No	Qty	Specification
	1	Protective Bellows for elevating screw.
	1	Spare Diamond Indenter.
	1	Case of four standard hardness blocks for underect verification to ISO 80. and BS 427.
8	1	WEAR TESTING MACHINE FOR METALS. Complete with Diagram Recorder, Electric Drive-2 speeds with reversing gear. Also equipment permitting the flow of lubricant or corrosive liquid, or abrasive powder, between the specimens.
9	1	WIRE TESTING MACHINE. for measuring the ductility of small diameter wires (up to 2mm.) by forward and backward bending. Bench type. Hand operated. To test in accordance with ISO 89, ISO 136, ISO 144 and ISO 145.
10	1	WIRE TESTING MACHINE FOR torsion tests on small diameter wires (up to 2mm.) . in accordance with ISO 89, ISO 136, ISO 144 and ISO 145. Bench type, hand operated.
11	1	SPRING TESTING MACHINE FOR tension and Compression tests on coil springs (automotive parts etc.) Accuracy to ISOR 147, ISO 376 and BS 1610 Grade 1. Capacity 200N (20kgf.) approx. Supplied with all Standard equipment.

C. PORTABLE EQUIPMENT

Item No	Qty	Specifications
1	1	PORTABLE HARDNESS TESTER. Rockwell Scales. for testing rounds, flats and structural members up to 50mm (2in) an site.
2	1	ELECTRIC MOTOR ½ H.P. Variable Speed (up to about 3000 r.p.m.) to facilitate dynamic tests on automotive components (e.g. pump diaphrams).
3	4	VEEDOR COUNTERS. for recording number of revolutions etc.
4	2	REVOLUTION COUNTER. for determining motor speed. Multi-range dial, maximum range up to about 3000 r.p.m.
5	1	LABORATORY SCALES (Pan balance) with weights 10kgx1gm.
6	2	COMPRESSED -AIR GUN for blowing loose material from parts of machinery after work.
7	3	WIRE BRUSHES
8	4	ELECTRONIC LOAD CELLS for measuring tensile and Compressive force. Combined tension and Compression cells complete with end fittings (i.e. hooks and shackles, load buttons.) Capacities as follows: 200KN, 50KN, 10KN, and 5KN.
9	4	DISPLACEMENT TRANSDUCERS for measuring deflection under load. Capacities as follows: 0- 50mm with Rod 0- 150mm with Rod 0- 600mm with Cable 0- 3000mm with Cable

Item No	Qty	Specification.
10	3	PRESSURE TRANSDUCERS for measuring load. Capacities as follows: 0- 200N 0- 500N 0- 5000N 0- 50000N
11	2	TORQUE TRANSDUCERS
12	1	STRAIN INDICATOR (wheatstone Bridge) for measuring load cells. Portable, Battery operated. Reading strain direct.
13	1	S-Y RECORDER with Chart Drive. for recording load & strain from cells and transducers.
14	1	STRAIN AMPLIFIER. To amplify static and dynamic strains
15	1	DC BRIDGE CONDITIONER. Static measurement.
16		STRAIN GAUGES for general use. Gauge length and type as follows:
	3	5mm. Packets of 10
	3	2mm. Packets of 10
	2	Residual stress measuring Packets of 10
	1	Torque measuring Packets of 10
	3	10mm. Packets of 10
	4	Cement (epoxy resin) Tins
	4	Moisture-proofing Wax 500gm cans.
	2	Epoxy Resin 100gm bottles.
	10	Terminals for Strain Gauges. Packets of 20
17	1	SWITCHING AND BALANCING Box (12 channel) for use with foregoing items.

Item No	Qty	Specification.
18	1	HYDRAULIC POWER UNIT Electrically operated 0-70,000 kPa for supplying oil to hydraulic cylinders and rams
19	1	HYDRAULIC PUMP. hand operated to 70,000 kPa for supplying oil to hydraulic rams and cylinders.
20	1	MOTORISED HYDRAULIC POWER UNIT. I.c.Engine operated (portable) up to 20,000kPa
21	1	AIRHYDRO (MADAN) Capacity 5,000-40,000kPa for high-pressure operations, complete with range of necessary pressure gauges.
22		HYDRAULIC CYLINDERS, Double acting. Capacity as follows:
	1	0- 100kN
	1	0- 300kN
	1	0- 500kN
		To be supplied with Complete accessories including Counter, External plug-in Timer, Programme Control Centre, Pressure Switch and Limit Switch.
23		HYDRAULIC RAMS. Capacities as follows:
	1	40kN 15mm. Stroke
	1	100kN 150mm. Stroke
	1	300kN 550mm. Stroke
	1	80kN 250mm. Stroke

D. SMALL TOOLS

Item No	Qty	Specification.
1	1	GAUGE LENGTH MARKING JIG for marking 50mm. gauge length on standard tensile specimens.
2	1	GAUGE LENGTH MARKING JIG for marking gauge lengths up to 400mm. in increments of 25mm.
3	1	REDUCTION OF AREA GAUGE for measuring reduction of area of standard tensile specimens.
4	2	DIAL GAUGE INDICATOR 0- 25mm.
5	2	DIAL GAUGE INDICATOR 0- 50mm.
6	2	MAGNETIC BASE BLOCK for dial gauges.
7	2	SPRING DYNAMOMETER. Hand-Held type with integral dial gauge indicator . 0- 50N
8	2	SPRING DYNAMOTER. Hand-held type with integral dial gauge indicator 0-200N.
9	6	G CLAMPS. 100mm.
10	6	G CLAMPS. 250mm.
11		BOX OF LABORATORY INSTRUMENTS AND TOOLS Comprising:
	1	Dividers, screw type, opening up to 150mm.
	1	Inside Calipers " " " " " " "
	1	Outside Calipers" " " " " " "

Item No	Qty	Specification.
	1	Vernier Protractor. 200mm.
	1	Trammels, adjustable length bar (in sections) to measurce up to 2 metres, with points.
	1	Steel Tape Measure. to measure up to 4 meters,
	2	Micrometer 0- 25mm.
	1	Micrometer 0- 50mm.
	1	Micrometer 0- 100mm.
	1	Micrometer Caliper 0- 250mm.
	1	Inside Micrometer 0- 25mm.
	1	Inside Micrometer 0- 50mm.
	1	Inside Micrometer 0- 100mm.
	1	Vernier Caliper 0- 250mm.
	4	Steel Rule graduated in half millimeters along 50mm. of 300mm. length.
	1 set	Steel Square comprising rule, square head, 45° angle head, with integral spirit levels.
	1	Spirit Level. steel 150mm. approx.
	1	Spirit level, steel, about 500mm.
12	1	FITTERS' TOOL KIT complete in box.

E. GOODS TESTING

Item No	Qty	Specification
1	1	SMALL HOT-AIR OVEN bench type, for drying out components if required. Automatic Control up to 110°C, accuracy about 2 per cent. Approximately 450x350 x350mm. (18x14x14 in) wide, deep, high.
2	1	VESSEL TESTING MACHINE for static and dynamic pressure tests on containers, accumulators, cylnders, pipes, hoses etc. according to ISO 2604 parts 1 and 2.
3	1	PRESSURE GAUGE TESTER apparatus for pressures up to (20,000)kPa(200 bar) to be supplied with Referance Pressure Gauges as follows.
	1	0- 700 kPa
	1	0- 3500 kPa
	1	0- 7000 kPa
	1	0-20,000 kPa

LABORATORY PORTABLE FURNITURE

Item No	Qty	Specification
1	4	HEAVY (WOOD) TABLES, Clear varnished. for distribution in laboratories as required Approx I meter high, 2x1½ meters top.
2	4	LABORATORY STOOLS. for work at tables (item 1).

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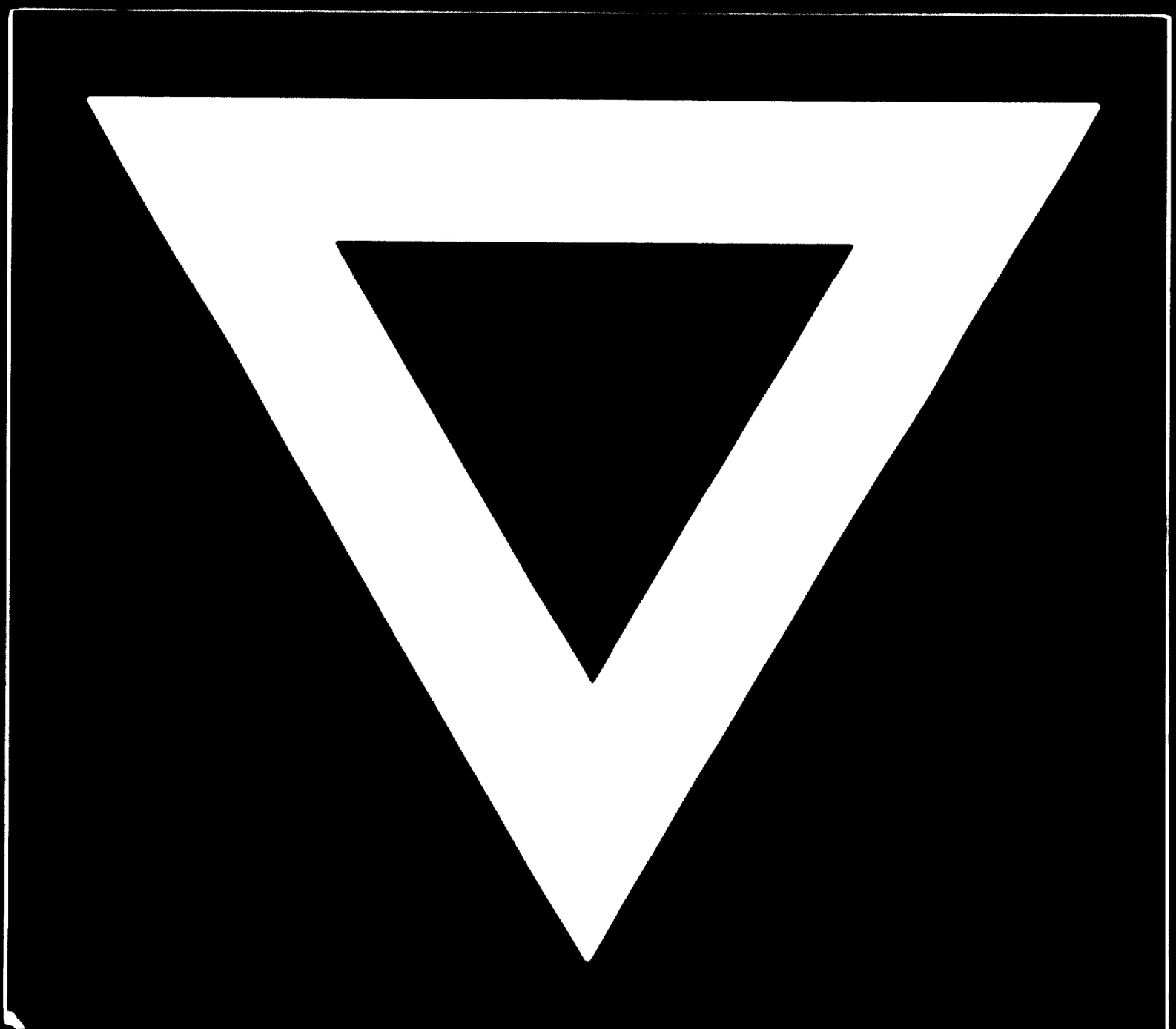

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