OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

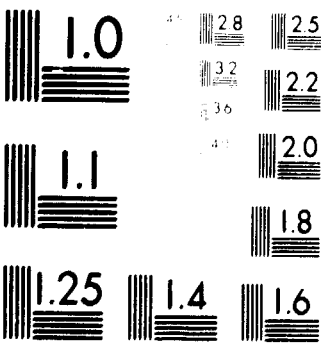
FAIR USE POLICY

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org



UNIDO UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

09733

M.P.D.U. SUDAN

TECHNICAL IMPLEMENTATION PLAN FOR A METAL PRODUCTION DEVELOPMENT UNIT IN THE DEMOCRATIC REPUBLIC OF THE SUDAN

FIAT ENGINEERING S.p.A

MARCH 1980

TABLE OF CONTENTS

ANNEXES

SUMMARY

The interest and the importance of a METAL PRODUCTION DEVELOPMENT UNIT for the Sudanese industrial development were confirmed by the UNIDO Missions that went to Sudan in late 1979 and early 1980.

A TECHNICAL IMPLEMENTATION PLAN for such a unit has been prepared, and it is now submitted to the proper Authorities. The purpose of the study is to provide all the basic figures and major information for the development of the final project.

The products wich could be conveniently manufactured by the new unit were defined through a market survey, taking into account import substitution opportunities and future development needs, in the frame of the Six Year Plan of Economic and Social Development.

In order of priority, the recommended products are: tools, moulds, dies, and other precision machined parts; steel plate fabricated parts; forged parts; metal sheet items.

The unit, intended as an infrastructural facility, shall also offer Manufacturing Services and Engineering Services to other industries, so to help and support their growth.

Another major task of this unit shall be the training of precision workers and specialized engineers/technicians, for the benefit of MPDU itself and of Sudanese industry in general.

To fulfill these tasks a plant of about 4600 sq.m. covered floor area has been envisaged, where a total manpower of 164 people will operate, on one shift, in the final stage.

The plant comprises two buildings: one for management and administration offices, training and engineering departments, tool and die workshop; the other one for cold and hot metal forming, steel plate fabricating, heat treatment.

The Training department will release, after the initial phases, 12 precision workers and 12 engineers/ technicians every year.

The capital investments will amount to 5,5 milion dollar: 1,4 for land building and general installations; 4,1 for machinery, equipment, office forniture, vehicles (1980 figures, uninflated).

The investments should be financed by equity (land and buildings) and by a soft loan from appropriate international funds (machinery and equipment).

The production should start in the third year, and gradually increase to reach full capacity in the sixth year, when the expected annual sales will be between 2,5 and 3 million dollar (uninflated figures).

According financial and economical calculations, the break-even point can be reached in fifth year (third year of production); while the cash-flow is expected to be positive already in third year (first year of production).

During the starting up period, the MPDU shall be assisted and helped by a certain number of foreign technical experts; while the local engineers and technicians expected tc be assigned key positions shall go through a period of training abroad, in their specific field of activity.

The cost of foreign experts and of abroad training for local key people, amounting to about 4 mill. dollar in 5 years, is expected to be financed as a Technical Assistance Programme by an outside grant.

1. - INTRODUCTION

1.01 - BACKGROUND

After a comprehensive overall survey carried on, in various countries, by UNIDO staff in cooperation with FIAT-ENGINEERING, some feasibility study were developed in order to identify the best opportunities for the establishment of basic metal casting and/or metal forming units, aimed to help and support the development of other local industries.

One of these opportunities was clearly seen in Sudan. A UNIDO-FIAT mission presented the proposal to the Government of Dem. Rep. of Sudan, enlightening the purpose and the advantages of a Metal Production Development Unit (MPDU) in their country. The Government was highly interested and in principle agreed to provide - as per UNIDO suggestions - land and buildings, together with an annual subsidy for training expenses, wnile the cost of the equipment would be financed by outside soft loans, and a period of Technical Assistance would be financed by an outside grant.

Under these assumptions UNIDO started the preparation of a technical Implementation Plan (T.I.P.) for the M.P.D.U. in Sudan.

1.02 - PURPOSE OF THE STUDY

The Technical Implementation plan is substantially aimed to define, in detail, the guidelines for the establishment and the operation of the MPDU. The various entities which should afterwards finance, design, build-up and run the Unit, should find in this plan all the information needed to properly carry on their task.

1.03 - METHODOLOGY

To correctly reach the T.I.P. goal, according UNIDO recommendations, the study was worked-out along the steps described in the following paragraphs.

Assessment of local conditions and needs

The first step was to verify in depth the current status

of metal working industry in Sudan, in order to identify the real needs for M.P.D.U., such as proposed by UNIDO. To this purpose a three-person Mission went to Sudan from Oct. 30 to Nov. 11, 1979. The results and the report were discussed with UNIDO in december. A second one-man Mission went to Sudan late January 1980, to collect further information and data, as required to better clarify some product, market and manpower aspects.

The work and the success of these missions were highly helped and supported by the great assistance provided by the Ministry of Industry.

Product and Market analysis

The findings of the Missions were utilized to define the size of those industry and market areas where the interest for products of a metal-working unit is higher, and the need is more urgently felt. Priorities were consequently identified, for the various types of metal products considered, always keeping in mind the purpose and scope of the proposed unit, i. e. to help and support the existing and/or planned industries, and not to compete with them as manufacturer of end products.

Import Analysis

The study of Government statistics and some interviews with importers of metal products-including the private industries that are currently importing for their own necessity-gave a sufficiently good idea of the magnitude of imports, and of the possibility of replacing part of them with products from the new unit.

Plant and Equipment

On the basis of information collected by the Missions, as described in previous paragraphs, the proper technologies were choosen, the equipment and machinery were studied and selected, the plant was sized, the general layout was designed.

Obviously, the size of the plant and the amount of equipment were highly influenced by the financial limitations of the program; nevertheless some additions were made in order to install certain facilities that are a must for a modern factory, and more so for a precision machining shop, which is expected to be fully operating in the late 80's.

Location, type and cost of land and buildings were discussed with various local sources (Ministry, private

companies, consultants) and the recommendations are based on the information gathered.

Training

Training needs were carefully assessed by the Missions, on the basis of existing educational programs for workers, technicians, engineers. The training objectives, the most important aspect of the infrastructural purpose of the M.P.D.U., were highly appreciated and commended by all the authorities contacted in Sudan, and also by the private companies visited by the Missions.

Organization and Production

Based on information and figures collected along the previous steps, Manpower, Organization and Production Plans were drafted, and an Implementation Schedule was set up, showing the gradual growth of the Unit along the six year period from the project start to the full production run. At this point all the inputs (capital investments; operating expenses; production output) were available for proceding to the last step, i. e. financial and economic calculations.

Financial and economic evaluation

Calculations were made to determine, under certain logical assumptions, and in two alternatives (one optimistic and one pessimistic), the magnitude and timing of money supply needed (both for fixed assets and for working capital), the operational costs (fixed and variable costs, both for production plant and for training department), the expected revenue from sales, the annual operating results (losses, break-even point, profits), the cash flow.

2. - PRODUCT AND MARKET SURVEY

2.01 - PURPOSE OF THE SURVEY

In accordance with the objectives of M.P.D.U. project set out at page IV of UNIDO "Working Paper" (by J. Mosgard, 22 august 1979); and under the assumption that this project refers to a metal working plant essentially designed to perform metal forming and precision machining operations, the surveys conducted by the Missions in Sudan have been oriented toward identifying which kinds of outputs - in terms of intermediate goods and manufacturing/engineering services - would meet the infrastructural needs of Sudanese economy, within the framework of the existing industrial structures and of the established development plans.

2.02 - BASIC ACTIVITIES OF M.P.D.U.

In more detail, the basic activities to be considered are:

- sheet metal forming (cutting, bending, stamping, welding of thin sheet metal parts, up to 3 mm, of relatively small size, up to 0.25 m^2 and 1.8 m bending and cutting lenght)
- steel plate fabricating (cutting, bending, welding of medium thickness parts, up to 15 mm)
- forging (relatively small parts, up to 10 Kg)
- precision machining (of forged, fabricated or cast parts, up to 500 Kg max weight)
- tool making (mainly dies and moulds for metal and plastics industries).

2.03 - POTENTIAL OUTPUT CLASSIFICATION

From a marketing point of wiew, it seems convenient - in the light of general findings of market survey - to classify the MPDU's potential output into the following categories:

Production tools for various industries

- Dies for metal working industry
- Moulds for plastics industry

. Metallic patterns for foundries
. Jigs and fixtures for metal working industries

Sheet metal formed items

. Components for products made by other metal industries
. Parts for light agricultural implements
. Replacement parts

Fabricated and forged items

. Components for other metal industries
. Parts for medium and heavy agricultural equipment
. Replacement parts for large factories (sugar, cement, oil, mills, textiles)

Machined parts

. Machining, as required, special precision parts, as an "emergency" service for other industries.

Manufacturing services

. Manufacturing operations, on a subcontracting basis
. Heat treatment
. Flame cutting
. Stainless welding
. Surface treatments

Engineering services

. Market and product analysis
. Product design
. Tool design
. Manufacturing & Industrial engineering

Note - Another very important output of the M.P.D.U. is, of course, the training of skilled workers, technicians, engineers and managers. As this is not , however, a "product" in marketing sense, it is discussed in a separate section.

2.04 - PRODUCT SELECTION CRITERIA

On the basis of statistical figures available, and information provided to the Missions by all the counterparts - public offices and private companies - in Sudan, and along the guidelines contained in the working papers prepared by UNIDO staff for any typical M.P.D.U. activi

ty, the attention was focused on:

- gathering information on metal working industries (number, size, type of product, efficiency, needs) in view of M.P.D.U. becoming a local supplier of items now imported, at the same time excluding from the range of possible M.P.D.U. products all items already manufactured locally in sufficient volume, since M.P.D.U. must carefully avoid duplication of and competition with already existing industries;

- gathering same information on plastics industries, as potential customers for moulds, and exceptionally for some metal components to be inserted in plastics items;

- having an insight into specific needs and potential absorption of M.P.D.U. products in the main strategic areas of today's Sudanese economy, i.e. agriculture and agriculture related industries (cotton, oil, sugar).

The survey clearly showed that the problem is not to find as many outlets as possible, but rather the opposite, i.e. to identify the most useful and significant ones, and define a limited range of products, both essential for country's needs and viable for M.P.D.U. correct management.

The areas explored offer a significant sample of existing and potential market for each output category of M.P.D.U.

In addition, following the "terms of reference" set out for the T.I.P., detailed data and statistical information were gathered (thanks to the remarkable efficiency and helpfulness of Sudanese counterparts) on all the items listed in paper VC/INT/76/113 M.P.D.U., sent to KHARTOUM before Mission's arrival.

The findings of the Mission's investigations are summarized in the following paragraphs, according the classification set out at paragraph 2.03.

2.05 - PRODUCTION TOOLS FOR VARIOUS INDUSTRIES

In Sudan no specific facility does currently exist for manufacturing dies, moulds, metallic patterns, jigs and fixtures, and in general for precision machining. Thus it is also impossible to repair locally dies and

moulds, or any mechanical parts requiring such precision work. As a consequence, the related skills are almost totally absent. The only exception is that some manufacturers of light steel-sheet pressed pieces (of very simple design) make themselves the dies they use; however, they would welcome the possibility of having them supplied by a specialized shop, according to proper professional standards.

This constitutes a serious infrastructural deficiency, that not only slows down further industrial development, but also makes life precarious for the exsisting industries.

Delivery times for any piece of equipment imported from abroad (due both to transport difficulties and bureaucratic fetters) run up to 9/12 months; and this applies also to parts sent back to manufacturers for repair. Clearly, this category of output really meets a very "sore need"; a need not only objectively verifiable,but also deeply felt by operators in the metal-working and plastics industry, as well as by economic operators in general. Demand will certainly exceed the capacity the new M.P.D.U. facility will have, within its economic limits; even more so in 5 or 6 years, the time required to train workers in the necessary skills.
A specific function of the facility might be the supply of metallic patterns for castings, and the precision machining of some special castings, for the Khartoum Foundry Co.; thus establishing an organic link with this other project, already fully operating. This connection should be carefully adjusted, in order to avoid any duplication of existing facilities and activities. To obtain some measure of the potential size of market for dies and moulds, the Mission has collected the following information, referred to individual firms (specific data for this type of equipment cannot be evinced from general import statistics):

. two major enamel ware manufacturers
  - annual consumption of imported moulds: 300 sets; average cost per set: SL 2500;in addition some simple moulds are made internally
. two major plastics factories (cans and pipes)
  - annual expense for imported moulds: dollars 500.000; in addition, the simpler moulds are made internally
  - lifetime of one mould: 1 million pieces
  - minimum production required: 200.000 pieces
. small agricultural implement manufacturer:

- uses simple dies (to cut spades and hoes) made internally; lifetime of a die: 1 year
- has bougth a German machine tool (press) that will require 2 sets of 12 dies, to be imported.

Metal working industries and plastics industries are the major potential customers for dies and moulds. Their present situation and forseeable development are given in enclosures C and D, based on lists and figures supplied by Ministry of Industry. An attempt made to extrapolate the annual absorption indicated by the companies visited, gives a total potential market of 1.2 to 2 million dollar per year. Assuming the M.P.D.U. will be able to catch, when fully trained, 50% of this volume, sales could be between 600.000 and one million dollar per year.

2.06 - SHEET METAL FORMED ITEMS

Components for products made by other metal industries

Within the Sudanese metal-working industry (88 firms) a relatively large number of firms process light sheet-metal (ferrous and non ferrous). Mainly, they are distributed as follows (according lists from Ministry of Industry):

. household utensils	6 firms
. metal furniture	23 firms
. crowncorks, tins and containers	10 firms
. refrigerators, coolers	3 firms

The mission visited two manufacturers of household utensils, one refrigerator factory, and one metal furniture manufacturer. The impression received is that this kind of industry has reached a good level of efficiency and self-sufficiency, also for the more complex products (refrigerators, air-coolers).
For example, the refrigerator factory performs all the operations of the cycle, on all the materials used (sheet metal, plastic, piping; they are also capable of rewiring electrical motors).

Thus, the demand from these consumer goods for components and parts seems to be quite limited.

With regard to sheet-metal finished products to be used as parts of larger machinery (e.g.: tractor seats, lift truck protection roofs, fittings for rolling stock, etc..) it seems that local industry has already the skill required to expand in these lines of products.

Parts for light agricultural implements

The mission visited one small factory manufacturing spades and hoes.
Here too, the impression received was that of a remarkable efficiency and ingeniousness, and of a sound businesslike outlook. With 16 workers, the factory produces 500 pieces per day (in one shift; retail price: SL 1,84 apiece).
Plans are afoot for the purchase of two new machine tools (well chosen), and for widening the product range to include rakes, mattocks and door-hinges.
The comment put forward under the preceding paragraph apply also here.

Replacement parts

The demand for sheet metal stamped items as replacement parts for vehicles, (small and large), and other products, could certainly be quite strong; but due to high number of models it will always be more convenient - when original parts not available - to use hand made or hand repaired parts, a specific tooling for mass production not beeing justified by the low volume of each item.

To conclude, as for sheet metal formed items it would be contrary to the spirit of M.P.D.U. to set up a facility whose output would occupy a space that can be filled by local industries. Therefore, within the M.P.D.U. this department will not be given high priority and be kept within limited size.

Future development

The sheet metal forming department could very likely, in the near future, play an important role in helping the start of new industries, which could otherwise be discouraged by the large investments required for sheet metal stamping equipment. Until these new industry will be mature to the point of reasonably face these investments, the M.P.D.U. could act as a suitable supplier of the sheet metal parts they need.
This is particularly true for the specific sector of farm equipment, where studies are at an advanced stage for the establishment in Sudan of an assembly unit for Tractors, Combines, other Farm Machinery. As a sizable percentage of parts (see table below), including sheet parts, should be in a short time supplied by Sudanese industry:

	annual volume	local content
- Tractors	4.000	30%
- Combines	400	15%
- Agric. Implements	4.000	80%

the M.P.D.U. could become a suitable supplier, thanks to its technological level (the parts will be required to meet tolerances and quality standards unusual for the present capabilities of the Sudanese metal-forming industry). Wheter the project will materialize and when, is still uncertain: thus it would not be wise to give the metal-forming facility, from the onset, the capacity to meet this possible demand.

Finally, it can be mentioned that one type of finished good - liquid gas (LPG) containers-might offer the sheet metal-forming plant a productive opening that would not interfere with existing local industry, and could contribute to "import substitution" objectives (at present these containers are totally imported: 450 tons during the 1973-78 period).

2.07 - STEEL PLATE FABRICATED ITEMS - FORGED ITEMS

Components for products manufactured by other metal industries

According to the list supplied by the Ministry of Industry there are 26 firms presumably operating in the sector, divided in two categories: "bus skeletons and tanks" (5 firms) and "Engineering works, metal products, maintenance workshops" (20 firms). The majority of these, however, are really craftsman workshops; furthermore, judging from the machinery and the work-methods of the two industrial plants visited and from the information gathered in these occasions, also within the restricted sphere of the larger concerns (probably around 10) the "state of the art" can be improved significantly even though a remarkable amount of ingenuity and resourcefulness, and a certain amount of manual skill, are deployed to make the best use of rather scanty production facilities. As a result, the quality standard of the end products is often quite primitive: for example, large trailers for agricultural transport without brakes.

It can be safely assumed that the local metal working industry is inadequate to manufacture (with acceptable standards of industrial efficiency and economy, as well as of quality of the end product) the more sophisticated pieces used in its own products. The mission visited

two firms, one manufacturing trailers and tanks and the other - tecnically more advanced, owing to a permanent link with an associated German firm - operating in various product lines: steelwork for big irrigation schemes (pipes, valves, water filtration plants, pumping stations); 3 to 5 ton trailers, tipping and non-tipping; storage tanks. In both cases a potential demand has been ascertained for certain parts (hubs, flanges, axles), which at present are either imported, or made by the firms themselves with inadequate machinery.

Parts for medium-heavy agricultural implements and machinery

This is a very important field for M.P.D.U. output absorption and import substitution (see Import Analysis, Annex B). Here again the existing industrial structure is not prepared to satisfy the demand: consequently M.P.D.U. could become an interesting local source for parts of agricultural equipment now imported in large quantities also by the state farming enterprises, such as the huge Gezira Board managed by the Ministry of Irrigation.
Furthermore, this could be an excellent training opportunity: relatively complex items to be manufactured with small series production techniques.

Additional openings in this area could materialize within a few years, as supplier of parts for large agricultural machines to be assembled in Sudan under the Massey-Ferguson project.The existance of a local source of parts, such as the M.P.D.U., should even constitute a substantial stimulus towards the realization of this project, and similar ones.

Replacement parts for large factories

The large processing plants of agriculture related industries (cotton, oil, sugar) and other industries having a major role in Sudan development programs (transport, cement, textiles) require a huge amount of parts and simple mechanical devices - such as conveyor chains,buckets; elevators - now almost totaly imported.
This is perhaps the most strategic area, as it is the backbone of Sudanese industrial economy. Some of these plants operate on a seasonal rythm, with higly intensive exploitation for some months, and extensive overhauling during the rest of the year. The role of M.P.D.U. in keeping these factories operating could happen to be tremendously beneficial for the Sudanese economy.

2.08 - MACHINED PARTS

In its role of "infrastructural facility" to support other existing or planned industries, the supply of special precision parts has to be considered; but only as an "emergency" service - when the existing machine shops cannot provide, and a small effort from M.P.D.U. could mean to keep other important plants active. Machining of such parts should be normally avoided,in order not to disturb the preminent activity of tool making.

2.09 - MANUFACTURING SERVICES

Here again the demand from other industries could be very strong: in Sudan there are no similar facilities that could perform manufacturing operations on a sub-contracting basis. The M.P.D.U. could provide some manufacturing services mainly in areas where this activity will not interfere with current production programs. Typical manufacturing services could be heat treatment of steel, stainless steel welding, aluminum welding, flame cutting, surface treatment (incl. painting and sand blasting).

2.10 - ENGINEERING SERVICES

Together with training, the availability of Engineering Services offered by M.P.D.U. Engineering Department will be one of the best supports for Sudanese Industry. From the beginning of its operation, the Engineering Dept., besides fulfilling its institutional tasks for M.P.D.U. itself, should be able to provide

- marketing identification of new products, and manufacturing possibilities
- assistance to other industries in product design, tool design, industrial engineering
- cooperation with large plants for their major replacement needs.

2.11 - CONCLUSIONS

The findings and results of the survey made it clear that a strong demand does exist in SUDAN for the potential outputs of M.P.D.U..

Under the assumption that this unit must be an "infra-

structural facility",aimed to help and support other industries, either existing or planned, and not to compete in the market by manufacturing end products, the areas of activity to be contemplated in the interest of Sudanese economy are related to the following products, in order of priority:

. production tools, mainly dies and moulds for metal and plastics industry, jigs and fixtures, simple pieces of equipment
. steel plate fabricated parts
. hot formed parts
. sheet metal cold formed parts
. manufacturing services

Examples of parts and items which could be conveniently produced by M.P.D.U., besides moulds and dies, are shown in the tables of Annex E.

The M.P.D.U. shall also provide Engineering Services, currently not available in Sudan, to other industries, with the aim of easing and improving their operations.

Engineering services will be oriented towards Product design, Techno-economical analysis, Industrial engineering, Quality improvement, Cost reduction.

The "level of interest" for the output of M.P.D.U. - both Products and Services - in the various areas of potential customers, is shown in the table of next page.

M.P.D.U. shall not, as already stated, enter in competition with other firm producing and marketing end products.

However, when existing industry cannot satisfy some important and urgent needs, the production of some end products could be considered. Examples are

. agricultural implements
. LPG containers
. bins and boxes for material handling.

Decisions about these or similar end products will be taken by future M.P.D.U. management.

Besides Products and Services, as above outlined, the M.P.D.U. will rear - through its Training Department an on the job - a certain number of skilled workers,as well as of technicians and engineers, and make them

available to other industries when the needs of M.P.D.U. itself are fulfilled.

The training activity and plans are described in Section 4.

The magnitude of M.P.D.U. output, in volume and value, cannot be easily calculated in advance. As we can safely anticipate that the demand of market will be in excess of plant capacity, which will be limited by number of trained people as well as by facilities, the revenue should be based on max effective working hours available.
However some attemps to evaluate the production output and potential revenue, based on average indexes of similar concerns in Europe, brought to total figures of 2.5 (pessimistic approach) to 2.9 (optimistic approach) million dollar per year, when the factory will be mature and working at normal speed (6th year; see table next page).

The calculation of annual revenues in previous years, when the operation is still growing, and the economical evaluation of results, so to establish if and when the break-even point will be reached, are developed in Section 8.

2.11. LEVEL OF INTEREST FOR POTENTIAL M P D U PRODUCTS

X = low - XX = medium - XXX = high

M P D U PRODUCT \ CUSTOMER SECTOR	METAL WORK INDUSTRIES	METAL HOUSEWARE	PLASTICS	ELECTRICAL APPLIANCES INDUSTRIES	AGRICULTURAL IMPLEMENTS & MACHINERY	SPARE PARTS FOR LARGE FACTORIES	SPARE PARTS FOR VEHICLES	CONTAINERS (LPG, others)	FOUNDRIES
MOULDS, DIES, METALLIC PATTERNS	X X	X X X	X X X	X X	X	X	X	X	X
SHEET METAL STAMPED PARTS		X		X X	X X		X	X X	
STEEL PLATE FABRICATED PARTS	X X				X X X	X X X	X	X X X	
FORGED PARTS	X X				X X X	X X X	X	X	
MACHINED PARTS	X X			X	X X	X X	X X	X	
MANUF.SERVICES	X X			X	X X	X X	X	X	
ENGINEERING SERVICES	X X X	X X	X X	X	X X X	X X	X		

3. - THE PLANT

3.01 - INTRODUCTION

Location: Khartoum (The Three Towns)

There is no doubt that the location should be selected within the Three Towns area, where 70% of Sudanese industry concentrates, and where - thanks to the presence of about 1 million inhabitants - it is possible to employ labour who is somehow already trained.

Moreover, in the Three Towns area there exists the majority of supplying sources of anything that may be necessary for a company's life. The Three Towns are a major center of transports and communications towards the whole country; they are also linked through international airway connections whilst the railway and the motorway from Port Sudan allow to quite easily receive any goods coming by ship.

Fig. 1.

Selection of the area

Industrial development areas have been most appropriately foreseen in the Three Towns area: the largest one, 4 sq.km., at Kartoum North; the second one, basically intended for the settlement of light industries, in Khartoum; and the last one, covering a limited area and where no railway connections exist, at Omdurman.

The choice can then be focused on one of the two first areas above, where the necessary infrastructures exist and where up to 20,000 sq.m., are available. If an area of 30.000 sq.m. is desired, it should be necessary to move by 25 km. up to El Gadid Ej Thawra, new industrial area; but this site seems too much off-the way, and above all, no residential settlements exist where the staff and labour required could be found and housed.

We tink that the M.P.D.U. should cover with its maximum future development an area of about 5÷6,000 sq.m.; it therefore results that a 20,000 sq.m. area can suffice, also meeting the requirements of parking spaces, outdoor storage, handling, and necessary enlargement.

Fig. 2-3-4.

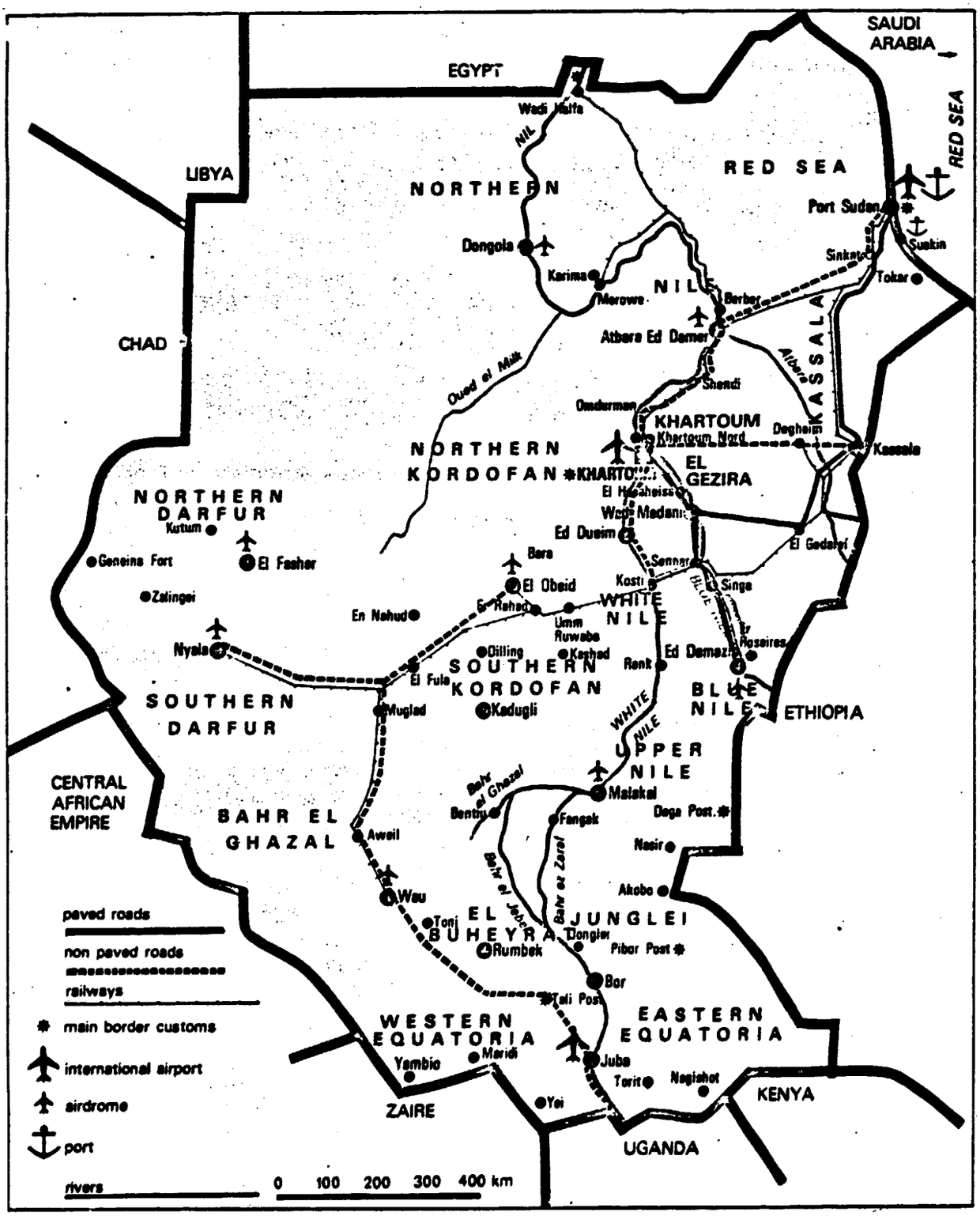


Fig. 1 The Sudan

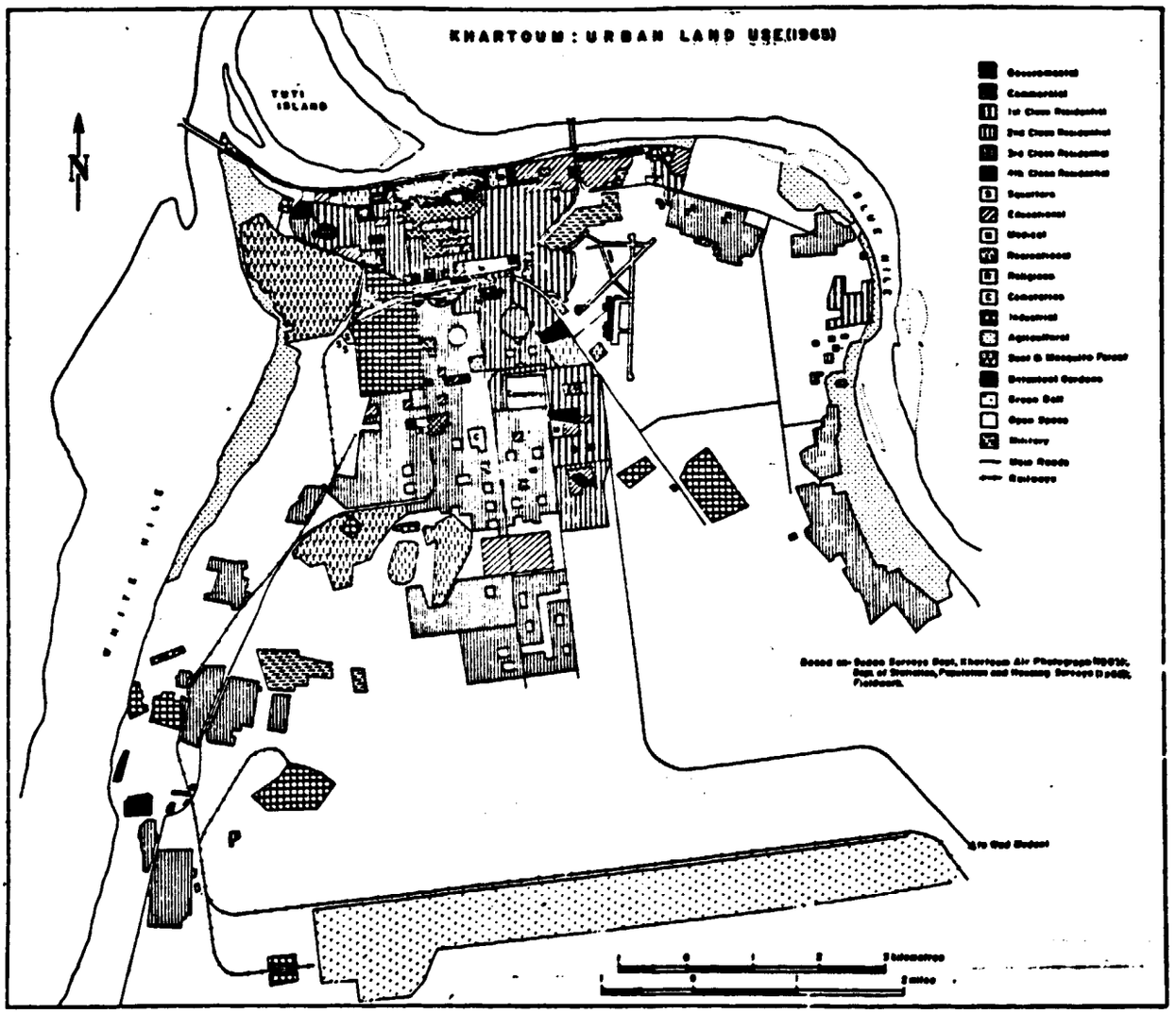

KHARTOUM : URBAN LAND USE(1968)
TUTI ISLAND
N
BLUE NILE
WHITE NILE

Fig. 2

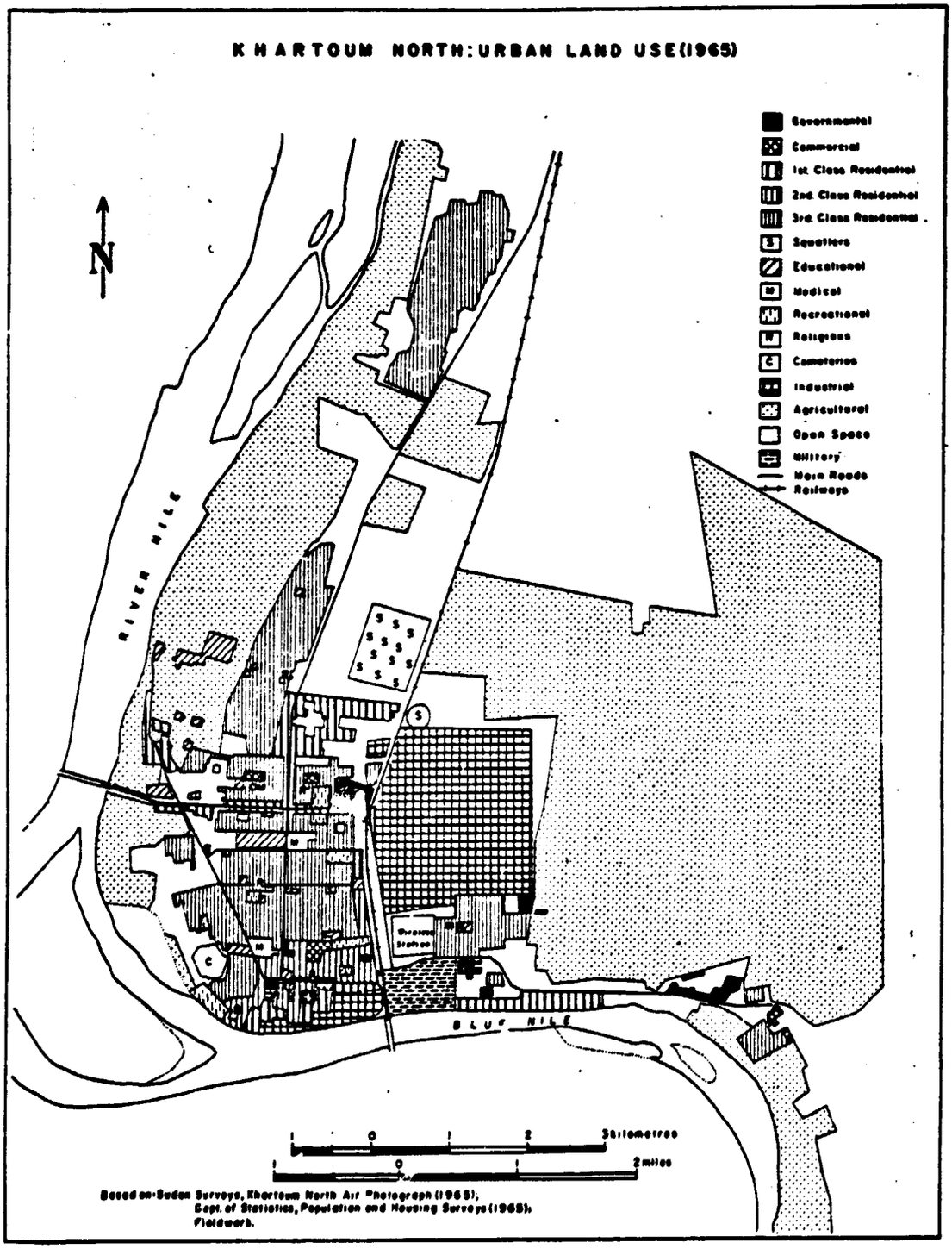
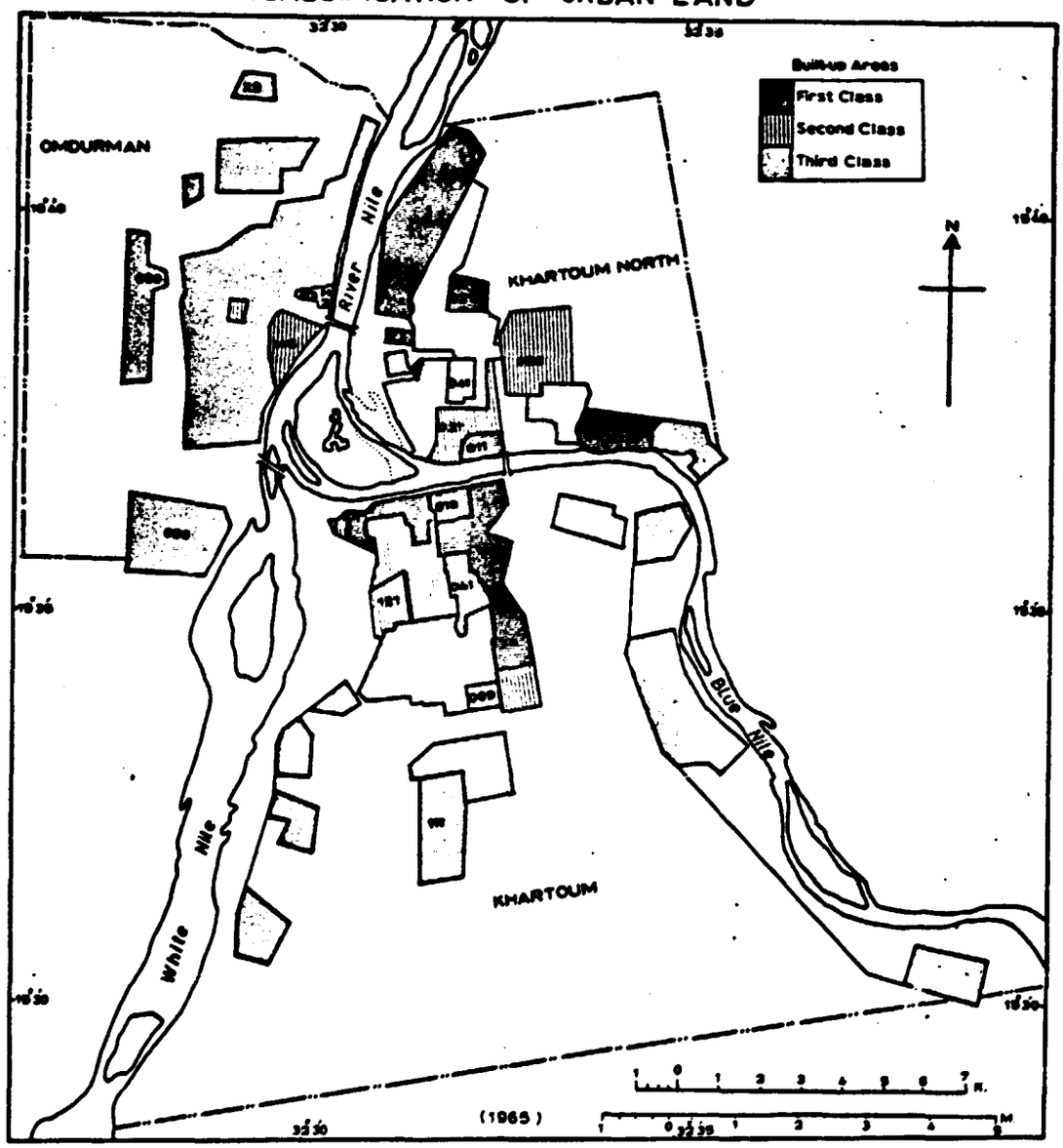

KHARTOUM NORTH: URBAN LAND USE (1965)
N
Governmental
Commercial
1st. Class Residential
2nd. Class Residential
3rd. Class Residential
Squatters
Educational
Medical
Recreational
Religious
Cemeteries
Industrial
Agricultural
Open Space
Military
Main Roads
Railways
RIVER NILE
BLUE NILE
0 1 2 3 kilometres
0 2 miles
Based on: Sudan Surveys, Khartoum North Air Photograph (1965);
Dept. of Statistics, Population and Housing Surveys (1965);
Fieldwork.

Fig. 3

KHARTOUM CONURBATION
CLASSIFICATION OF URBAN LAND



Khartoum			Khartoum North			Omdurman		
Code	Name of ward	Density per Sq.M	Code	Name of ward	Density per Sq.M	Code	Name of ward	Density per Sq. M.
013	Khartoum East(B)	3120	011	El Amlak	1250	MO	Muazmme Quarter	4730
041	Khartoum No.2(old)	7550	025	El Safya	2950	R2+3	Beit El Mal	34070
069	Eastern Dem(B)	30820	021	El Amlak	11890	060	Umm Badda	19430
111	Gabra & El Oshara	1790	041	Kh. North Deims	43520	090	El Fitaihab	12900
121	Industrial Area	1420	050	Industrial Area	200	X2	Marzoug	1460

Fig. 4

Cost of land

The price fixed by the Government for the land - a political price - should amount to 4 SL/sq.m., and therefore the locking-up for land shall be 80,000 SL/sq.m. approximately.

The site

Average height above sea level: 370 m.
The site, located at the confluence of the White Nile with the Blue Nile, is entirely flat, formed of Gezira clay resting as a more or less thick layer on Nubian sandstones.
Particular care shall then be given to the design of the building main foundations, as well as of power hammers and presses foundations. A previous soil investigation must be done.

The climate

This area has a continental tropical climate, with highest temperatures in May-June and a short rainy season July through September.

Maximum temperature:	+ 48°C in June
Minimum temperature:	+ 6°C in December
Minimum mean temperature in January:	+ 24°C

The hottest period from April till June comes together with the Haboobs wind season; when the rains come, the heat decreases while the humidity increases, and the Haboob winds are less frequent. Then a warm October comes, followed by the most temperate period, November through February.
Direction of winds is mainly from the North.

The mean yearly rainfall in Khartoum is 167 mm; mean humidity for over 8 months is less than 20%.

Fig. 5-6-7-8.

Air pollution

The proximity of desert and the aridity of soil originate a large amount of dust which can be very harmful for high precision machinery.

Population

The total inhabitants of the Three Towns amount to about 1 million (according to 1975 census), of which 40% under fifteen years of age. The average human life does

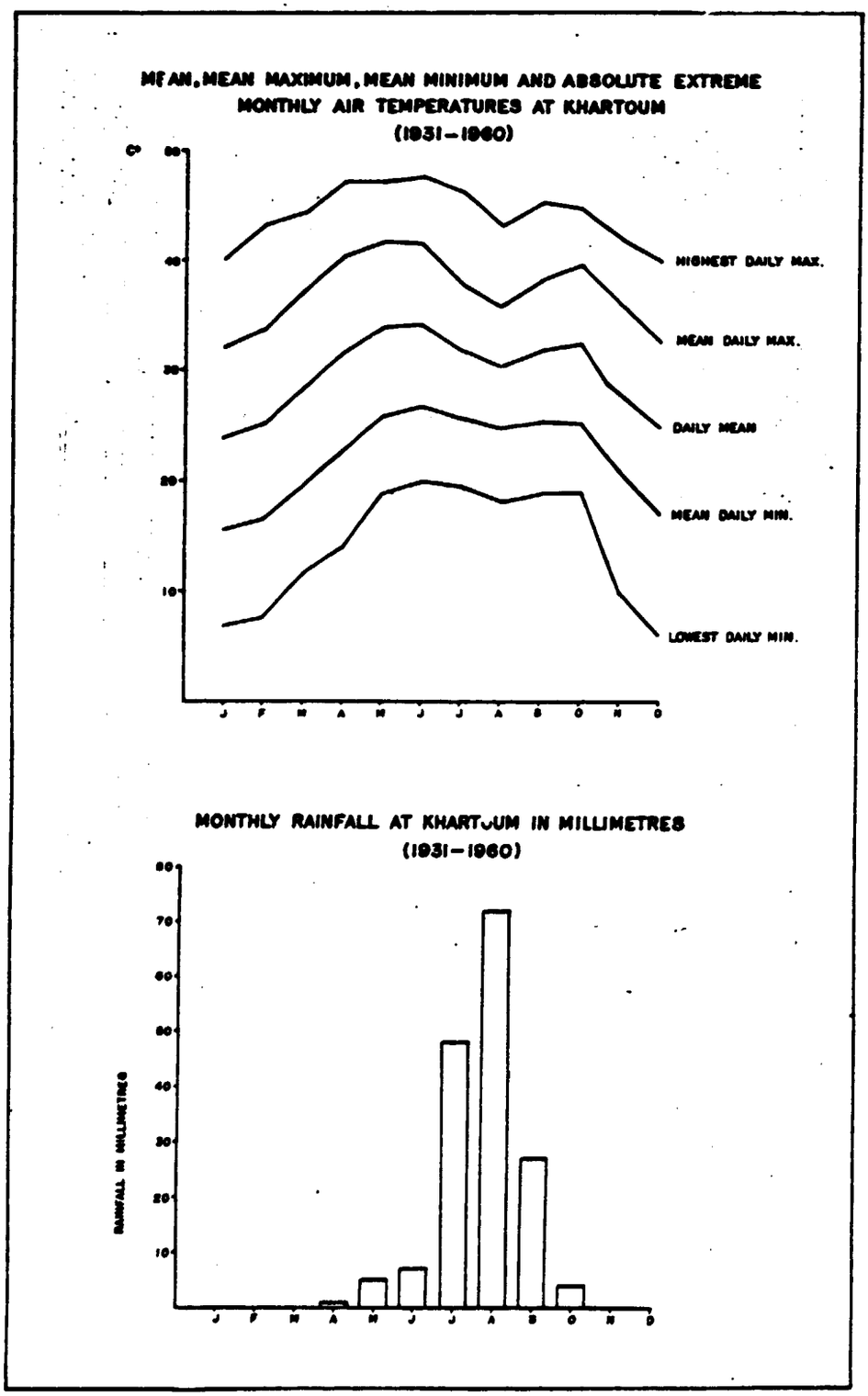

MEAN, MEAN MAXIMUM, MEAN MINIMUM AND ABSOLUTE EXTREME
MONTHLY AIR TEMPERATURES AT KHARTOUM
(1931–1960)
C°
40
30
20
10
HIGHEST DAILY MAX.
MEAN DAILY MAX.
DAILY MEAN
MEAN DAILY MIN.
LOWEST DAILY MIN.
J F M A M J J A S O N D
MONTHLY RAINFALL AT KHARTOUM IN MILLIMETRES
(1931–1960)
RAINFALL IN MILLIMETRES
70
60
50
40
30
20
10
J F M A M J J A S O N D

Fig. 5

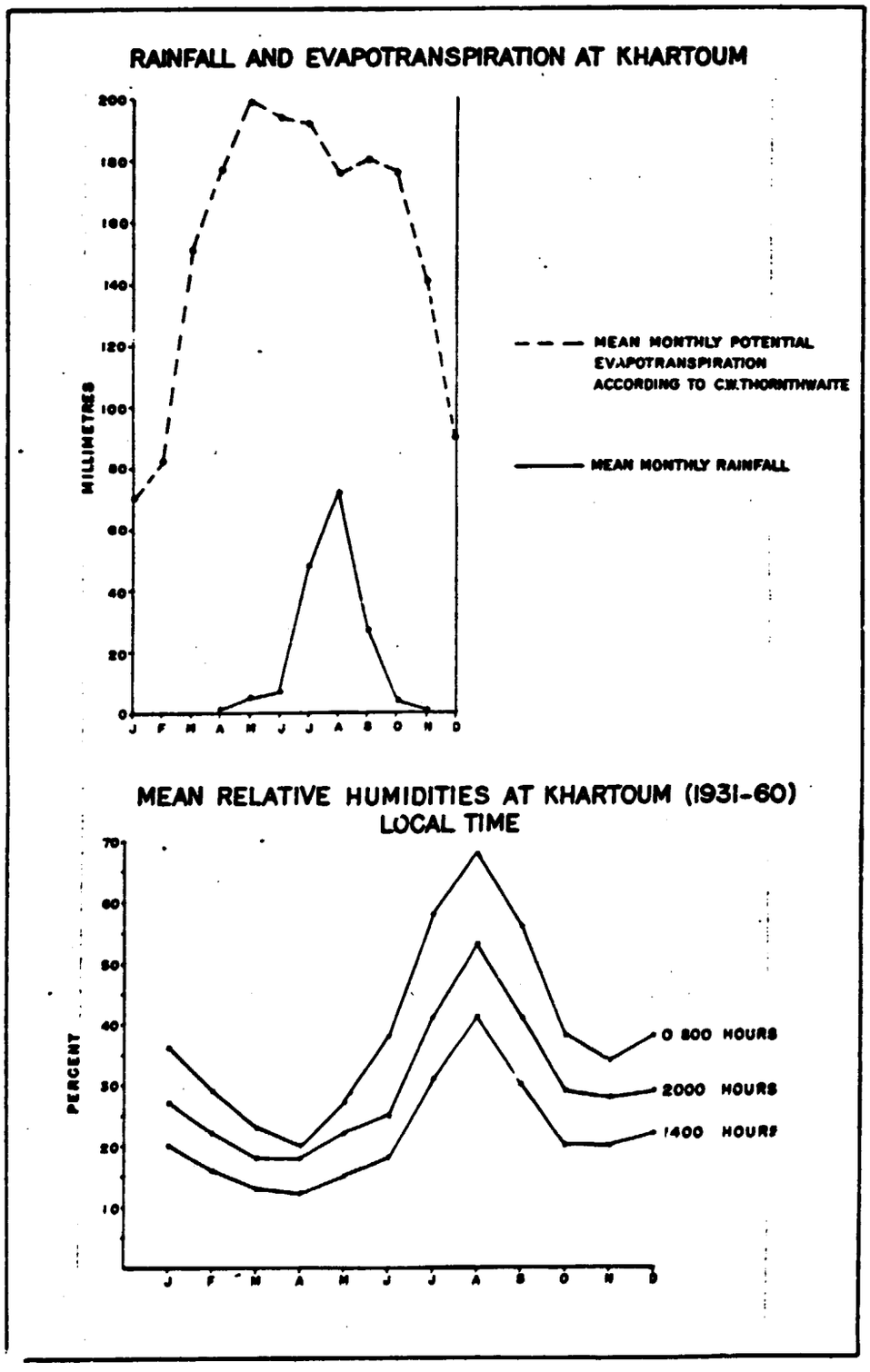

RAINFALL AND EVAPOTRANSPIRATION AT KHARTOUM
MILLIMETRES
200
180
160
140
120
100
80
60
40
20
0
J F M A M J J A S O N D
MEAN MONTHLY POTENTIAL EVAPOTRANSPIRATION ACCORDING TO C.W.THORNTHWAITE
MEAN MONTHLY RAINFALL
MEAN RELATIVE HUMIDITIES AT KHARTOUM (1931-60)
LOCAL TIME
PERCENT
70
60
50
40
30
20
10
J F M A M J J A S O N D
0 800 HOURS
2000 HOURS
1400 HOURS

Fig. 6

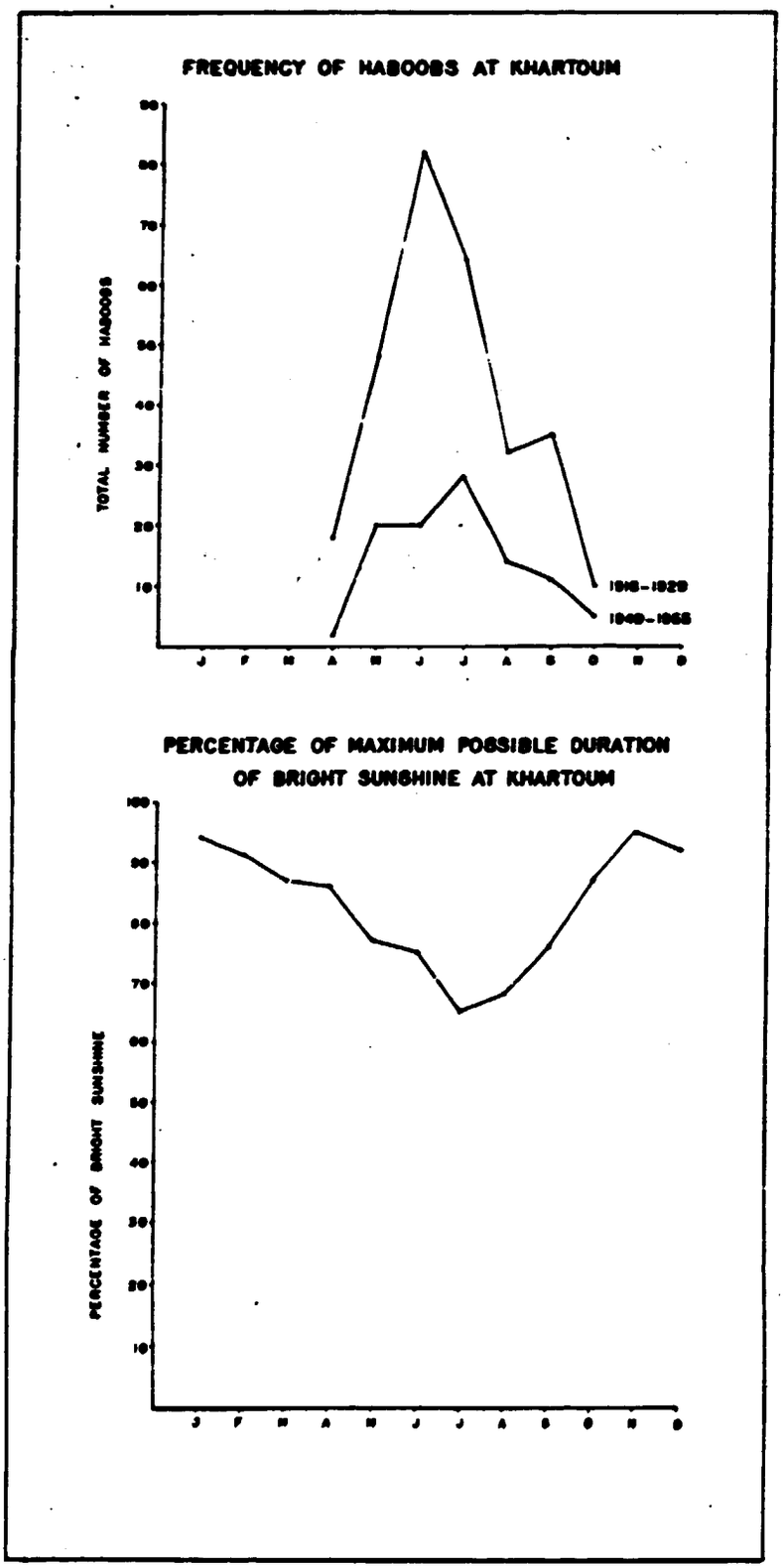

FREQUENCY OF HABOOBS AT KHARTOUM
TOTAL NUMBER OF HABOOBS
1916-1929
1949-1965
J F M A M J J A S O N D
PERCENTAGE OF MAXIMUM POSSIBLE DURATION
OF BRIGHT SUNSHINE AT KHARTOUM
PERCENTAGE OF BRIGHT SUNSHINE
J F M A M J J A S O N D

Fig. 7

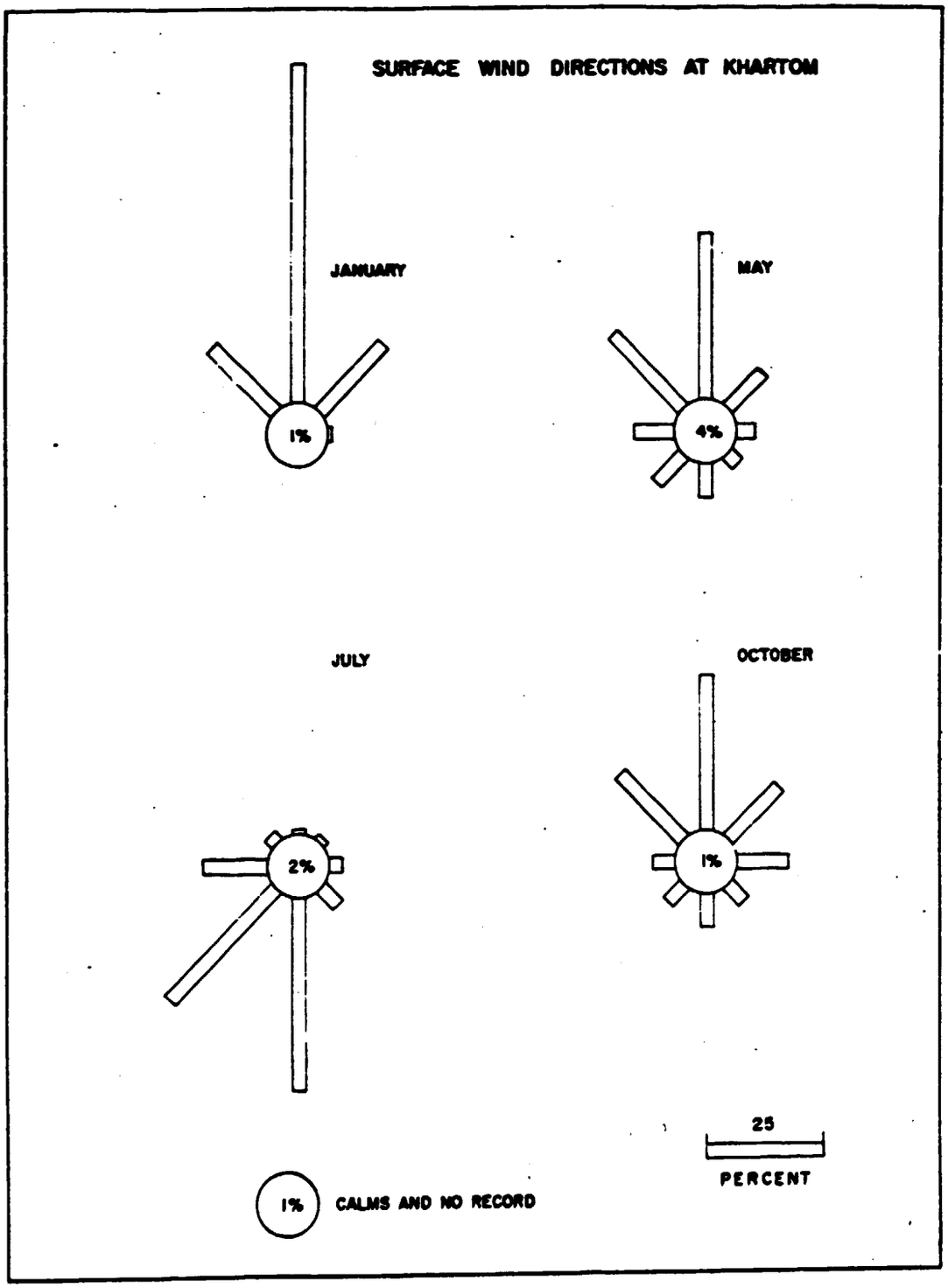

SURFACE WIND DIRECTIONS AT KHARTOM
JANUARY
1%
MAY
4%
JULY
2%
OCTOBER
1%
25
PERCENT
1%
CALMS AND NO RECORD

Fig. 8

not get over 40. The women are outnumbered by men, due to the immigration; illiterate persons amount to about 70% of the population.

Infrastructures

Said industrial areas are equipped with the following infrastructures:

- Electricity: power is supplied to the transformer room - to be erected by the Client - at 33,000 or 11,000 V, or at 4'2 V according to the demands. The transformers are supplied by the electricity company.

  At present, power is almost insufficient; it undergoes voltage changes and interruptions.
  Should the Khartoum power station not be increased in the future an auxiliary generating set must be provided.

- Water: Khartoum water municipal system can supply water of good quality but in limited quantity. The installation of a water tank is recommended, having a capacity of about 50 cu.m., located about 3 m. above the highest point of the factory. Water wells in this area have an average depth ot 90 mt.

- Sewer and drainage system: a drainage system only exists, and therefore particular care shall be taken in order to avoid any pollution. As for sewage, septic tanks and water disposal wells have to be used. Industrial polluting wastes shall obviously be treated by mean of traps.

- Gas: no centralized gas distribution system exists, only liquid gas in bottles is available. Due to the consumption that has been foreseen, high capacity tanks are to be provided to be filled from tank truck.

- Telephone and telex: they are both available. The second one is far more the quickest communication system towards foreign countries, as the telephone international connections are often very difficult.

- Urban transportation: Urban transportations in Khartoum are effected by means of pick-up vehicles capable of transporting No. 8/10 passengers. The number of such vehicles in circulation is not sufficient and quite often the large firms arrange private transport for their staff.

- Road, rail and airway transport are fully available in the Khartoum area.

3.02 - GENERAL CHARACTERISTICS

The design, the imports

The local conditions of building materials make the utilization of steel structures more suitable for the erection of industrial plants in Khartoum. Such a structure shall also be used for the M.P.D.U. Most probably the structures shall be manufactured abroad and then imported into the country. Consequently, they shall be assembled under the supervision of the manufacturer by a local firm that should also be responsible for any other construction works.

Therefore it appears quite evident that a close cooperation between local architects and foreign suppliers must be established.

Obviously, Khartoum architects will be responsible also for work management.

The local professional feees are at level with the European ones and amount to about 10% of the value of the construction.

There is no doubt that the building - being erected by Sudanese Government - will enjoy preferential custom duties on the imported materials.

Also the design and the construction of electric, air, water system etc., which are particularly important in an industrial building, shall be carried out abroad;but the assembly shall be entrusted to local concerns under supervision of manufacturers.

Time schedule

Owing to the fact that most of the factory will be built abroad, special care should be given in order to meet the construction time schedule and in the planning of transport, so as to allow the erection works to regularly progress without any slowing down or stoppages. Transport by ship, unloading in Port Sudan and transfer by road to Khartoum do often take several months. A detailed program prepared in advance is therefore essential.

External area

The area of the factory shall be fenced with cement prefabricated elements available on the local market and a shed shall be foreseen at the entrance gate. Possibly, a road weighing bascule could be foreseen.

The internal access roads to the different buildings shall be oil paved whilst the outdoor storage area shall be paved with concrete mix, as well as the side walk 3 m. wide around the buildings.

Buildings

The climatic and environmental conditions highly affect the selection of the type of construction. The high temperature and the high degree of dust in the air make the air conditioning necessary in departments where special high precision machinery is located and in the offices.

Therefore, we think that the factory can be clearly divided in two parts: one will house offices, training laboratories, tools and dies workshop; in the second part, metal sheet forming, forging and heat treatments shall be located.

Total air conditioning and filtering should be provided for in the first part.

The latitude of Khartoum and the climatic conditions of Sudan discourage the use of lean to roof shed covering and require an adequate protection of the buildings walls towards the east. Building must be stretched along the EST-WEST direction in order to expose to the prevailing wind (from North) the longest side for ventilation. Insulated roofings with very large pitches are preferred, fitted with wide static aerators arranged on the ridge, and large side openings.

The floor level is recommended to be slightly above naturale ground level in order to avoid any flood during the rains.

Buildings costs (February 1980)

Cement is locally available and is supplied on the site-only in bags - at a price of SL 94 per ton. The metallic structures that must be imported - including windows doors - cost about SL 50 ÷ 70/ sq. m. on average.

As a result, the present cost of buildings is of 110-140 SL/sq.m. on the average.

The use of insulation into traditional structure makes the cost increase by SL 30-80/sq.m. according to the type of materials and to the solutions adopted.

Mean prices of constructions are as follows: offices 250 SL/sq.m.; shops (insulated roof) 180 SL/sq. m.; electric transformers room and air compressors room 250 SL/sq.m.; storing sheds 150 SL/sq.m.; 50 cu.m. overhead watertank: 30.000 SL; bituminous roads 15 SL/sq.m.;

concrete courtyards 25 SL/sq.m.; 20÷80 people septic tank 20.000 SL; land preparation 5-10% of land value; concrete fencing 35 SL/mt.

Facilities, installations

Standard facilities have to be provided for both in offices and in the workshop, namely:

- lavatories; locker rooms with showers; canteen; first-aid station.

Installations should include the following systems:

- water
- fire fighting
- lighting
- electric power
- compresed air
- miscellaneous gas
- fuel
- air conditioning and ventilation

Provision should be made for lifting, handling, testing, painting, etc.

3.03 - DEFINITION OF THE DESIGN

Terms of the problem

It resulted from the market survey carried out in Sudan that the M.P.D.U. shall split its activity towards different trends of the mechanical field, in order to fulfill the tasks of driving, of training and of integration it is likely to take on.

These different activities were identified as follows:

1. Mechanical workings:

   a. manufacturing of jigs, tools,dies, moulds, etc.;
   b. thin sheet forming and cutting;
   c. fabrication with medium-to-thick steel plates;
   d. forging and hot pressing;
   e. heat treatments.

2. Engineering services for:

   a. product and tool designs:
   b. work and production study, factory planning;
   c. techno-economic analysis.

3. Training for:

   a. precision workers;
   b. technicians and engineers.

The following staff estimates have been approximately calculated to fulfill such activities.

	Person n.
Offices	(*) 70
Training shop	40
Tool & die	60
Metal forming	50
TOTAL	220
(*) foreign experts included	

Therefore the M.P.D.U. needs approximatly 1.000 sq.m. office and 3.000/3.500 sq.m. of workshop area.

We think that, owing to the type of operations which are characteristic in the sheet processing and forging depts., they should be kept separate and far away, due to the vibration and noise level, from the tool & die shop as well as from offices.

It results that the M.P.D.U. complex shall include two separate buildings:

- the first one will house offices, general facilities, the tool & die shop and the training department;
- the second building will be devoted to sheet processing, forging and heat treatments.

Alternatives, choices

The different solutions to be adopted in the design of industrial buildings have already been dealt with. But the very difficult problem concerning the installation of the air conditioning system in the tool and die work shop and in the training laboratories had to be solved.

A thorough examination of the problem - also based on the outcomes of the studies carried out in Khartoum area for the implementation of an air conditioning system in an industrial building - emphasized the high costs of such installation but also the extreme necessity of protection for the high precision machine tools in the dusty air of Khartoum. Conseguently it has been decided to equip the tool & die and training shops with an air conditioning system.

Another doubtful point was the choice between the office building connected or separate from the tool & die workshop and the training workshops. The connection between the two buildings was selected upon consideration of continuous relationships between workshop and offices, as well as of the essential contact between training workshop and instruction rooms. The two buildings are, therefore located side by side, but indipendently from a structural point of view.

Also the alternative between the installation of traditional lifting equipment (bridge cranes) in the tool and die workshop, and the use of simple hand-operated elevators was quite important; on the basis of previous UNIDO experiences, the bridge crane was given up, and has been foreseen only in the sheet processing workshop.

Layout

The 20,000 sq.m. foreseen in Khartoum industrial area were assumed in a rectangle 100 x 200 m. where the two buildings above mentioned, will be located 48 m. apart. Such a distance - being a multiple of the selected 12x 12 mesh - would allow a perfect connection between the two buildings, should future extension requirements arise.

The building for the transformer room and the compressed air station will be located at a corner of the site.

Along the fence, the water tank, fuel tanks, sheds for storing gas bottles, paints, lubrificants, etc., scrap and waste disposal areas are arranged.

A bituminized road leads from the entrance - near which the guard-house and the platform scale are located - up to the parking yard in front of the offices, to the goods reception and shipment area of warehouse, and to the miscellaneous product storage yards.

The area between the two buildings is partly devoted to material outdoor storage, and therefore its paving shall be formed of concrete mix.

Any area not intended for buildings, yards or access areas shall be treated with an anti-dust mineral oil-based substances.

Building No.1

It will house offices, training department and tool & die workshop. It will be formed of two adjacent buildings: one, on two storeys, for offices and general fa

cilities, the other one for tool & die workshop and training laboratories.

Both buildings will have a steel structure: curtain walls shall be partly made of brickwork and partly of prefabricated concrete or insulated metal sheet panels. The roofing shall be adequately insulated.

Offices and facilities

The office building shall be approximately 9 m. high, since enough space has to be provided for on each individual floor for passage of air-conditioning ducts, and since the ground floor level is higher than the natural ground level.

The building will be 12 m. wide, 60 m. long, and its facade, adequately protected by means of sunshading, should be oriented towards the south.

The workshop facility area is located on the west side.

The building central area houses on the ground floor the workshop offices, the training department offices and the training class room; with separate facilities for office staff and trainees.

At the first floor, on the east side, the management of M.P.D.U. is located, and in the center the Engineering department, with their relevant facilities.

The ground floor, on the east side, houses the training dept. fitting area.

The workers' facility area is formed of: entrance, lobby with time-clocking area, first-aid room, locker room with showers and toilets, access stairs (separate) to the canteen and meeting room on the first floor. The workshop offices overlook the workers' lobby through windows and counters.

A second group of toilets even though included in this facility complex, has a direct entrance from the workshop, in order to avoid personnel movement in the locker room during working hours.

These facility areas will be paved in such a way to allow easy cleaning; they will be fitted with fluorescent lighting fixtures and air stirrers; traditional 2-box type lockers in locker room could be provided.

The area and staff of office building are:

Offices	Sq.m.	Persons (^)	Sq.m./ Person
M.P.D.U. Direction	144	4	36,0
Engineering Dept.	350	19	18,5
Manufacturing and Administration	200	23	9
Training Dept.	120	6	20
Office Facilities	190	70	2,7
Worker's Facilities	210	150	1,9
Total	1294	-	-
(^) Experts and trainees not included			

The offices of M.P.D.U. shall be simple and functional as far as the selection of materials and furnishings is concerned.

The air conditioning is of primary importance, therefore special care shall be given to insulations, window frame tightness, type of glasses, regulation of sunshading, location of ducts and diffusers, etc. In particular large glazings are not recommended.

The offices are formed of large rooms where the different working areas will be separated by a particular arrangement of furnishings; this solutions allows a better conditioned air regulation and distribution, but makes the use of soundproof materials (above all on the ceiling) essential. On floors carpets should be used.

A suspended ceiling is recommended because of the large space occupied by air conditioning ducts as well as of other installations, lighting fixtures included.

The separation between the different offices shall be foreseen with mobile partitions, with the exception of M.P.D.U. management, where gypsum or similar panels will preferably be used.

Tool and die Workshop & Training Dept.

Including the training workshop; the tool & die workshop covers an area of 1630 sq.m. approx., of which almost 450 for training:

WORKSHOPS	SQ.M.	WORKERS	SQ.M/ WORKER
- Tool and die	1,200	60	20,00
- Training	450	40	11,25
Total	1,650	100	16,50

The steel structure shed is built on a 12x12 mesh; with an overall height of about 7 m. The 12x12 mesh was selected since it is the most suitable to the type of workings foreseen: it leaves large areas free from columns without reaching such values beyond wich the installations of bridge cranes would be particularly expensive and non-functional; moreover it allows an effective arrangement of machines and of passageways for easy flow of materials.

The structural columns should be dimensioned considering the possible installation of runways, even though no bridge cranes have been forseen.

The window openings shall be located on the three sides of the building, and one third of them should be openable.

The curtain walls under the windows shall be made of cement blocks.

The main doors shall be of the sliding type and their tightness should be good, as well as that of windows.

An insulated ceiling must be also provided due to the air conditioning system that has been adopted.

Vibrated dust proof concrete floor with adequate subbase must be provided.

The warehouse area and the inspection area shall be separated by means of net partitions.

Building No. 2

This building houses the sheet processing dept., heat treatments and forging.

Steel shed on a 12x12 mesh, 9 m. high, 24 m. wide, 60 m. long.

Its 1,440 sq. m. of area are divided as follows:

DEPARTMENT	SQ.M.	WORKERS	SQ.M/ WORKER
- Sheet processing	1,152	40	29
- Forging	288	12	24
Total	1,440	52	27,7

The shed is divided into two separate parts: in the west end, crosswise, the forging department is located.

In consideration of the high number of heat sources in this department, the structures should allow the maximum air circulation.

The forging dept. will have a tamped soil paving; the rest of the shed will have vibrated concrete paving. Side enclosures will be formed, for the first 2 m., of cement blocks with continuous windows, openable by one third, on the top.

Double-pitch roofing formed of aluminium ribbed sheet, with ridge static air-exhauster chimney shall be used.

Bridge cranes with capacity of 3 ÷ 5 tons will be available in both bays with possibility of serving both the forging and sheet processing dept. On the east side, the runways shall project by further 24 m. over the stock yard in order to be used for truck loading and unloading and material handling.

Along the partition wall, between the two dept. above mentioned, the heat treatments dept. and the foremen office are located. Sanitary facilities have been foreseen outside, on the north side.

3.04 - PLANTS AND INSTALLATIONS

The definition and selection criteria for plants are of primary importance for a M.P.D.U. intended to operate in a place where situations and conditions are considerably different from what is generally met in Europe.

The surveys carried out in Sudan enable a clarification on these matters to be effected through the examination of local situation, and contacts and interviews with local experts. The conclusions are hereinafter summarized.

Water system

The water will be supplied from Khartoum water municipal system. An overhead water storage tank has been foreseen, capacity 50 cu.m., located at + 16 m. above natural ground level. This tank shall be adequately insulated.

From the bottom of the tank, a distribution network will start with connections to the different users.

The average daily consumption has been roughly calculated around 50 cu.mt.

The fire-fighting system will consist of an adequate number of hydrants outside and inside the building. Fire hydrants outside will be of UNI 125 type, and those inside of UNI 45 type, wall-mounted.

In locations where combustible or explosive materials are stored, proper fire-extinguishers portable and wheel mounted shall be provided for.
Proper care shall be taken in order to avoid direct sun rays on gas bottles.

Lighting system

The illumination levels suggested in the M.P.D.U. are shown in the following table:

- Administration offices	300 lux
- Draftsmen's offices	500 "
- Halls, stairs, lobbies	100 "
- Facilities	100 "
- Tools and dies workshop	500 "
- Training workshop	500 "
- Warehouse	200 "
- Sheet processing workshop	300 "
- Forging workshop	200 "
- Heat treatments	300 "
- Yards, access areas	50 "

The lighting system to achieve the above values could include:

- Tube fluorescent fixtures
  a) in offices and facilities
  b) in workshop of building No. 1
- Mercury-vapour lamps:
  a) in workshops of building No. 2
  b) in the electrical and compressed air station

- Sodium-vapour lamps:

  a) in yards, access areas, etc.

The tube fluorescent fixtures will be adequately integrated in the suspended ceiling of the office building.

The tube fluorescent fixtures in the workshop will be located in rack-type reflectors with 2 ÷ 3 tubes installed under bus - bars (50 A) that may be supported by bus-ducts.

The mercury-vapour lamps will be installed into reflectors fastened to the shed beams.

Power system

The connected load is as follows (transformers should be sized for about half the total power connected).

	MAX. KVA
Building No. 1	
- Offices - Facilities	25
- Workshops (tools & dies - training)	230
- Air conditioning	120
Building No. 2	
- Sheet metal forming	160
- Heat treatment	90
- Forging	40
- Compressed air station	100
Total	765

The transformer room, where the control boards are located, will be equipped with tranformers supplied by the local utility company.

The two buildings will be connected to the electrical station at 380 V through cables, laid underground in trench duct.

The distribution boxes will be located for the Building No. 1 in the warehouse and for the Building No. 2 in the heat treatment dept.

From the distribution boxes the different lines start: in the workshops they will be mainly bus-bars (350 A - 150 A) - as from the enclosed diagram.

Compressed air system

The highest compressed air demand within the M.P.D.U. is recorded in building No. 2, where large amounts of air are required mainly by the press hammer for forging operations. Quite a high demand is also recorded for painting, air-operated tools, etc.

The compressed air station will be located adjacent to the transformer room; four rotating compressor units will be utilized, each one with a demand of 40 KW approx. In addition to the above four units, the station shall also include one cooler and two storage tanks.

The station will be very well aerated and at the same time provision should be made to protect it from dust.

The distribution network will connect the locations where the drawing operations will be effected, and will be equipped with automatic water traps before each branch as well as with water and oil filters, where required.

Gas and fuel

The following gases are likely to be utilized in the M.P.D.U.:

- oxygen;
- carbon dioxide;
- acetylene;
- LPG (Liquid Pretroleum Gas)

It is impossible to obtain gases in a liquid form, in cryogenic tanks; therefore they will be kept in bottles, the delivery of which shall be effected in packs - much easier to connect - for the gases that are most commonly used.

Obviously LPG will be contained in regular tanks with refueling from tank truck.

All bottles stored will be protected from direct sunrays and kept away from working positions as much as possible. Moreover, all accident prevention measures in force in this connection, shall be met.

Fuel in the M.P.D.U. will be used by forging heat furnaces; a proper tank located along the west side of the n.2 building will easily feed the three furnaces through a piping network and shall have a minimum capacity of about 25.00 cu.m. Proper fire-fighting system shall be provided for near the bottle stores and the fuel tanks.

Air conditioning system

The air conditioning system will be provided for in offices, tool & die workshop, and training shop for a total volume of 12,000 cu.m. approx.

Room for the central station has been provided above the tool and die workshop.

By means of appropriate cross-section ducts, ceiling mounted, air will be distributed throughout the building. The air change should be atleast 1.5 Volume per hour. The design of this air-condition system must be executed quite carefully considering the very severe conditions of the Khartoum climate.

We deem advisable that the Company which is going to build the plants should also be responsible of the design.

Lifting, transport and weighing equipment and systems

The handling of the different materials within the M.P.D.U. will be effected as follows:

- Buildin No. 1 - No bridge crane has been foreseen, therefore ordinary requirements will be met by the use of mobile gins; in particular cases, the fork lift truck shall be used.
- Building No. 2 - Two bridge cranes have been foreseen to meet any requirement; some devices for handling of heavier loads near furnaces and power hammers might be required.
- Warehouses, storage yards - in the M.P.D.U. two fork lift trucks have been foreseen, alternatively equipped with crane hook; two units are recommended: 3 and 5 tons respectively.

The M.P.D.U. should be equipped with one 5 tons truck fitted with an hydraulic crane.

The vehicles of the M.P.D.U. should also include a 1,5 ton van and 3 station cars.

Weighing of different materials and trucks shall be effected either on the platform scale located adjacent to the guard house or on the weighbridge to be installed in the warehouse.

Wastewater disposal, sewerage and collecting basins

We already mentioned that in Khartoum, only drainage systems exist, while generally sewage disposal is effected through septic tanks and abosrbing wells.

This solution should also be foreseen for M.P.D.U., and therefore septic tanks for treatment of sewage shall be foreseen for the different sanitary facilities, as well as the most effective system for the disposal of the resulting wastewater.

A collecting basin shall be provided for the polluting wastes such as those coming from painting, hardening tanks, oils, etc.

The site arrangement should obviously take account of rainwater disposal.

Telephones and Telex

The M.P.D.U. should be provided with a telephone system based on 4 external lines and 30 to 40 internal extensions.

The telephone exchange should be located in the reception office at the ground floor of the office building where also the telex receiver will be placed.

3.05 - MACHINERY AND OUTFIT (See Annex E)

Hereinafter are listed the general criteria which the selection of machinery, outfit and equipment should be based on:

- quality: should be absolutely of good level due to the type of operations that must be performed, particularly in the tool and die shop;
- price: even with the high level of quality required, prices should be kept as low as possible through wide bidding and careful market investigation;
- strenght: the machinery will be operating in difficult conditions due to many factors, such as climate, workers at a training stage, distance from supplier's factories, etc., and therefore a particular robustness is required;
- spares and service: a large quantity of spares must be stored to avoid stops in production and consequantly a careful after sales service program must be agreed upon;
- not too sophisticated: due to the limited volume of parts that shall be manufactured and to the fact that for many years the workers will not be extremely skilled, too complicated or automated devices should be avoided;
- universal application: fields of activity for the MPDU have been already listed and the necessity of a variety of application has been highlighted; therefore the machinery must be as universal as possible.

In order to have real and reliable data on machinery, written quotations (with catalogues, drawings, information) were asked for. Evaluations are based upon the prices communicated, but,owing to the increasing inflation,care should be given in future to the use of the supplied data.

As requested, the specifications are neutral but the sources where such information were drawn from are available.

The equipment will be purchased on a precise schedule aiming to get the machines and equipment when needed. The schedule should be according to the following or

der:

- training department should be the first to start the activity;
- tool and die workshop will be the second;
- the third should be the metal forming whorshop.

Tool & Die Workshop

The aims of this worhshop. are clearly defined as far as moulds, patterns and dies are concerned; dimensional limit as for lenght - 500 ÷ 600 mm. - and weight - 500 kg. approx - has been indicated.

Production will start with quite simple assemblies, but, gradually, more and more complex and sophisticated assemblies will be manufactured.

The field of tools is much less defined; its development will depend on the capability of finding work and on the different solutions that will be adopted by the Engineering Dept. Obviously, the manufacturing of tools & dies will also involve the sheet forming and heat treatment workshop.

This workshop will employ about 40 ÷ 60 workers and therefore adequate working positions have been foreseen: a half on the machine tools and a half on the fitting benches or in the assembly areas.

The following machine tools have been foreseen:

- 6 lathes;
- 4 milling machines;
- 3 grinding machines;
- 1 radial drill;
- 1 pantograph;
- 1 electroerosion machine;
- 2 die testing presses;
- 1 copy milling machine;
- 2 jig boring machines;
- 1 shaping machine;
- 1 universal sharpening machine;
- 1 sharpening machine for twist drills;
- 1 sharpening machine for cutter;
- 1 hacksaw;
- 1 pillar drill.

The last four machines are located within the tool crib; furtermore, other small machines such as bench grinders, bench drills, etc. are available.

The working positions at the fitting benches are 15, whilst about 5 ÷ 6 workers, in proper areas, will take care of disassembly, repair and re-assembly of machine tools.

The inspection department is located in a glazed area where laboratory and testing equipments are placed.

The actual inspection of parts will be effected also in the fitting area where a plane having adequate dimensions is located.

An area of the workshop is also reserved for the maintenance team.

Training Workshop

The training workshop will house the trainees during the first two years of the training course: it shall have No. 46 working positions, of which No. 24 at fitting benches and marking off and No. 22 at machine tools.

The following machine tools have been foreseen:

- 10 lathes
- 6 milling machines
- 3 grinding machines
- 1 shaping machine
- 1 vertical band saw
- 1 pillar drill
- 1 bench double ended grinder
- 3 bench drills
- 2 marking off planes
- 24 fitting benches

Two types of machines were chosen: one is only meant for training, while some machines could enter production; this is so because during the second year, the trainees will devote some time to carry out simple works for the tool & die workshop.

A high number of outfits, control means and equipment, has been foreseen and is stored in the central tool-crib in separate shelves.

We think that with such outfits the training department can find a high place on the quality scale, certainly higher than the European average, and therefore it is commended that the selection of trainees be very cautiously carried out in order to find people able to entirely make use of such a qualified installation.

Warehouse

The M.P.D.U. warehouse is formed of two parts: tool crib located in building No. 1, and stocked material outside and inside building No. 2.

The tool crib is intended to support the tool & dies and training workshop operation, and therefore raw mate

rial inflow and outflow are moderate, while a high flow of tools, equipment, fixtures, etc., auxiliary materials and consumables is recorded. The outfits for training in the warehouse are kept separate from the tool & die workshop ones.

In this area, sharpening of tools by means of the three sharpening machines above mentioned is carried out.

The large number of expensive material is kept in proper shelves.

The tool crib has two hatches opening towards the workshops.

Warehouse of building No. 2 is formed of the outside and inside storage areas where various stocks and raw materials are stored, such as:

- ferrous material storage yards under external bridge crane;
- storage area between the two buildings, with concrete paving;
- storage yard under shed for bottles and inflammable materials (oils, paints, solvents, packages, etc.);
- storage yards for scraps, wastes, etc.;
- fuel oil tank for furnaces:
- L.P.G. tanks.

Sheet Metal forming Workshop

The variety of parts and products that can be manufactured in this workshop is extremely wide and cannot be evaluated in full details as far as quality, type and quantity are concerned at the present stage.

The M.P.D.U. can be, particularly in the field of the products manufactured in this workshop, extremely useful to the Sudanese industry as it can deal and solve a great number of technical problems. Consequently, the equipment of this workshop corresponds perfectly to such requirements.

As far as forming of medium thick sheet is concerned,the following has been foreseen:

- oxygen cutting with 4 torches;
- guillotine shears;
- press-brake;
- straightening press;
- roll bender.

As for thin sheet, there are three presses, 25 - 70 and 200 tons respectively, that will utilize dies manufactured in the M.P.D.U. itself; one nibbler, as well as a set of light machines such as hand lever shear; box bender; beadin machine, etc.

The parts will be assembled in welding booths where different welding systems will be available:

- electrode welding;
- solid and hollow wire welding (CO_2);
- spot welding;
- oxy-acetylene welding.

The following operations have also been foreseen:

- various drilling and,almost,boring operations can be carried out with a big radial drill;
- as for tubes and profile bending, a bender has been foreseen, operating coupled with a disk cutting-off machine;
- as for bar cutting, a horizontal belt saw of high capacity has been foreseen;
- an area is devoted to parts painting, equipped with a water film booth;
- other auxiliary machines such as grinders, sensitive drill, etc. have been foreseen.

Finally, this workshop also houses the billet shearing machine where parts for the forging department are cut.

Forging shop

This department can carry out the different hotpressing and forging operations thanks to a wide range of machines and furnaces intended for the following operations:

- open-die forging on C-power hammer;
- die forming on press hammer;
- die forming on friction press;
- trimming.

These four essential machines are intercalated with three furnaces where proper heating is effected.

The training of a group of technicians and skilled workers in this field is an essential condition to the succes of the project. Later on, when a satisfactory cohesion among people working in the department, as well as an acceptable average technical level are achieved, it could prove profitable to organize stages at European factories specialized in this field.

Heat Treatment

The department is fitted with the equipment necessary to carry out basic heat treatment on parts manufactured by the M.P.D.U. and on parts that could come from other local industries:

annealing, normalizing, hardening, tempering, quenching, etc.

The equipment of the dept. includes:

- 2 muffle furnaces (electric);
- 1 salt furnace;
- 3 quenching tanks for water and oil;
- hardening boxes;
- equipment for hardness control, Rockwell and Brinell (other tests can be carried out using tue equipment of the Inspection Service).

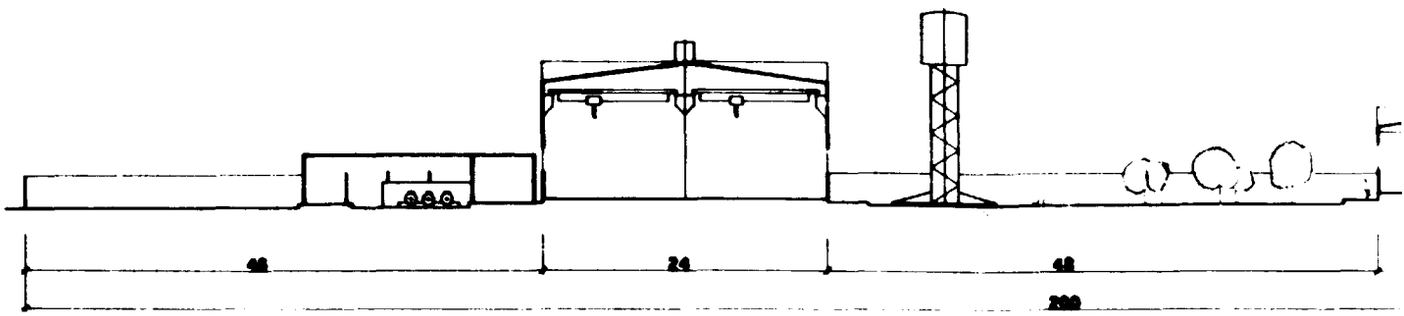
In order to satisfactorily carry out heat treatments, it is eesential to have availability of control and analysis equipment whose number here can only be limited, due to cost reasons. However, the department can avail itself of the well equipped laboratory of IRCI in Khartoum, where additional chemical and physical analyses could be carried out.

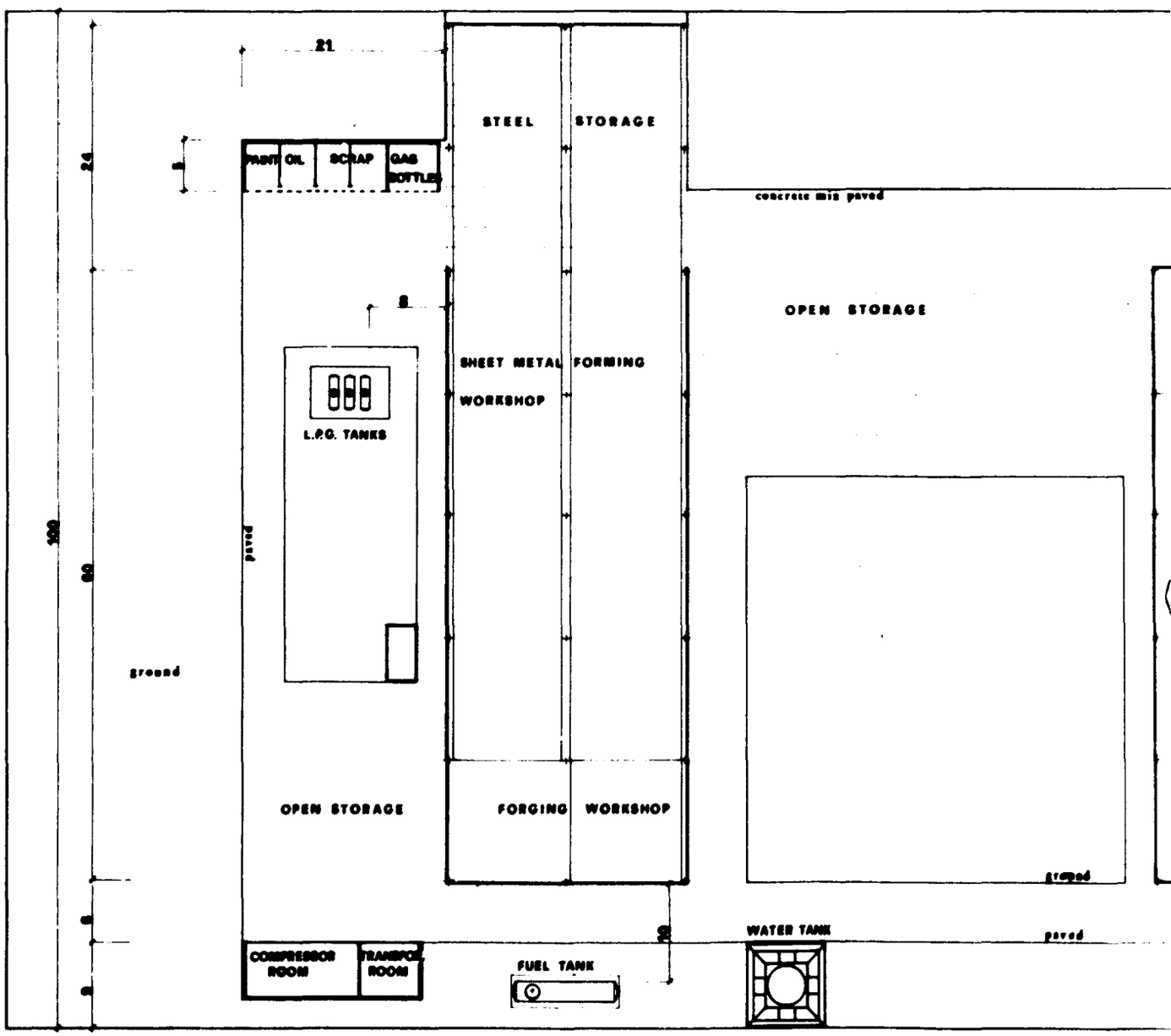
Office Furniture and equipment

They have been forseen as follows:

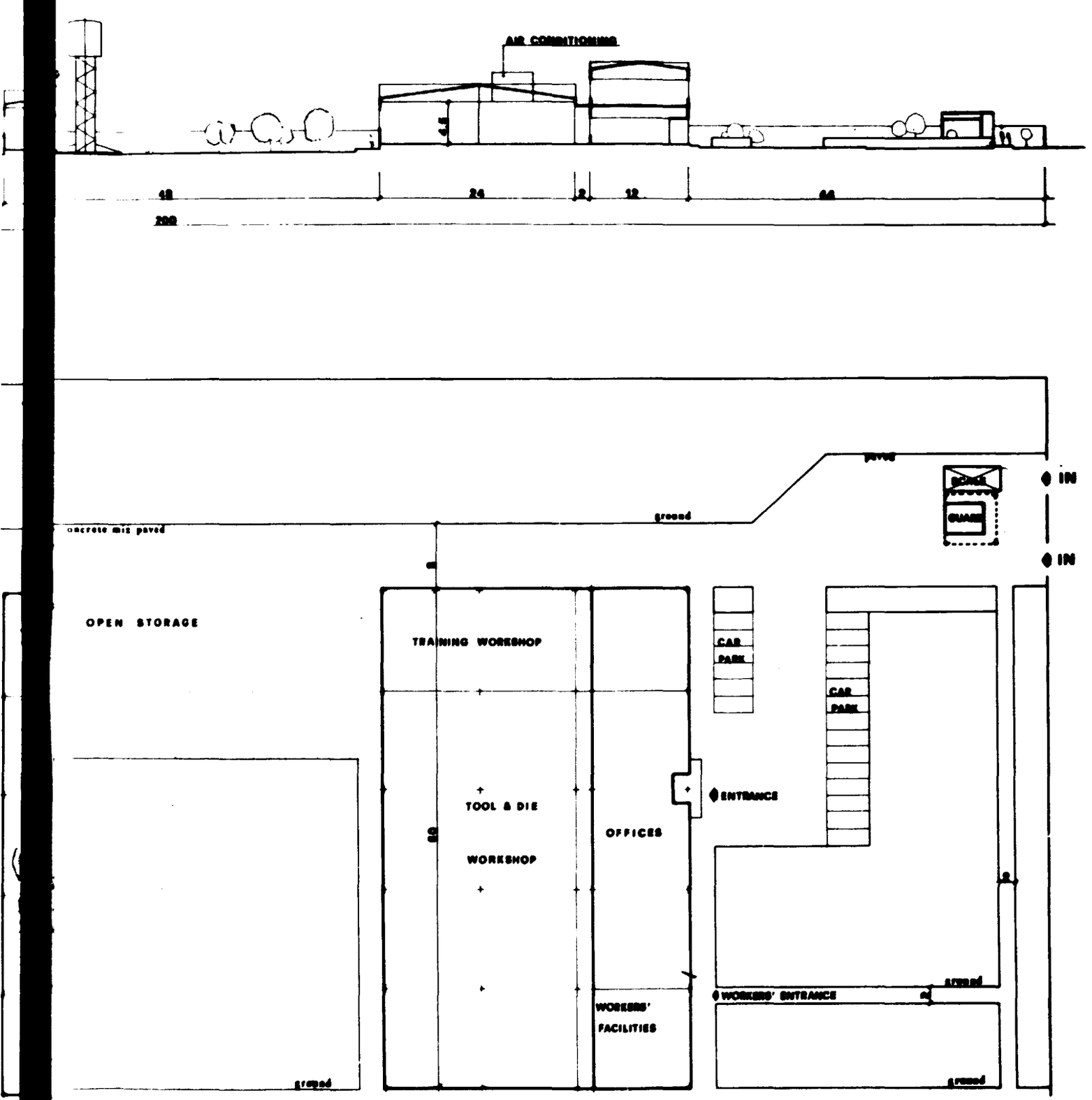
F U R N I T U R E & E Q U I P M E N T			
	N.	Unit Cost	Total Cost
Managers	4	2.000	8.000
Engineers/Technicians (with drawing board) (with desk)	 10 34	 1.500 500	 15.000 17.000
Clerk (with typing machine)	9	1.500	13.500
Board Room (1) Meeting Room (2) Waiting Room (2)	5	-	12.500
Conference Room (for 25 persons) (equipment included)	1	-	6.000
Canteen (for 120 persons) Kitchen facilities	- -		5.000 3.000
Others	-		11.500
		Total	91.500

UPDD BOARD
GENERAL LAYOUT

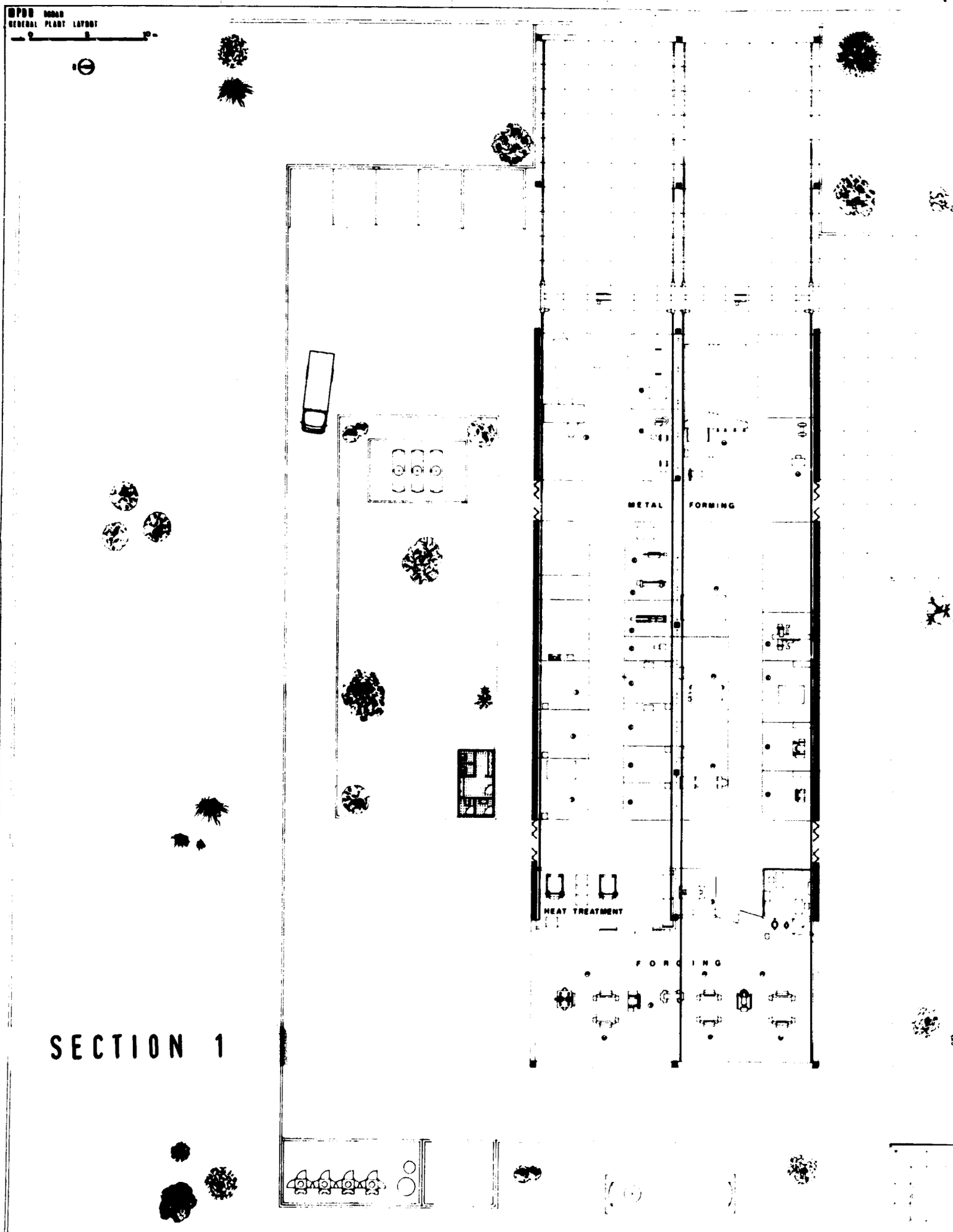




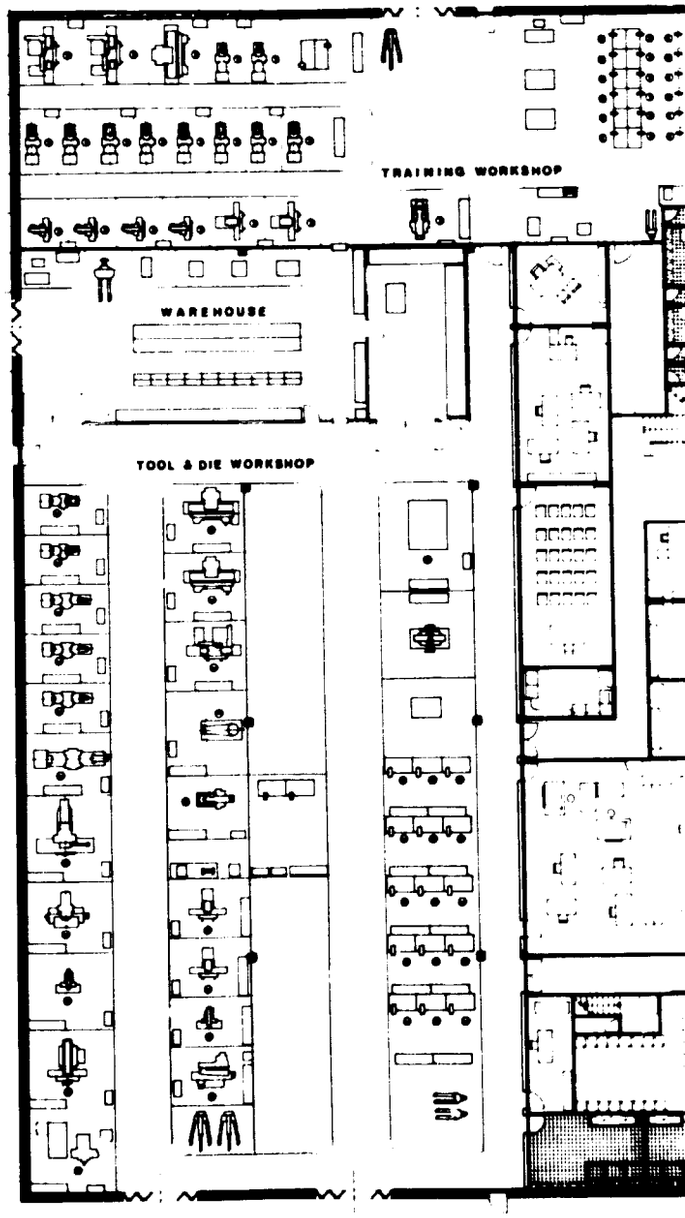
SECTION 1


AIR CONDITIONING
48
24
2
12
44
200
paved
IN
ground
concrete mix paved
IN
OPEN STORAGE
TRAINING WORKSHOP
CAR PARK
CAR PARK
ENTRANCE
TOOL & DIE
WORKSHOP
OFFICES
WORKERS' FACILITIES
WORKERS' ENTRANCE
ground
ground
ground
OUT
WATER TANK
paved
ground

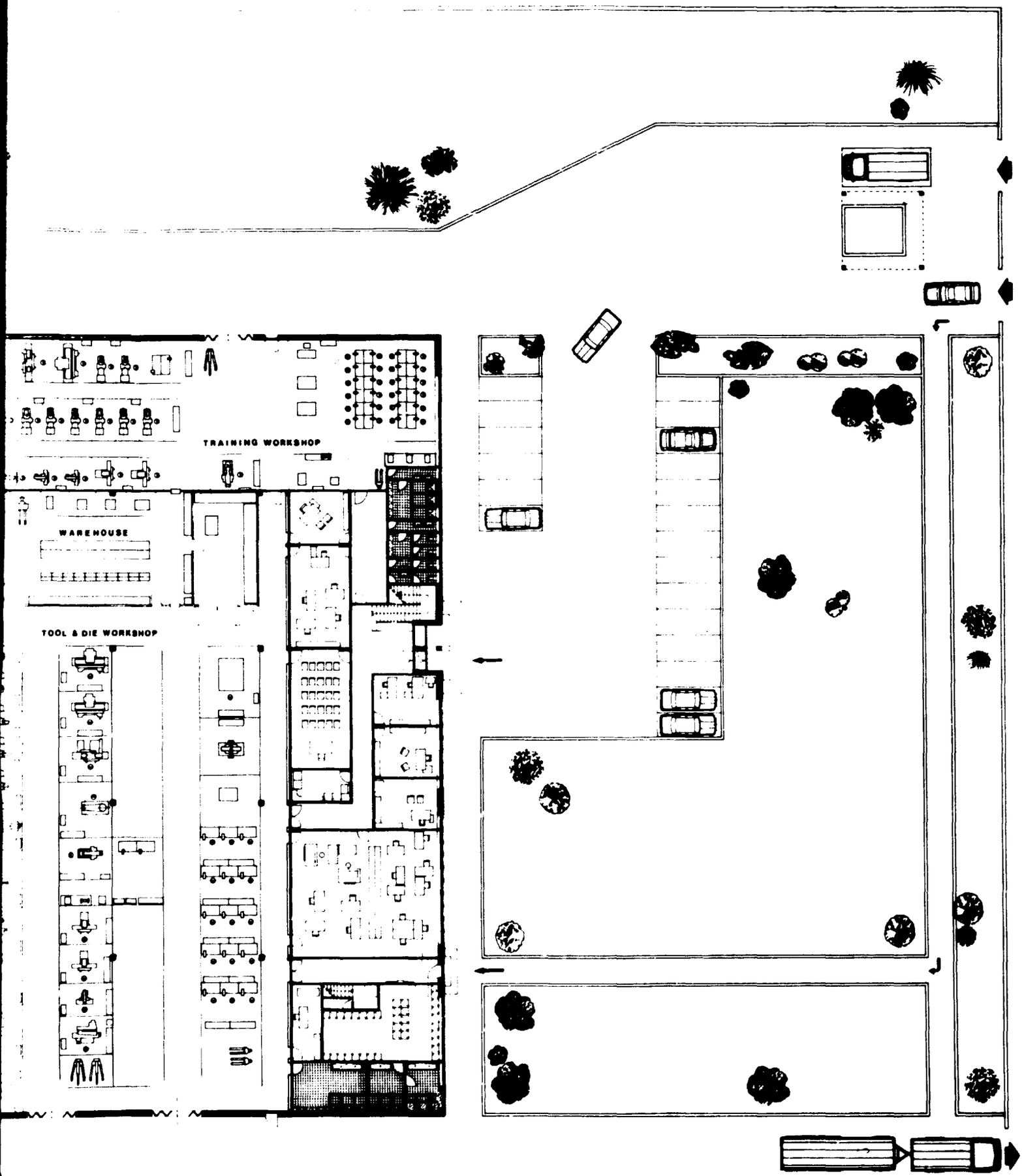
SECTION 2



SECTION 1



SECTION 2



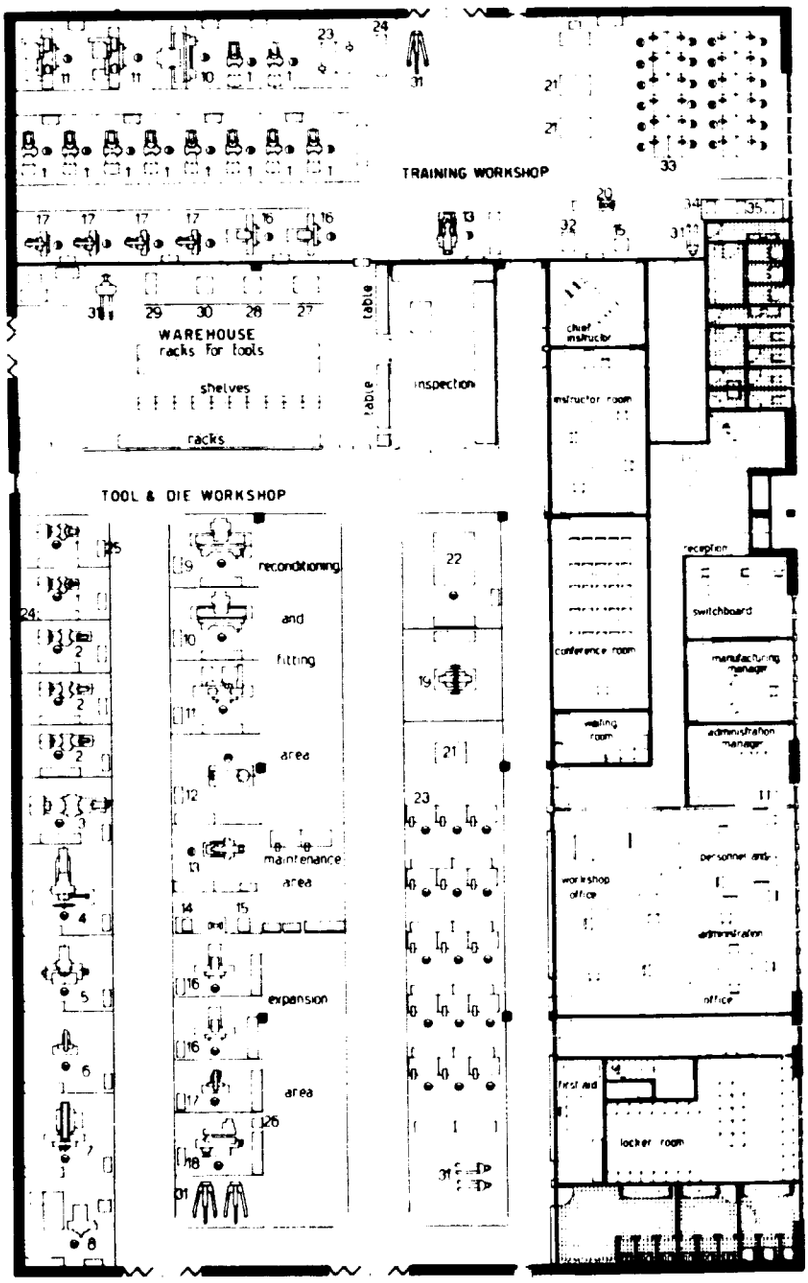
SECTION 3

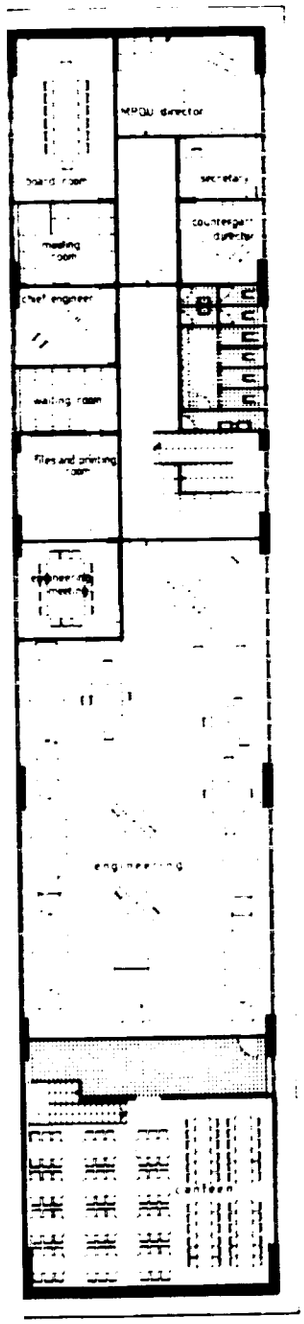
MPDU BOGAR

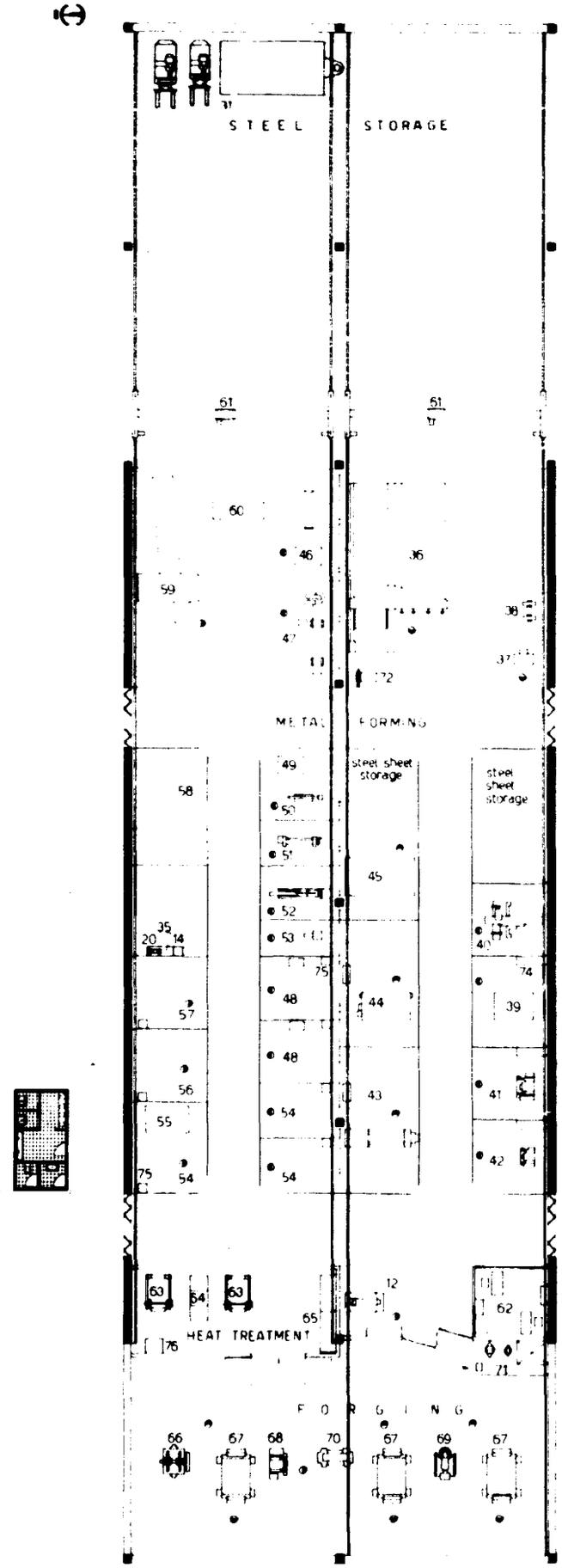
TOOL & DIE WORKSHOP - TRAINING - OFFICES

0 1 2 3 10m

1 High precision tool maker lathe h 180 L 800
2 " " " " " h 225 L 1000
3 Heavy duty lathe h 375 L 2000
4 Hydraulic copy milling machine
5 Jig boring machine
6 Manual boring machine
7 Horizontal heavy duty milling machine
8 Spark erosion machine
9 Precision hydraulic surface grinder (table 1100 × 300)
10 " " " " (table 700 × 500
11 Universal cylindrical grinder - external / internal
12 Radial drill
13 Filing and sawing machine
14 Bench drill and tapping machine
15 Pillar drill and tapping machine
16 Precision universal milling machine (table 1000 × 300)
17 " " " " (table 600 × 200)
18 Engraving machine pantograph
19 Handoperated precision screw press - 22 ton
20 Bench grinder - double ended
21 Surface plates
22 Precision die spotting press - 50 ton
23 Fitter bench w vice - 1500 × 800
24 Bench
25 Tool cabinet
26 Single cutter mill grinding machine
27 Universal tool and cutter grinder
28 Drill sharpener
29 Hack sawing machine
30 Hand operated precision surface grinder
31 Lifting and handling equipment
32 Vertical bandsaw
33 Fitter benches w vice (1000×670)
34 Sensitive drill
35 Bench for sensitive drill







12 Radial drill
14 Bench drill
20 Bench grinder - double ended
31 Lifting and handling equipment
35 Bench grinder and drill
36 Oxycutter
37 Straightening press
38 Pedestal grinder - double ended
39 Hydraulic press - 200 ton
40 Nibbler
41 Eccentric press - 70 ton
42 Eccentric press - 25 ton
43 Roll bender machine
44 Press brake
45 Guillotine shear
46 Cutting-off machine
47 Pipe bender
48 Oxyacetylenic welder
49 Surface table
50 Hand-lever shear
51 Hand-operated box bender
52 Beading machine
53 Spot welder
54 Arc welder
55 Steel surface plate
56 Wire CO_2 welder 300 Amp
57 Wire CO_2 welder 600 Amp
58 Spray-painting booth
59 Billet shear
60 Horizontal bandsaw
61 Overhead crane - 5 ton
62 Supervisor office
63 Heat treatment furnace
64 Quenching tanks oil & water
65 Tool cabinet and bench
66 Friction screw press
67 Muffle furnace
68 Trimming press 120 ton
69 Open frame hammer
70 Power hammer
71 Hand-forging area
72 Weighing machine
73 Tool cabinet
74 Die shelves
75 Tool cabinet for welders
76 Salt bath furnace

4. - TRAINING

4.01 - PURPOSE OF TRAINING

The establishment of a Training Department within the Metal Production Development Unit is justified by the need to provide skilled personnel with highly professional working experience to meet the demands not only of the Metal Production Development Unit (MPDU) but also of other industries which will be centered round it. In fact, the latter was the main reason it was decided to establish a Training Department in a key position with sound resources and facilities.

4.02 - TRAINING LINES

With the above aims in view, three main training lines are envisaged:

- One, for students from Vocational Training Centres, intended to become Operators in production departments (Tool and die, Metal forming).

- A second, for students from Upper Technical Secondary School, intended to become Precision workers, divided into three specializations:

  . Machine tool fitters
  . Precision machinists
  . Tool/pattern makers

- A third, for Engineers and Technicians, divided into the following specializations:

  . Product and tool design
  . Industrial and plant engineering
  . Techno-economic analysis and new factory planning

4.03 - AVAILABILITY AND EDUCATIONAL STANDARD OF THE LOCAL POPULATION FOR TRAINING

There should be no real difficulty in finding personnel for the MPDU training lines.

Personnel for production shops (Tool and die; Metal forming) for simply running machinery or doing work not requiring a particularly high standard of skill (Operators) will be recruited from students with Vocational Trai

ning Centre certificates.There are a number of Vocational Centres in Sudan which take Junior Secondary School leavers (16 years of age) and train them in various skills in three years. The average standard of students from this type of school if fair even with regard to manual skillis.

Students for Precision worker training can be recruited among Upper Technical Secondary School leavers.
The education they receive in these schools is essentially theoretical.
The standard of these students, however, is not high enough, when they leave school, for a modern, efficient unit, such as the MPDU should be.
Consequently, further training will be needed within the Training Department.

There should be no difficulty in finding the right number of Engineers and Technicians with the required standard of skill.
The current level is high enough for them to undertake short term specialization training before starting work in their respective departments.

4.04 - TRAINING PROGRAMMES (see next page)

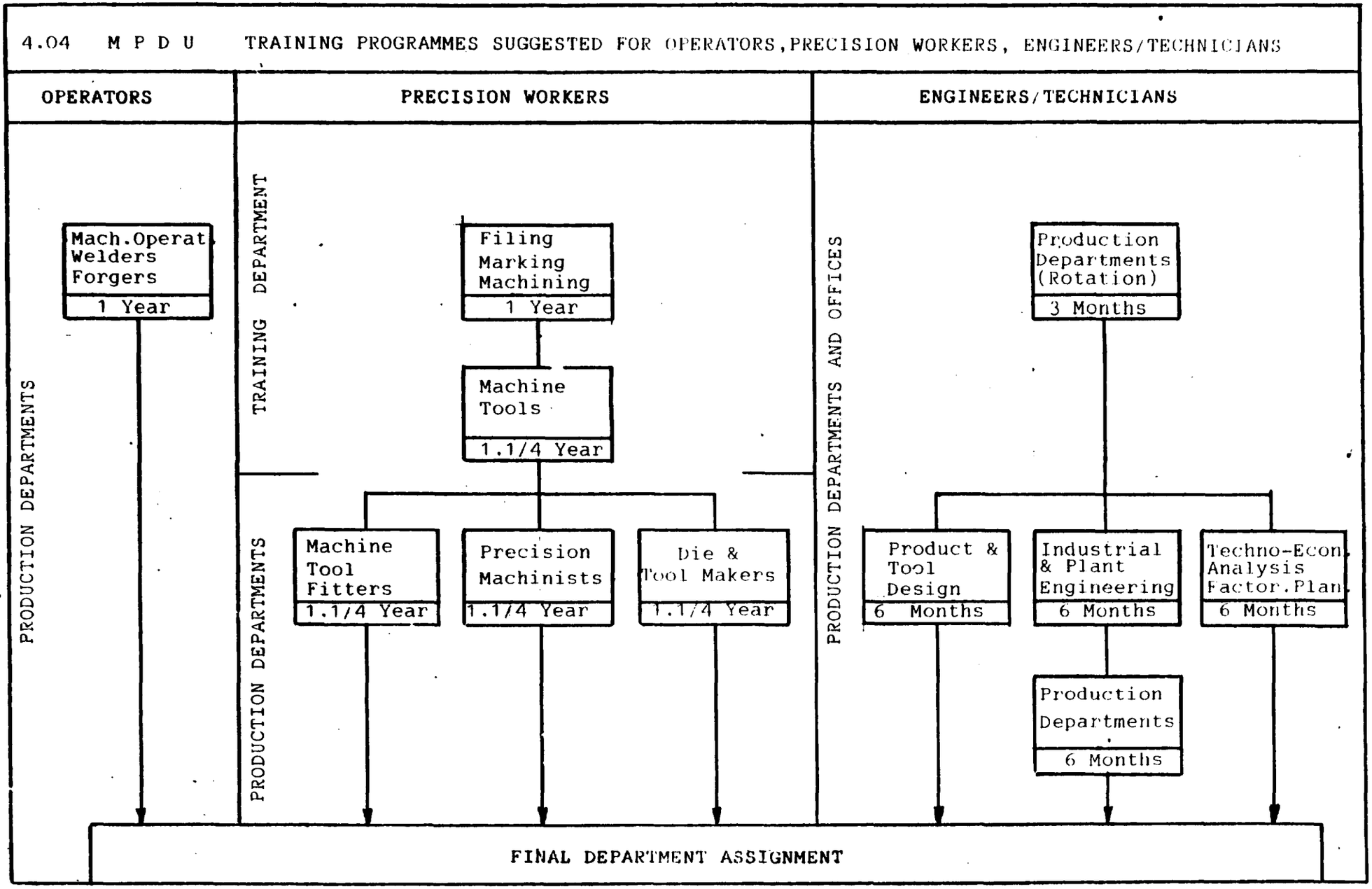
Operators

The job of these workers (machinists, welders, forgers, press operators) is to operate control machinery and tooling in production shops under guidance of skilled departmental personnel.
This means no specific training is needed beforehand.
Training will be imparted over one year, gradually entering in a normal production activity under the guidance and responsibility of their direct superiors.
The Training Department will help to recruit personnel and provide them with the basic training needed for them to be absorbed quickly and easily into the MPDU organization.

Precision Workers

Depending on the standard of education these students have already been given, this is an essentially practical training (90% practice and 10% theory) both to provide trainees with greater incentive and speed up their entry into the working life of the country.
The training programme, covering a total of $3\frac{1}{2}$ years, is divided into three phases:

4.04 M P D U TRAINING PROGRAMMES SUGGESTED FOR OPERATORS, PRECISION WORKERS, ENGINEERS/TECHNICIANS



Phase 1 - This comprises one year preliminary teaching in which trainees are given basic training in filing, marking and machining.

Phase 2 - During this 15 months' phase, the emphasis is on making trainees production-minded, by practical exercises in making parts or simple production assemblies. Like the previous phase, this is carried out within the training area by training staff.

Phase 3 - During this 15 months' period, trainees are assigned to production shops according to three specialization groups:

a) Machine tool fitters
b) Precision machinists
c) Tool/pattern makers

During this phase, trainees will work directly under department supervisors with the execption of some theoretical teaching which will be held in the Training Department. This phase will be coordinated and controlled by the Training Department to ascertain the students' standard of skill.

The Annese F shows a diagram of the practical and theoretical content proposed for these stages.

Engineers and Technicians

The training programme for Engineers and Technicians is based on a detailed analysis made in cooperation with UNIDO experts. A number of different proposals were examined including separate programmes for Engineers and Technicians and/or longer periods, but it was finally decided to organise one common short-term training period, both on account of personnel incentive and uniformity, and for management and organizational reasons. The training programme for Engineers and Technicians is divided into three phases:

Phase 1 - The purpose of this 3 months' phase is to familiarize Engineers and Technicians with the technologies adopted and the type of work carried out by the MPDU.
This phase provides for personnel rotations within the major departments of the company.

Phase 2 - This is a highly specialized phase covering six months during which personnel will be divided into three groups and be trained while

working:

. Product and tool design
. Industrial and plant engineering
. Techno-economic analysis and new factory planning

The work carried out during this stage will be essentially practical. The theoretical part will consist in short specialized periods of a technical and economical-organizational nature held by MPDU experts.

Phase 3 - This is a 6 months' period reserved for Industrial and plant engineers who will work along side an expert of the department or office they are later to be assigned to.

4.05 - TRAINING PLANNING (see next page)

The number of people trained will be over and above the requirements of the MPDU in that, as already mentioned, this training activity should have a snowball effect so as to spread the acquired know-how outside the confines of the company.

Operators

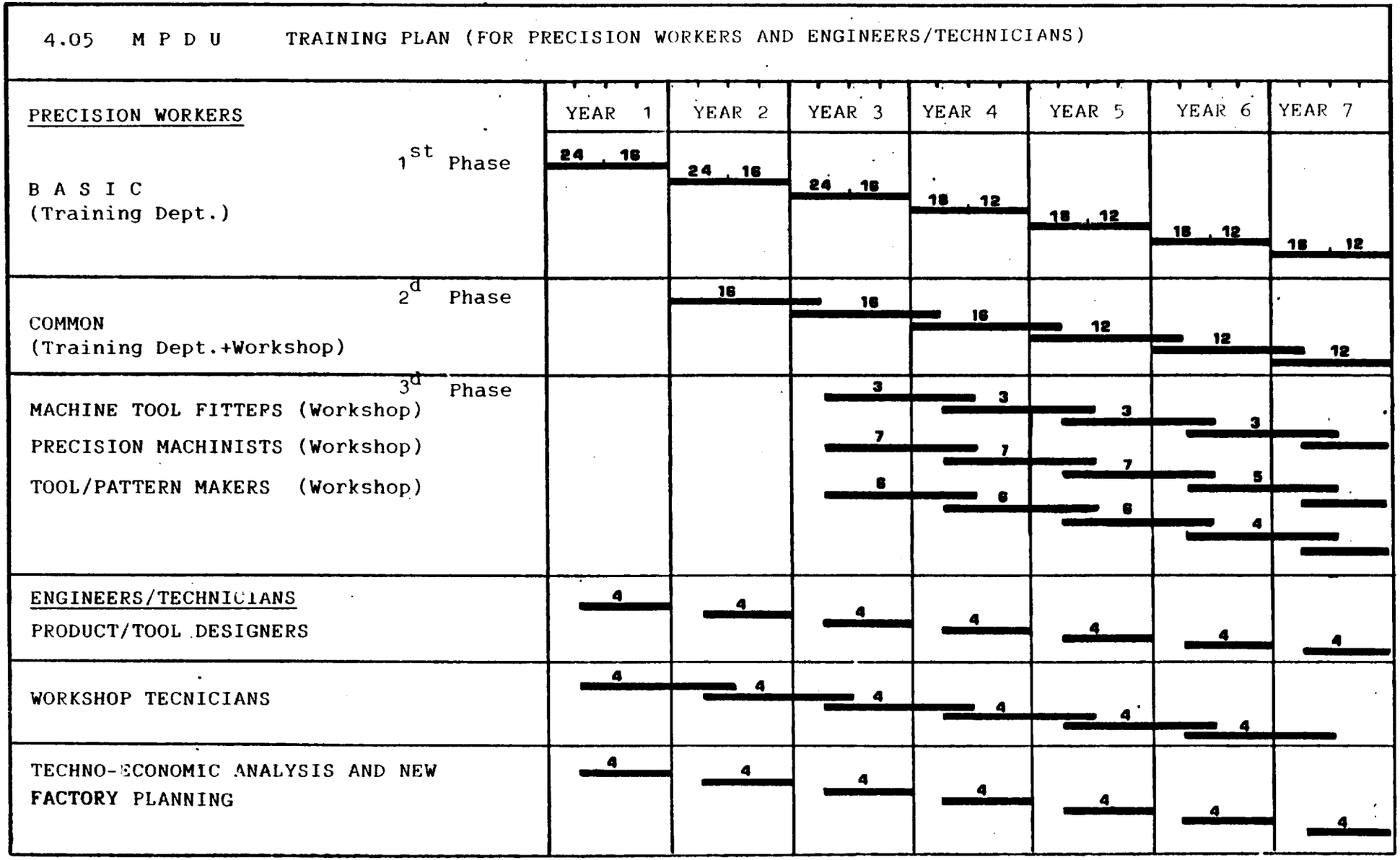
The majority of production workers are Operators whose number should be proportional with workshop machinery and requirements.

Hiring n. 15 young people at the mid of year 2d and 15 and 10 at the beginning of years 3d and 4th should cover the demand. This would guarantee the availability of 40 young people, for initial training by experts in machine and plant assembly and later in production machinery operation.

Precision Workers

It is proposed to take in 15-18 people a year so to retain a group of 10-12 people after 5-6 months.
A higher number of students (20-24) will be admitted to the first three courses to increase the number of Precision workers available when MPDU's production activity commences.
The yearly output of skilled workers will therefore be:

4.05 M P D U TRAINING PLAN (FOR PRECISION WORKERS AND ENGINEERS/TECHNICIANS)



	4th-5th-6th years	7th year onwards
Total		
of which:	16	12
. Machine tool fitters	3	3
. Precision machinists	7	5
. Tool/pattern makers	6	4

As the MPDU Training Department will still be under construction when teaching commences, the first phase of the Precision workers period will have to be held in an existing Training Centre (e.g. the Polytechnic) for two years. The trainer staff, however, should be from the MPDU.

Engineers and Technicians

It is proposed to train in the first year n. 6 Engineers and n. 6 Technicians; then n. 3 Engineers and n. 9 Technicians starting from year 2. This means, from the 3th year, the number of Engineers and Technicians groomed by MPDU each year will be:

- n. 4 for Product and tool design
- n. 4 for Industrial and plant engineering
- n. 4 for Techno-economic analysis and new factory planning

It should be pointed out that these figures are purely indicative. The training programme is organized so elastically (rotation between departments, seminars, work alongside experts) that the number of trainees can be easily adapted to meet changes in demand.

The table on the next page shows the number of trainees attending training periods for Precision workers and Engineers/Technicians in the Training Department from the 1st year to the 7th year (from which the number of trainees will be stabilized).

4.06 - TRAINING INSTRUCTORS

Foreign Personnel (Experts)

A certain number of Expert instructors will be needed during the initial training stage. The posts we think should be filled by foreign staff are:

4.05 MPDU - NUMBER OF PERSONS UNDER TRAINING

Years	Period	PRECISION WORKERS								ENGINEERS AND TECHNICIANS	
		TRAINING DEPARTMENT					3d Phase (Production workshop)		Total		
		1st Phase		2d Phase (Workshop)		Total					
	Quarter	In - Out	n°	In - Out	n°	n°	In - Out	n°	n°	In - Out	n°
1	1st	24	24			24			24		
	2d		24			24			24	12	12
	3d-4th	- 8	16			16			16		12
2	1st	-16 + 24	24	16	16	40			40	- 8	4
	2d		24		16	40			40	+ 12	16
	3d	- 8	16		16	32			32	- 4	12
	4th		16		16	32			32		12
3	1st	-16 + 24	24	+ 16	32	56			56	- 8	4
	2d		24	- 16	16	40	16	16	56	+ 12	16
	3d	- 8	16		16	32		16	48	- 4	12
	4th		16		16	32		16	48		12
4	1st	-16 + 18	18	+ 16	32	50		16	66	- 8	4
	2d		18	- 16	16	34	+ 16	32	66	+ 12	16
	3d	- 6	12		16	28	- 16	16	44	- 4	12
	4th		12		16	28		16	44		12
5	1st	-12 + 18	18	+ 12	28	46		16	62	- 8	4
	2d		18	- 16	12	30	+ 16	32	62	+ 12	16
	3d	- 6	12		12	24	- 16	16	40	- 4	12
	4th		12		12	24		16	40		12
6	1st	-12 + 18	18	+ 12	24	42		16	58	- 8	4
	2d		18	- 12	12	30	+ 12	28	58	+ 12	16
	3d	- 6	12		12	24	- 16	12	36	- 4	12
	4th		12		12	24		12	36		12
7	1st	-12 + 18	18	+ 12	24	42		12	54	- 8	4

- Mechanical and metallurgical technology Expert who will also act as Trainer/manager n. 1
- Machine tool Expert n. 1
- Fitting and tooling Expert n. 1

To ensure sound training, local Instructors should work for the first three years alongside this staff. After the 4th year, the local training Instructors should be in a position to work on their own so that two of the foreign Instructors can leave. The third will stay on at the MPDU for a further two years as chief of the Department after which training will be conducted entirely by local staff.

Local staff

The following assistant Instructors will be needed for running, coordinating and controlling the training programmes:

- Mechanical technology n. 1
- Machine tools n. 2
- Fitting n. 1
- Coordination and control (3d phase of Precision workers training period) n. 1

Taking into account that the maximum number of trainees being tought directly at one time is 30-40, the instructors/trainees ratio works out at about 1 : 7/8.

The instructors listed above should be recruited from among the best technicians from local Technical schools with at least five years' practical experience in the metal-working industry.

They will be sent abroad for a certain period to get familiarised with the technology and organization methods of modern companies making products such as the ones the MPDU is interested in.

For a certain period they will work alongside foreign Experts who will conduct training programmes as described in detail in the "Technical Assistance Programme" section (see 4.08).

4.07 - TRAINING STRUCTURE

Judging by the number of trainees expected to be admitted and the average number being tought at one time, 26 work posts will be needed in the machine tool shop and 20 in the filing and marking shop. The area required by the Training Department works out at:

Workshop

a) Filing (20 work posts)	96	sq. m.
b) Machine tools (26 work posts)	336	sq. m.
Workshop Total	432	sq. m.

The machinery and facilities are listed in Sect. 3.05.

Instruction room

1 Instruction room with 25 places	45	sq. m.

Offices

1 Office for Chief trainer	20	sq. m.
1 Room for staff, secretary, library	40	sq. m.
Instruction and Office Total	105	sq. m.

4.08 - TECHNICAL ASSISTANCE PROGRAMME

General

To get best returns on investments in the MPDU by ensuring all departments are run smoothly right from start-up and for successful training of skilled personnel to meet the demands of the plant as well as other firms which will undoubtedly develop in the wake of the MPDU, all sectors must be managed by highly trained personnel of proved ability. We already know it is very unlikely the required number of skilled people will be found in Sudan, so foreign Experts will have to be relied on for a certain period of time.
Initially, they will be responsible for organizing and supervising the entire working life of the MPDU especially skilled sectors such as:

. Training
. Engineering

. Manufacturing

The Experts will be assigned local people (Counterparts) - at least two for each Expert - chosen from amongst the most promising trainees to form a group of specialists to act as managers (Key positions) or instructors in the various Departments.

The number of Experts, of whom short job descriptions are given in Annex G , to be recruited abroad, the length of their stay and the number of Counterparts needed are indicated in the Technical Assistance Programme (see next page) according to the MPDU's staff and organization structure.
According to the programme, a certain number of Counterparts will be sent abroad for a brief period to study the organization and working methods of modern companies working in the MPDU's field.
The Experts will stay at the MPDU for three years with the exception of Project and Chief Trainer Managers who, in view of the special nature of their duties, will be expected to arrive earlier and stay longer than the others.
Only a short stay abroad has been programmed for the Key-position people. Their practical work alongside the foreign Experts is considered more imperative particularly as far as specific training of Counterparts is concerned.
However, a few months a year will be set aside for further training periods (Quality control, Value analysis, Safety, Responsibility, Working methods, Special projects, etc.) organized by foreign Experts when convenient.

4.08 M P D U TECHNICAL ASSISTANCE PROGRAMME

M P D U	EXPERTS			COUNTERPARTS			
	N°	Stay at MPDU		N°	Overseas training		
		Years	Total man years		N°	Months	Total man years
- Management (Engineers) . Project manager	1	5	5	2	2	3	6
- Training . Chief trainer (and mechanical technology instructor) . Machine tool instructor . Basic toolmaking instructor	3	5-3 (5) (3) (3)	11	5	5	3	15
- Engineering . Mould,die,pattern design . Tool design . Part & product design . Industrial and plant engineering . Techno-economic analysis	5	3	15	14	5	3	15
- Manufacturing . Work shop coordination . Tool and die shop (2) . Metal forming	4	3	12	8	8	3	24
- Miscellaneous . Short term (4-6 months)Engineering consultants - e.g. Quality control, Heat treatment, etc.			3				20
Total	13		46	29	20		80

5. - ENGINEERING

One of the major infrastructural activities of M.P.D.U. is expected to be the Engineering Service, aimed to support the development of M.P.D.U. itself and to help the establishment and the growth of other industries.

5.01 - PURPOSE AND SCOPE

The Engineering Department will be concerned with the following three areas of activity:

a) Product and tool design
b) Industrial and plant engineering,
c) Tecno-economic analysis and new factory planning-Marketing.

The work will be carried out on behalf of:

- M.P.D.U.n enabling start-up and operation,
- other industries, by giving service on a commercial basis.

The training of engineers-technicians will be another goal of this department.

5.02 - STRUCTURE

The Engineering Department will consist of 3 groups:

Product and tool design. This will be concerned with:

- tool, die, modul and fixture design,
- part and new product design.

Considering the high complexity and variety of the matter 3 foreign experts will be required, namely:

- expert in tool, die, fixture design;
- expert in mould design;
- expert in part and product design;

with the cooperation of 6 local engineers 2 of which must have a training period abroad.
The experts' stay will be 3 to 5 years.

Industrial and plant engineering. The duties will be:

- metod study;
- process, system, plant study;

- machine and tool utilization;
- machine and plant maintenance and repair;
- safety.

Also for this sector, an expert supported by 3 local technicians-engineers, one of which attending training abroad, will be required.
The activity of this sector will be mainly of assistance and will be concentrated, at leas in the first years, as concerns outside customers, on maintenance and repair of machines and plants: major problem for the whole Sudanese industry.

Techno-econmic analysis and new factory planning-Marketing

The duties of thisGroup will be:

- market survey to identify local production needs and consequently suggest new manufacturing possibilities for the industry.
- introduction and development of licenses, patents and know-know in Sudan both in the M.P.D.U. and in other industries;
- investigation of new industrial products that Sudan could export and viability analysis of such operations;
- assistance in establishing joint-venture propsals for new industries in partnership with the Sudanese Government;
- responsability of marketing M.P.D.U. products and services throughout the Sudanese market;
- responsability of forecasting and preparing techno-economic analysis for M.P.D.U. activities;
- training engineers/technicians in undertaking viability and techno-economic analysis in product planning, in workshop economics and investment analysis.

The tasks of this Group are obviously rather wide and difficult and require large experience; 2 experts supported by 5 local engineers will be required.

5.03 - STAFF AND LOCATION

The staff of the Engineering Department will be as follows:

- 1 Chief Engineer,
- 14 Engineers,
- 1 Clerk,
- 3 Common Clerks.

In addition, 10 Engineers/Technicians trainees will be

active in the department, and they will alternate their educational activity to practical work.
The whole group will be assisted and guided by 5 Foreign Experts. Due to the complexity of duties assigned, the stay of the experts will last between 3 and 5 years.
The Engineering department will be located on the first floor of the office building, and will avail of an area of 350 sq.m.

5.04 - IMPLEMENTATION

The Engineerinf Department shall start its activity as soon as possible in order to achieve 2 goals:

- offering to the Sudanese industry its consulting engineering aid;
- preparing a program of activity for M.P.D.U. manufacturing facilities.

It can therefore be stated that the Engineering Department is the part of M.P.D.U. among the very first to assert the positive effect of its work in Sudan.

Then with the consolidation and refinement of its organization, thanks to a wider acquisition of information and deeper knowledge od the Sudanese industry, besides the availability of highly qualified production facilities - such as M.P.D.U. will have - the Engineering Department will be in a position to improve its working systems and to complete its former activity making its action more efficient and appreciated.

6. - ORGANIZATION PLAN

The implementation of the organization plan, as recommended in the following paragraphs and shown in the enclosed charts, should take place by steps and be completed in the 4th year.

6.01 - ORGANIZATION CHARTS

M.P.D.U. has to be considered divided into three basic areas, with aims and outputs of different nature.

The M.P.D.U. Management presides over the following operative groups:

Engineering - in charge of supplying technical, technological, commercial services, to third parties - besides M.P.D.U. itself; it is formed by engineers and technicians trained by M.P.D.U. and guided to full efficiency by a group of foreing experts.

Training - in charge of preparation - with the assistance of foreign technical experts - of skilled workers at various M.P.D.U. shop levels, as well as engineers and technicians for the Engineering group, and for the requirements of other domestics industries.

Manufacturing - divided in the following workshops:

- Tools and Dies (precision machining, toolmaking, fitting)
- Metal forming (hot forming, cold steel plate forming, heat treatment).

Each one of these departments, although framed in a single industrial unit, works independently supplying products which are not stricly interconnected.

M.P.D.U. structures are shown in the organization charts of the following pages. Table 1 indicates the general organization framex while table 2 shows a more detailed description of the manufacturing sector. Table 3 gives a general picture pf M.P.D.U. personnel, according to professional levels and operation specializations.
Tables 4 to 7 show in more details the personnel recommended for each department.

6.01 M P D U

Table 1

ORGANIZATION CHART (Final Stage)

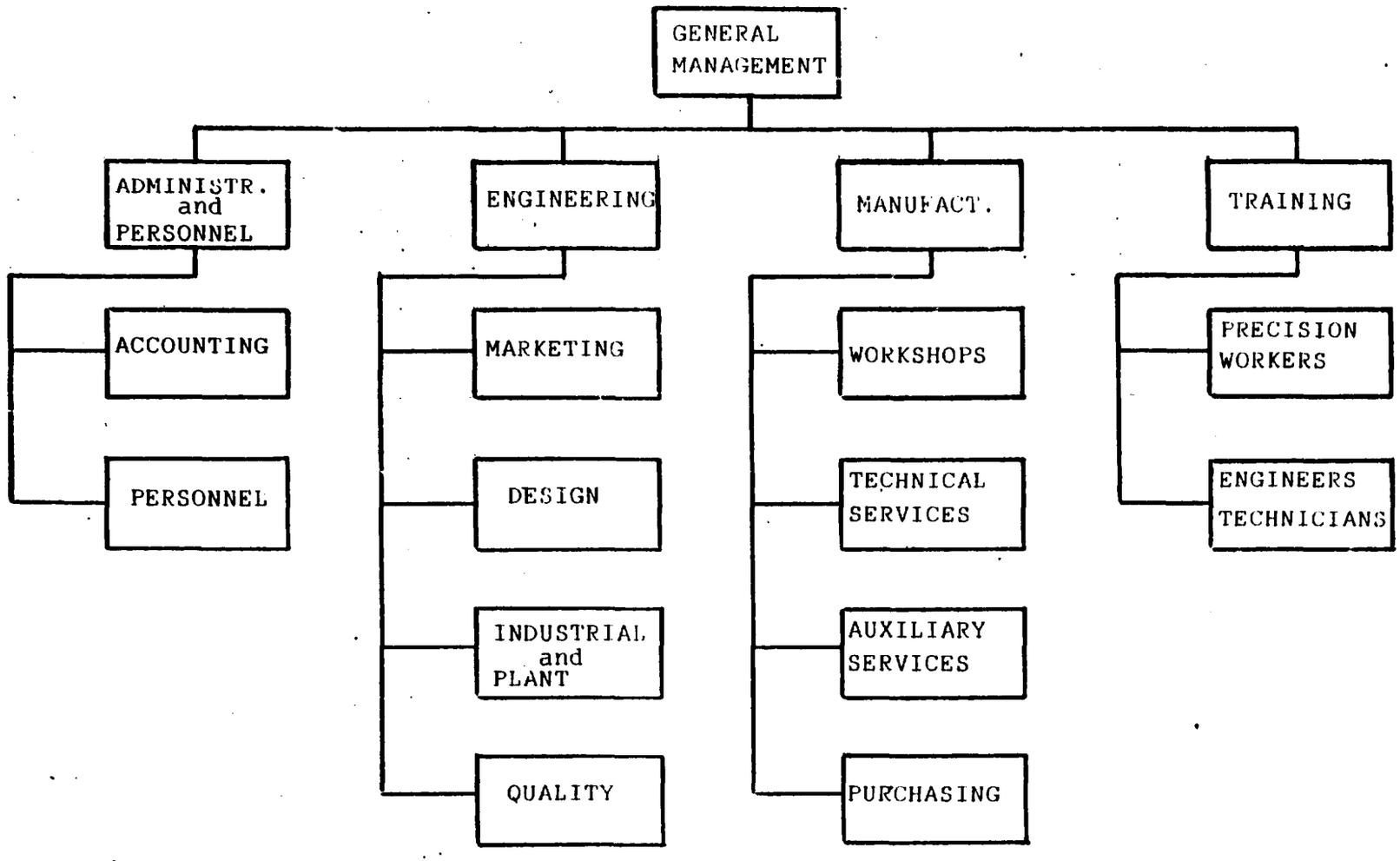
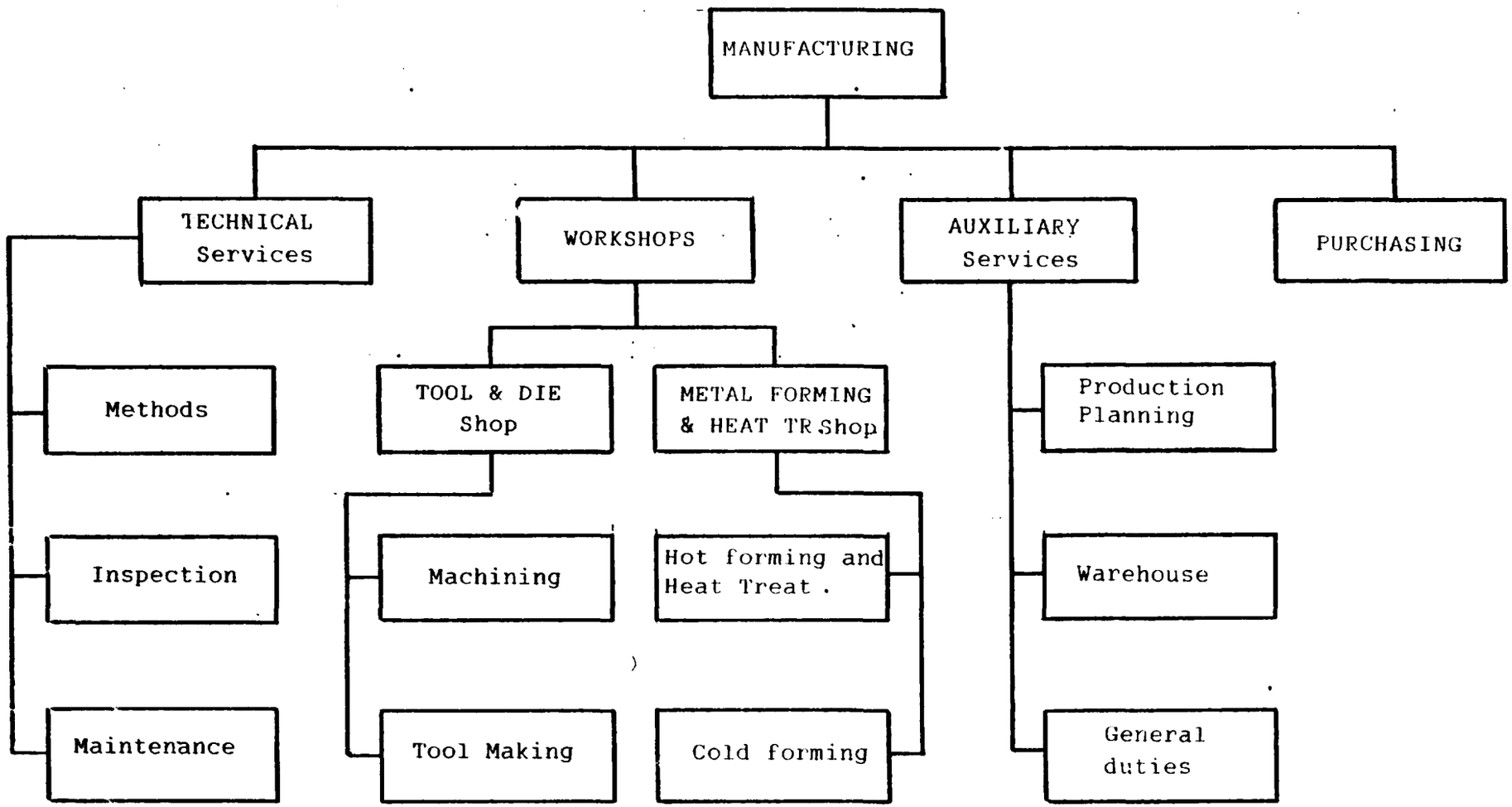


Table 1

Table 2

6.02 M P D U MANUFACTURING ORGANIZATION CHART (Final Stage)



6.01 M P D U PERSONNEL

	Managers	Engineers	Technicians	Clerks	Common Clerks	Senior Toolm.	Precision Workers	Skilled Workers	Operators	Unskilled Workers	Total
General Management	1	1		1	1						4
Administration and Personnel	1		2	1	2						6
Engineering	1	14		2	2						19
Training		1	4	1							6
Manufacturing	1	4	9	1	2	8	37	12	40	15	17 112 129
Total	4	20	15	6	7	8	37	12	40	15	164

Table 4

6.01 M P D U	ADMINISTRATION AND PERSONNEL										
	Managers	Engineers	Technicians	Clerks	Common Clerks	Senior Toolm.	Precision Workers	Skilled Worlers	Operators	Unskilled Workers	Total
Chief Accountant & Company Secretary	1										1
Accounting			1	1	1						3
Personnel			1		1						2
Total	1		2	1	2						6

Table 5

6.01 M P D U — ENGINEERING

	Managers	Engineers	Technicians	Clerks	Common Clerks	Senior Toolm.	Precision Workers	Skilled Workers	Operators	Unskilled Workers	Total
Management and services	1			2	2						5
Marketing & Sales		5									5
Design & Quality		6									6
Industrial & Plant		3									9
Total	1	14		2	2						19

Table 6

6.01 M P D U — TRAINING

	Managers	Engineers	Technicians	Clerks	Common Clerks	Senior Toolm.	Precision Workers	Skilled Workers	Operators	Unskilled Workers	Total
Chief instructor & Service		1		1							2
Instructor			4								4
Total		1	4	1							6

Table 7

6.01 M P D U — MANUFACTURING

	Managers	Engineers	Technicians	Clerks	Common Clerks	Senior Toolm.	Precision Workers	Skilled Workers	Operators	Unskilled Workers	Total
Management and Service	1	2	3	1	2	2	2	-	10	10	33
Tool & Die		1	3			6	30	12	-	2	54
Metal Forming & H.T.		1	3				5		30	3	42
Total	1	4	9	1	2	8	37	12	40	15	17 112 129

As already said, these charts represent the situation to be reached when M.P.D.U. will be in full operation, as expected in sixth year.

6.02 - JOB DESCRIPTION OUTLINE

The General Manager (initially this positions should be entrusted to the Project Manager foreing expert, who could act as General Manager for the first three years) will be responsible for the general development of M.P.D.U. according the policy and guidelines dictated by the Government and by the Board of Directors. Taking the basic decisions relative to the choice of products to be manufactured, he will be responsible for the economical results of the operation. Through the department managers in charge of the various functions, he must assure the attainment of objectives, including the social function of M.P.D.U., the work continuity, the product quality, the overall company image.

The Manufacturing Manager will be responsible for all the manufacturing activities, and related services. Besides running the workshops, he will cooperate with the General Manager, both with information and advise. In case urgent and important decisions are to be taken, in absence of General Manager the Manufacturing Manager shall take the responsibility, acting as substitute of General Manager.
However the essential function of the Manufacturing Manager will stay in production area, where he must assure the correct quality, quantity and cost of the products manufactures. He will be helped by a Method enginner, in charge of work cycles and cost evaluation, an Inspection supervisor, a Maintenance supervisor and a clerk in charge of store keeping.

Responsibility of Chief Accountant - Company Secretary will be to carry on the entire administration, to work out the balance sheets and financial reports, to monitor the financial changes and trends keeping the General Management aware of the Situation; he will also be responsible for industrial accounting, and for annual budgeting, on the basis of data supplied by Marketing and Manufacturing functions. The budget, submitted by General Management to Boards od Directors, represents

when approved the annual objective of MPDU. The chief Accountant will be helped by a Personnel officer for all the matters concerning the employee and community relations, includind hiring, compensation, health and safety, social problems.

The structure and functions of the Training and Engineering Departments are described in detail in the relevant sections.

6.03 - PERSONNEL COMPENSATION

It has been deemed expedient, on the ground of information collected in Sudan at the beginning of current year, to outline the levels of wages and salaries along the years of M.P.D.U. development.

Personnel costs have been calculated as annual figures, taking into account qualification, tasks and educational level for salaried employees and hourly workers. Improvements have been anticipated for eacn year, rates of increase ranging between ten and twenty percent. These improvements are not related to inflation, but only to expected increase in ability, performance and productivity.

The table of next page shows the compensation levels,or, to be more precise, the manpower costs for each group of employees; reference has been made to hiring date, or to seniority in the job.

All the calculations of operating costs, as far as labour costs are concerned, have been based on these figures (see section 8, Financial and Economic Evalution).

6.03 - PERSONNEL COMPENSATION (000 US $)								
SPECIFICATION	year 0 (hiring)	1	2	3	4	5	6	7
- Managers	7	8	9	10	11	12	13	14
- Engineers	4	4,5	5	5,5	6	6,5	7	7,5
- Technicians	2,5	3	3,5	4	4,5	5	5,5	6
- Clerks	2	2,2	2,4	2,6	2,8	3	3,2	3,4
- Common Clerks	1	1,2	1,4	1,6	1,8	2	2,2	2,4
- Senior Toolmakers	2,5	3	3,5	4	4,5	5	5,5	6
- Precision Workers	1,5	1,7	1,9	2,2	2,5	2,8	3,1	3,4
- Skilled Workers	1	1,2	1,4	1,6	1,8	2	2,2	2,4
- Operators	0,9	1	1,2	1,4	1,6	1,8	2	2,2
- Unskilled Workers	0,8	0,9	1	1,1	1,2	1,3	1,4	1,5

7. - IMPLEMENTATION SCHEDULING

7.01 - M.P.D.U.'s implementation will take place according to a program carried out in the course of 6 years. This period of time may seem too long to reach 100% operating condition. But there is to consider that, if it is possible to build and to equip in the proper way this plant in a much shorter period of time - 2 ÷ 3 years -, the training of young workers to this type of work - absolutely new for Sudan - will take several years(before all the equipment foreseen could be used at its best). However, 6 to 8 months time could be saved should a preliminary project be prepared immediately in order to have, ready to be sent out for bidding, engineering drawings for the beginning of year zero.

7.02 - YEAR ZERO

It starts when the anticipated funds are available, but after the technical assistance body coordinating the implementation of M.P.D.U. has been indicated.

a) Building - A Sudanese firm will be entrusted with the construction engineering.
Approximately 5 months of the year zero will be required for the preparation of the projects and tender documents.

The tender, the award, the opening of the yard will require another 4 months. The work will start in the last quarter of the year zero.

It is advisable that all building work as well as general facilities be entrusted to a single company which will thus become the sole responsible counterpart to deal with.

b) Equipment - It consists of machinery, spare parts and miscellaneous equipment.
Considering that transportation from Europe to Khartoum may require 3 ÷ 4 months, the orders for the equipment will be placed during the last quarter of the year zero in order to ensure the availability in Khartoum by the second quarter of the year 2,when the buildings will be ready.

The equipment should be ordered in the following sequence:

- training equipment,
- office equipment,
- tool and die equipment,
- metal forming equipment.

c) Personnel - The M.P.D.U. Project Manager should be enrolled before year zero.
The Training Project Manager will be selected at the beginning of the year to start his activity in the second quarter. The other experts for the Training and the Engineering will be also selected during the year zero to start at the beginning of year one.

Sudanese positions. The M.P.D.U. Project Manager Counter part shall be selected at the beginning of the year with an assistant engineer and a general secretary. Ten other engineers/Technicians will be recruited in the second quarter and sent to Europe for a period of three months with the former two engineers.
Afterwards there will be other recuitments (for starting at the beginning of the year one):

- Administration: 1 manager
  1 clerk
- Engineering : 4 engineers
  2 clerks
- Training : 1 clerk

Trainees. The selection of the first group of trainees for high precision workers training program will be made towards the end of year zero. The first three courses (starting in year 1, year 2 and year 3) will begin with 24 trainees from which 16 precision workers are expected to come out. Afterwards the courses will start only with 18 trainees. In the event an agreement can be reached with the Polytechnic of Khartoum in order to use its shop, the first two courses will take place in these provisional premises.

The first course for 12 engineers/technicians shall start in the second quarter of year one and therefore their recruitment will take place at the beginning of year one.

7.03 - YEAR ONE

a) Building construction will continue. Site development, drainage works, foundations and floors, roads, fencing and minor brickwork shall be completed within the first six months.
It is believed that the work progress will enable to start, during the second half of the year, the erection of the structures which should be completed by the end

of the year. The assembling of the installations will begin once the roof has been completed.

b) Equipment. During the second quarter of the year 2, part of the machinery will already be in a condition to start operating, thus, even in a very limited way, raw materials, semi-finsihed products, consumption material shall be available. Consequently, the relevant orders shall be placed in the second quarter of year 1 versus procurement and transportation.

c) Personnel. In this year all the M.P.D.U. services, except manufacturing, will be, even if in a limited size, at work:

General Management:	3 positions over 4
Administration & Personnel:	2 positions over 6
Engineering:	11 positions over 19
Training:	6 position over 6

Trainees:

- engineers/technicians:	12
- precision workers :	24

During the year one, some other recruitments will take place for enrolment in the same year:

Manufacturing:	4 experts (first quarter)
	8 key positions (first quarter)
	2 clerks (second quarter)

- The 4 experts shall start at the middle of the year.

For enrolment in year two some other recruitments should take place:

- General Management :	1 clerk
- Administration adn Personnel:	2 technicians
	1 clerck

Manufacturing:	2 engineers
	4 technicians
	1 clerk

They all will start at the beginning of year two.

Trainees for second courses of engineers/technicians and precision workers should be recruited towards the end of year one.

7.04 - YEAR TWO

a) Buildings. At the beginning of year two the roofing and the wall works are in progress. They will be completed in 2-3 months; for the offices it will take longer: they may be finished towards the end of the second quarter. Also the assembling of the installations will be in progress and it may be completed by the third quarter. Nevertheless, the training may start in the shop already in the second half of the year with, if necessary, temporary electric power supply.

d) Equipment. The training, office and tool & die equipments will arrive at the beginning of the second quarter. The installing will be carrier out within 4 to 6 months and the equipment may start to operate during the second part of the year - when the delivery inspections will take place and the Training will move, from the provisional premises, to the M.P.D.U. shop.

The Engineering Department will move to its office in the M.P.D.U. in the last quarter.
Equipment for the metal forming shop will arrive towards the fourth quarter and will be in operation by the end of the first quarter of year three.

Production materials should have been arrived in the second quarter: they will be in charge of the warehouse that will start to operate as soon as the roofing will be finished.

c) Personnel. General management, Administration and Personnel, Engineering and Training positions will be almost completely covered: during year two, there will be only the recruitment of two clerks for the Administration and Personnel and for the Enginnering.

As far as manufacturing is concerned during year two there will be:

- Recruitments : 2 engineers
  4 technicians
  1 clerk
  (for starting in year three)
- Europe training : 8 engineers/technicians
  (in the second quarter)
- Work starting : said 8 engineers/technicians
  2 clerks
  (from third quarter)

Besides recruitment of the yearly quantities of Engineers/

technicians and precision workers trainees, a first group of 15 operators - possibly young workers coming from the Vocational Centers - shall be enroled to start their activity in the second half of the year.
A second group of 15 operators should be recruited at the end of the year for starting in January of year three.
A third group of 10 operators will be enroled from January of year four.
These operators, before being utilized in production work, must be properly trained by the experts in order to be able to use, even for very simple operations, the highly expensive and delicate machine tools. This in shop training will last almost one year and shall be performed for each group of incoming operators.

7.05 - YEAR THREE

It must be considered to all effects the starting year when a manufacturing level equivalent to 30% of the total capacity must be reached.

Tool & Die Workshop. Slow rate start with few employees: manufacturing of precision simple parts is accomplished. Accelerated specialization courses are held for the operators while the first batch of precision worker trainees enters in the tool and die shop coming from the Training Department.

Forging, Heat Treatment, Steel sheet forming. Training, through accelerated qualification courses, and gradual start of operation take place.

Engineering Department. Marketing should already be at and advanced stage and the first resulsts should be attained with the acquisition of orders engaging the shop.

Design, after the first year of work, can be considered in a position to face the first tasks entrusted to it.

Industrial and plant engineering will instead be mostly concentrated in the supporting work to the start up of M.P.D.U. workshop.

7.06 - YEAR FOUR

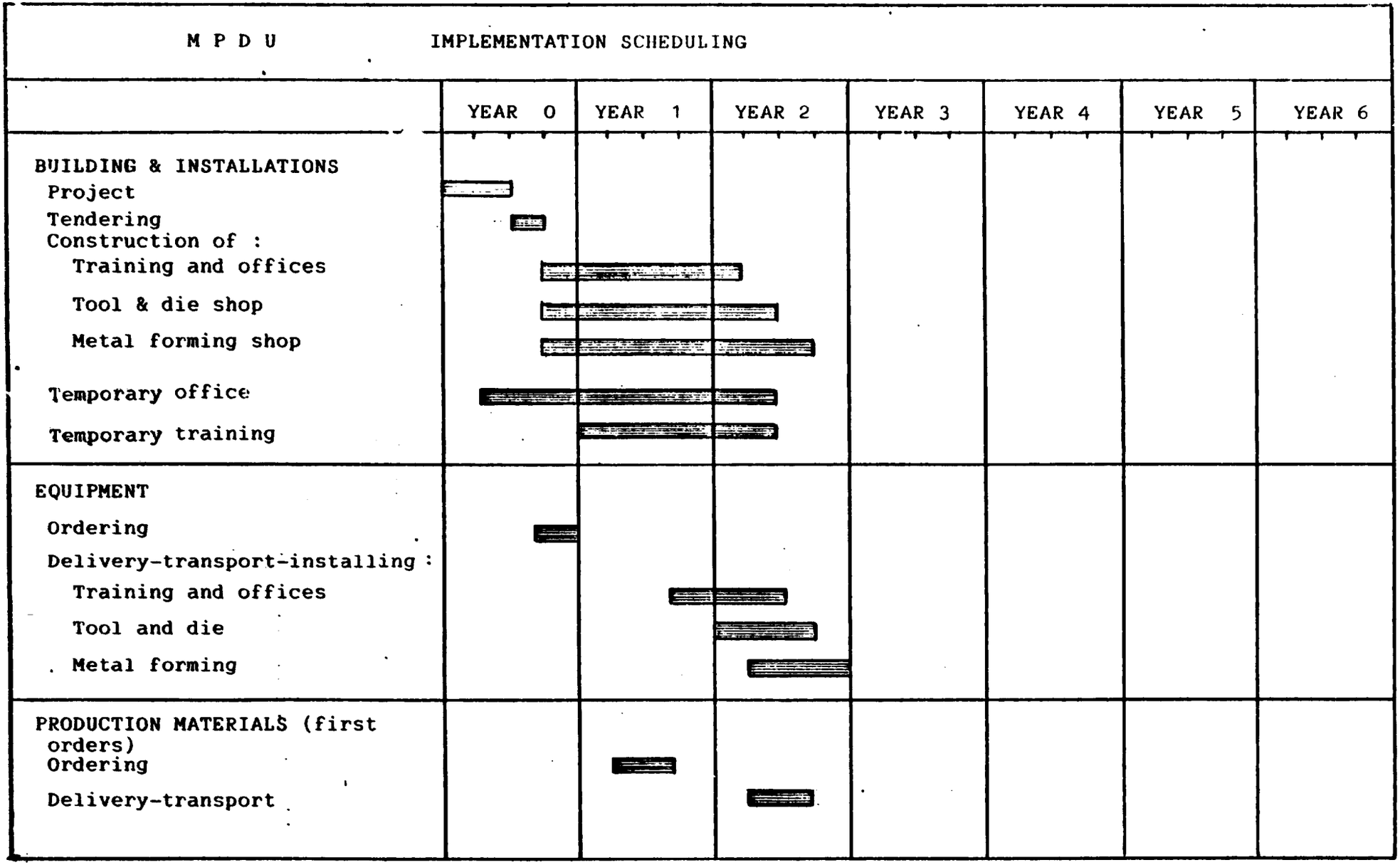
The first 16 precision workers are out of training period and can be profitably employed thanks to the qualification received. The workshop may reach in the course of the year 55% of its manufacturing capacity and start on the way of die and mould manufacturing. In the meantime, the 30 first operators will have completed the accelerated specialization courses and will be in a position to give a better performance. But year four has another very important goal to reach; the break-even point.
It will be a rather difficult task for M.P.D.U. people since several foreing experts will leave at the end of year three.

7.07 - YEAR FIVE

The goal for this year should be to reach the 80% of the manufacturing capacity. But since this percentage would be too high for the tool and die workshop, it is necessary that the metal forming workshop should utilize at a higher degree its facilities.

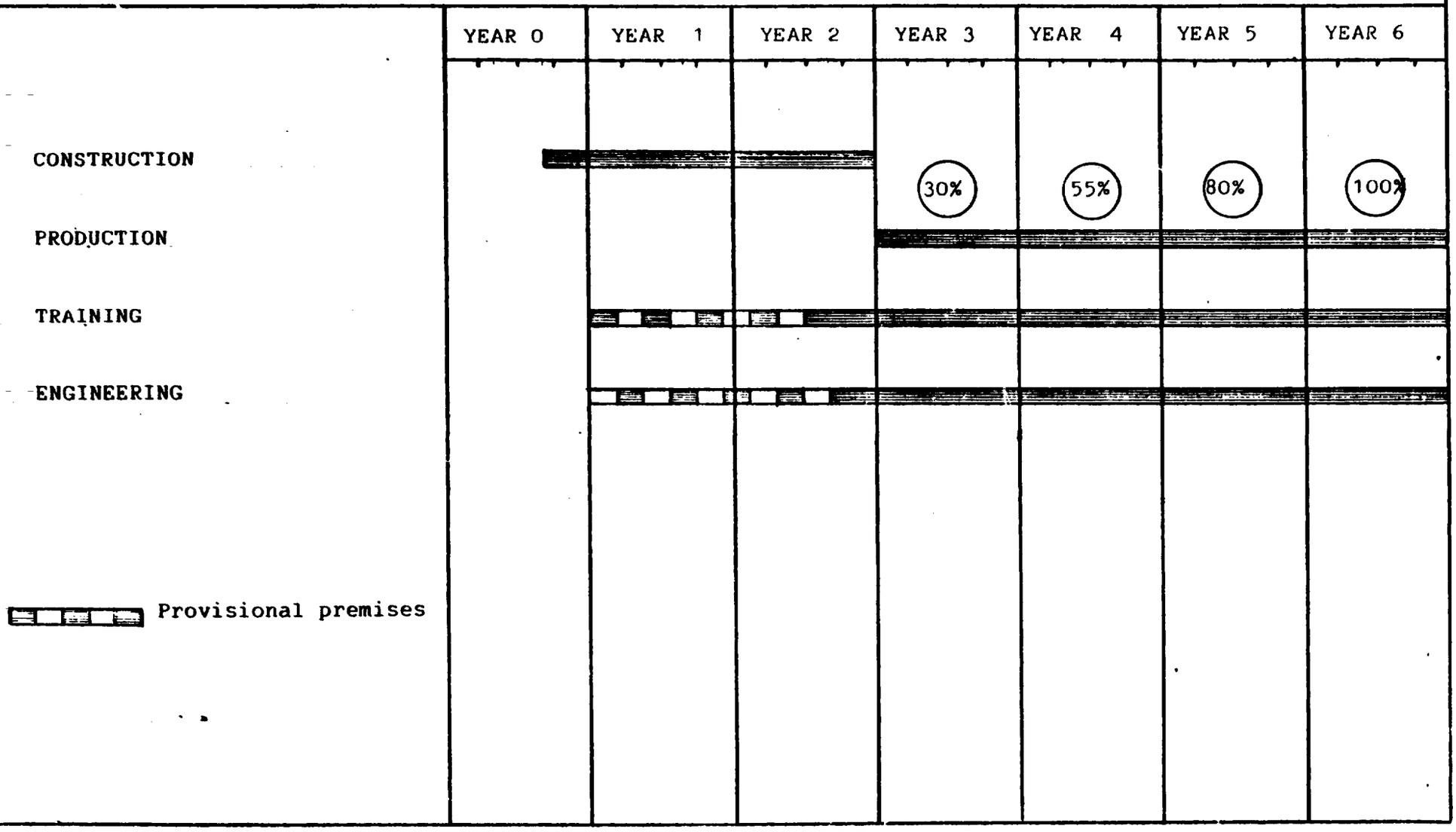
At the end of the year the 100% manufacturing capacity should be reached.

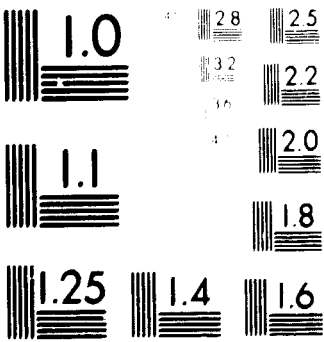
M P D U IMPLEMENTATION SCHEDULING

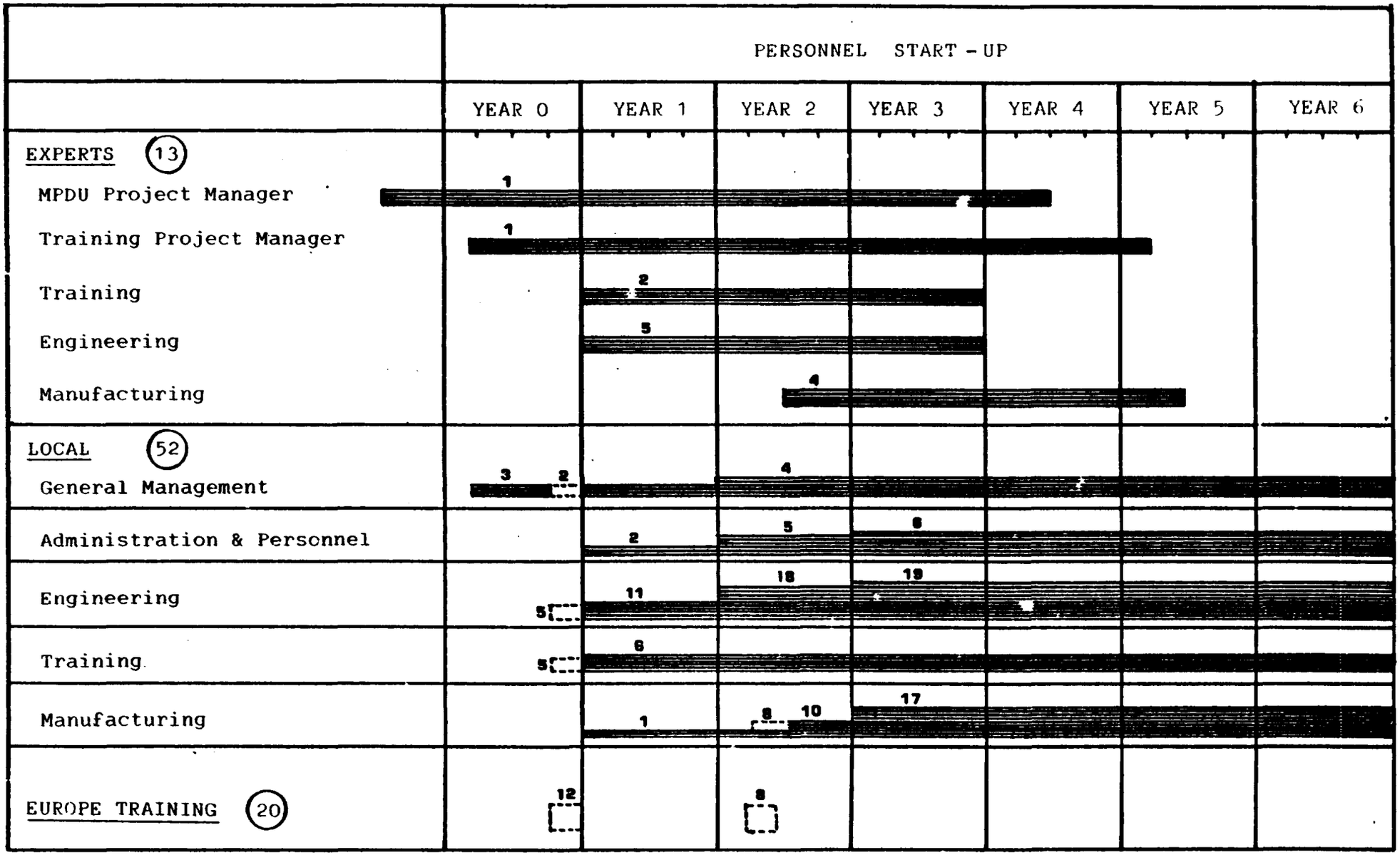


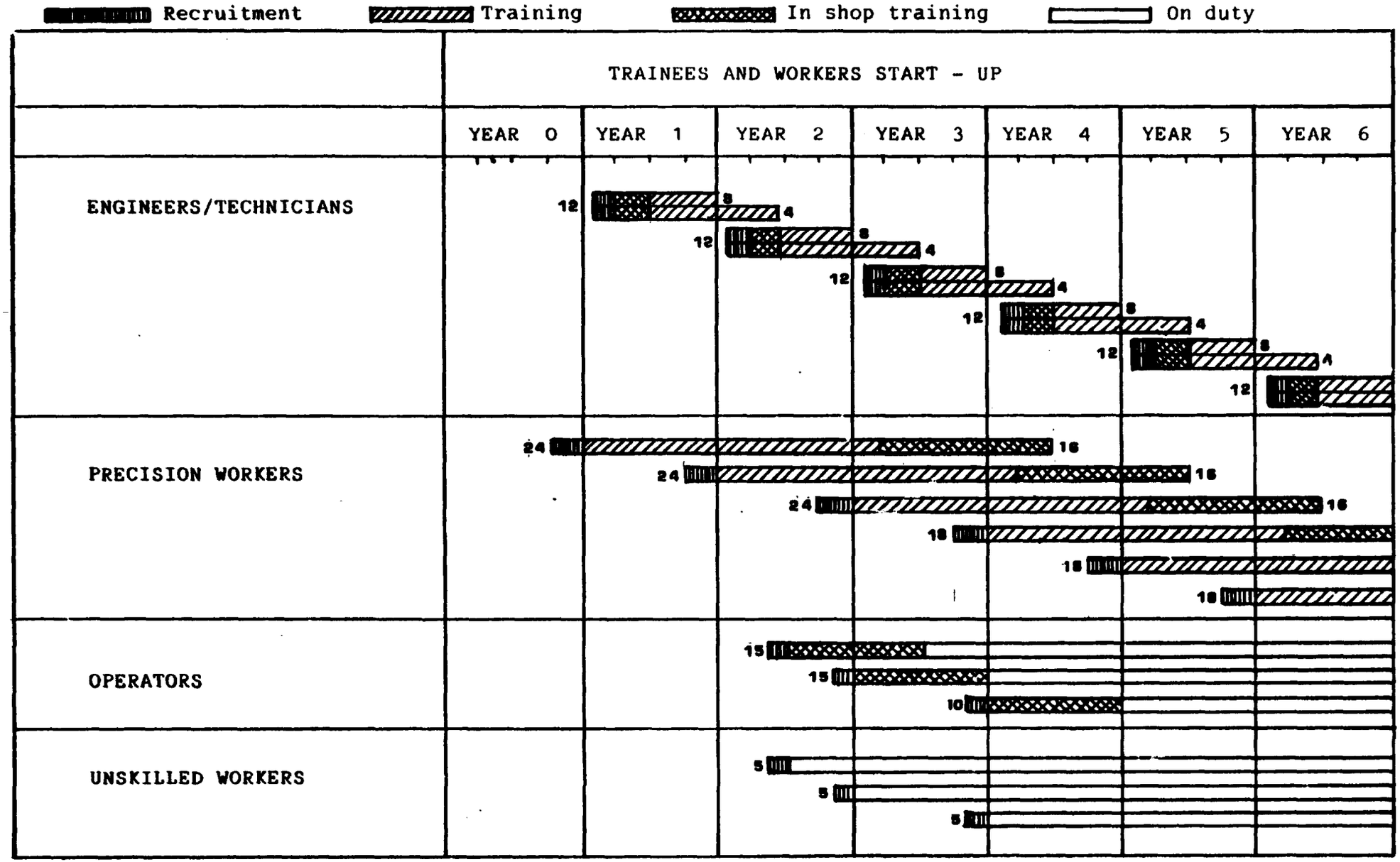
M P D U

OPERATION START-UP






PERSONNEL START - UP
YEAR 0
YEAR 1
YEAR 2
YEAR 3
YEAR 4
YEAR 5
YEAR 6
EXPERTS (13)
MPDU Project Manager
Training Project Manager
Training
Engineering
Manufacturing
LOCAL (52)
General Management
Administration & Personnel
Engineering
Training
Manufacturing
EUROPE TRAINING (20)


Recruitment
Training
In shop training
On duty
TRAINEES AND WORKERS START - UP
YEAR 0
YEAR 1
YEAR 2
YEAR 3
YEAR 4
YEAR 5
YEAR 6
ENGINEERS/TECHNICIANS
12
8
4
12
8
4
12
8
4
12
8
4
12
8
4
12
PRECISION WORKERS
24
16
24
16
24
16
18
18
18
OPERATORS
15
15
10
UNSKILLED WORKERS
5
5
5

8. - FINANCIAL AND ECONOMIC EVALUATION

8.01 - TOTAL INVESTMENT COSTS

Some information about investment costs

The investment scheme is shown in Tables 1 through 10. As far as fixed assets are concerned, the investment forecast provides for entire manifestation in year 0 for Land and Site Development; for starting in the year 0 and development for 3/4 in the year 1 for Buildings; while General Installations are equally distributed over the years 1 and 2.

Machinery and Equipment of production depts. have been foreseen - for 1/3 - in the year 1 and - for 2/3 - in the year 2, according to the commencement of production activity in the year 3 (with 25% saturation of manufacturing plants), whilst for Training Department an equal distribution over the years 1 and 2 has been effected.

The purchase prices considered are referred to the first 6-month period of 1980, except for Machinery and Equipment (both of Manufacturing Depts. and of Training Dept.) in respect of which an increase has been evaluated: 5% increase for investments foreseen in the year 1, and 10% increase for investments foreseen in the year 2.

The pre-production capital expenditures distributed over the years 0, 1, 2 include the expenses relevant to foundation of the company, market and product surveys, tests and setting up of machinery and plants, and availability of a temporary office for engineering and training activities, while awaiting the construction of the company's headoffice to be completed. The sale of engineering services has been foreseen already starting from the year 1.

The investment in working capital has been foreseen starting from the year 3; it includes the cost for purchase of equipment stock and components for machinery, as well as of the minimum permanent stock of raw materials.

The equipment stock does not grow proportionally with production, in relation to the improvement of the utilization rate; whilst materials for production vary proportionally with the latter.

8.01 - TOTAL INVESTMENT COSTS - FIXED ASSETS (.000 $ US) Tab. 1

Item	Description	Prices 1st half-year 1980			
		year 0	1	2	TOTAL
1. LAND	Land purchasing and leveling - Roads, service areas, fence, sewerage, gates	414			414
2. BUILDINGS	Buildings for offices, training, workshops, auxiliary services	140	764	183	1087
3. GENERAL INSTALLATIONS	Water, electrical system, compressed air oil & gas distribution, air conditioning		395	345	740
4. MACHINERY AND EQUIPMENT	*Tool & Die workshop - Metal Forming workshop (incl.spare parts, contingencies, erection, freight, packing) *Office furniture		850	1700	2550
5. TRAINING	Machinery and equipment for training dept.		240	240	480
	TOTAL	554	2249	2468	5271

8.01 - TOTAL INVESTMENT COSTS - FIXED ASSETS (.000 $ US) Tab. 2

Item	Description	Prices 1st half-year 1980			
		year 0	1	2	TOTAL
1. LAND	Land purchasing and leveling - Roads, service areas, fence, sewerage, gates	414			414
2. BUILDINGS	Buildings for offices, training, workshops, auxiliary services	140	764	183	1087
3. GENERAL INSTALLATIONS	Water, electrical system, compressed air oil & gas distribution, air conditioning		395	345	740
		Prices 1st	half year 5%	1980 inflated 10%	TOTAL
4. MACHINERY AND EQUIPMENT	*Tool & Die workshop - Metal Forming workshop (incl.spare parts, contingencies, erection, freight, packing) *Office furniture		892	1870	2762
5. TRAINING	Machinery and equipment for training dept.		252	264	516
	TOTAL	554	2303	2662	5519

8.01 - FIXED ASSETS - LAND AND SITE DEVELOPMENT

(Prices 1st half-year 1980)

Table 3

	EVALUATION		
	Size	Cost per Unit $	TOTAL COST $
- Land purchasing and leveling	20.000 sq.m	5	100.000
- Roads (asphalt)	3.000 "	20	60.000
- Service Areas (concrete)	2.500 "	30	75.000
- Prefabricated Fence	600 m.	38	23.000
- Gates (vehicles and personnel)			3.000
- Sewage and Drainage			75.000
- Water tank			40.000
- Engineering Cost			38.000
TOTAL			414.000

8.01 - FIXED ASSETS - BUILDINGS
(Prices 1st half-year 1980)

Tab. 4

Description	EVALUATION		
	Size	Cost per Unit $	Cost $
- Tool & Die Shop	1200 sq.m	180	216.000
- Training Shop	450	180	82.000
- Offices (2 stories)	1300	300	390.000
- Metal Forming Shop	1152	180	208.000
- Hot Forging Shop	288	180	52.000
- Transformer Building	36	300	11.000
- Compressor Building	58	300	17.000
- Auxiliary Penthouses	100	60	6.000
- Guard and scale House	20	250	5.000
- Engineering Cost			100.000
TOTAL			1.087.000

8.01-FIXED ASSETS - GENERAL INSTALLATIONS Tab. 5
(Prices 1st half-year 1980)

Description	COST $
- Communication System (telephone, telex)	15.000
- Electrical System	125.000
- Water & Firefighting system	45.000
- Compressed Air System	75.000
- Air Conditioning (Offices & Workshop)	200.000
- Gasoil And Gases Distr. System	80.000
- Platform Scale	35.000
- 2 Overhead traveling cranes	40.000
- Vehicles (truck, station wagons)	85.000
- Spare parts	40.000
(Including engineering cost, freight, erection)	
TOTAL	740.000

8.01 FIXED ASSETS - WORKSHOP MACHINERY AND OFFICE EQUIPMENT
(Prices 1st half year 1980) Tab. 6

Description	COST $
* MACHINERY AND EQUIPMENT FOR TOOL & DIE WORKSHOP	1.226.000
- Machinery (inc.foundation and erection)	926.000
- Equipment for machinery and workers	130.000
- Spare parts, contingencies	64.000
- Freight and Packing	106.000
* MACHINERY AND EQUIPMENT FOR METAL FORMING WORKSHOP	1.234.000
- Machinery (inc.foundation and erection)	990.000
- Equipment for machinery and workers	68.000
- Spare parts, contingencies	70.000
- Freight and Packing	106.000
* OFFICE	
- Furniture, Services, Equipment	90.000
TOTAL	2.550.000

8.01 - FIXED ASSETS - TRAINING MACHINERY AND EQUIPMENT

(Prices 1st half year 1980) Tab. 7

Description	COST $
- Machinery (inc.foundation and erection)	330.000
- Equipment for machinery and for trainees	65.000
- Spares and Contingencies	30.000
- Freight and packing	55.000
TOTAL	480.000

8.01- TOTAL INVESTMENT COSTS - PRE PRODUCTION CAPITAL EXPENDITURES (.000 $ US) Table 8				
Description	year 0	1	2	TOTAL
- Capital issue - Formation of Company - Other legal costs	30	10		40
- Salaries and Travel - for initial analysis of market opportunities; study, evaluation and selection of products for starting MPDU production	40	60	70	170
- Temporary officies, for initial activity of engineering and training	20	50	50	120
- Other unforeseen expenses	10	30	30	70
- Testing of Machinery and equipment; trial runs			100	100
TOTAL	100	150	250	500

8.01 - TOTAL INVESTMENT COSTS - WORKING CAPITAL (.000 $ US) Table 9

Item	Description	year 3		4		5		6	
BASIC INFRASTRUCTURE STOCK	Steel for forgings and plateworks; tool components (Stock and production increases are not proportional)	200		300		300		400	
	ALTERNATIVE ⟶	A	B	A	B	A	B	A	B
MATERIAL FOR WORK IN PROGRESS (3 month production run)	Tool and Die Shops	3	5	9	12	13	16	15	20
	Metal Forming and Heat Treating	38	50	80	113	113	150	150	200
	TOTAL	241	255	389	425	426	466	565	620

8.01 - TOTAL INVESTMENT COSTS (.000 $ US)-Synthesis tables 2 - 8 - 9 Tab.10														
Description	year 0	1	2	3		4		5		6		TOTAL	
FIXED ASSETS	554	2.303	2.662									.519	
PRE-PRODUCTION CAPITAL EXPENDITURES	100	150	250									500	
A l t e r n a t i v e	⟶	⟶	⟶	A	B	A	B	A	B	A	B	A	B
WORKING CAPITAL				241	255	148	170	37	41	139	154	565	620
TOTAL	654	2.453	2.912	241	255	148	170	37	41	139	154	6584	6639

As for materials, the investment has been foreseen in accordance with the two alternatives (High and Low) which the Net Income Statement (see Section 8.03 Tables 1 and 2) has been formulated into.
The two alternatives refer to different activity levels over the years, both of Manufacturing Departments and Engineering Department.

As far as the year 6 is concerned, the variability range of the Engineering Dept. and of the Metal Forming Workshop is equal to ± 7%.

As regards Tool & Die Workshop, a cautional variability of ± 10% has been evaluated, in relation to the possibly higher variation range of return unit prices and to the greater complexity of training of senior toolmakers and precision workers.

The differences between the two alternatives lie in consideration with Income, as well as with Costs, within the limits of utilization of raw materials and expendable materials, with the costs of personnel and general structural costs unchanged.

8.02 - PROJECT FINANCING

Three financing sources have been foreseen:

- Equity up to an amount of US $ 1,500,000 corresponding to the investment in Land and Buildings;
- Soft Loan up to an amount of US $ 4,000,000 at the yearly interest rate of 1%, to be paid in 40 years after 10-year grace period;
- Commercial Loan at the yearly interest rate of 10%, for a variable amount according to the financial requirer nt.

8.03 - NET INCOME STATEMENT AND CASH RESULTS

Some information about incomes and costs

Introduction

All estimates of cost and income items have been considered at constant prices (1st half-year 1980) generally assuming that the dynamics of cost variations on the whole is similar to that of income variations on the whole.

8.03 - NET INCOME STATEMENT AND CASH (.000 $ US) Alternative A (low)								Table 1
Item	Description	year 0	1	2	3	4	5	6
INCOME	Sale of production	-	-	-	510	1.110	1.550	2.050
	of which: Tool and Die				160	350	500	650
	Metal Forming H.T.				350	760	1.050	1.400
	Sale of Engineering Services	-	50	150	300	380	420	450
	* TOTAL SALES	-	50	150	810	1.490	1.970	2.500
	* TRAINING SUBSIDY	28	98	100	104	83	75	71
	T O T A L I N C O M E	28	148	250	914	1.573	2.045	2.571
COSTS	Raw materials	-	-	-	162	355	500	660
	Ancillary Expendable materials	-	-	-	30	67	94	124
	Energy	-	-	10	40	65	75	85
	Salaries Wages	4	46	124	202	286	372	493
	Overheads	10	10	20	44	78	104	129
	Depreciation (Fixed assets)	-	-	-	409	409	409	409
	Depreciation (Pre operational exp.losses)	-	-	-	-	160	166	166
	Loan interests	-	40	40	40	40	40	40
	Financial burdens	-	3	8	65	60	79	100
	* Total	14	99	202	992	1.520	1.839	2.206
	* Training department (personnel)costs	28	98	100	104	83	75	71
	T O T A L C O S T S	42	197	302	1.096	1.603	1.914	2.277
	P R O F I T (L O S S)	(14)	(49)	(52)	(182)	(30)	131	294
	C A S H R E S U L T S	(14)	(49)	(52)	227	539	706	869

8.03 - NET INCOME STATEMENT AND CASH (.000 $ US) Alternative B (high) Table 2

Item	Description	year 0	1	2	3	4	5	6
INCOME	Sale of production	-	-	-	600	1.320	1.840	2.400
	of which: Tool and Die				200	440	640	800
	Metal Forming H.T.				400	880	1.200	1.600
	Sale of Engineering Services	-	70	190	360	450	520	520
	* TOTAL SALES		70	190	960	1.770	2.360	2.920
	* TRAINING SUBSIDY	28	98	100	104	83	75	71
	TOTAL INCOME	28	168	290	1.064	1.853	2.435	2.991
COSTS	Raw materials	-	-	-	220	495	665	880
	Ancillary Expendable materials				41	93	125	165
	Energy			10	45	70	80	90
	Salaries Wages	4	46	124	202	286	372	493
	Overheads	10	10	20	48	89	118	146
	Depreciation (Fixed assets)	-	-	-	409	409	409	409
	Depreciation (Pre operational exp.losses)	-	-	-	-	133	133	133
	Loan interests	-	40	40	40	40	40	40
	Financial burdens		3	8	65	71	95	117
	* Total	14	99	202	1.070	1.686	2.037	2.473
	* Training department (personnel)costs	28	98	100	104	83	75	71
	T O T A L C O S T S	42	197	302	1.174	1.769	2.112	2.544
	P R O F I T (L O S S)	(14)	(29)	(12)	(110)	84	323	447
	C A S H RESULTS	(14)	(29)	(12)	299	626	865	989

Production Implementation (see Section 7.00)

The activity of the Manufacturing Department starts in the year 3 according to the availability of machinery and skilled workers.

The activity of the Engineering Department starts already in the year 1, according to the availability of engineers and experts.

Income

The total income results from estimated unit prices combined with forecast plant utilization rate (see Annex H).

In both alternatives (low and high) the average rate of income growth is approximately 45% a year.

Materials

The materials are purchased at international prices, inclusive of the usual additional costs for delivery in Karthoum.

As for raw materials, the effect on the value of the product which is sold greatly differs for the two workshops.

In the Tool & Die Workshop, the incidence amounts to about 11%, whilst in the Metal Forming Workshop it amounts to 43%.

Therefore, the raw materials price variations shall greatly affect only the cost structure of the Metal Forming Workshop.

Personnel, Wages and Salaries (see Annex H)

The personnel is progressively hired over the years in relation to the development of training activity, and the number of permanent staff in normal operating conditions of the unit will be reached at the end of the year 6.

The costs of personnel were estimated in accordance with the composition of the different employees' levels each year.

The variation of the salary/wage of each employee over the years is a result of seniority and of possible promotion to a higher level.

As far as the personnel of Tool & Die Workshop is concerned, the reduction from year 5 to year 6 (from 62 down to 54 people) is due to the contemporary presence of Precision Workers (having just completed their training) and Operators yet to be transferred to the Metal Forming Workshop.

Depreciation (Fixed Assets)

To estimate Fixed Assets depreciation, the following rates have been used:

- 4% per year for buildings;
- 5% per year for general installations;
- 10% per year for machinery and equipment.

The depreciation starts from year 3 with an annual rate calculated as follows (,000 US $):

	Investment	Depreciation
Buildings	1,087	44
General Installations	740	37
Machinery and Equipment	2,762	276
Training	516	52
T O T A L		409

The yearly depreciation rate for the years 3, 4, 5 has been considered at full rate in spite of the still partial utilization of plants in such years.

Depreciation (Pre-operational expenses and losses)

Depreciation of pre-operational expenses and losses has been calculated in five years from their origin, starting from the year 4, since in the high alternative losses terminate in the year 3, and in the low alternative they are rather reduced in the year 4.

Loan Interest

It refers to the interests on Soft Loan, equal to 1% per year on US $ 4,000,000.

Financial Burden

The term refers to the charges associated with the utilization of a Commercial Loan at the yearly interest rate of 10%.

Such utilization has been estimated up to the year 3 on an average yearly financial requirement, whilst starting from the year 4, the financial charges are estimated at 4 per cent of total sales.

Training Department (personnel Costs) (see Annex H)

The local training costs - that should be entirely covered by a training subsidy, considered as an income - have been clearly specified.

8.04 - CASH FLOW TABLE FOR FINANCIAL PLANNING

The cash flow tables for financial planning have been elaborated on the basis of Investments in Fixed Assets, Pre-operational Capital Expenses and Working Capital, and Cash Results in the two alternatives A and B. (See tables 1 and 2 next pages).

8.04 - CASH FLOW TABLE FOR FINANCIAL PLANNING (.000 $ US) Alternative A(low) Table 1								
Item	Description	year 0	1	2	3	4	5	6
DISBUR-SEMENTS	Fixed assets	(554)	(2303)	(2662)				
	Pre-production capital expenditures	(100)	(150)	(250)				
	Working Capital				(241)	(148)	(37)	(139)
	Cash Results	(14)	(49)	(52)				
	TOTAL	(668)	(2502)	(2964)	(241)	(148)	(37)	(139)
REVENUES	Equity	1501						
	Soft loan	4000						
	Cash results				227	539	706	869
	TOTAL	5501			227	539	706	869
DIFFER.	(year)	4833	(2502)	(2964)	(14)	391	669	730
DIFFER.	(progressive)	4833	2331	(633)	(647)	(256)	413	1143

8.04 - CASH FLOW TABLE FOR FINANCIAL PLANNING (.000 $ US) Alternative B (High) Table 2								
Item	Description	year 0	1	2	3	4	5	6
DISBUR-SEMENTS	Fixed assets	(554)	(2303)	(2662)				
	Pre-production capital expenditures	(100)	(150)	(250)				
	Working Capital				(255)	(170)	(41)	(154)
	Cash Results	(14)	(29)	(12)				
	TOTAL	(668)	(2482)	(2924)	(255)	(170)	(41)	(154)
REVENUES	Equity	1501						
	Soft loan	4000						
	Cash results				299	626	865	989
	TOTAL	5501	-	-	299	626	865	989
DIFFER.	(year)	4833	(2482)	(2924)	44	456	824	835
DIFFER.	(progressive)	4833	2351	(573)	(529)	(73)	751	1586

8.05 - CONCLUSION

The economic and financial results brought about in the two alternatives from the Net Income Statement and Cash and from the Cash Flow tables are directly linked to the availability of :

- a large amount of financing sources represented by equity and soft loan, very little burdensome;
- skilled labour in accordance with the scheduled training activity over a period of time required to train workers at the different specialization levels;
- scheduled assistance program, mainly of experts and engineers of the Engineering Dept., in the number and with the qualification required to give an important contribution to the company's activity already from the year 1.

The economic forecast indicates :

- the achievement of the break-even point in the year 4 in the high alternative, and in the year 5 in the low alternative;
- a dynamics of creation of self-financing internal sources, whose amount should cover the soft loan reimbursement and produce a satisfactory return on investment over a reasonable period of time..

ANNEXES

Annex A

SOURCES OF INFORMATION

a) - Publications

1 - THE SIX YEAR PLAN OF ECONOMIC AND SOCIAL DEVELOPMENT
Ministry of National Planning - April 1977.

2 - AN INTRODUCTION TO SUDAN ECONOMY
Ali Mohamed El-Hassan, Editor Khartoum University Press - 1976.

3 - KHARTOUM CONURBATION
El-Sayed El-Bushra University of Khartoum - 1976.

4 - INDUSTRY SURVEY OF THE SOUTHERN REGION OF SUDAN
UNIDO - Dec. 1978.

5 - DESK STUDY OF INDUSTRIAL DEVELOPMENT OF THE DEMOCRATIC REPUBLIC OF SUDAN
UNIDO - August 1976.

6 - ECONOMIC REVIEW OF SUDAN
The Economist Intell. Unit Ltd. - 1979.

7 - REACH FOR THE FUTURE - A REVIEW OF SUDAN
The Economist - March 1978.

8 - SUDAN - THE COUNTRY AND ITS MARKET
J. A. Groupe - Paris, 1979.

9 - MARKETING IN SUDAN
U.S. Dept. of Commerce - 1977.

10 - SUDAN DEVELOPMENT CORPORATION
Annual Report - 1975.

b) - Specially prepared by Ministry of Industry

11 - List of 64 groups of Products Imported in large quantities - for the period 1973 - 1978.

12 - List of Major Government Importers and Users of Metals.

13 - List of Major Private Importers of Metal Products.

14 - List of Metal Product Industries.

15 - List of Plastics Industries.

16 - Industrial Investment Guide - by I.R.C.I., 1976.

17 - General List of Operating Factories, 1972.

Annex B

IMPORT ANALYSIS

B.1 - Sources

B.2 - Remarks

B.3 - Comments

B.4 - Trends

Tables

1. - Metal Products imported in large quantities
2. - Metal Product Imports (20 major classes)
3. - Imports of "Machinery and Equipment"and "Transport"
4. - Road Transport Vehicle Imports
5. - Total Import of Metal Goods
6. - Trends of imports and some Economic Indicators

B.1 - SOURCES

a) Specially prepared by Ministry of Industry

- List of 64 groups of "Products Imported in Large Quantities", with figures (in value) for the six year period 1973-78. This list does not include two major classes of metal products: "Machinery and Equipment" and "Transports".

- List of "Major Government Importers and Users of Metals". For each of the 13 Government Agencies included, the types of metal imports are given, but not quantities and values.

- List of "Major Private Importers of Metal Products", with rough specifications of types, but without volumes and values.

b) Others

- "Marketing in Sudan", published by U.S. Depart. of Commerce, contains figures of the period 1972-76.

- "Sudan", published by Groupe A.J. - Paris, contains figures up to 1977.
From these publications list of imports were derived, for the two categories "Machinery and Equipment" and "Transports", with values for the six-year period 1972-77; quantities are known only for year 1977.

- Figures covering the period 1974-78 were supplied by I.R.C.I., for 5 classes of goods in "Transport" category.

B.2 - REMARKS

- Even if the information and figures are not completely safe and reliable, as a whole they give a sufficiently good idea of the magnitude of imports, and the relative importance of various areas.

- The 64 groups of products listed in the documents supplied by Ministry of Industry can be aggregated in 9 major categories; the values shown, in thousands of Sudanese pounds, are referred to 6 year period 1973-1978 (see table 1).

- The major 20 classes of products (out of 64) are shown in more detail in table 2, where they are listed according value rank. The values are given for the 6 year period, and also splitted for each year, from '73 to '78.

- The products listed in tables 1 and 2 do not include General Machinery and Transport Vehicles. These two categories are shown in table 3.
Table 4 shows the number (not the value) of Road Vehicles imported from 1979 to 1978.

- Data from various sources are brought together in table 5, so to have a complete picture of metal good imports, in a 6 years period. In fact, the time periods do not coincide for all the products (one source refers to 1972-77; another one to 1973-78); however, considering the purpose of the study, the comparison of data, although referred to slightly discrepant periods, remains significant.

B.3 - COMMENTS

- The most important items in the list of 64 metal import classes are related to irrigation (tubes, pipes, except hydroelectric - see table 2); they are followed by two other classes related to agriculture. The largest category of finished metal goods (n. 3 of table 1) is "Agricultural Equipment" (aggregation of items 2, 3, 10, 17 of table 2).

- Imports of Raw and semifinished materials keep a relatively modest place: 31% of metal imports other than "Machinery" and "Transport"; and less than 10% of total metal imports.

- Judging from import figures of semifinished materials, local manufacturers processing tin plate seem to have a much higher activity than steel sheet processing manufacturers:

	SL 000	Tons	Value Ranking	Quantity Ranking	Price SL/Kg
Tin Plate	3095	16942	12	9	0.18
Steel Sheet	417	2769	39	20	0.15

Local industry processing steel sheet could be stimulated.

- By far the largest single item of all metal imports is "Machinery Spare Parts".
It represents 58% of the Machinery and Equipment group; and its value is 1,7 times the value of machinery itself. Spare parts in "Transport" group represent 38% of the group total. "Automotive Spare Parts" are worthy 71% of all cars, trucks and buses. "Locomotive Spare parts" 1435% of all locomotives imported during the same period (see table 5).
All added up, spare parts (without those that are not disaggregated in the data source, such as textile spare parts) in the six year period amount to 178 million SL, i.e. 39% of all metal imports.

B.4 - TRENDS

- From the time series statistics shown in table 6, where import figures are summarized alongside with corresponding statistical figures of basic economic indicators, some patterns and trends are discernible.

- The import cuts that followed the heavy situation of Current Account and Balance of Payments in 1975 and 1976 seem to have seriously hit the "Transport" group (which fell down in 1976 to less than 30% of 1975; then picking up again in the following years, on a steep upward slope) and the "Other metal goods" group (wich was less seriously reduced, but did not recover through 1978).

- On the contrary, the "Machinery and Equipment" group continued its upward trend also in '76, with a strong upward jump in '77, then leveling off in '78.

- Another remarkable pattern discernible in table 6 is the inexorably steep upward trend of "Machinery Spare Parts". Their import shows a rate of increase close to 100% a year. Clearly, Sudan is heavily and rigidly dependent on imports for its basic "value-adding" resources: mechanized agriculture, agriculture-related industries, and transports. The point is how to decrease this dependency.

- It follows that the choices suggested by the Mission for the MPDU outputs are correct, as far as they concentrate upon:
  - helping manufacturing industry (mainly metalworking and plastics), with local supply of tooling and equipment, together with engineering and manufacturing services;
  - supporting the manufacturers of end products with supply of component parts;
  - supporting the large processing plants of agriculture-related industries with supply of spare-parts now imported in large quantities;
  - helping the basic economic undertakings of the country by creating a local source of components for agricultural implements and agricultural machinery which are expected to be produced, in the rear future, in Sudan.

Annex B - Tab. 1

METAL PRODUCTS IMPORTED IN LARGE QUANTITIES

(Aggregated in 9 major categories) - Period 1973-1978 - Total value

PRODUCT GROUPS	VALUE SL 000
1. Raw Materials (pig iron, ingots, alloys)	2 705
2. Semifinished materials (steel plate, tin plate, strip, angles, sections, rods bars, wire, rails chains)	39 481
Total raw and semifinished	42 186
3. Agricultural Equipment	31 871
4. Engines (steam, int. combustion), boilers	19 667
5. Tubes, pipes, fittings	16 010
6. Containers and stoppers (tanks, boxes, crown corks, stoppers, caps)	6 674
7. Hand tools and utensils (including agricultural)	6 012
8. Household and Office Utensils and Equipment	5 387
9. Small Hardware (nails, nuts, bolts, screws, etc.)	5 358
Total finished metal goods	90 979
TOTAL METAL IMPORTS (Other than "Machinery" and "Transports") 1973 to 1978	133 165

METAL PRODUCT IMPORTS (1973-1978)-FIRST 20 CLASSES
(Without Machinery and Transport)

Value ranking	PRODUCTS		6 Year Total SL 000	TIME SERIES SL 000					
				1973	1974	1975	1976	1977	1978
1	Tubes, pipes (except hydroelectric)		14.253	548	469	7.725	3.364	1.242	905
2	Agricultural machinery (harvesting, threshing)		13.036	393	1.381	3.300	2.569	3.471	1.922
3	Agricultural tractors		13.017	736	1.151	3.482	4.333	1.272	2.043
4	Bars, Rods (except wire rod)		12.166	2.460	2.519	3.051	1.476	1.806	854
5	Internal combustion and diesel parts		12.264	1.956	1.644	2.263	1.873	3.080	1.448
6	Plates, heavy and medium sheets		10.883	2.050	2.755	1.743	2.080	357	1.898
7	Angles, shape sections		7.581	1.003	1.281	1.321	652	2.415	909
8	Engines, diesel & semidiesel		4.802	27	432	1.007	2.191	705	440
9	Casks, drums, boxes for petroleum products		3.977	690	857	557	650	1.019	204
10	Agri-horticultural soil prep. machinery		3.969	296	159	1.640	1.100	352	422
11	Hoop and strip iron and steel		3.734	784	720	774	400	799	257
12	Tin plate		3.092	617	369	915	115	609	467
13	Hand tools, chisels, anvils vices, etc.		3.026	292	378	620	621	420	695
14	Ingots, other forms		2.505	11	586	1.002	5	597	304
15	Internal combustion engines and parts		2.072	525	422	374	535	216	-
16	Bolts, nuts, screws, rivets, washers		1.899	170	159	343	312	555	360
17	Other agricultural machinery and appliances		1.847	17	4	24	641	1.038	117
18	Locks, keys, blanks		1.770	330	248	356	206	292	338
19	Other tubes, pipes, fittings		1.753	146	526	244	338	334	165
20	Base metal items of iron and steel, excl.casting		1.412	204	121	330	387	258	112
39	Steel sheets, under 3 mm		415	-	8	61	244	101	1

IMPORTS OF "MACHINERY & EQUIPMENT" AND "TRANSPORTS" - 1972-196
(Source : Marketing in the Sudan).

Machinery & Equipment	Values (S L 000)					Totals (SL 000)
	1972	1973	1974	1975	1976	
Machinery, electric	453	641	1.152	503	900	3.649
Machinery, non electric	1.653	1.618	5.400	11.240	9.826	29.737
Machinery spare parts	2.017	4.465	7.392	13.486	28.119	55.479
Textile mach. parts				325	3.337	3.662
Refrigerators	5	20	9	16		50
Air conditioners	1	5	16	19	5	46
Oven		3	5	5	11	24
TV radio				146	276	422
Dry batteries				30	13	43
Miscellaneous						
Total	4.266	6.863	13.984	25.770	42.487	93.370
TRANSPORTS						
Aircraft		2.793	8.337	5.684	345	17.159
Aircraft parts				1.712	1.057	2.769
Locomotives		71	16	326	8	421
Wagons	4	2	120			126
Locomotive parts				2.948	1.193	4.141
Ferries and steamers			256	1.115	311	1.682
Automobiles	234	725	775	9.104	1.371	12.209
Trucks	1.918	2.514	2.231	5.173	3.751	15.587
Buses	3	24	816	129	41	1.013
Auto spare parts	1.540	5.442	6.255	3.706	1.382	18.325
Motorcycles	12			41	2	55
Bicycles	5			9	4	18
Miscellaneous	329	179	294	717		1.519
Total	4.045	11.750	19.100	30.664	9.465	75.024
Grand Total	8.311	18.613	33.084	56.434	51.952	168.394

ROAD TRANSPORT VEHICLES - IMPORT STATISTICS (NUMBER OF UNITS) - 1970-1978

TYPE OF VEHICLE	1970	1971	1972	1973	1974	1975	1976	1977	1978
PASSENGER CARS	989	521	391		1725	3056	3865	1764	312
BUSES	641	440	834		403	272	99	217	111
TRUCKS	322	370	9		689	2216	1188	921	549
SPECIAL PURPOSE VEHICLES	221	44	165		176	125	274	52	43
CHASSIS WITH ENGINE					407	1608	489	122	525

N O T E :
- No data available for 1973
- Data for 77 and 78 refers to 9 months

Annex B - Tab. 4

TOTAL IMPORTS OF METAL GOODS (6 years) 457.299

Within each major group, product categories are listed in order of magnitude (volumes)

		6 Year totals SL 000
MACHINERY AND EQUIPMENT (1972-1977)		
- Machinery spare parts		126.679
- Machinery, non electric	63.747	73.796
- Machinery, electric	10.049	
- Textile machinery and parts :		12.962
- TV, Radio, tape rec.	1.622	2.485
dry batteries	545	
refrigerators	50	
ovens	24	
- Miscellaneous		248
		216.170
TRANSPORT (1972-1977)		
- Spare parts : auto	31.225	41.335
locomotive	6.041	
aircraft	4.069	
- Trucks		24.287
- Automobiles		18.109
- Aircraft		17.499
- Ferries and steamers		2.082
- Miscellaneous		1.519
- Buses		1.513
- Railway wagons		1.126
- Locomotives		421
- Motorcycles		55
- Bicycles		18
		107.964
OTHER METAL GOODS (1973-1978)		
- Materials : raw	2.705	42.186
semifinished	39.481	
- Agricultural equipment (except hand tools)		31.871
- Engines (steam, combustion, jet), water boilers		19.667
- Tubes, pipes, fittings		16.010
- Containers and stoppers		6.674
- Hand tools and mechanical utensils		6.012
- Household and office equipment		5.387
- Small hardware		5.358
		133.165

TRENDS OF IMPORTS AND OF SOME ECOMIC INDICATORS

IMPORTS (million dollars)	1972	1973	1974	1975	1976	1977	1978
- Machinery & equipment (excl.spare parts)	2.2	2.4	6.6	12.3	14.1	51.6	
spare parts	2.0	4.4	7.3	13.4	28.1	71.2	
	4.2	6.8	13.9	25.7	42.2	122.8	112.0
- Transport equipment (excl. spare parts)	2.5	6.3	12.9	22.3	6	16.8	
spare parts	1.5	5.4	6.2	8.3	3.4	16.1	
	4.0	11.7	19.1	30.6	9.4	32.9	57.5
- Other metal goods : first 20 classes		13.2	16.1	31.0	23,8	20,8	13.8
ECONOMIC INDICATORS (July-June)							(August)
- Gross domestic Product	1.239	1.307	1.375	1.510	1.570	1.714	
- Trade balance		+ 14.5	- 6.8	- 125.4	- 85.5	+ 8.2	- 2.8
- Services (net)		- 16.0	- 23.7	- 34.9	- 21.9	- 17.0	
Courrent Account		- 1.5	-30.5	- 160.3	-107.4	- 8.8	
- BALANCE OF PAYMENTS		- 0.7	-15.2	- 51.7	- 85.5	- 1.5	
- OFFICIAL FOREIGN DEBT (Public sector loans)		102.8				403.6	

NOTE :

- Sources : Bank of Sudan, Economic and financial statistics review
" Sudan"(for gross domestic Product)
" Sudanow" magazine (for 1978-1979 data)
" Financial Times" (for foreign debt.)

Annex C

THE METAL WORKING INDUSTRY

C.1 - Sources

C.2 - Remarks

C.3 - Future developments

Tables

1. - Metal Working Industry (private Sector)
   Distribution by product and size

2. - Data on future development of metal working industry

C.1 - SOURCES

- List of Metal working industries currently in operation, prepared for UNIDO Mission by the Ministry of Industry. It includes 88 firms, distributed in 12 branches. See table 1.

- Industrial Investment Guide, issued by I.R.C.I. in 1976. Mainly related to historical background, up to 1975.

C.2 - REMARKS

- The metal working industry takes a marginal place in the Sudanese Industry structure. It is almost entirely in private hands, the State owning only few plants.

- A certain number of industries are really only assembly units: the entire. "Electrical Equipment" sector (radios, TV, fans, etc.), as well as "Car assembly", are basically assembly shops. We must note that the present stated policy of Government is to refuse licences for assembly plants, if not utilizing a certain amount of locally made parts or components.

- Heavy industry is absent. What comes nearest to it is the production of trailers, bus skeletons, tanks; and perhaps the "Pipes, fittings, water works", and some "Engineering works".

- Light sheet metal and tin plate industry is clearly the most developed. Sheet metal stamping and fabrication includes 3 groups of products: Household utensils, Furniture, Refrigerators and coolers.
  These activities are the first to have been established in Sudan, within the metal working industry; their expansion, as number of firms, is quite large relatively to other activities: 33 firms (24 of them in "Furniture") on a total of 88. Another 10 firms of the remaining 25 are making tin plate products, thus bringing to 43 (50% of total number) total of industries based on light metal sheet.
  Of the remaining 45 firms, 10 are in the "Small Hardware" sector, and 16 have less than 25 employees.

- With regard to other metal working facilities, it is important to note that a substantial amount of metal work is performed by repair and maintenance workshops attached to the large State agencies and Corporations, whose output is not a metal end products. In fact these workshops are major users of many classes of raw and semifinished materials currently imported.

- No specialized factories exist in the field of tools, dies, moulds,jigs, fixtures, precision machining in general, at industrial level. Some minor efforts are made within some industries for their own use, limited to simple items; the same applies to Government concerns.
  The information supplied by the Ministry of Industry specifically indicate, in this connection, one private company and three plants of the public sector.

- Similar remarks apply, obviously enough (no production, no need for engineering), to mechanical engineering, both product design and industrial engineering. The point has been made explicit in the information supplied by the Ministry of Industry, on UNIDO request.

C.3 - FUTURE DEVELOPMENTS

- Lists of new projects were supplied by Ministry of Industry, showing the status of each project (see table 2):

  A - already approved
  B - under active study
  C - project being contemplated

  For projects in A and B status the name of Applicant Company is Known. For status C only the type of industry is indicated; it has to be inferred that these projects have not yet reached the licence application stage.

- Some new lines of products are envisaged:
  - aluminum doors and windows
  - automotive components (radiators, springs, pedals)
  - bycicles (assembly and manufacture)
  - fishing boats
  - shaving blades
  - toys
  - welding electrodes.

- There seems to be a strong pressure from private entrepreneurs towards a further expansion of the metal industry; if all the projects were to be implemented, this sector would cover over 30% (as no. of plants) of the whole metal industry.

- With regard to tool-making and precision machining, no effort is beeing undertaken or envisaged in this area.

- A marked development effort is noticeable in two main groups of infrastructural concerns, namely "Engineering , Maintenance" and "Foundries".
  Besides that no undertaking of a new infrastructural type of industry is envisaged.

- From a statistical standpoint, considering the existing and the planned metal working industry, there is ample space - we should say, more appropriately, a urgent need - for the potential outputs of the MPDU, as described in this section.

- Examples of items which could be produced by the metal forming shop, and supplied to other industries, already existing or planned, are shown in table 3 to 13.

Annex C Tab. n° 1

METAL WORKING INDUSTRY (Private Sector)

DISTRIBUTION BY PRODUCT AND SIZE (in n° of employees)

PRODUCTS	N° of firms	SIZE					
		Und. 25	25 50	51 100	100 300	300 500	Over 500
Household utensils	6		1		1	2	1
Small hardware	5		3	1	1		
Furniture	24	12	5	2	4		
Bus skeletons, tanks, trailers	5	1	1	3			
Engineering works, metal prod., Maintenance	20	14	3	1		1	
Agricultural equipment	1				1		
Pipes, fittings, water works	6	1		3	2		
Foundries	2			2			
Electrical equipment	4		2	1			
Refrigerators, coolers	3			1			
Car assembly	2						
Crown corks, tins containers	10		1	4	5		
Total	88*	25	16	18	14	3	1

NOTE :

* The n° of employees is not known for 11 companies.

Annex C Tab. n° 2

DATA ON FUTURE DEVELOPMENT OF THE METAL WORKING INDUSTRY

This data has been supplied by the Ministry of Industry-responsible for granting licences - in the form of three lists:

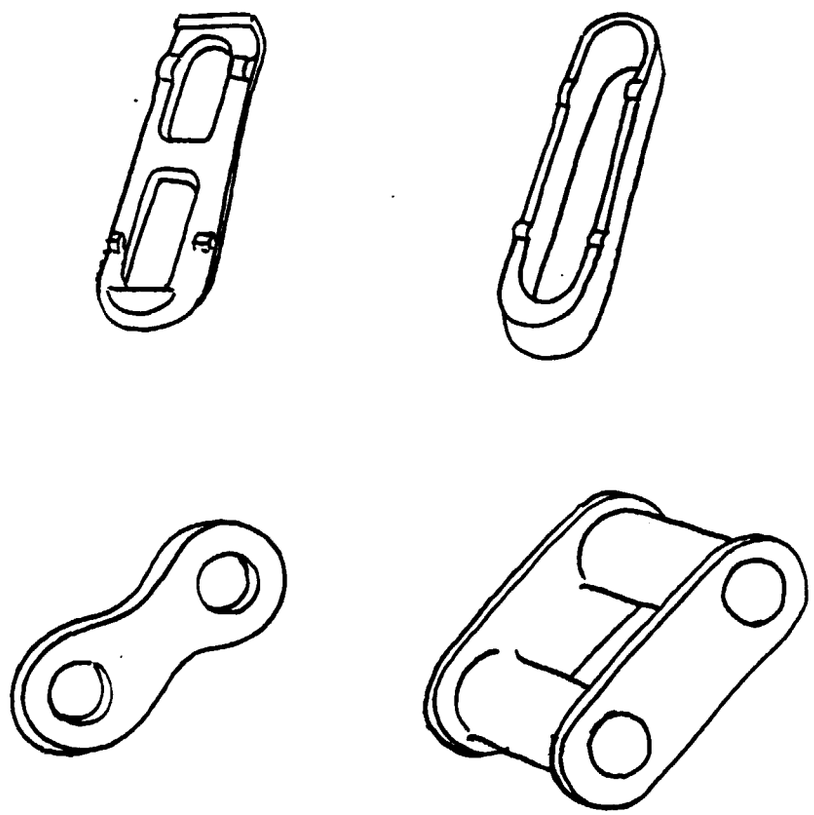
A - Already approved new plants
B - Projects under active study
C - Projects being contemplated.

	PRODUCT	STATUS		
		A	B	C
A	Household utensils		1	
B	Small hardware (nails, brushes, bolts, nuts, springs, wire)	2	3	1
C	Furniture (metal)	5	25	29
D	Bus skeletons, tanks			
E	Engineering works, metal products, maintenance spare parts, workshops	2	7	15
F	Crown corks, tin containers	2	5	9
G	Agricultural equipment	1	1	4
H	Pipes, fittings, water works	1	1	1
I	Foundries	1	8	13
L	Electrical equipment: electric/fans, radio and TV assembly, welding electrodes	4	2	2
M	Refrigerators, coolers, cookers		3	
N	Car assembly			
O	Other: car parts (clutch and brake pedals, radiators, springs)	3		
P	Other: aluminum doors & windows		4	
Q	Other: shaving blades, toys	1		2
R	Other: bycicles, bycicle & motorcycle assembly		2	2
S	Other: fishing boats		1	
	Total	22	63	78

Annex C - Table 3

COMPONENTS FOR CONVEYORS

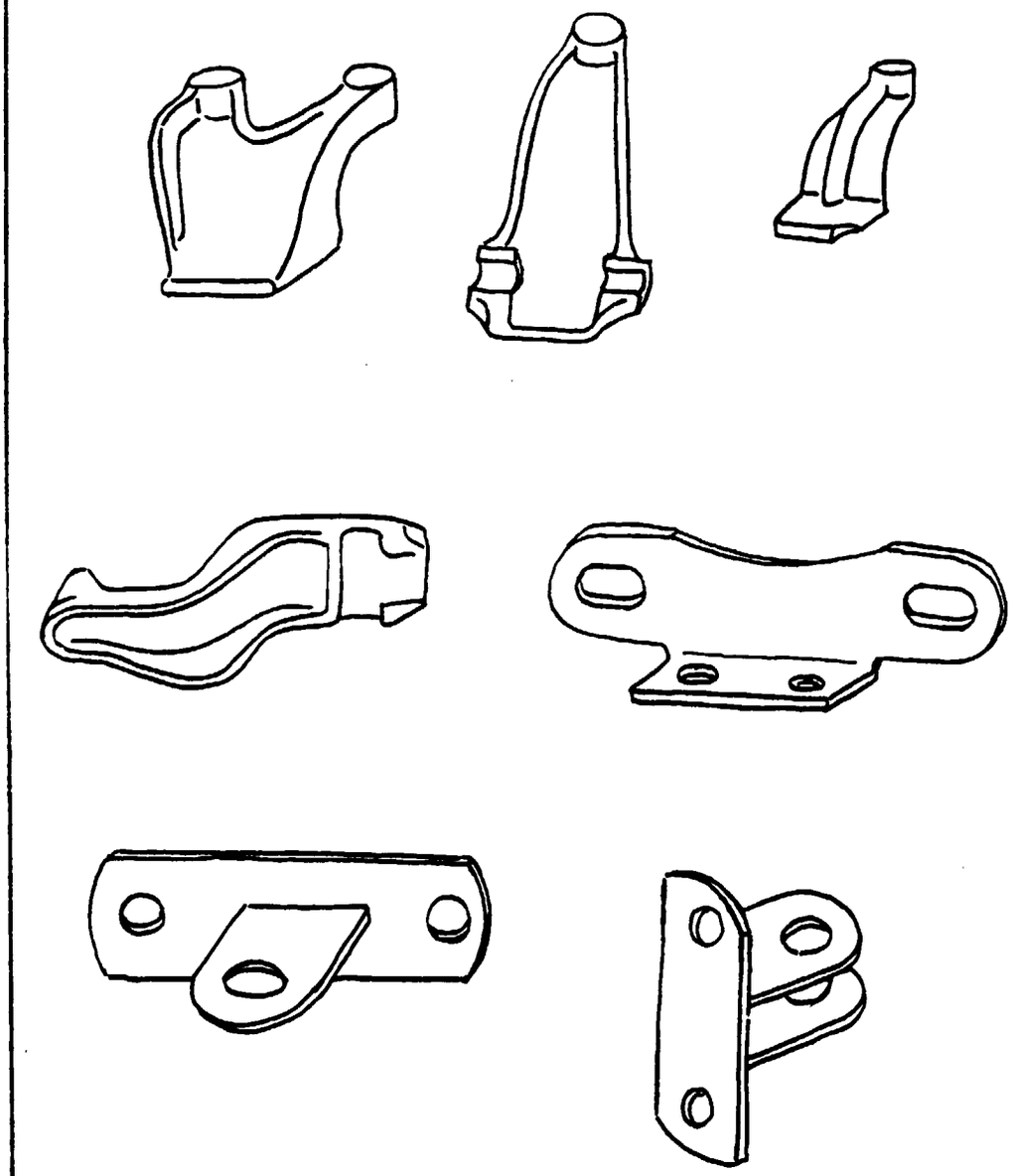
Links, bars, etc.



Annex C - Table 4

COMPONENTS FOR CONVEYORS

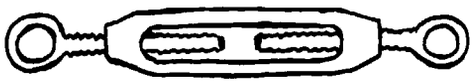
Brakets, supports, etc.

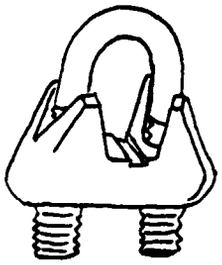


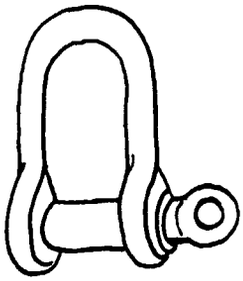
Annex C - Table 5

COMPONENTS FOR FARM EQUIPMENT

Turnbuckles, clamps, hooks, etc.



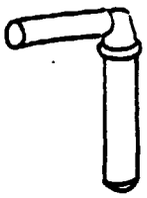


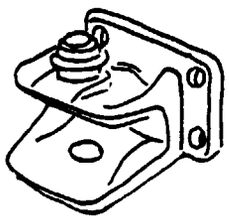


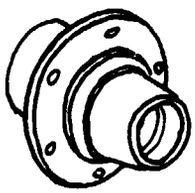
Annex C - Table 6

COMPONENTS FOR FARM EQUIPMENT

Pins, hooks, hubs, etc.



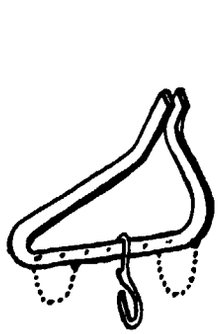




Annex C - Table 7

COMPONENTS FOR FARM EQUIPMENT

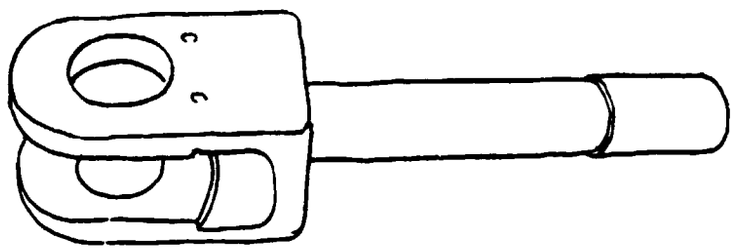
Seats, coulters, clamps, hitches, etc.

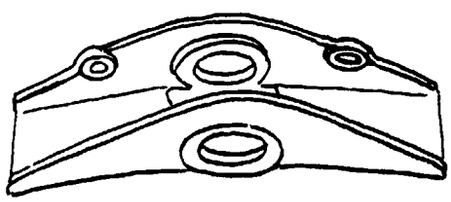


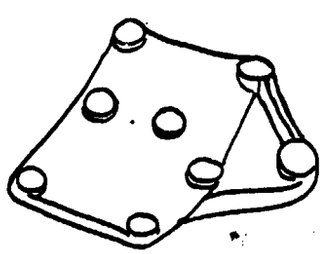
Annex C - Table 8

COMPONENTS FOR VEHICLES

Rods, brake, pads, etc.



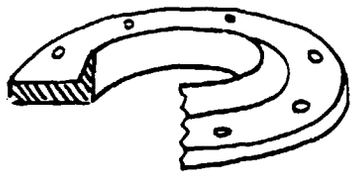


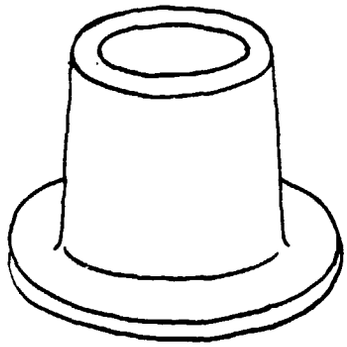


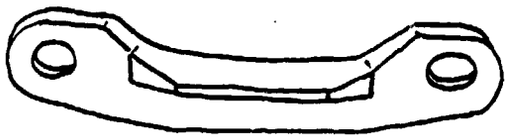
Annex C - Table 9

COMPONENTS FOR VEHICLES

Hubs, flanges, connectors, etc.



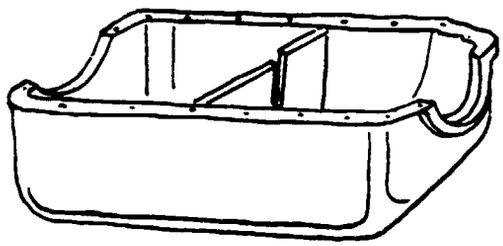


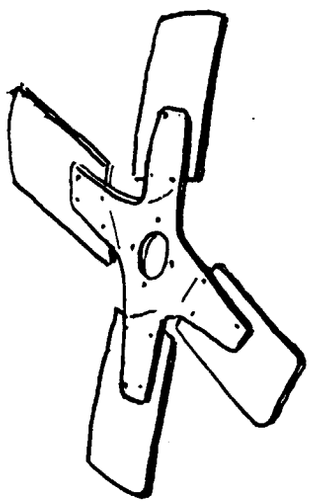


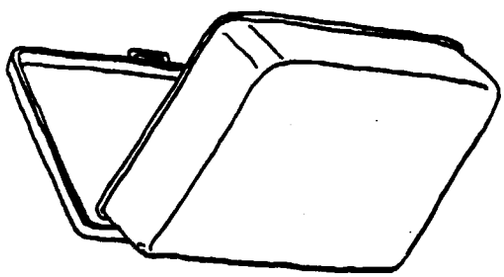
Annex C - Table 10

COMPONENTS FOR VEHICLES

Oil sumps, fans, tool boxes, etc.



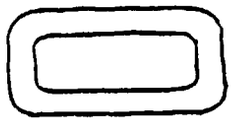


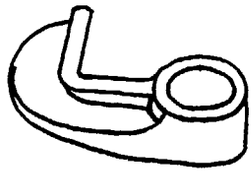


Annex C - Table 11

COMPONENTS FOR VARIOUS EQUIPMENT

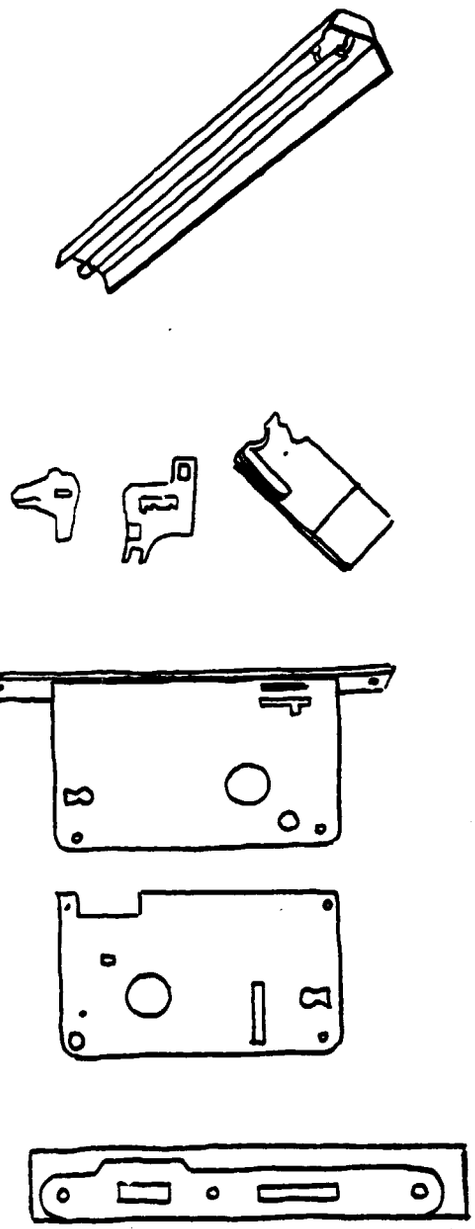
Brackets, hooks, hangers, etc.





Annex C - Table 12

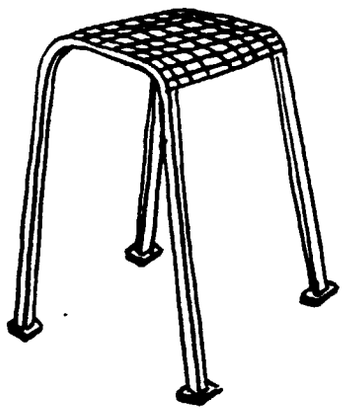
COMPONENTS FOR LIGHT FIXTURES AND LOCKS

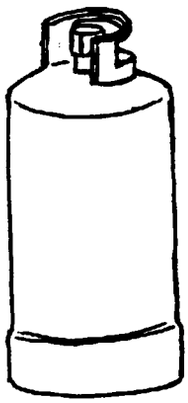


Annex C - Table 13

- PROTECTIVE STRUCTURE FOR TRACTORS

- L.P.G. CONTAINERS





Annex D

THE PLASTICS INDUSTRY

D.1 - Sources

D.2 - Remarks

Table

1 - Plastics Industry - Present situation and future development

D.1 - SOURCES

- List of Plastics factories currently in operation, prepared by the Ministry of Industry for UNIDO Mission.
- Industrial Investment Guide, issued by I.R.C.I.

D.2 - REMARKS

- The plastics industry has developed in recent years, at a fast pace. The annual rate of increase, up to 1976,has been around 20%.
  And this in spite - according I.R.C.I. publication - of several shortcomings, such as:
  - restrictions and high level of duties on import of processing equipment and basic resins, not available in the country
  - low technological level of people and environment
  - inadeguate growth of marketing and advertising channels
- The whole plastics industry is in private hands; some companies are tighted to European or Asiatic concerns, which are helping in providing technology and equipment.
- The industry concentrates on the following products:
  - footwear
  - PVC pipes, ropes, hoses and containers
  - PS and HDPE houseware
  - LPDE films
  - Miscellanea: cups, pens, fasteners, plastic sponge.
- Table 1 shows the present number of factories and the future development under consideration.

P L A S T I C S I N D U S T R Y

	PRESENT SITUATION (Distribution by size, n° of employees)							FUTURE DEVELOPMENT (see note)	
- n° of Employees	Under 25	25 50	51 100	100 300	300 500	Over 500	Tot. n° of Facto-ries	A	B
- n° of Factories	3	7	4	1		1	16	8	15

N O T E : A = already approved new plants
B = projects under active study

Annex 5 Tab. n° 1

Annex E

MACHINE-TOOLS JUSTIFICATION AND CHARACTERISTICS

E.1 - Justification of machine tools for the tool & die and for the training workshops

E.2 - List of equipment for said

E.3 - Justification of machine tools for the metal forming workshops

E.4 - List of equipment for said

E.5 - Equipment specifications

E.6 - List of suppliers

E.1 JUSTIFICATION OF MACHINE TOOLS FOR THE TOOL AND DIE AND FOR THE TRAINING WORKSHOPS

The task of this shop is the manufacture of dies - moulds - metallic patterns - jigs - tools; therefore, high precision and quality are the main characteristics of its operations. Unfortunately, in Sudan the level of professional experience in this field is, at present, still rather low since the metal industry is at its very beginning: it will take a certain period of time to train the young pupils of technical schools to become highly specialized precision workers. Even after qualification, years of practical experience in workshop will be required to obtain the skill necessary for the manufacturing of certain types of moulds used, for instance, by the plastic industry.

Consequently, it can be easily understood that the importance and the difficulty of parts manufactured should increase slowly and gradually; therefore the scheduling of production should be made carefully in order to meet a constant, but not too sharp, increase of skill required.
Nevertheless, from the beginning, due to the type of production that should be manufactured, the maximum level of precision must be required: even simple jigs or bending dies must be machined within the very tight limits of tolerance required. This in order to obtain that particular mental mind habit which is indispensable to deal with highly sophisticated tooling. On the other hand, the type of work that must be performed in this workshop and the present conditions of the Sudanese market do not require for too fast and automatic operations and give sufficient time to accomplish the task of forming groups of well trained mechanic workers for the starting Suda-

nese metal industry.
These, then, the characteristics which have guided the choice of different machines for the tool and die shop: precision, quality, durability but not automation or highly sophisticated devices.

Six precision lathes have been foreseen (for tool making), three of them are medium size h=225 mm and L 1000 mm, two have smaller dimensions h=180 and L. 800 mm; one gives possibility of operation on big parts h=375 and L=2000.

Heavy milling operations, which are generally required in the early stages of tool manufacturing, can be performed with an horizontal milling machine having an installed power of 10 KVA, Table 1600 x 450.

General precision milling can be obtained from four universal milling machines; two are of small size - table 600 x 200 mm, 1 KVA - and two of medium size - table 1000 x 300, 6 KVA.
For copy-milling only one machine has been foreseen but with very good characteristics: table 2700 x 600; hydraulic copying: 6 KVA.

The best and most qualified machines have been foreseen for milling and jig boring; two of them will be operating: one for small dimension parts - table 210 x 600, KW3; one for big parts - table 550 x 1400, 14 KVA. The accuracy of these machines should be of 0.005 mm.

The finishing of dies, moulds etc. requires a Pantograph of high precision and a Sparkerosion machine; tank of 950 x 630 mm, up to 60 A.

Three grinding machines have been foreseen: two for surface grinding - one small with table of 700 x 600 mm and a medium one with table of 1100 x 300, both 10 KVA - and one for external and internal cylindrical grinding

h=160 mm, L=500 ÷ 1500 mm, 6 KVA.

Sharpening can be accomplished by means of three units: one universal sharpener - table 650 x 100 mm - one drill sharpener, and one single cutter mill grinder.

For testing dies and moulds two presses have been provided: one hand screw press of 22 Tons and one hydraulic die spotting press of 50 Tons.

Finally, some auxiliary machines have been foreseen: some drills, a radial drill, a double ended grinder, a shaper, an hack-sawing machine.

Machine tools for the training department are of two types: training machines and production machines, This because it has been fixed that the trainees, already from the 2nd year, will do some production work for the tool and die shop.
As far as the second type of machines is concerned, same models have been chosen for both the training and the tool and die workshop in order to give to the trainees the possibility of getting acquainted with the same type of machines that they will use afterwards. Ten lathes, six milling machines, three grinders - one for surface and two cylindrical - one filing and sawing machine, one pillar drill and several bench grinders and drill have been provided. To these 24 working positions at the machine tools, 24 fitter benches and two surface plates - 1500 x 100 mm for at least 4 ÷ 6 tracers - have been added.

EQUIPMENT SPECIFICATION-TOOL & DIE WORKSHOP						
ITEM NO.	DESCRIPTION	TOT KW	Qty No.	TOTAL COST MACHINES $	EQUIPMENT $	SPARES $
1	HIGH PRECISION TOOL-MAKER LATHE: h 180 - L 800 CHUCK HOLE Ø 50	6	2	13800	2400	1380
2	HIGH PRECISION TOOL-MAKER LATHE: h 225 - L 1000, Ø 52	21	3	45000	8200	4500
3	HEAVY DUTY LATHE: h 375 - L 2000		1	43000	5000	4300
4	HYDRAULIC COPY MILLING MACHINE	6	1	72000	7600	7200
5	PRECISION UNIVERSAL MILLING AND JIG BORING MACHINE	14	1	106000	6000	10600
6	PRECISION UNIVERSAL MILLING AND MINI JIG BORING MACHINE	3	1	25000	6000	2500
7	HORIZONTAL HEAVY DUTY MILLING MACHINE	10	1	55000	5600	5500
8	SPARK EROSION MACHINE	6	1	103500	12500	5000
9	PRECISION-HYDRAULIC SURFACE GRINDER: TABLE 1100 x 300	10	1	57000	5000	5700
10	PRECISION-HYDRAULIC SURFACE GRINDER: TABLE 700 x 300	10	1	37000	4400	4000
11	UNIVERSAL CYLINDRICAL GRINDING MACHINE, EXTERNAL - INTERNAL	12	1	15600	2000	1600
12	RADIAL DRILLING MACHINE: 1300 RADIUS	3	1	26500	3400	2650
13	FILING & SAWING MACHINE: TABLE 300 x 400	3	1	9500	-	950

EQUIPMENT SPECIFICATION - TOOL & DIE WORKSHOP						
	DESCRIPTION	TOT KW	Qty No.	TOTAL COST MACHINES $	EQUIPMENT $	SPARES $
14	BENCH DRILL AND TAPPING MACHINE: Ø 18,TABLE 315x340	1	1	3000	-	300
15	PILLAR DRILL AND TAPPING MACHINE: Ø 32,TABLE 350x350	1	1	3500	900	350
16	PRECISION UNIVERSAL MILLING MACHINE: TABLE 1000 x 300	6	2	60000	10300	6000
17	PRECISION UNIVERSAL MILLING MACHINE: TABLE 600 x 200	2	1	17000	SEE TRAINING	
18	ENGRAVING MACHINE - PANTOGRAPH	2	1	53000	10000	5300
19	HANDOPERATED PRECISION SCREW PRESS : 22 TON, TABLE 500 x 400	-	1	2500	400	-
20	BENCH GRINDER-DOUBLE ENDED	1	1	1000	-	-
21	SURFACE PLATE - 1500 x 1000 x 900	-	1	1000	-	-
22	PRECISION DIE SPOTTING PRESS: TABLE 1000 x 800, 50 TON	5	1	45000	-	4500
23	FITTER BENCH W. VICE: 1500 x 800 x 900	-	17	10500	-	-
24	BENCH: 200 x 500 x 700	-	34	4500	-	-
25	TOOL CABINET: 800x400x 1000	-	23	3000	-	-

EQUIPMENT SPECIFICATION - TOOL & DIE WORKSHOP						
	DESCRIPTION	TOT KW	Qty No.	TOTAL COST MACHINES $	EQUIPMENT $	SPARES $
26	SINGLE CUTTER MILL GRINDING MACHINE	1	1	4500	300	450
27	UNIVERSAL TOOL & CUTTER GRINDER: TABLE 650 x 100	1	1	6700	3000	670
28	DRILL SHARPENER	1	1	2900	-	300
29	HACKSAWING MACHINE	1	1	2500	-	250
30	HANDOPERATED PRECISION SURFACE GRINDER	1	1	4800	800	500
31	LIFTING & HANDLING EQUIPMENT	-	5	8000	-	-
-	UNLOADING AND INSTALLING			27700		
	TOTAL	127	-	870000	93800	74500
	INSPECTION TOOLING			33000	-	-
	TURNER'S TOOL SET		6	2500		
	MILLING MACHINE OPERATOR'S SET		8	3000		
	GRINDING MACHINE OPERATOR'S SET		3	1700		
	FITTER'S TOOL SET		15	13200		
	FURNITURE FOR TOOL-ROOM		-	600		
	TOTAL	127		54000		
	TOTAL	127		924000	93800	74500

EQUIPMENT SPECIFICATION - TRAINING SHOP						
	DESCRIPTION	TOT KW	Qty No.	TOTAL COST MACHINES $	EQUIPMENT $	SPARES $
1	HIGH PRECISION TOOL-MAKER LATHE: h 180 - L 800 CHUCK HOLE ø 50	30	10	69000	10000	6900
10	PRECISION-HYDRAULIC SURFACE GRINDER: TABLE 700 x 300	10	1	37000	4400	4000
11	UNIVERSAL CYLINDRICAL GRINDER MACHINE	24	2	31200	2000	3120
13	FILING & SAWING MACHINE: TABLE 300 x 400	3	1	9500	-	950
15	PILLAR DRILL AND TAPPING MACHINE: ø 32, TABLE 350 x 350	1	1	3500	900	350
16	PRECISION UNIVERSAL MILLING MACHINE: TABLE 1000 x 300	6	2	60000	10350	6000
17	PRECISION UNIVERSAL MILLING MACHINE: TABLE 600 x 210	8	4	67400	28800	6740
20	BENCH GRINDER - DOUBLE ENDED	1	1	1000	-	-
21	SURFACE PLATE: 1500 x 1000 x 900	-	2	2000	-	-
23	FITTER BENCHES W. VICE: 1500 x 800 x 900	-	2	1200	-	-
24	BENCHES: 2000 x 500 x 700	-	4	500	-	-
25	TOOL CABINET: 800x400x1000	-	12	1500	-	-
31	LIFTING & HANDLING EQUIPMENT	-	2	1500	-	-
32	VERTICAL BANDSAW	1	1	5400	850	540

EQUIPMENT SPECIFICATION-TRAINING SHOP						
ITEM NO.	DESCRIPTION	TOT KW	Qty No.	TOTAL COST MACHINES $	EQUIPMENT $	SPARES $
33	FITTER BENCHES W. VICE: 1000 X 670 X 900	-	24	7600	-	-
34	SENSITIVE DRILL	3	3	3900	300	400
35	WOOD BENCH FOR SENSITIVE DRILL	-	1	300	-	-
-	UNLOADING AND INSTALLING	-	-	25500		
	TOTAL	87		328000	57600	29000
	TURNER'S TRAINING TOOLS	-	10	800	-	-
	MILLING MACHINE OPERATOR'S TRAINING TOOLS	-	6	600	-	-
	GRINDING MACHINE OPERATOR'S TRAINING TOOLS	-	3	1800	-	-
	FITTER'S TRAINING TOOLS	-	16	7000	-	-
	FURNITURE	-	1	800	-	-
	TOTAL	87		11000		
	TOTAL	87		339000	57600	29000

E.3 JUSTIFICATION OF THE MACHINE TOOLS FOR THE METAL FORMING WORKSHOP

Justification of the different machine tools foreseen in the metal forming shop appears clearly from the attached chart where the different flows of materials are described.
Starting from the raw materials:

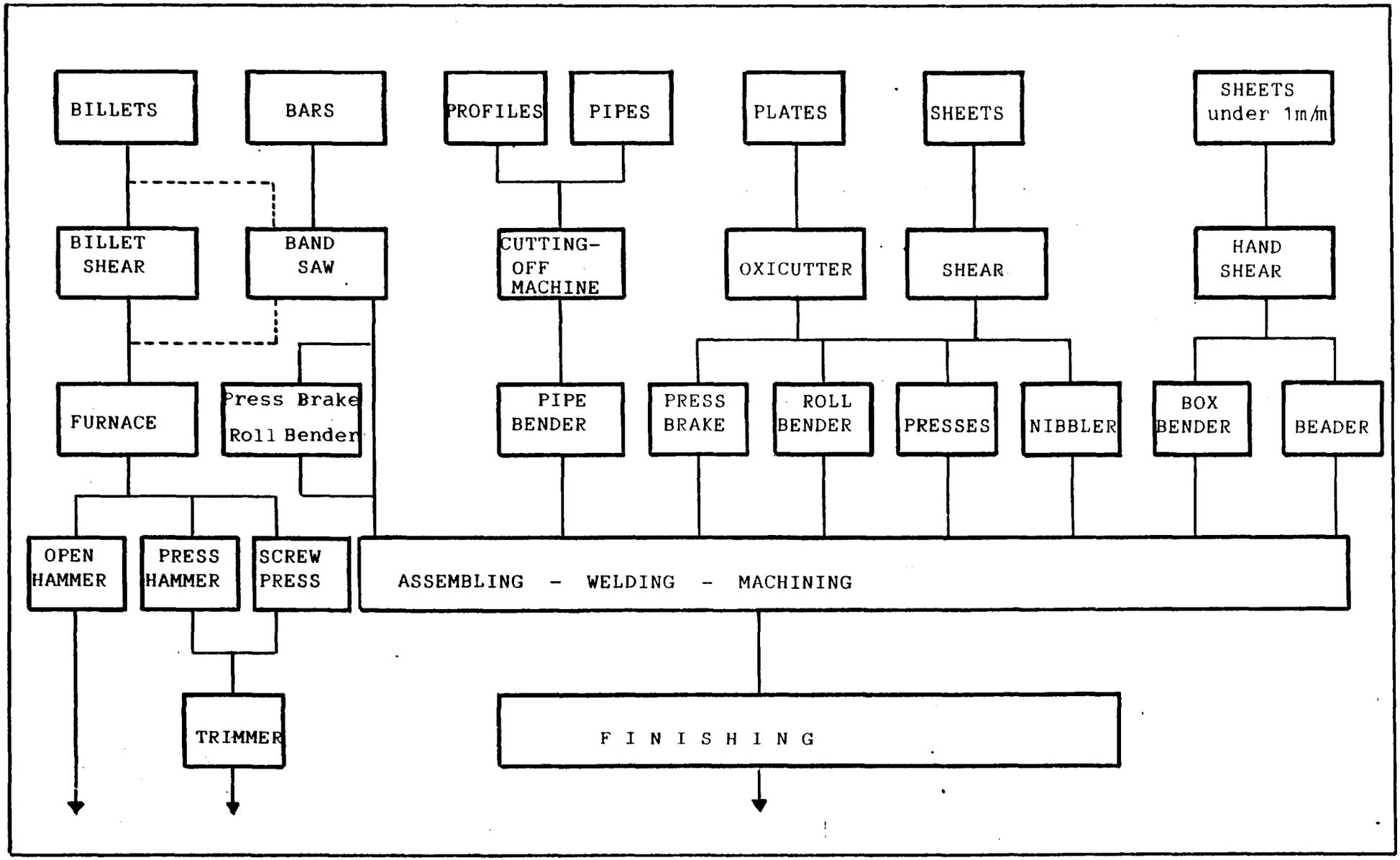
- Billets
- Bars
- Profiles
- Pipes
- Plates
- Sheets
- Thin sheets

there are different lines of flow.

- Billets, with cross sections up to 80 x 80 mm, can be cut at the billet shear which is a very productive machine able to grant the quantities that the forging shop, with 3 stamping units, could require. In case of necessity a band saw can integrate or substitute the billet shear. This machine is normally used for bar cutting.
Three furnaces are provided for heating up the parts. In normal conditions two of them are sufficient but, due to the very long periods of time required for their overhauling - which does not rarely occur - three units have been foreseen. Their disposition is such that minimum handling from furnaces to hammers or to the press is required.

The four stamping machines which have been foreseen are: forging hammer, press hammer, screw press and trimmer: they give wide possibility of operation in almost any kind of forging that could be required at this stage, by the Sudanese market. Open forging can be done adequately at the C hammer while the rather big press hammer can forge parts up to 10 Kg. (Compressed air for this machine is provided from the central air station). With the screw friction press

- METAL FORMING & FORGING FLOW CHART -



we have all the advantages that derive from the mechanical transmission. Trimming comes as necessary complementary operation, but this press with 120 Tons has been chosen so that it can be utilized also in different operations.

Still in hot forming this plant has another possibility: the use at the hydraulic 200 Tons press which should normally operate for cold stamping.

- Steel plates, which shall have the average dimensions of 6000 x 2000 mm, are stored under crane, at the end of the metal forming building. They will be moved for the first operation to the oxicutter where four torches can be used simultaneously to cut the plates.
Then parts can be grinded at a big double-end pillar grinder (Ø 600 mm) and straightened with an hydraulic press of 100 Tons. Plates under 15 mm can also be cut by means of guillotine shears able to cut a maximum width of 3000 mm.
Afterwards, parts can be bent at a press brake, or rolled at a roll bender, or drilled at a radial drill.
Thin metal sheets must be stored inside the building to avoid rusting and damaging.
The same guillotine shear, used for plates up to 15 mm thick, can be utilized for squaring these sheets and also the press brake and the roll bender can be used while, to cut particular shapes in limited number, a nibbler has been foreseen. Thin sheets can be cold formed with presses. There are 3 different units: one 200 Tons hydraulic press with table 1300 x 1000 mm; one 70 Tons and one 25 Tons eccentric presses with table of 550 x 750 mm and 350 x 500 mm respectively.

A large section has been provided for fabricating and welding. There are many different welding machines giving the possibility to use the most suitable type

of technology: rod-arc welders; solid and hollow wire CO_2 welders; oxyacetylenic welders, spot welders.

Should the necessity arise to weld parts of very big dimensions, the outside, but covered, area under crane can be utilized.

Very thin metal sheet parts can be required in a variety of applications and, due to the limited cost of the machine tools necessary for this type of manufacturing, a complete set has been foreseen with: hand shear, box bender, beading machine.

Finally, as far as finishing is concerned, a painting booth has been provided.

EQUIPMENT SPECIFICATION-SHEET METAL FORMING & FORGING SHOP						
ITEM NO.	DESCRIPTION	Tot KW	Qty No.	TOTAL COST MACHINES $	EQUIPMENT $	SPARES $
36	OXYCUTTER	1	1	43500	600	4300
37	STRAIGHTENING PRESS	3	1	10200	3150	1000
38	PEDESTAL GRINDER - DOUBLE ENDED ø 600	1	1	1900	250	-
39	HYDRAULIC PRESS:200 TON	37	1	110000	11500	11000
40	NIBBLER	2	1	28800	10700	2880
12	RADIAL DRILLING MACHINE: 1300 RADIUS	3	1	26500	3470	2650
41	ECCENTRIC PRESS:70 TON	6	1	12500	-	1250
42	ECCENTRIC PRESS:25 TON	2	1	6300	-	630
43	ROLL BENDER MACHINE	13	1	26600	950	2660
44	PRESS BRAKE	10	1	50000	6250	5000
45	GUILLOTINE SHEAR	18	1	59000	2500	5900
46	CUTTING-OFF MACHINE	1	1	1800	300	180
47	PIPE BENDER	8	1	21500	2050	2150
48	OXYACETYLENIC WELDER	-	2	1400	-	-
49	SURFACE PLATE	-	1	1000	-	-
50	HANDLEVER SHEAR	-	1	2300	-	-
51	HAND-OPERATED BOX BENDER	-	1	3700	-	-
52	BEADING MACHINE	2	1	4800	-	480
53	SPOTWELDER	15	1	1600	-	160

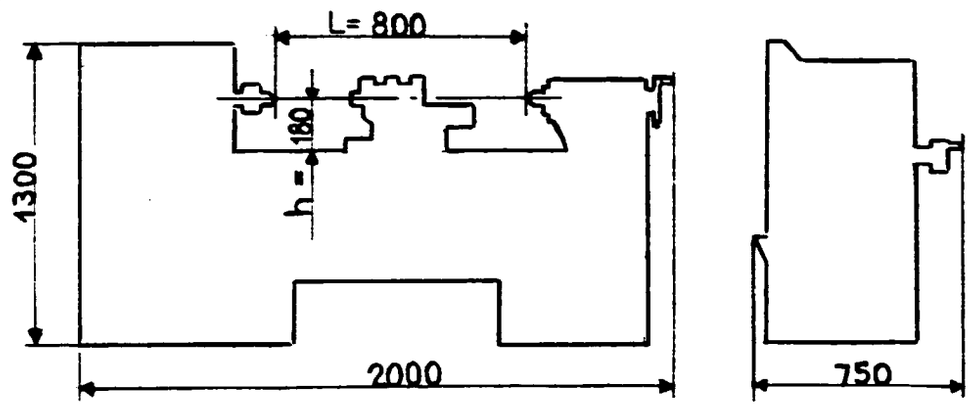
EQUIPMENT SPECIFICATION-SHEET METAL FORMING & FORMING SHOP						
ITEM NO.	DESCRIPTION	Tot KW	Q.ty No.	TOTAL COST MACHINES $	EQUIPMENT $	SPARES $
54	ARC WELDER	-	3	2700	200	-
55	STEEL SURFACE PLATE	-	1	1300	-	-
56	WIRE CO_2 WELDER 300 A		1	4000	65	-
57	WIRE CO_2 WELDER 600 A		1	6000	65	
58	SPRAY PAINTING BOOTH	2	1	11300	-	1000
59	BILLET SHEAR	12	1	83500	300	7500
60	HORIZONTAL BANDSAW	2	1	11100	200	1100
61	OVERHEAD CRANE - 5 TON	12	2	40000	-	6500
62	SUPERVISOR OFFICE		1	1200	-	-
63	HEAT TREATMENT FURNACE 180° + 1050°	72	2	40000	10700	4000
64	QUENCHING TANKS - OIL & WATER	2	1	5600	-	-
65	TOOL CABINET AND BENCH FOR HEAT TREATMENT		-	800	-	-
66	FRICTION SCREW PRESS	8	1	39000	3750	3900
67	MUFFLE FURNACE FOR FORGING SHOP	12	3	9000	-	4500
68	TRIMMING PRESS:120 TON	11	1	16300	-	1660
69	OPEN-FRAME HAMMER	10	1	30000	-	2200
70	POWER HAMMER	-	1	120000	-	6000
71	HAND FORGING EQUIPMENT	-	-	3000		

EQUIPMENT SPECIFICATION - SHEET METAL FORMING & FORGING SHOP						
	DESCRIPTION	TOT KW	Qty No.	TOTAL COST MACHINES $	EQUIPMENT $	SPARES $
72	WEIGHING MACHINE	-	1	380	-	-
73	TOOL CABINET: 1000x500x1200	-	2	320		
74	DIE SHELF	-	3	2500		
75	TOOL CABINET FOR WELDER 400 x 500 x 1000	-	7	700		
76	SALT BATH FURNACE	16	1	15000		2000
31	LIFTING AND HANDLING EQUIPMENT		3	71600	-	-
20	BENCH GRINDER - DOUBLE ENDED	1	1	1000	-	-
14	BENCH DRILL	1	1	3000	-	300
35	BENCH FOR GRINDER & DRILL	-	-	300		
	UNLOADING AND INSTALLING	-	-	38000		
	TOTAL	283		971000	57000	80900
	ACCESSORIES FOR HORIZONTAL BANDSAW & CUTTING OFF MACHINE OPERATOR			30		
	ACCESSORIES FOR OXYCUTTER OPERATOR			40		
	ACCESSORIES FOR STRAIGHT-ENING PRESS OPERATOR			230		
	ACCESSORIES FOR SHEAR OPERATOR			150		

EQUIPMENT SPECIFICATION - SHEET METAL FORMING & FORGING SHOP

	DESCRIPTION	TOT KW	Qty No.	TOTAL COST MACHINES $	EQUIPMENT $	SPARES $
	ACCESSORIES FOR PRESS BRAKE OPERATOR			350		
	ACCESSORIES FOR BENDING MACHINE OPERATOR			70		
	ACCESSORIES FOR NIBBLER AND 200 T - 70 T - 25 T PRESS OPERATOR			40		
	ACCESSORIES FOR ROD AND WIRE WELDER OPERATOR			110		
	ACCESSORIES FOR OXYACETYLENE WELDER OPERATOR			65		
	ACCESSORIES FOR CARPENTER			8000		
	ACCESSORIES FOR SPRAYING OPERATOR			500		
	ACCESSORIES FOR PIPEBENDER OPERATOR			160		
	ACCESSORIES FOR ASSEMBLING OPERATOR			500		
	ACCESSORIES FOR FORGE			320		
	ACCESSORIES FOR HEAT TREATMENT			3200		
	COMPRESSED AIR STATION	100		55000		4000
	INSTALLING AND PIPING			12235		
	TOTAL			81000	57000	84900
	TOTAL	383		1052000	57000	84900

(1)



All dimensions only indicative

HIGH PRECISION TOOL-MAKER LATHES - h = 180 - L= 800

Power absorption 3 KW UNIT COST U.S. $ 6900

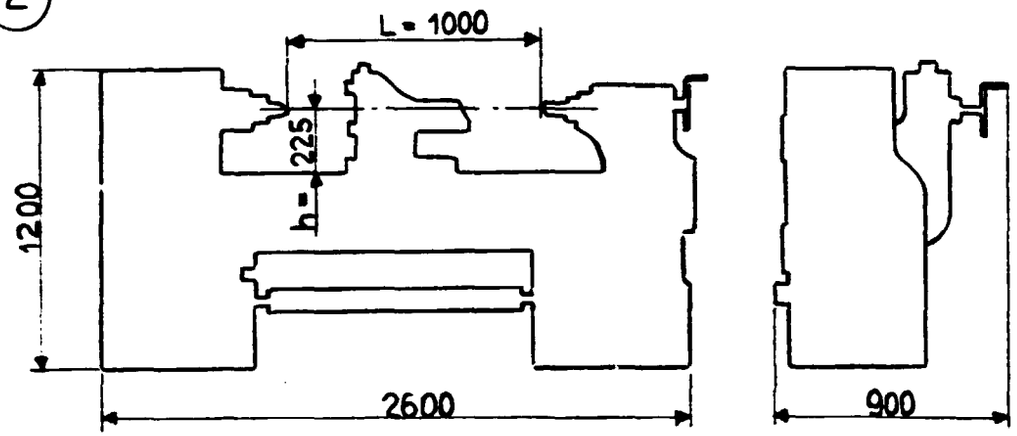
Qty. 2 in the tool shop

Qty. 10 in the training shop weight Kg. 1100

- SMALL - SIZE MACHINE
- FOR RELATIVELY SMALL PARTS
- GOOD FOR TRAINING PURPOSES

EQUIPMENT	TOOL SHOP $	TRAINING SHOP $
- 3 - jaw self-centering chuck and mounting accessories - Quick-lock tool turret complete with 6 tool holders - Workpiece carrier with 4 independent jaws	2400	10,000

(2)



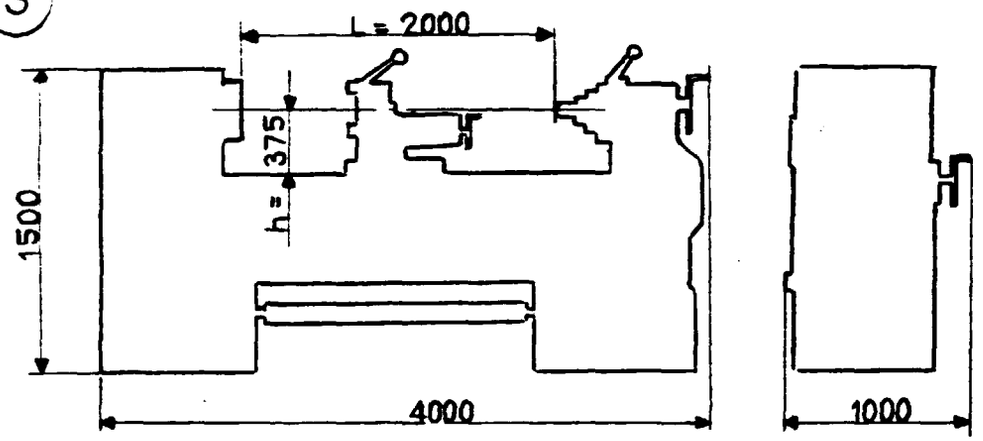
All dimensions only indicative

HIGH PRECISION TOOL-MAKER LATHES h=225 - L=1000	
Power absorption 7 KW	UNIT COST U.S. $ 15000
Q.ty 3	weight Kg. 2000

- MEDIUM-SIZE MACHINE
- SUITABLE FOR ALL TURNING OPERATIONS

EQUIPMENT	COST $
3-jaw self-centering chuck and mounting accessories Quick-lock tool turret complete with 6 tool holders Workpiece carrier with 4 independent jaws taper turning attachment	
	8200

(3)



All dimensions only indicative

HEAVY DUTY LATHES h=375 L=2000

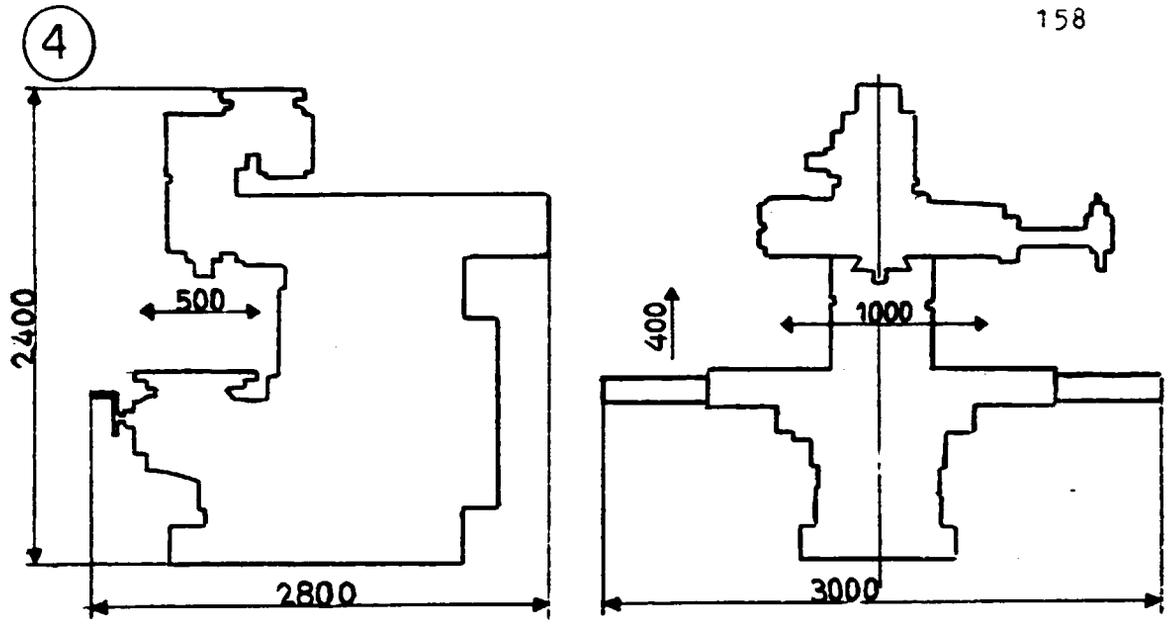
Power absorption 12 KW UNIT COST U.S. $ 43000

Q.ty 1

weight Kg. 5500

- LARGE SIZE MACHINE
- SUITABLE FOR MACHINING LARGE SIZE COMPONENTS

EQUIPMENT	COST $
3-jaw self-centering chuck and mounting accessories Quick-lock tool turret complete with 6 tool holders Taper turning attachment	5000



All dimensions only indicative

HYDRAULIC COPY MILLING MACHINE

Power absorption 6 KW

UNIT COST U.S.$ 72000

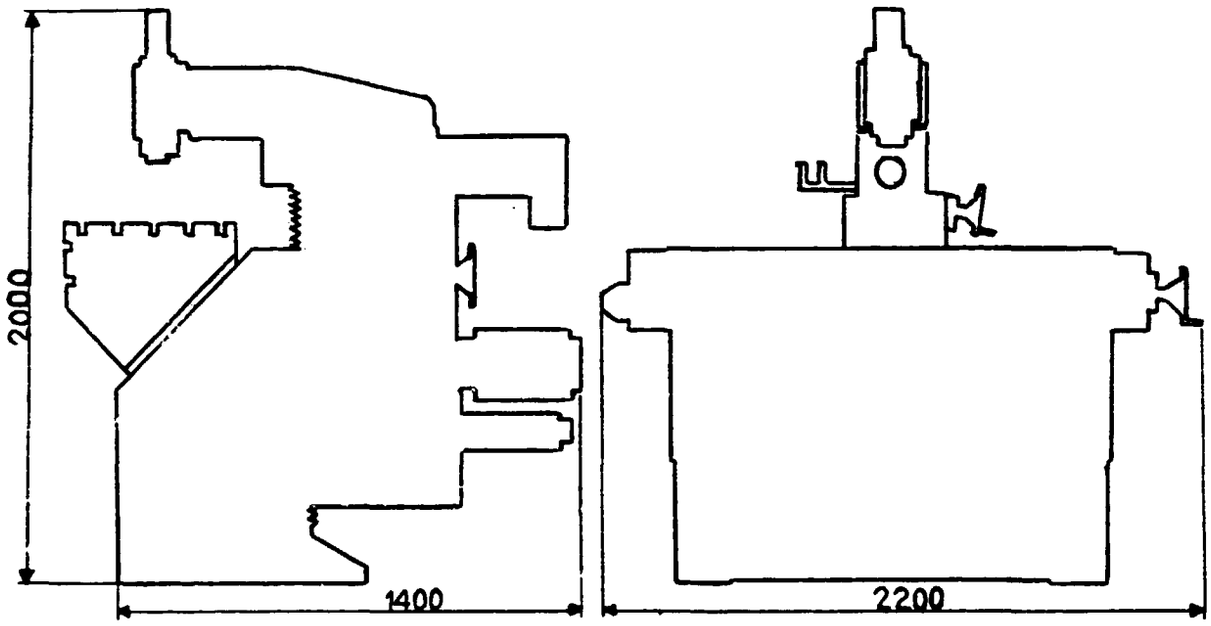
Q.ty 1

weight Kg. 5000

- HIGH-PRECISION, MEDIUM-SIZE MACHINE SUITABLE FOR TWO AND THREE DIMENSIONAL COPYING OPERATIONS
- SURFACE TABLE mm 2600 x 600

EQUIPMENT	COST $
- Automatic tool holder - Template carrier device - Revolving head - Pushbutton operated speed change	
	7600

(5)



All dimensions only indicative

PRECISION UNIVERSAL MILLING & JIG BORING MACHINE	
Power absorption 14 KW	UNIT COST U.S $ 106 000
Q.ty 1	weight Kg. 1 500

HIGH PRECISION BORING AND MILLING MACHINE INCLUDING

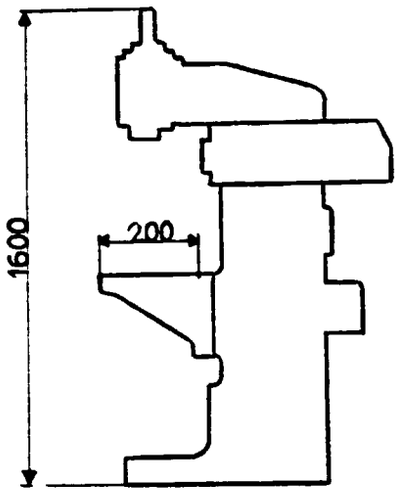
- 3-axis display with automatic positioning
- Fixed table
- Reclining vertical milling head
- 500 mm dia. dividing head

HORIZONTAL SURFACE PLATE mm 1000 x 440

VERTICAL " " mm 600 x 220

EQUIPMENT	COST $
- Spindles chucks - Automatic tool holder - Set of collets - " " accessories - " " adapters	
	6000

(6)



All dimensions only indicative

PRECISION UNIVERSAL MILLING & MINI JIG BORING MACHINE

Power absorption 3 KW

UNIT COST U.S.$ 25000

Q.ty 1

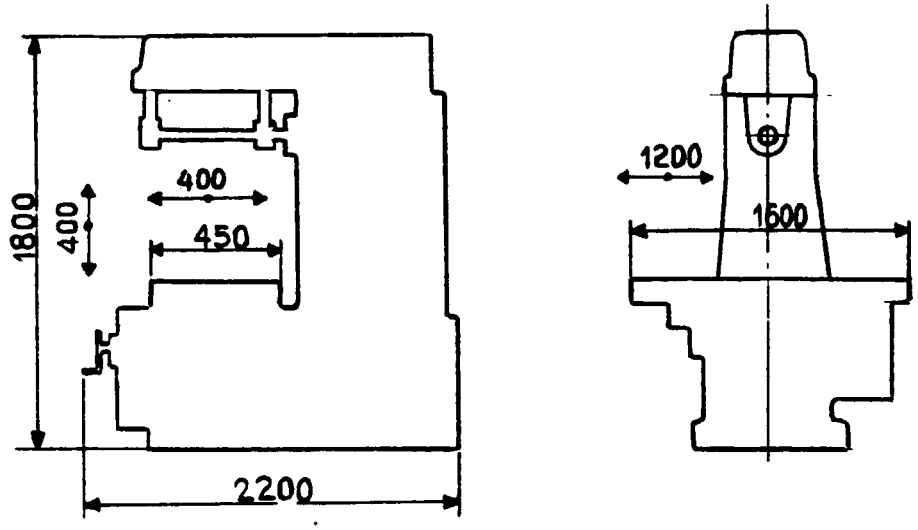
weight Kg. 800

HIGH PRECISION BORING AND MILLING MACHINE INCLUDING

- 3-axis display with automatic positioning
- High precision boring head
- Reclining vertical milling machine
- Fixed table

EQUIPMENT	COST $
- Spindles - chucks - Automatic tool holder - Set of collets - " " accessories - " " adapters	6000

(7)



All dimensions only indicative

HORIZONTAL HEAVY DUTY MILLING MACHINE

Power absorption 10 KW

UNIT COST U.S. $ 55 000

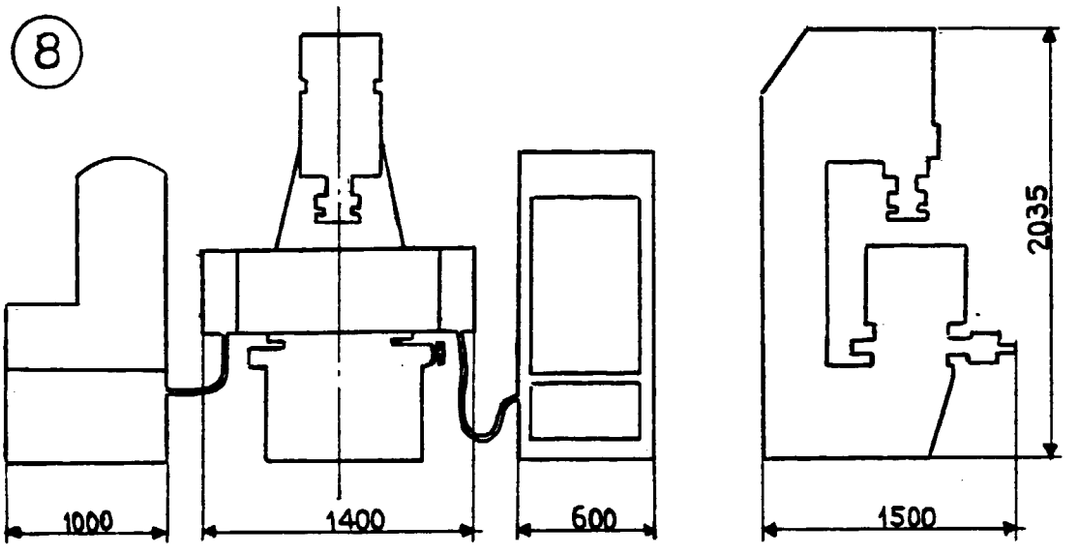
Q.ty 1

weight Kg. 3200

- SUITABLE FOR MACHINING LARGE SIZE COMPONENTS

EQUIPMENT	COST $
3-axis display Dividing head with tailstock Rotating clamps Cutter spindle Collet spindle	Included
	5600

(8)



All dimensions only indicative

SPARK EROSION MACHINE

Power absorption 6 KW — UNIT COST U.S. $ 103 500

Q.ty 1 — weight Kg. 3000

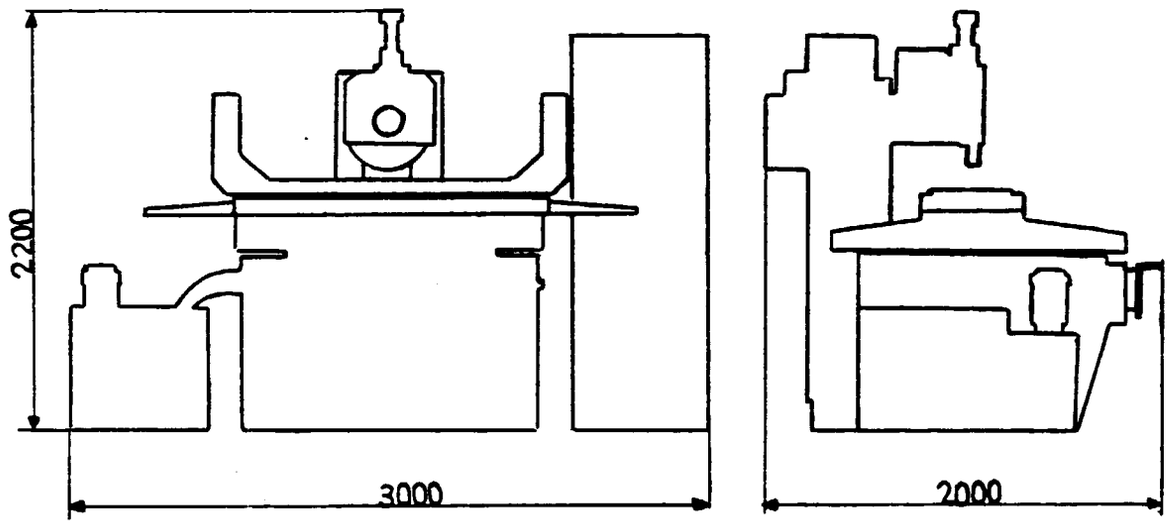
	$
_ Machine complete with 50 mm dia. gauge and microswitch on machine	60,000
Tool box	
Roughness meter	
_ GENERATOR 60 Amp. 2 channel	28,000
_ FOSSIL DUST FILTER COMPLETE WITH:	15,500
_ Pressure flushing pump	103,500
_ Pre-filter pump	
_ Fossil dust feed pump for filter element covering	
_ Rapid tank filling pump	

VARIOUS ACCESSORIES FOR MOUNTING AND CONSTRUCTION OF ELECTRODES

_ Mounting flanges	
_ Collet chucks	
_ Collets	
_ Angular adjusting devices	
_ Squareness adjustment devices	12,500
_ Squareness inspection column	
_ Electrode processing taper	
_ Electrode preparation head	

WORKING TANK INSIDE DIMENSIONS	mm	950 x 630
MAX COMPONENT SIZE	"	900 x 600
MAX DIELECTRIC FLUID HEIGHT	"	330
WORKPIECE TABLE SIZE	"	700 x 400

(9)



All dimensions only indicative

PRECISION HYDRAULIC SURFACE GRINDER

Power absorption 10 KW

UNIT COST U.S.$ 57 000

Q.ty 1

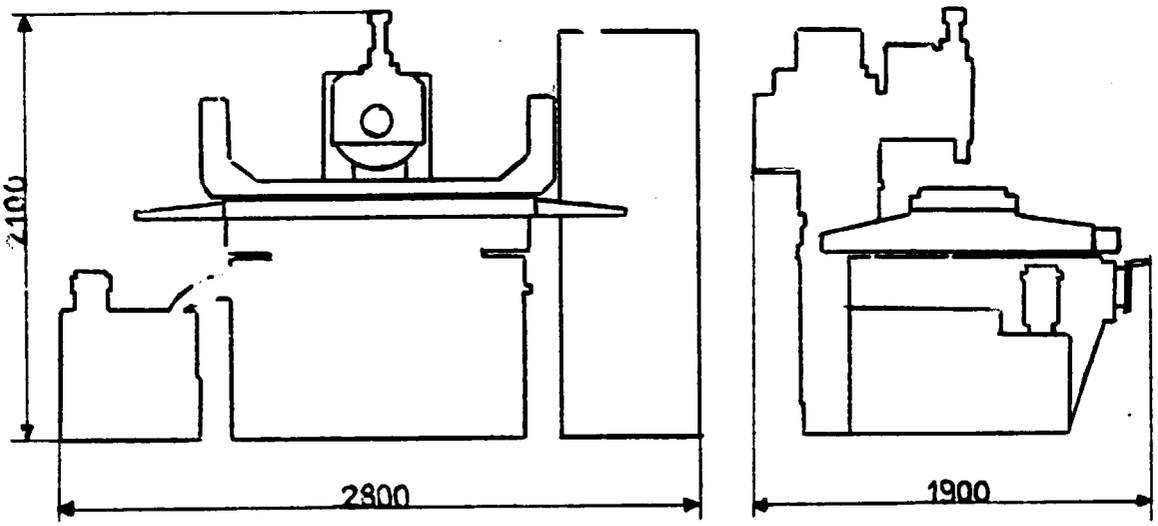
weight Kg. 3400

HIGH PRECISION SURFACE FINISHING MACHINE
FOR LARGE COMPONENTS

SURFACE TABLE mm 1100 x 300

EQUIPMENT	COST $
MAGNETIC CHUCK ADJUSTABLE VICE	
	5000

(10)



All dimensions only indicat ve

PRECISION HYDRAULIC SURFACE GRINDER

Power absorption 10 KW UNIT COST U.S. $ 37 000

Q.ty 1 in the tool shop

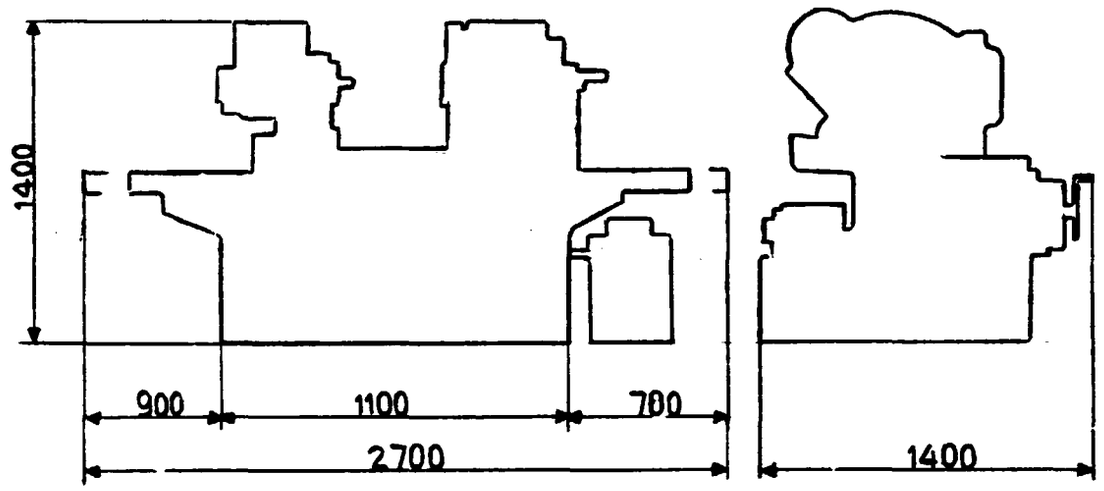
Q.ty 1 in the training shop weight Kg. 3100

HIGH PRECISION SURFACE FINISHING MACHINE FOR SMALL COMPONENTS

SURFACE TABLE mm 700 x 300

EQUIPMENT	COST $
MAGNETIC CHUCK ADJUSTABLE VICE	4400

(11)



All dimensions only indicative

UNIVERSAL CYLINDRICAL GRINDING MACHINE EXT./INTER.

Power absorption 12 KW UNIT COST U.S. $ 15 600

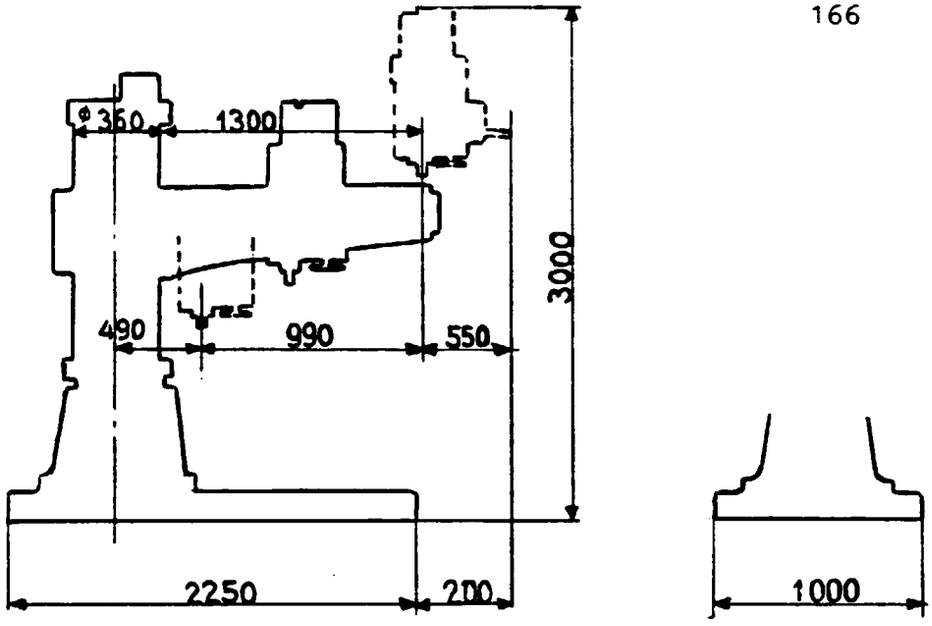
Q.ty 1 in the tool shop weight Kg. 1800

Q.ty 2 in the training shop

CENTRE DISTANCE	mm	500
STANDARD CENTRE HEIGHT	"	160
GRINDING WHEEL DIAMETER	"	400

EQUIPMENT FOR 3 MACHINE	COST $
6 self-centering chuck 6 set of internal grinding wheel spindlets - each set is composed of 5 parts of progressive length and mounting collets 3 Grinding wheel balancing benches (to be used also for surface grinder)	
	2000

(12)



All dimensions only indicative

RADIAL DRILLING MACHINE 1300 RADIUS

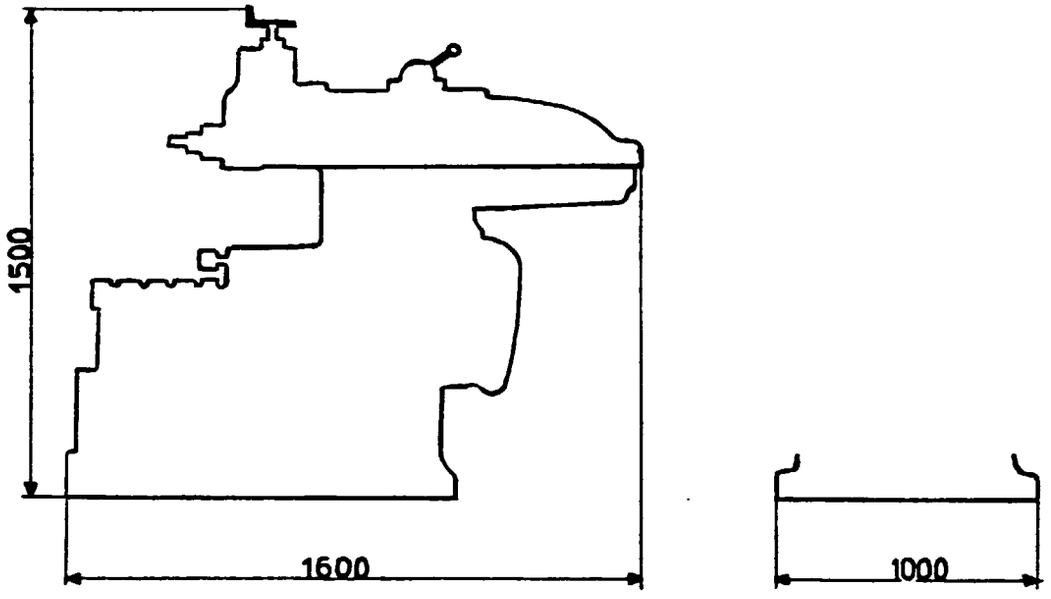
Power absorption 3 KW UNIT COST U.S. $ 26500

Q.ty 1 in the tool shop

Q.ty 1 in the sheet metal forming shop weight Kg. 3600

EQUIPMENT	COST $
FIXED BLOCK 750 x 600 x 500	
VICE CAPACITY 250 x 200	
CENTERING SPINDLE DIA 105 DIA 320	
QUICK CHANGE SPINDLE FOR MORSE 5 TAPER TOOLS	
3 MORSE 5 TAPER BUSHING	
3 " 3 " "	
3 SET OF MORSE TAPER ADAPTERS 5/4 - 3/2 - 3/1	
	3400

(13)



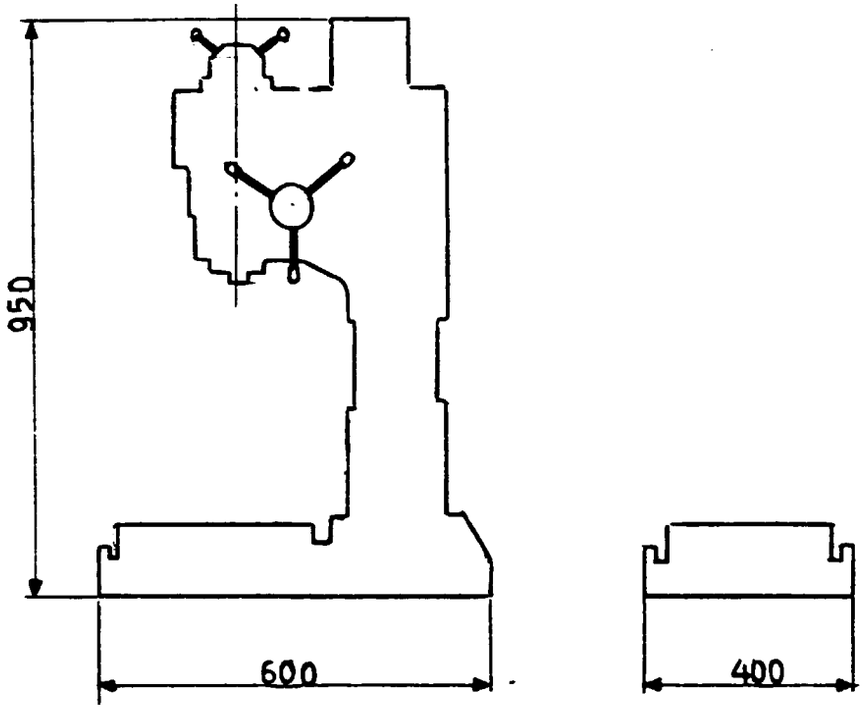
All dimensions only indicative

FILING AND SAWING MACHINE			
Power absorption	3 KW	UNIT COST U.S. $	9500
Q.ty	1 in the tool shop		
Q.ty	1 in the training shop	weight Kg.	900

Shaping machine complete with accessories and automatic tool holder feed

- Min. and max slide stroke	mm	25 ÷ 400
- Table horizontal stroke	"	460
- Table vertical stroke	"	300
- Table size	"	300 x 400 x 300
- Vice capacity	"	160

(14)



All dimensions only indicative

BENCH DRILL AND TAPPING MACHINE

Power absorption 1 KW

UNIT COST U.S. $ 3000

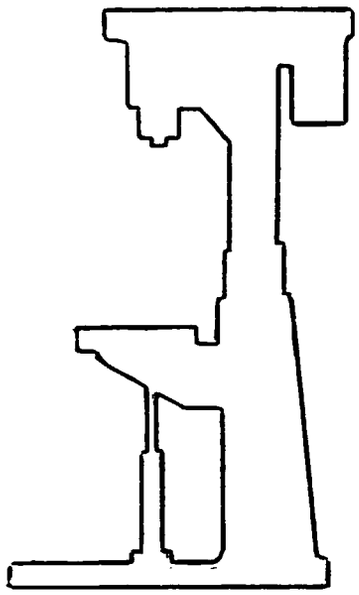
Q.ty 1

weight Kg. 110

- DRILLING CAPACITY mm 18
- MORSE morse taper 2
- TRAVEL OF SPINDLE mm 100
- HEADSTOCK VERTICAL DEPLACEMENT " 170
- RANGE OF SPINDLE SPEEDS r.p.m. 270 ÷ 3000
- TABLE DIMENSIONS mm 300 x 340

EQUIPMENT including type 15

(15)

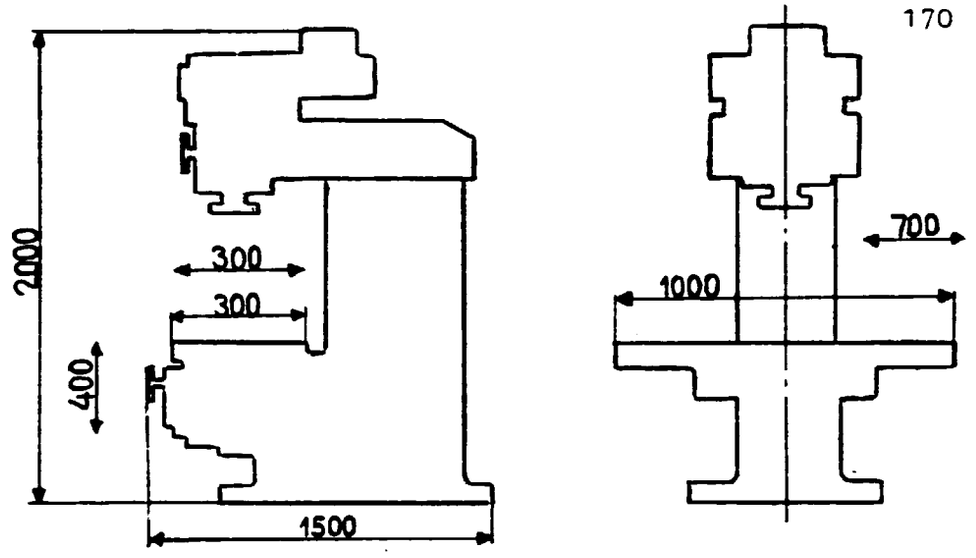


PILLAR DRILL AND TAPPING MACHINE Ø 32	
Power absorption 1 KW	UNIT COST U.S. $ 3500
Q.ty 1 in the tool shop	
Q.ty 1 in the training shop	weight Kg. 340

- DRILLING CAPACITY . mm 32
- SPINDLE CONNECTION morse taper 4
- MAX DISTANCE SPINDLE TO TABLE mm 630
- SPINDLE TRAVEL mm 130
- TABLE SIZE inch 13"3/4 x 13"3/4
- RANGE OF SPINDLE SPEEDS r.p.m. 85 ÷ 400

EQUIPMENT including type 14	COST $
- Self-clamping chuck 1- 0÷13 1- 3÷16 - Tap chuck 1 3÷10 1 10÷20 1 Threading die chuck (up to 38 mm dia) 1 1/4 ratio head for leader-type tapping machine for pitches below 0.5 dia	
	900

(16)



All dimensions only indicative

PRECISION UNIVERSAL MILLING MACHINE	
Power absorption 3 KW	UNIT COST U.S. $ 30 000
Q.ty 2 in the tool shop	
Q.ty 2 in the training shop	weight Kg. 1600

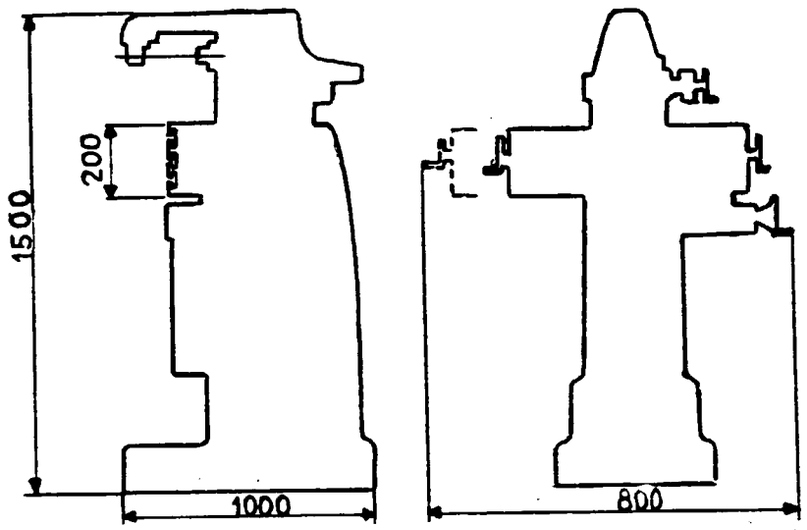
MILLING MACHINE WIDELY UTILIZED BY MANUFACTURERS
OF DIES AND SMALL TOOLS

3-AXIS DISPLAY

SURFACE TABLE = 1000 x 300

EQUIPMENT FOR 2 MACHINE	COST $
2 Rotating clamps 2 Indexing table with dividing head 2 Dividing head with tailstock h. 160 10 Cutter spindles 10 ISO 40 collet spindles 8 Set of collets	(Included)
	10300

(17)



All dimensions only indicative

PRECISION UNIVERSAL MILLING MACHINE

Power absorption 2 KW UNIT COST U.S. $ 17000

Q.ty 1 in the tool shop

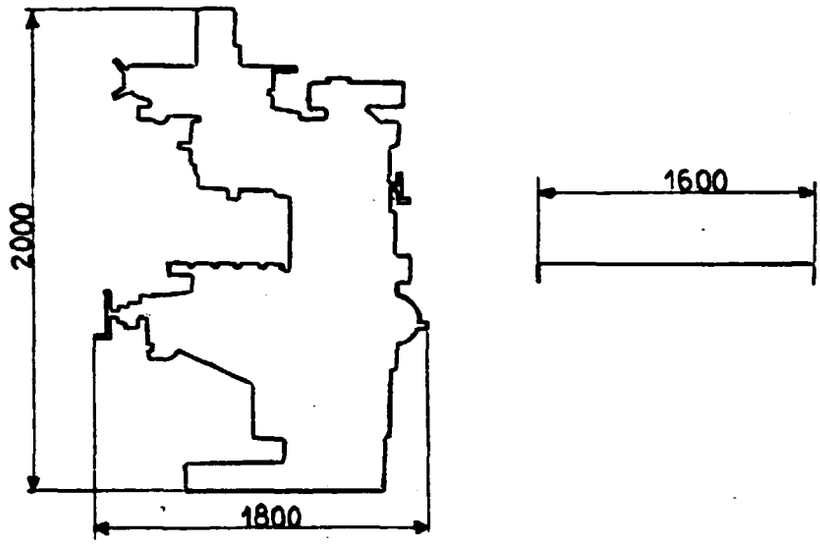
Q.ty 4 in the training shop weight Kg. 700

EXTRA SMALL MACHINE FOR TOOLMAKERS ESPECIALLY SUITABLE FOR TRAINING PURPOSES

SURFACE TABLE 600 x 200

EQUIPMENT for total machine	COST $
- Vertical swivel (360°) head with overarm for application to horizontal head	
- High speed swivel (360°) head with overarm and independent motor	
- Slotting head	
- Punch-milling device for fitting to dividing head	
- Universal dividing head assembly	
- Dividing head for helical milling	
- Adjustable 3-joint universal table 430 x 260	
- Fixed square table 600 x 200	
- Rotary circular table Ø 380	
- Cutter arbors Ø 16 - 27 - 32	
- Cutter spindles Ø 16 - 27 - 32	
- Bar collets plus spindles	
- Set of 3 sockets plus adapter	
	28800

(18)



All dimensions only indicative

ENGRAVING MACHINE - PANTOGRAPH

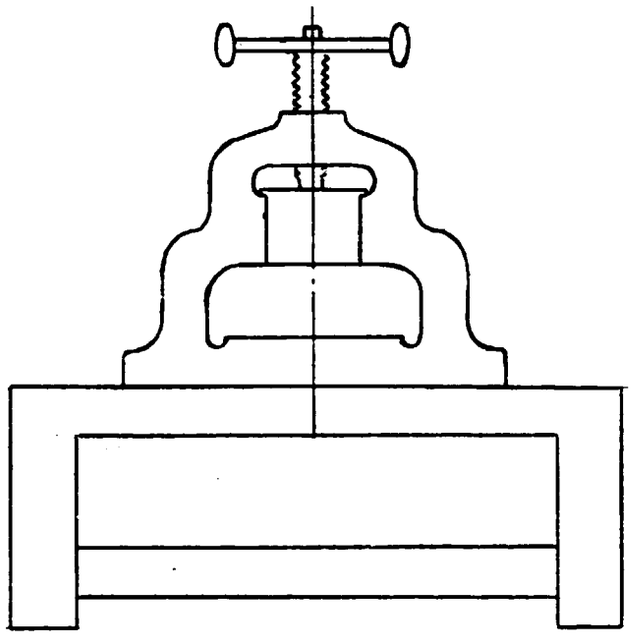
Power absorption 2 KW UNIT COST U.S. $ 53000

Q.ty 1 weight Kg. 1400

Manually controlled copying milling machine.
These machines, with standard attachments in the ratio 1 to 1 ensure high form precision and excellent surface finish

EQUIPMENT	COST $
- Enlarging and reducing device - Pattern milling - Roughing spindle	
	10,000

(19)



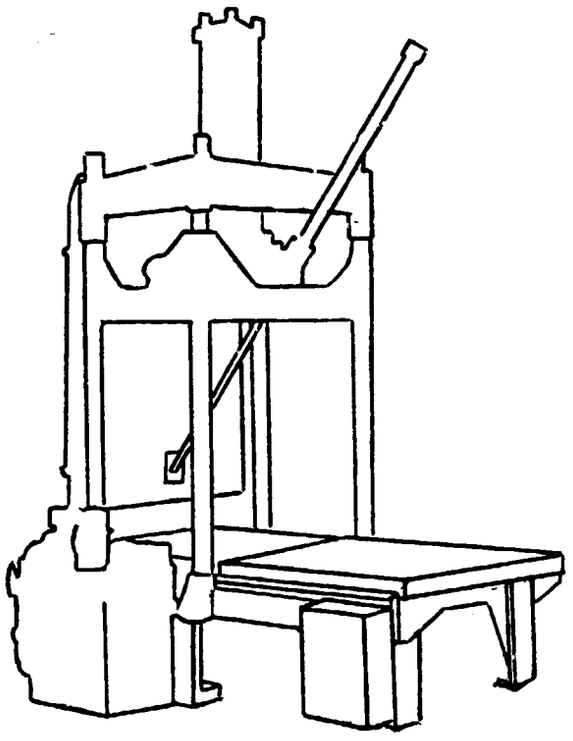
HANDOPERATED PRECISION SCREW PRESS	
Power absorption [—] KW	UNIT COST U.S. $ [2500]
Q.ty [1]	weight Kg. [700]

Small press for testing die

Table size	mm	500 x 400
Screw dia	"	80
Rating force	ton	22

EQUIPMENT	COST $
Bench wood top	(Included)
	400

(22)



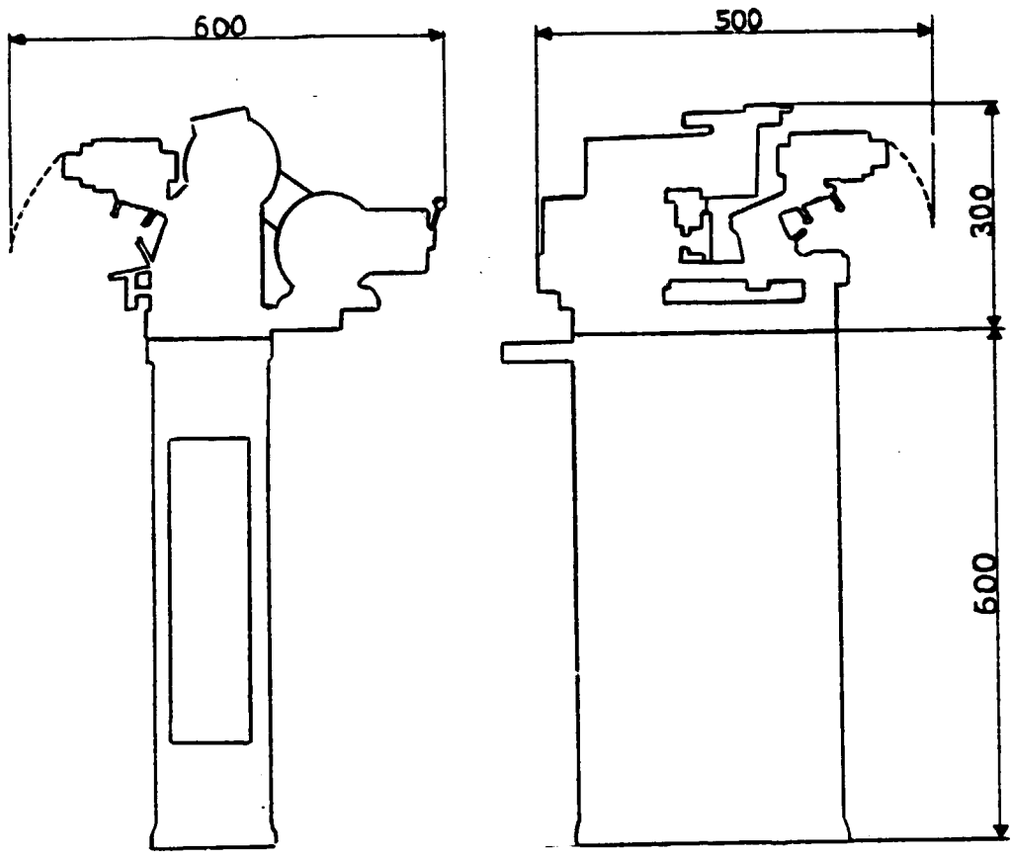
PRECISION DIE SPOTTING PRESS	
Power absorption 5 KW	UNIT COST U.S. $ 45 000
Q.ty 1	weight Kg. 5200

Table size	mm	1000 x 800
Max platen daylight	"	2000
Rating force	ton	50

Wax injection die tester

The two die halves are spotted using tilting and sliding platforms

(26)



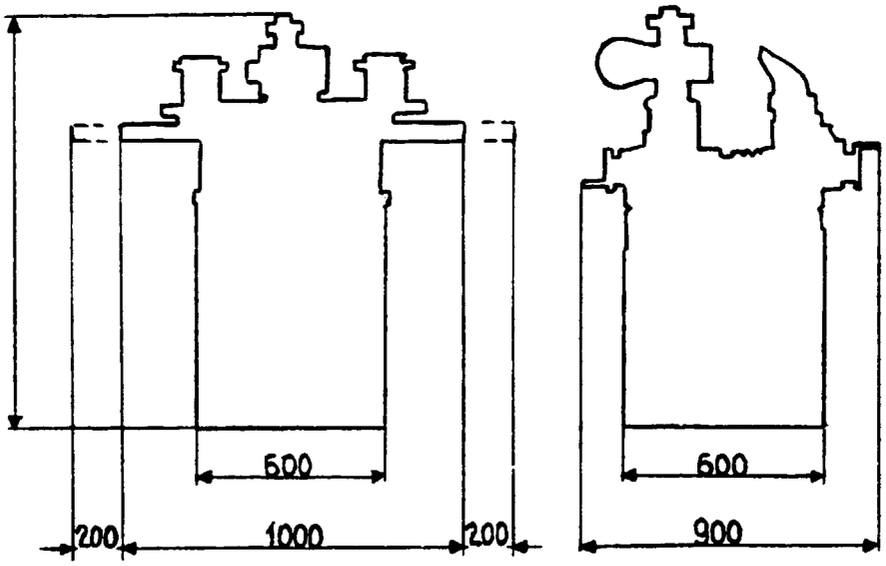
All dimensions only indicative

SINGLE CUTTER MILL GRINDING MACHINE	
Power absorption 1 KW	UNIT COST U.S. $ 4 500
Q.ty 1	weight Kg. 70

Including ol cabinet

EQUIPMENT	COST $
Set of 10 clamps	300

(27)

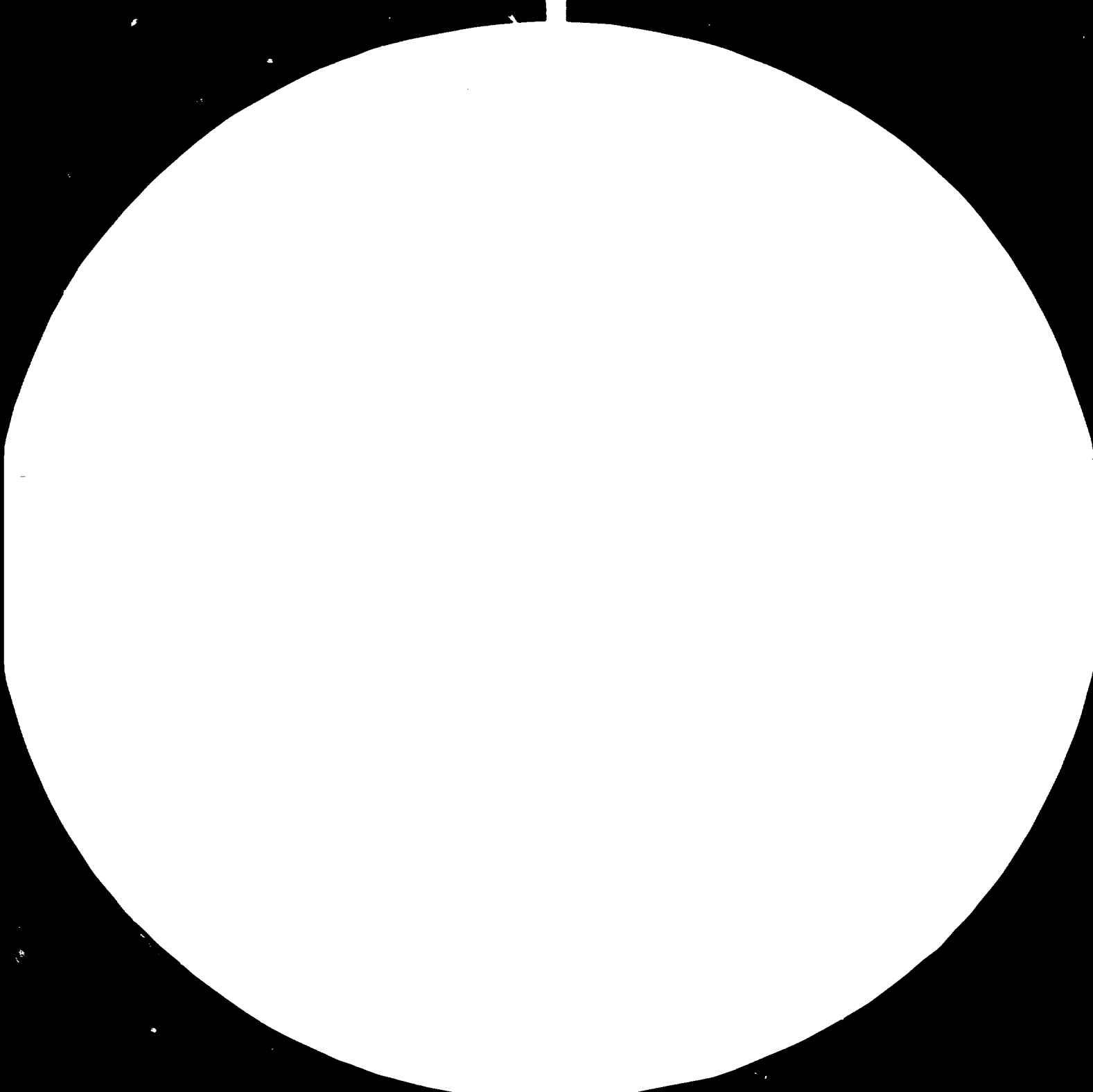


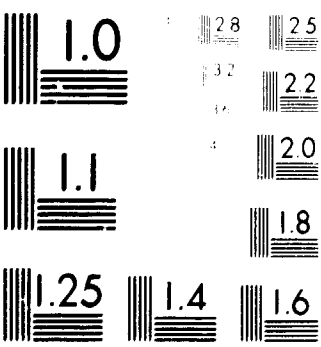
All dimensions only indicative

UNIVERSAL TOOL AND CUTTER GRINDER			
Power absorption	1 KW	UNIT COST U.S. $	6700
Q.ty	1	weight Kg.	600

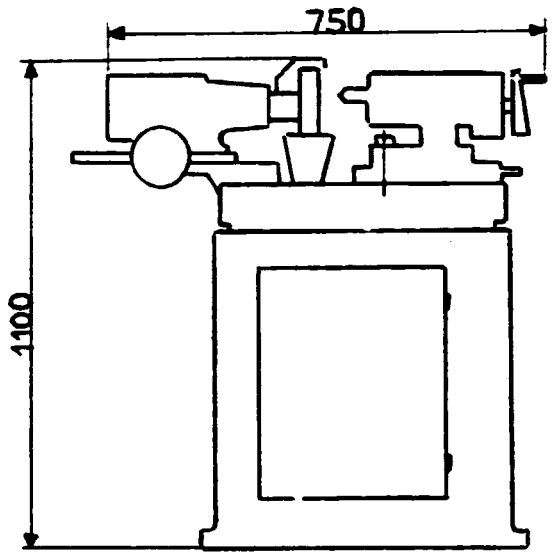
It is used for grinding most workshop tools working surface table mm 650 x 100

EQUIPMENT	COST $
Hob grinding device 3 dividing plates 1 collet carrier 5 collets Tap grinder device 5 spring collets for tap grinder device 3-axis adjustable vice Tool vice Surface grinding accessories (magnetic chuck - wheel flange - boot) Diamond dresser support	
	3000





(28)



All dimensions only indicative

DRILL SHARPENER

Power absorption 1 KW — UNIT COST U.S. $ 2900

Q.ty 1 — weight Kg. 140

Minimum sharpenable dia. mm 2

Max. sharpenable dia. " 35

Minimum drill angle 40°

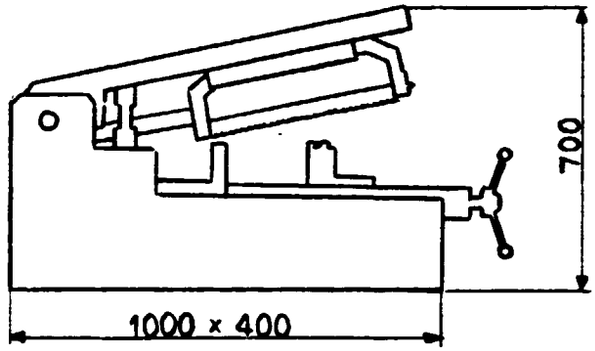
Max. drill angle 180°

Right & left tool cutting edges Nos. 2-3-4-6

Right Kg. 140

EQUIPMENT SUPPLIED WITH THE MACHINE

No. 1 cam for 2 r.h. cutting edge tools
No. 1 cam for pilot drills
No. 1 cam for 3 & 6 r.h. cutting edge drills
No. 1 cam for 4 r.h. cutting edge drills
No. 4 centering cones CM1 - CM2 - CM3 - CM4
Wheel dressing unit
No. 1 wheel dia. 200 x 32 x 32 for conoid sharpening
No. 1 wheel dia. 200 x 12 x 32 for web thinning
Revolving articulated lampholders



All dimensions only indicative

HACKSAWING MACHINE

Power absorption 1 KW

UNIT COST U.S. $ 2500

Q.ty 1

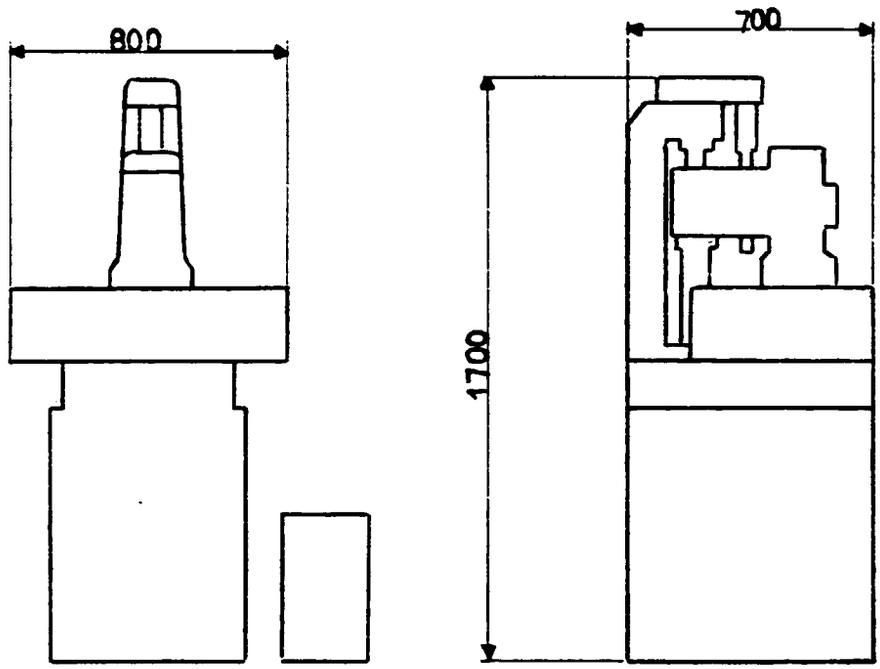
weight Kg. 300

Cutting capacity at 90°

Round bars	mm	200
Square bars	"	170
Blade carrier	inches	16"
Blade stroke	mm	160
Stroke / minute	No.	90

EQUIPMENT	COST $
Clamps for raising rounds ø 20 ÷ 200	125

(30)



All dimensions only indicative

HANDOPERATED PRECISION SURFACE GRINDER

Power absorption 1 KW

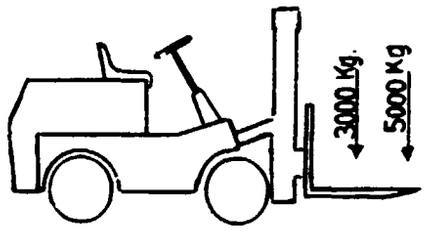
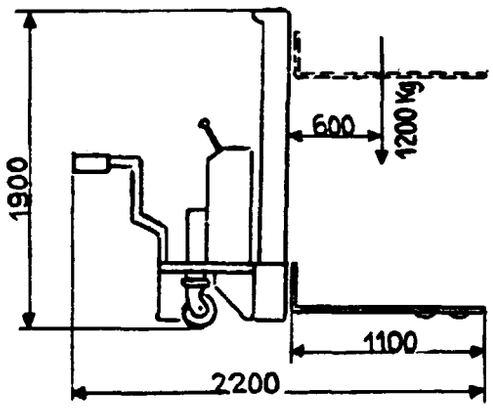
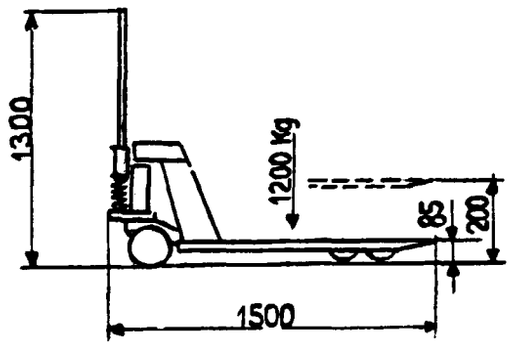
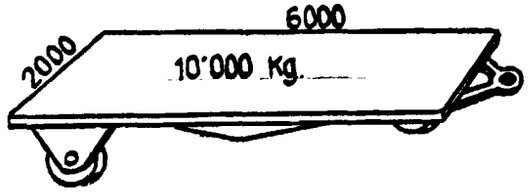
UNIT COST U.S. $ 4 800

Q.ty 1

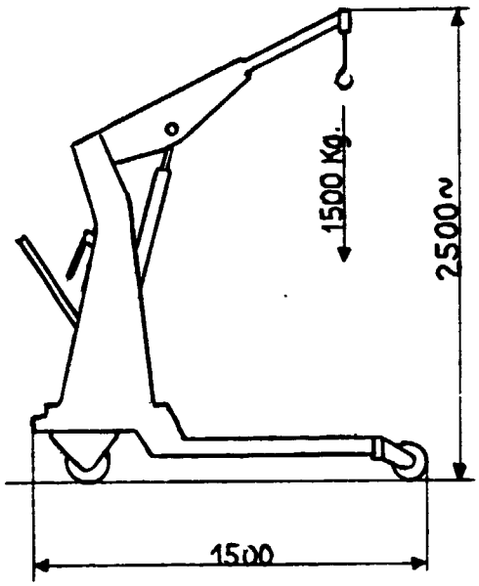
weight Kg. 500

EQUIPMENT	COST $
Magnetic chuck	
Coolant tank	
	800

(31) LIFTING & HANDLING EQUIPMENT FOR INTERNAL SHOPS

		UNIT COST $	No.	TOTAL COST $
	Kg 3000	27,000	1	27,000
	Kg 5000	38,000	1	38,000
		5,000	1	5,000
		500	3	1,500
		5,600	1	5,600

(31)



UNIT COST $	No.	TOTAL COST $
1,000	4	4,000
		81,100

INSPECTION TOOLING

- Granite surface plate, 800 x 600 x 150
- Square cylinder
- Try-square
- Johanson slip gauges (box of 88 workpieces)
- Square, 300 x 180
- Back square, 300 x 200
- Millimeter rules, L = 500 and L = 1000
- V-blocks (2 pairs) 100 x 80 x 60
  150 x 110 x 65
- Vernier caliper gauges 1/50 scale
  Measuring capacity 155 mm
  " " 200 mm
  " " 500 mm
- Depth gauge, 1/50 scale
  Measuring capacity 300 mm
- Set of external micrometers (0 to 25) etc.
- Micrometer depth gauge, 0 to 100
- Inside micrometer for 10 to 150 holes
- Inside stem micrometer
  Capcity 50 to 75 and set of extensions (25 to 500)
- Protractor (with lens), 300 mm
- Sine bar
- Screw pitch gauge (whitworth-metric)
- Feeler gauge (20 blades)
- Radius gauge (30 blades)

- Dial gauge, centimeter scale with carrier
- Magnetic-base dial gauge carrier
- Marking-off compass, L = 200
- Inside calipers, L = 200
- Marking-off compass, L = 1000

- Surface gauge, millimeter scale, 500 mm
- Hardness tester (Galileo)
- Column surface plate, 1500 x 1000 (granite)
- Set of curved 12-point wrenches (12-pieces) from 6 to 12 across flats
- Set of fixed open double end wrenches (6 pieces)
- 14" bastard flat file
- 6" second cut three-square file
- 6" smooth round file

- Set of 10 Allen keys 2 to 12 across flats

- Master gauge
- Profile projector

TOTAL $32,740.00

TURNER'S TOOLS

Vernier caliper gauge, 1/20 scale
Lead hammer, 1 Kg.
Double meter measure
Precision rule (millimeter scale)
Screw-pitch gauge
Radius meter
Magnetic-base gauge barrier
Box of 1 to 13 dia. twist drills
14" bastard flat file
8" second cut three square file
8" smooth round file
Saw blade frame
2 blades, 22 and 32 teeth/inch

TOTAL $375.00

MILLING MACHINE OPERATOR'S TOOLS

Vernier caliper gauge, 1/20 scale
Lead hammer, 1 Kg.
Rule (millimeter scale)
Square, approx. 150 x 100
Magnetic-base dial gauge carrier
14" bastard flat file
6" second cut three square file
6" smooth round file
1 twist drill case, 1 to 13 dia.

TOTAL $375.00

GRINDING MACHINE OPERATOR'S TOOLS

Micrometer, 0 to 25
Micrometer, .25 to 50
Vernier caliper gauge, 1/50 scale
Gauge carrier with clock
Nylon mallet, head dia. 27
Lead hammer, 1 Kg.

TOTAL $550.00

FITTER'S TOOLS

Files:
- 14" bastard flat
- 10" second cut flat
- 10" second cut half-round
- 10" second cut round
- 8" smooth three-square
- 10" second cut square
- Set of 6 needle files

Adjustable metal hacksaw frame
2 hacksaw blades, 22 and 32 teeth/inch
Screwdrivers: 1 for slot 4
1 for slot 10
1 for slot 16
Philips head screwdrivers: 1 6 dia.
1 8 dia.
Combination pliers
Adjustable pliers, pipes and nuts
Tongs
Sheet metal shears (manual)
Scissors
Set of 10 Allen keys 2 to 12 across flats
2 hand clamps, L = 120 mm
Scraper with hard metal blade
Spare blade for scraper
Triangular scrapers (super high speed), L = 315/85
L = 230/55
Hammer, 250 gr.

Lead hammer, 1 Kg.
Nylon mallet, 27 dia. head
Chisels: 28 wide, L = 250
16 wide, L = 125

Punch

Box of twist drills
(19 super high speed drills 1 to 10)

Vernier caliper gauge, 1/50 scale
Diestock - tap wrench

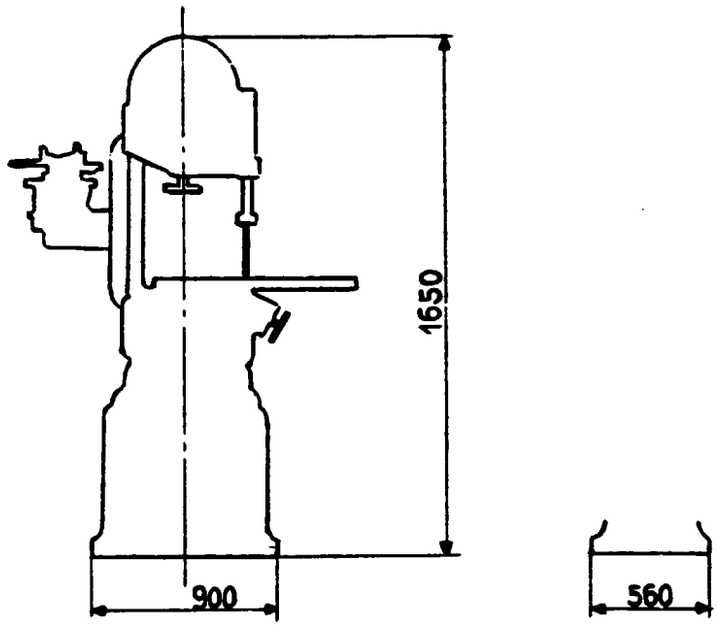
TOTAL $560.00

FITTER'S TOOLS FOR TOOLROOM

2 pneumatic angle polishers, 180 dia. grinding wheels
2 polishers, end mills and grinding wheels
1 assortment of mills and grinding wheels for polishers
1 electric drill, capacity 13 mm dia. on steel
2 boxes of male hex. socket wrenches
(11 sockets + carriers + joint 3 to 10 accross flats)
2 boxes of female hex. socket wrenches (5 to 19 accross flats)
with ratchet handle
3 sets of combination wrenches
(17 wrenches, 6 - 22 accross flats)
2 sets of caliper wrenches
(11 to 60/14-100/22 to 125)
2 boxes of punches for numbers, 5 mm high
2 boxes of punches for numbers, 10 mm high
2 boxes of punches for letters 5 mm high
2 boxes of punches for letters 10 mm high

TOTAL $ 4.800..

(32)



All dimensions only indicative

VERTICAL BAND SAW

Power absorption 1 KW UNIT COST U.S. $ 5 400

Q.ty 1

Saw for steels and light alloys

Table size mm 500 x 500

Fixed top 500 x 500

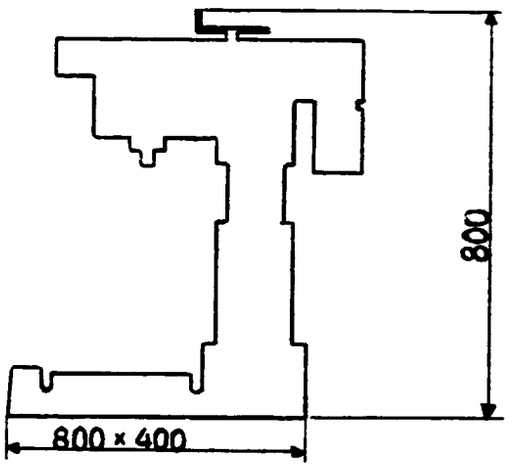
Lubrification - cooling system

Hydraulic band tensioner indicator

Speed from 18 to 660 m/1'

EQUIPMENT	COST $
Bulb holder Form sawing device Welding unit with shears and grinding wheel	
	850

(34)



All dimensions only indicative

SENSITIVE DRILL

Power absorption 1 KW UNIT COST U.S. $ 1 300

Q.ty 1

- High precision sensitive drill press
- Swivelling head, vertically adjustable
- Micrometric feed depth dial
- Drilling capacity in steel mm 15
- Travel of spindle " 100
- Headstock vertical deplacement " 170
- Surface table " 300 x 350

EQUIPMENT	COST $
Series of spindles	300

TURNER'S TOOLS (TRAINING)

1 Vernier caliper gauge, 1/20 scale
1 Lead hammer, 1 kg.
1 Double meter measure
1 Precision rule, millimeter scale
1 Screw-pitch gauge
1 Radius meter
1 8"_three square second cut

TOTAL $80.00

MILLING MACHINE OPERATOR'S TOOLS (TRAINING)

1 gauge, 1/20 scale
1 lead hammer, 1 Kg.
1 rule, millimeter scale
1 square, 150 x 100
1 6"_three square second cut file

TOTAL	$100.00

GRINDING MACHINE OPERATOR'S TOOLS (TRAINING)

1 micrometer, 0 to 25
1 micrometer, 25 to 50
1 vernier caliper gauge, 1/50 scale
1 gauge carrier complete with clock
1 nylon mallet, 27 dia. head
1 lead hammer, 1 Kg.

TOTAL	$600.00

FITTER'S TOOLS (TRAINING)

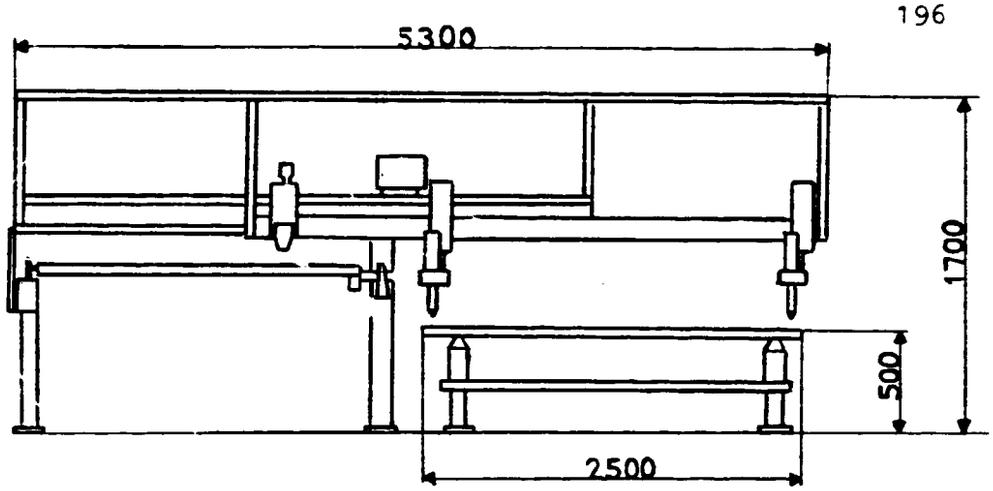
Bench surface plate, 300 x 200 mm
Files: 14" flat bastard
10" flat second cut
8" three square smooth
10" square, second cut

Adjustable metal hacksaw frame
Hacksaw blades, 22 and 32 teeth/inch (2 + 2)
Scraper with hard metal blade
Triangular scrapers (super high speed)
L = 315/85
L = 230/55

Hammer, 250 gr.
Nylon mallet, 27 dia. head
Chisels: 28 wide, L = 250
16 wide, L = 125
Punch
Vernier caliper gauge, 1/20 scale

TOTAL $430.00

(36)



All dimensions only indicative

4 OXICUTTER WITH ELECTRONIC TRACER

Power absorption 1 KW

UNIT COST U.S. $ 43 500

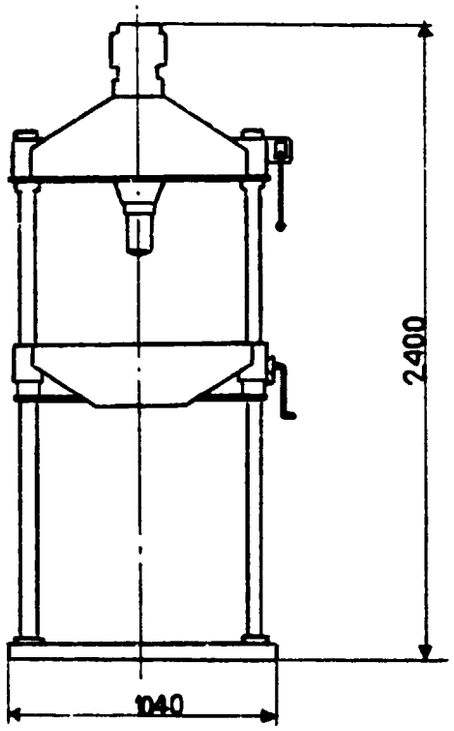
Q.ty 1

weight Kg. 1000

- Cuts sheet thickness 4 mm and upwards
- Simultaneously cuts 4 or more identical components
- Machine cost includes cutting and copying device, conveyors, sheet support benches with copper tips for 2 x 6 m. sheets

EQUIPMENT	COST $
Sheet lift clamps Quantity 4 size 10 ÷ 40 mm " 4 " 25 ÷ 50 " " 4 " 25 ÷ 100 "	
	600

(37)



All dimensions only indicative

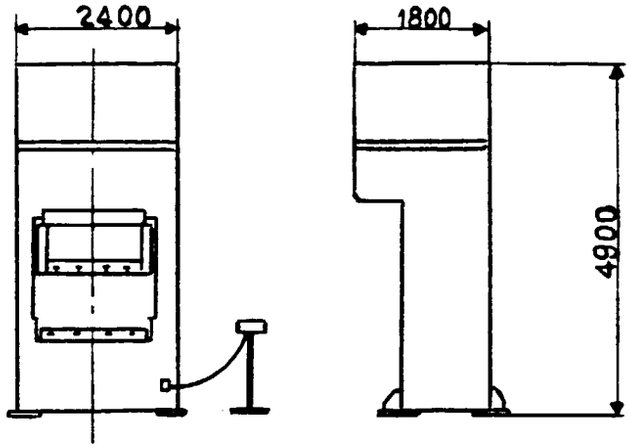
STRAIGHTENING PRESS	
Power absorption 3 KW	UNIT COST U.S. $ 10200
Q.ty 1	weight Kg. 1300

Complete with pressure regulating valves

Working pressure	ton	100
Effective platform dimension	mm	800 x 450
Maximum piston stroke	"	330
" bottom platform stroke	"	790
" table top height above ground	"	1200

EQUIPMENT	COST $
4 table lockup rings	
Straightening tool	
	3150

39



All dimensions only indicative

HYDRAULIC PRESS 200 TON

Power absorption 37 KW UNIT COST U.S. $ 110 000

Q.ty 1 weight Kg.

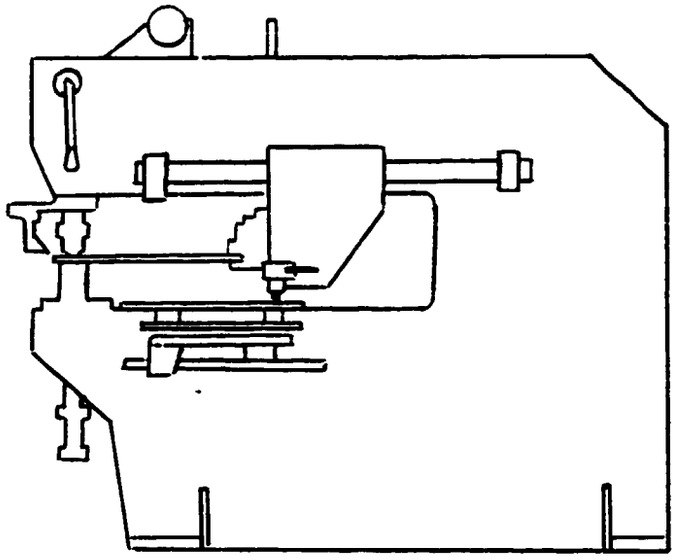
Column type double-acting hydraulic press suitable for blanking and deep drawing

May be adapted for mass production throught the addition of automatic feed

Working pressure	ton	200
Effective platform dimension	mm	1300 x 1000
Maximum table top height above ground	"	1000

EQUIPMENT	COST $
Manual slide lockup hook at top of stroke Safety barrier guard Sheet down holders Provision for safety barrier application	
	11500

(40)

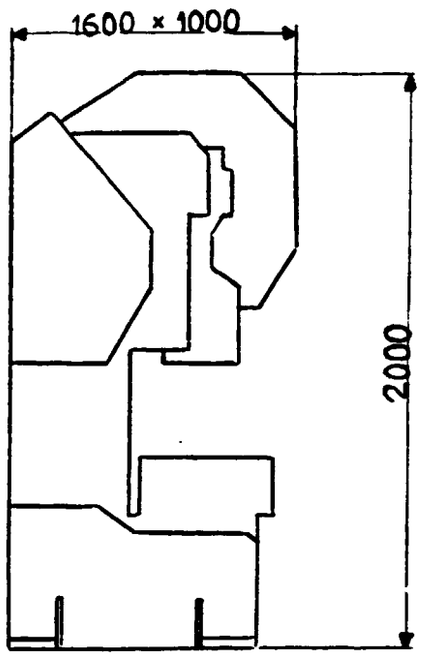


NIBBLER - SHEARING CUTTING COPYING MACHINE	
Power absorption 2 KW	UNIT COST U.S. 28800
Q.ty 1	weight Kg. 2100

To be used for a wide variety of different operations on metal sheet as straight and circular cutting, edge-making, ribbing, slotting-louvring, nibbling, seaming etc.

EQUIPMENT	COST $
- Double ball-bench with supporting structure attached to machine - Pair of tools for straight, form and circular cutting - Pair of nibbling tools for quick connect attachment - Pair of slotted tools for standard attachment - Pair of rounded edge tools for standard attachment - Punch holder - dieholder - downholder - Quick change drift, die and ejector attachment - Quick release hydraulic clamps	
	10,700

(41)



All dimensions only indicative

ECCENTRIC PRESS 70 TON

Power absorption 6 KW

UNIT COST U.S. $ 12500

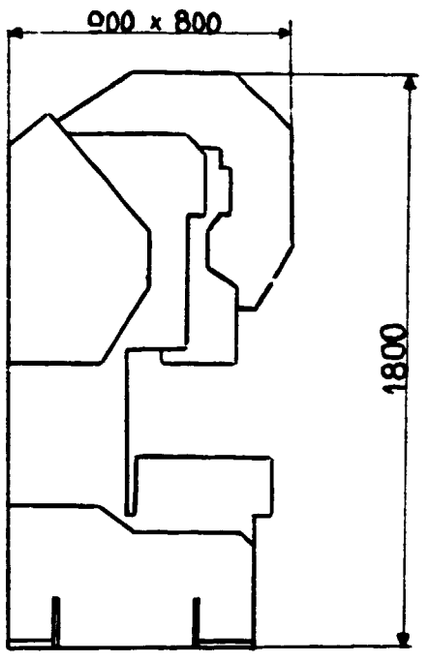
Q.ty 1

weight Kg. 3500

Press for medium-size components

Capacity	ton	70
Table surface	mm	550 x 750
Hole of the ram	"	50
Strokes per minute	no.	60

(42)



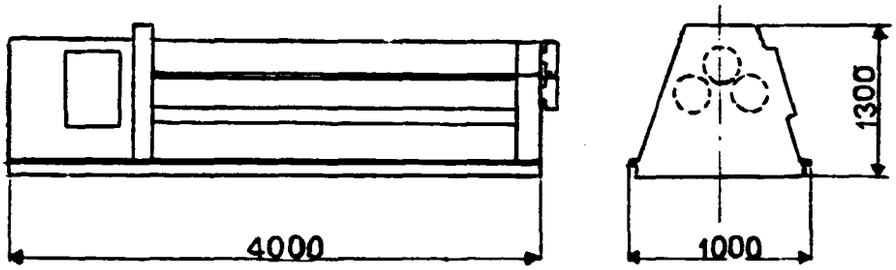
All dimensions only indicative

ECCENTRIC PRESS 25 TON	
Power absorption 2 KW	UNIT COST U.S.$ 6 300
Q.ty 1	weight Kg. 1200

Press for small-size components

Capacity	ton	25
Table surface	mm	360 x 480
Hole of the ram	"	35
Strokes per minute	no.	125

(43)



All dimensions only indicative

ROOL BENDER MACHINE

Power absorption 13 KW — UNIT COST U.S. $ 26 600

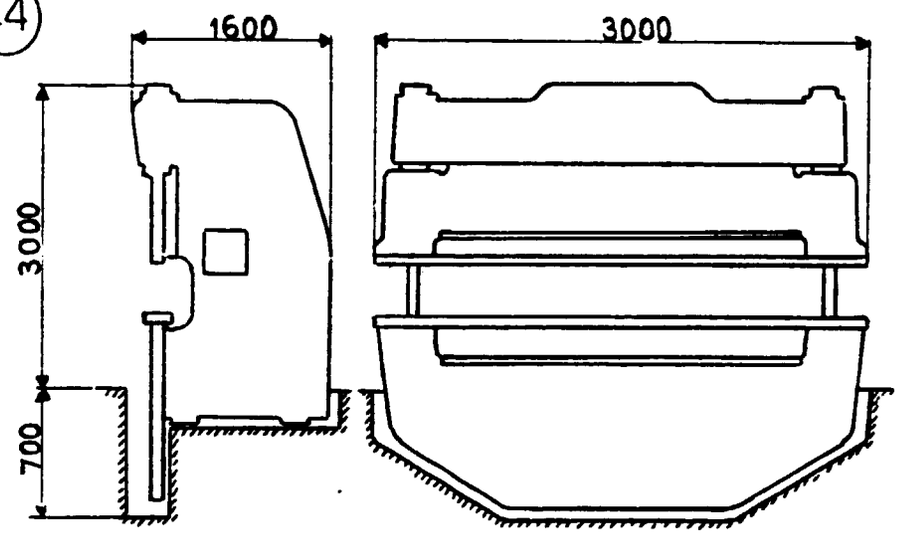
Q.ty 1 — weight Kg. 4 700

With rolls for bending profiles

Working lenght	mm	2000
Maximum precurving thickness	"	8
" calendering thickness	"	10
Minimum ø to calendering	"	360

EQUIPMENT	COST $
Rolls for bending profiles	950

(44)



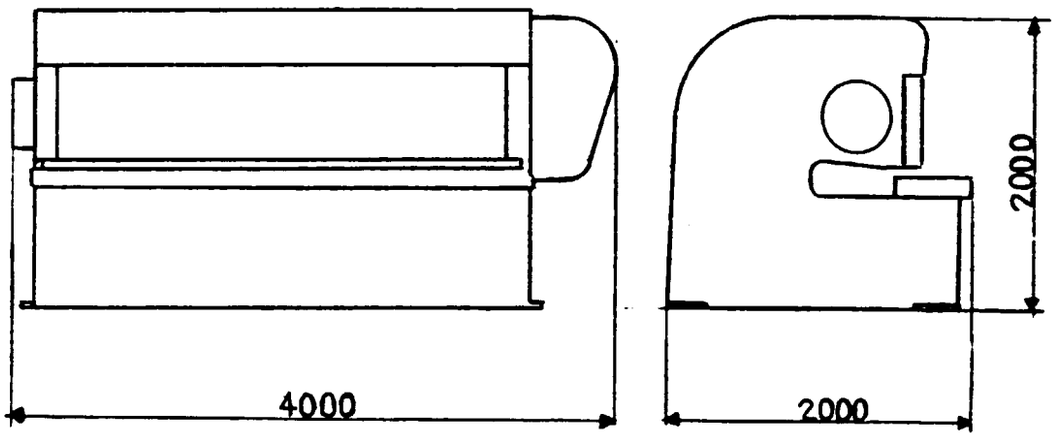
All dimensions only indicative

PRESS BRAKE	
Power absorption 10 KW	UNIT COST U.S. $ 50 000
Q.ty 1	weight Kg. 10 500

Rating adjustable up to	ton	120
Adjustable stroke	mm	200
Clearance between uprights	"	2600
Length of table and slide	"	3000
Width of table	"	140

EQUIPMENT	COST $
- Inserted blade tools including: tool holder - inserted blade - die carrier - die with cavities - High capacity sheet register with micrometric adjustment - Safety device	
	6250

(45)



All dimensions only indicative

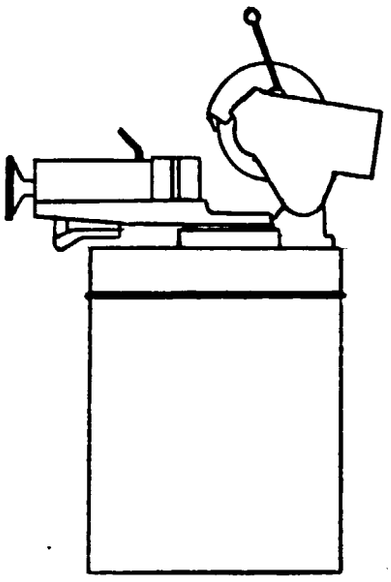
GUILLOTINE SHEAR

Power absorption 18 KW - UNIT COST U.S. $ 59 000

Q.ty 1 weight Kg. 14 000

Effective cutting length	mm	3000
Clearance between uprights	"	3000
Rating adjustable up to	ton	140

EQUIPMENT	COST $
Safety features: - Light beam at rear for hand protection during work - Two hand push button unit for cutting of small components - Machine side protectors	
	2500

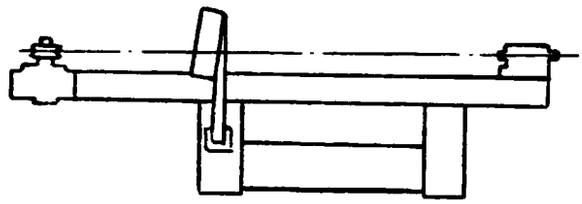


All dimensions only indicative

CUTTING-OFF MACHINE	
Power absorption 1 KW	UNIT COST U.S. $ 1800
Q.ty 1	weight Kg. 150

With quick release manual vice and stand

EQUIPMENT	COST $
Set of blades ø 200 - 250 - 275 - 300 - 350	300



PIPE BENDER	
Power absorption 8 KW	UNIT COST U.S. $ 21 500
Q.ty 1	weight Kg. 1400

Pipe min. diameter	mm	18
Pipe max. diameter	"	60 x 4
Curve minimum inside radius	"	36
Curve maximum inside radius	"	230
Minimum pipe length	"	3400
Maximum bend angle		190°

EQUIPMENT	COST $
Hydraulic clamp	
Accessories	
	2050

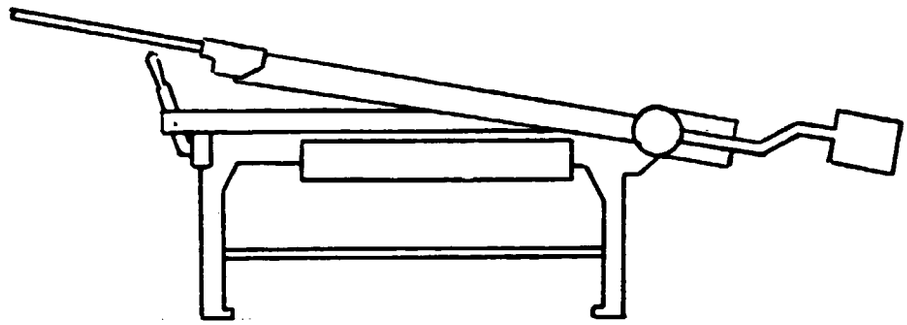
(48)

Oxyacetylenic welding unit

- 2 bottle trolley
- Regulators - pipes - pliers
- Heating torch
- Set of cutting tips
- 5 heating torches - 5 Kcal max. (high power per heat)
- Set of welding and brazing nozzles
- Bench for oxyacetylenic welder

TOTAL COST $ 700

50



HANDLEVER SHEAR

Power absorption [-] KW

UNIT COST U.S. $ 2300

Q.ty [1]

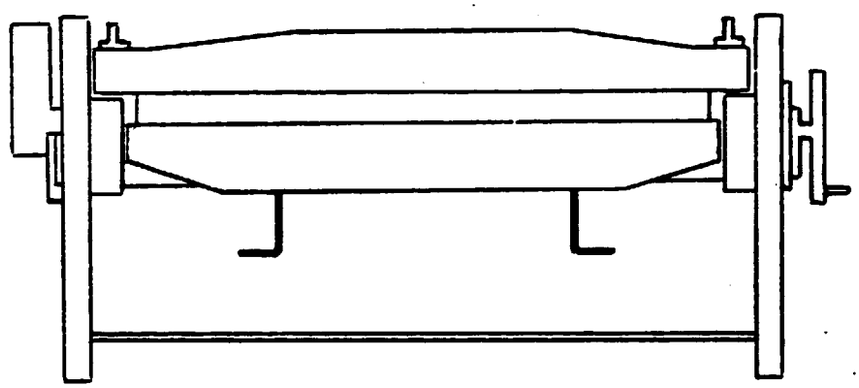
weight Kg. 400

Working length mm 1000

For plate R = 40 Kg./sq.mm mm 2

Complete with accessories

51



HANDOPERATED BOX BENDER

Power absorption [-] KW

UNIT COST U.S. $ 3700

Q.ty [1]

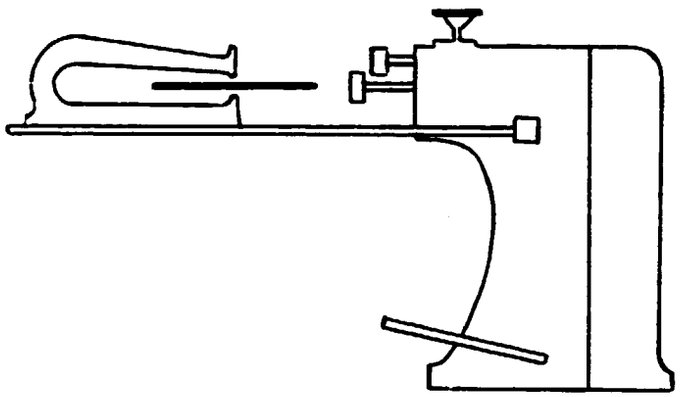
weight Kg. 850

Working length mm 1300

For plate 40 Kg./sq.mm " 2

Complete with accessories

(52)



BEADING MACHINE

Power absorption 2 KW

UNIT COST U.S. $ 4 800

Q.ty 1

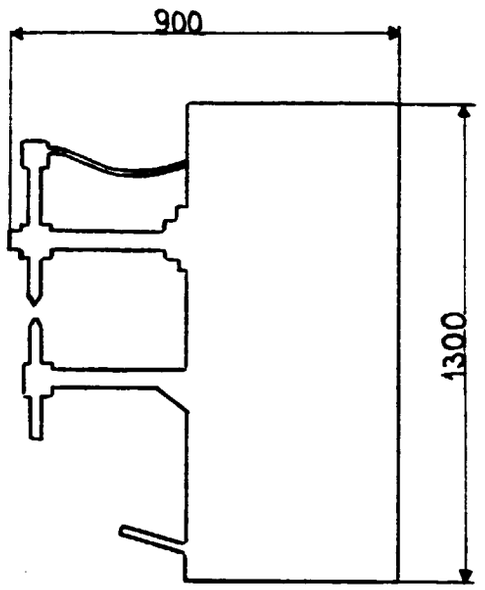
weight Kg. 700

Edging shear with circular support

Complete with accessories

Cuts and trims sheet up to 3 mm

(53)



All dimensions only indicative

SPOTWELDER

Power absorption 15 KW

UNIT COST U.S. $ 1600

Q.ty 1

weight Kg. 160

Standard horn length	mm	400
Maximum welding capacity on steel	mm	3 + 3

(54)

STATIC WELDER FOR TORCH WELDING

Employable electrodes

- Under minimum current Ø 2 mm at 80 Amp.
- Under maximum current (40% intermittence) Ø 6 mm at 320 Amp.
- Under continuous current 5 ÷ 6 mm at 260 Amp.
- Dimensions 900 x 600 x 700 mm
- Weight 110 Kg.

unit cost = $ 900

- Accessories

cost = $ 65

---

(56)

SEMIAUTOMATIC SYSTEM FOR CONTINUOUS WIRE WELDING WITH GAS SHIELD 300 AMP.

- For thicknesses from 0.8 to 6 ÷ 7 mm
- Transformer - rectifier: dimensions = mm 900 x 800 x 600
  weight = Kg. 200
- Toolkit for water cooled welding gun
- Electrically adjustable wire feed: dimensions = mm 500 x 400 x 400
  weight = Kg. 25
  unit cost $ 4000

Accessories.....cost $ 65

---

(57)

SEMIAUTOMATIC SYSTEM FOR CONTINUOUS WIRE WELDING WITH GAS SHIELD 600 AMP.

- Suitable for thick sheet metal
- Transformer - rectifier: dimensions = mm 900 x 900 x 600
  weight = Kg. 270
- Toolkit for water cooled welding gun
- Electrically adjustable wire feed: dimensions = mm 500 x 400 x 400
  weight = Kg. 25
  unit cost $ 6000

Accessories.....cost $ 65

58

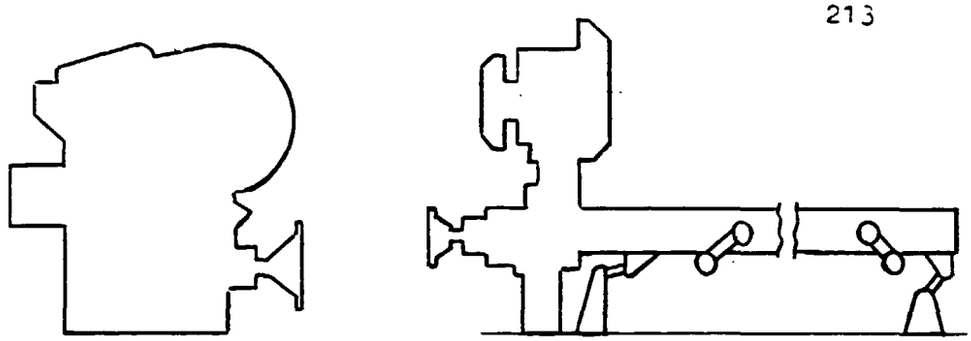
WATER FILM SPRAYBOOTH

Power absorption 2 KW UNIT COST U.S. $ 11300

Inclusive of:

- water recycling;
- paint suction and filtering;
- atomized spraying

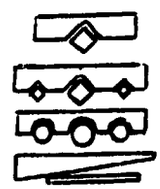
59



BILLET SHEAR	
Power absorption 12 KW	-UNIT COST U.S. $ 83500
Q.ty 1	weight Kg. 6500

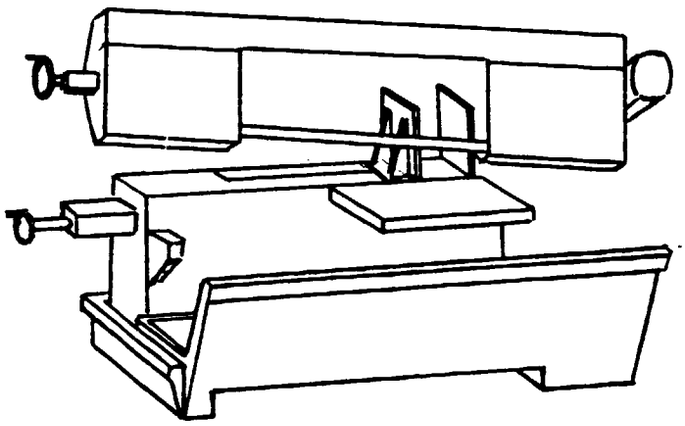
Including:

- Roller feeding
- Electrical and pneumatic systems for roller conveyor
- Adjustable bar feed
- Length setting register
- Electrical control cabinet

- Cutting capacity	Ton	230
- Stroke per minutes	No.	40
- Slide stroke	mm	65
- Blades length	"	360
- Roller feeding length	mt.	5
	mm	80
	"	50 - 80 - 50
	"	55 - 85 - 55
	"	200 x 33

EQUIPMENT	COST $
Clamps for raising rounds Ø 30 ÷ 500	300

60



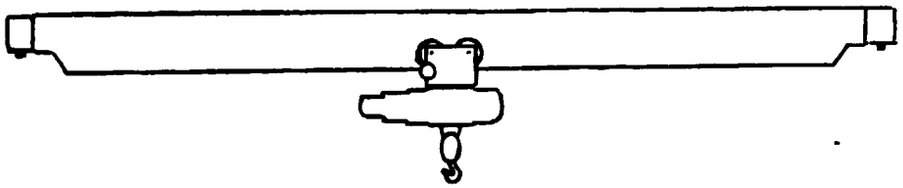
HORIZONTAL BANDSAW	
Power absorption 2 KW	- UNIT COST U.S. $ 11 100
Q.ty 1	weight Kg. 900

Cutting capacity at 90°

Round bars	mm	420
Square bars	mm	350 x 350
Dimensions	mm	3000 x 1000 x 1200

EQUIPMENT	COST $
Clamps for raising rounds Ø 30 ÷ 500	200

(61)



OVERHEAD CRANE - 5 TON

Power absorption 6 KW — UNIT COST U.S. $ 20·000

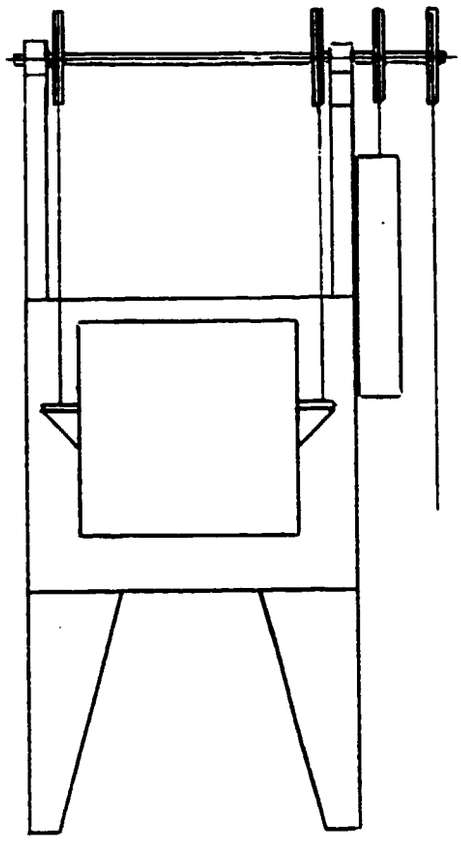
Q.ty 2

Consisting of:
5-Ton crane
Trol-e-duct

Paths are assumed to be already mounted in the shed structure.

EQUIPMENT	COST $
Spares for no. 2 cranes: No. 1 tackle including trolley, pushbutton strip, cable No. 1 slide reduction motor	
	6500

(63)



HEAT TREATMENT FURNACE

Power absorption 36 KW UNIT COST U.S. $ 20 000

Q.ty 2

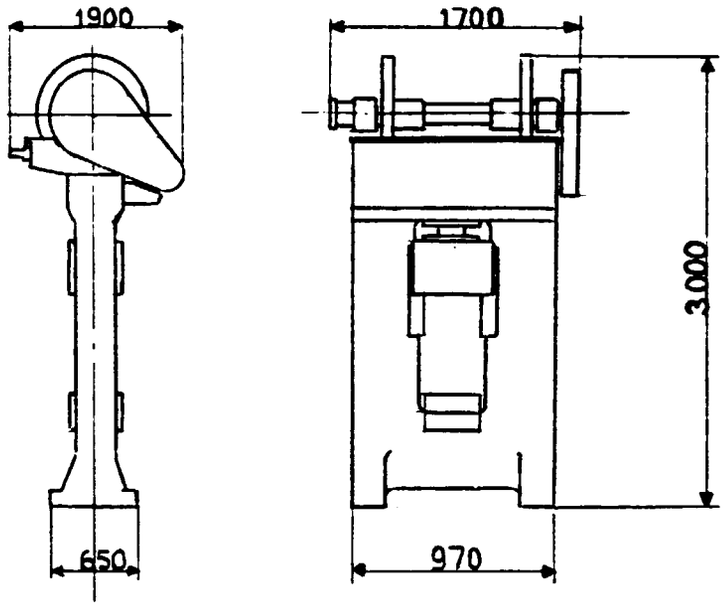
Temperature from 180° to 1050°

Size of chamber mm 1000 x 650 x 500

Door clearance " 500

EQUIPMENT	COST $
10 carburising boxes mm 400 x 600 x 300	10700

(66)



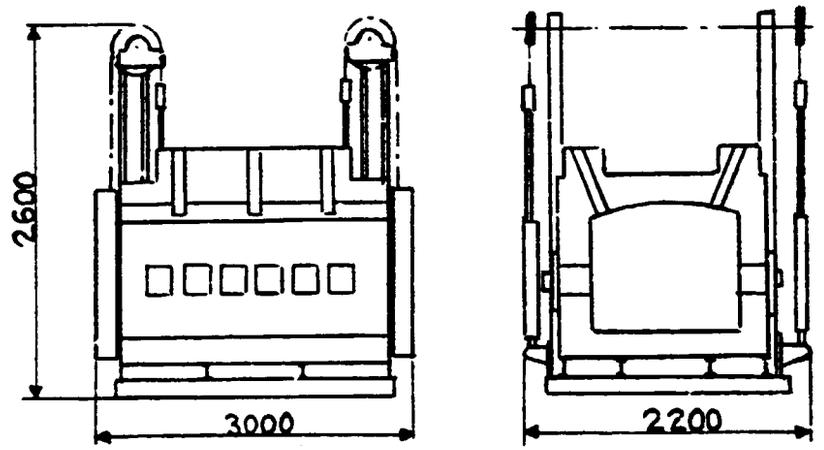
All dimensions only indicative

FRICTION SCREW PRESS	
Power absorption 8 KW	- UNIT COST U.S. $ 39 000
Q-ty 1	weight Kg. 4 800

- Screw diameter	mm	130
- Rating (force)	Ton	160
- Maximum power	Kgmt.	550
- Frame gap	mm	370
- Ram stroke	mm	300

EQUIPMENT	COST $
Automatic mechanical ejector	3750

(67)



All dimensions only indicative

MUFFLE FURNACE

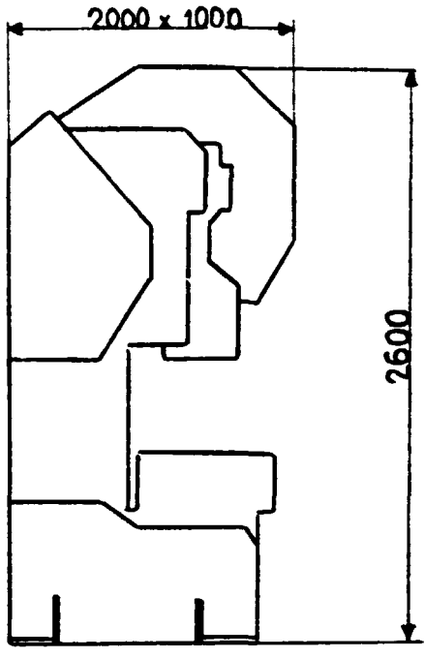
Power absorption [4] KW — UNIT COST U.S. $ [3 000]

Q.ty [3]

Oil-fired muffle furnace

Inside dimensions	mm	800 x 1500 x 600
Door clearance	mm	400
Maximum temperature	°C	1150
Peak fuel consumption	Kg/h	30

(68)

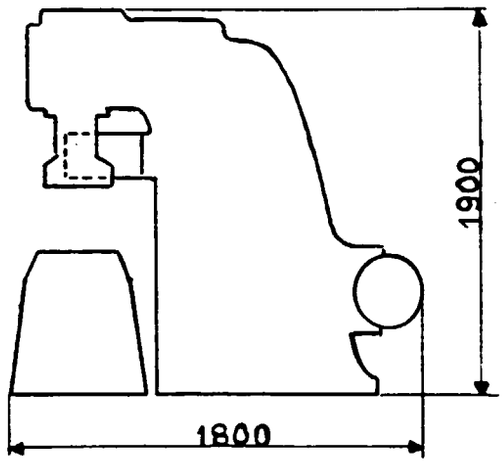


All dimensions only indicative

ECCENTRIC PRESS 120 TON	
Power absorption 11 KW	UNTI COST U.S. $ 16 300
Q.ty 1	weight Kg. 4 800

Eccentric friction trimming press

Pressure	Ton	120
Adjustable stroke length	mm	15 ÷ 100
Platform size	"	600 x 800
Ram bore	"	50



All dimensions only indicative

OPEN-FRAME HAMMER

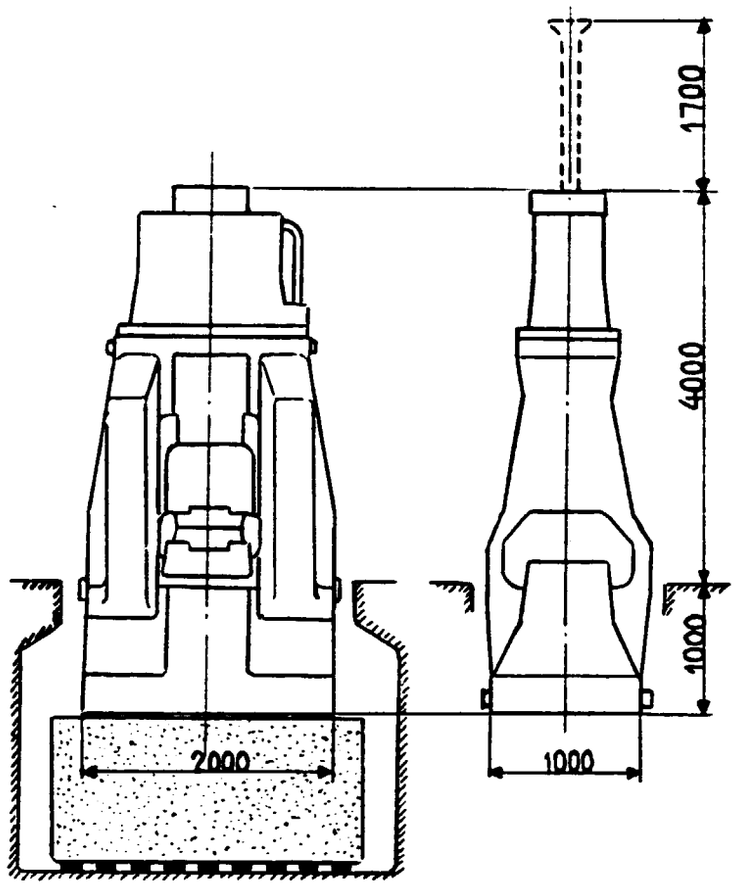
Power absorption 10 KW _ UNIT COST U.S. $ 30 000

Q.ty 1 weight 4000

- Incorporated air compressor
- Water cooled
- Cooling water not recycled
- Suitable for hand forging
- Maximum work piece size: 100 x 100 mm square bar

Ram weight	Kg.	100
Strokes per minute	No.	260
Height from floor	mm	1800

(70)



All dimensions only indicative

POWER HAMMER

Power absorption [-] KW - UNIT COST U.S. $ [120 000]

Q.ty [1] weight Kg. [22000]

- Double-acting pneumatic power hammer

- Striking force	Kgmt.	2000
- Rating (weight)	Kg.	1200
- Stroke length	mm	750
- Die size	"	450 x 600

HAND FORGING EQUIPMENT

- Forge
- Anvil 20 Kg.
- Anvil 80 Kg.
- Swageblock 80 Kg.

WOODSTOCK BASES FOR ANVILS AND SWAGEBLOCK

- Sledge, 2 Kg.
- Sledge, 5 Kg.
- Sledge, 8 Kg.
- Mould for lead mallet

TOTAL $ 3,000.00

ELECTRIC SALT BATH FURNACE

Bath capacity	mm 150 x 150 x 250	
Absorbed power	KW 16	
Max. temperature	950°C	$ 11,000.00
4 stainless steel salt silos - dia. 400 h 500		$ 1,440.00
Cyanide fumes exhaust system		$ 2,500.00
	TOTAL	$ 14,940.00
Spares:		
No. 8 metal crucibles		$ 2,000.00

- Accessories for horizontal bandsaw and cutting off machine operator

  For each operator

  - Rule, millimeter divisions
  - Double meter measure
  - Safety gloves and shoes

  TOTAL $ 30.00

- Accessories for oxygen cutter operator

  - Safety gloves and shoes
  - Double meter measure
  - Torch lighter
  - Wire brush for cleaning torch nozzles

  TOTAL $ 40.00

- Accessories for straightening press operator

  - Carpenter's rule, 500 mm
  - " " 1000 mm
  - Safety gloves and shoes
  - 2 roughed VEE blocks
  - 1 try square, 300 x 180 mm

  TOTAL $ 230.00

- Accessories for shear operator

  - Try square, 300 x 180 mm
  - Double meter measure
  - Safety gloves, shoes and apron
  - Scriber
  - Rule, 1000 mm
  - Hammer, 250 gr

TOTAL $ 150.00

- Accessories for press brake operator

  - Try square, 300 x 180 mm
  - Double meter measure
  - Safety gloves, shoes and apron
  - Scriber
  - Rule, 500 mm
  - " 1000 mm
  - Protractor with lens, 30 mm

TOTAL $ 350.00

- Accessories for bending machine operator

  - Double meter measure
  - Try square, 330 x 600 mm
  - Scriber
  - Safety gloves and shoes

TOTAL $ 70.00

- Accessories for nibbler and 200T - 70T - 25T operator

  - Safety gloves and shoes

TOTAL $ 40.00

- Accessories for rod and wire welder operator

  - Gauntlets - shoes - leggings - apron - mask - cap
  - Chipping hammer
  - Insulated combination pliers for cutting 3 mm diameter wire
  - Wire brush

TOTAL $ 110.00

- Accessories for oxyacetylene station

  - Gloves - shoes - apron
  - Goggles

TOTAL $ 65.00

- Accessories for fabricaticns station

  - Gloves - shoes (for each operator)
  - Welding mask " " "
  - Scriber " " "
  - Double meter measure " " "
  - Rules, 500 mm and 1000 mm (each 2 operators)
  - Clamps, 3 sets of 4 different lengths (each 2 operators)
  - Try square " " "
  - Back square " " "
  - 1 work bench, 1500 x 3000 (each 2 operators
  - Marking off compasses " " "
  - 1 protractor " " "
  - 1 surface gauge, height 500 mm (each 2 operators)
  - 1 portable disc grinder " " "

Complete accessories for 2 operators

TOTAL $ 8,000.00

- Accessories for spraying personnel

  - Shoes - gloves - overalls - facemask
    for each operator

  PER STATION
  - 3 pray guns
  - 1 spray gun for protective oil
  - 1 grease gun

TOTAL $ 500.00

- Accessories for pipebender personnel

  - Shoes and gloves
  - 1 scriber
  - 1 protractor
  - 1 double meter measure

TOTAL $ 160.00

- Accessories for assembly personnel

TOTAL $ 500.00

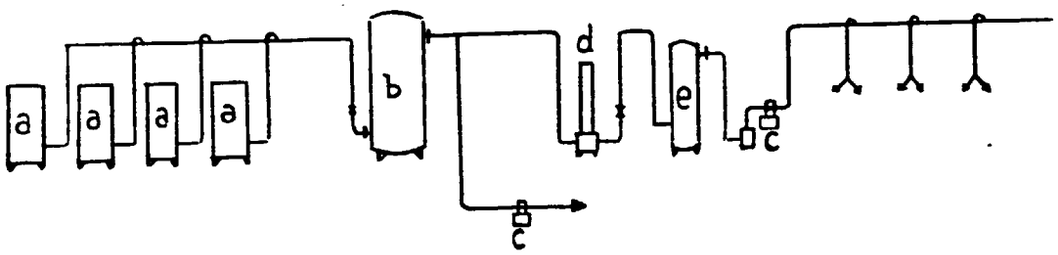
- Forge accessories

  - 5 complete sets forge tongs (5 types) $ 320.00

- Accessories for heat treatment

  - 1 instrument cabinet
  - 1 carburizing box bench
  - 1 measuring instruments bench
  - 1 Galileo hardness meter

TOTAL $ 3,200.00



COMPRESSED AIR STATION

Air delivery = 1050 cu.mt./hr.

Air pressure = 7 Kg./sq.cm.

4 compressors 350 cu.mt./hr	a	$ 48000
1 tank capacity 6000 liters	b	" 4000
2 oil traps	c	" 1100
1 cooler	d	" 1100
1 tank capacity 1000 liters	e	" 800
Total		$ 55000
Spares (for 5 years)		" 4000
Total		$ 59000

E.6 - LIST OF SUPPLIERS OF MACHINE TOOLS

NAME OF COMPANY	MANUFACTURE
Costruzioni Meccaniche 15057 - TORTONA - C. Della Repubblica 74	Lathes
AEG TELEFUNKEN - 20124 - MILANO Via Pirelli 12	Electroerosion Machines
ALPA S.p.A. 27100 - PAVIA Strada Vigentina 106/108	Grinding Machines
RIBON 20090 - SEGRATE (MILANO) Via Marconi 21	Grinding Machines
ATREMA S.p.A. 10135 - TORINO C.so Unione Scvietica 455	Radial Drills
EXCELSIOR 20029 - TURBIGO (MILANO) Via 11 febbraio 2	Shapers
INDUSTRIE MECCANICHE S.N.C. 36045 - LONIGO (VICENZA)	Drills
DECKEL, Fredrich Aktiengesellschaft 8000 Munchen 70 Plinganser Str., 150, FR6	Milling Machines
DELLAVIA S.p.A. 20141 - MILANO Via Palmieri, 39	Hand Screw Presses
T.C.S. S.r.l. 21042 - CARONNO PERTUSELLA (Varese) Via E. Fermi 355	Die Testing Presses
LA PRORA s.r.l. 20016 - PERO (Milano) Via F.lli Bandiera	Sharpeners
CUOGHI 41100 - MODENA Via S. Allende 119	Sharpeners

MUNDUS - OFF. Mecc. Galliatese 28066 - GALLIATE (Novara) Via Novara 62	Hack Saws
ARTER 10138 - Torino Via Aurelio Saffi 24	Lifting & Handling Equipment
S.I.O. 10095 - GRUGLIASCO (Torino) Strada Del Portone 215	Oxicutter and Welders
EMANUEL S.p.A. 10074 - S. Pietro Moncalieri (TO)	Straightening Presses
OMES Costruz. Mecc. S.p.A. 36014 - SANTORSO (Vicenza) Via Marconi, 23	Nibblers
APUANIA 20158 - MILANO Viale LAncetti 33	Eccentric Presses
SERTOM 25060 - COLLEBEATO (Brescia) Via E. Mattei 6	Roll Bending Machines
COLLY 69607 - VILLEURBANNE (France) 72 Rue E. Decorps	Press Brakes
MARIANI 20038 SEREGNO Via O. Visconti 6	Shears
PEDRAZZOLI 36061 - BASSANO DEL GRAPPA Via P. Giraldi	Cut off Machines
CRIPPA 22060 - AROSIO (COMO)	Pipe Benders
CACCIA 20029 TURBIGO Piazzetta 5 Vie n° 2	Beaders
C.E.A. - SICMU 10137 - TORINO C.so Orbassano 452	Spot Welders
VALDARNO 21020 BUGUGGIATE (VARESE) Via 1° Maggio 2	Billet Shears

FRIGGI 20086 - MOTTA VISCONTI Via Vittorio Veneto 13	Horizontal Band Saws
DEMAG 10141 - TORINO Via Spalato 51	Over Head Cranes
HUMBERT 10093 - COLLEGNO (TO) Via PAsubio 19	Furnaces
PENSOTTI 20025 LEGNANO (Milano) Via Bezzecca 10	Open Die Hammers Press Hammers
PNEUMOFORE 10141 - TORINO Via Sagra S. Michele 66	Air Compressors
L.T.F. 24051 - ANTEGNATE (BG)	Instection Equipment
WMW - Export -Import Volkseigner Aussenhandelsbetrieb der Deutschen Demokratischen Republik DDR - 109 BERLIN Chausseestrabe 111/112	Machine tools and tools from the GDR
SMART & Brown (Machine Tools) London Road, Biggleswade, Bedfordshire, SG18 8QP	Lathes, Tool and cutter Grinders
WICKMAN Machine Tools (Overseas) Banner Lane, Coventry CV4 9GE	Radial Drilling Machines EDM Machines
ABMTM (Associated British Machine Tool Makers LTD. 20 Park Street, London W1Y 4 NA	Horizontal Milling Machines Drilling Machines
KEIGHLEY Grinders (Machine Tools) Limited, Aireworth Works Keigley, Yorkshire BD21 4DP - England	Cylindrical grinding Machines

./.

SCHAUDT Maschinenbau, GmbH, Stuttgard-Hedelfingen, Hedelfingen StraBe 137	Cylindrical grinding Machines
REYNOLDS & WILSON Ltd. Victoria Road, Surbiton Surrey KT6 4LX	Saw Sharpening Machines Lathes, Radial Drill Tool and Cutter Grinder, Milling Machines & Pedestal Grinders, Filing Machines
HERBERT SIGMA Ltd. Spring Road, Letchworth, Herts., SG64 AJ - ENGLAND	Contour Projectors, Gauges Microscopes
HENRI HAUSER Ltd. CH-2500 Bienne 4, Switzerland	Contour Projectors
HARTLE Machinery International, Alexander Machinery (Dudley) Ltd. Hall Street, Dudley West Midlands DY2 7DA	Bandsaw and Filers
VAUGHAN Associates Limited Trent Works, Abbeyfield Road, Nottingham NC7 2SU	Copy Lathes
OSBORN Mushet Tools Limited, P.O. Box 37 Penistone Road, Sheffield S6 3 AH	Drills, Cutters and Toolbits
Adcock-Shipley Textron Limited, P.O. Box 22, Forest Road, Leicester, LE5 OF J	Horizontal & Turret Milling Machines
ELLIOTT Machine Tools Limited, Padholme Road, Peterborough PEI 5x5	Surface Grinders
RANK Optics Taylor Hobson 200 Harehills Lane, Leeds LS8 5QS - ENGLAND	Engraving Machines

./.

TRIMOS S.A. Lausanne/Switzerland Av du Tribunal-Federal 2, CH - 1005 Lausanne	Dial Indicators-Micrometers Master Gauge, Calipers,
James NEILL (Sheffield) Limited, Napier Street, Sheffiels S11 8HB	Dial Indicators-Micrometers Master Gauge, Calipers Handtools
WINDLEY Bros Ltd., Crown Works, Beach's Drive, Chelmsford CM1 2NW	Surface Plates
THOMAS MERCER Ltd., Eywood Road, St. Albans, Herts AL1 2ND - ENGLAND	Gauges
DOWNHAM Engineering C. Ltd. Priory Road, Downham Market, Norfolk PE38 9JN - ENGLAND	JIG Borers
SHW Postfach 3280 7080 Aalan, Wasseralfingen, - WEST GERMANY	Toolroom Milling Machines
THIEL, Gebruder GMBH 3501 Emstal 1 (Sand) UB Kassel, Uhland Str. 20 FRG	Milling Filing Machines
WEILER KG. Werkzeugmaschinemfabrik 8522 Herzogenaurach, Wurzburger Str 17 Postfach, FGR	Lathes
KUHLMANN FRANZ K.G. 3422 Bad Lauterberg (Harz) 1, Promenade 55, Postfach 240, FRG	Milling Engraving Machines
FLOTT REMSCHEID Aiehe Arnz, Friedr AU6, Remscheid, FRG	Saws

./.

WERKZEUGMASSHINENFABRIK, OERLYKON - Buehrle AG Birchstrasse AS5, 8050 Zurich Switzerland	Lathes
JMTTA (Japan Machine Tool Trade Ass.) Kikai Shinko Kaikan, 3-5-8, Shiba Koen, Minato-Ku, TOKYO	Milling Machines
SUMMIT Machine Tool Mfg. Corp. P.O. Box 1402, Oklahoma City, Okla 73 101, U.S.A.	Cyt-Grinders Lathes

Annex F

BASIC TRAINING PROGRAMMES

FOR PRECISION WORKERS

PHASE 1

- Theoretical training (190 h)
  - . Mathematics and Geometry (20 h)
  - . Drawing (40 h)
  - . Technology:
    - = Marking off (30 h)
    - = Drilling (20 h)
    - = Turning (40 h)
    - = Milling (40 h)
- Practical training (1,570 h)
  - . Filing and marking off (560 h)
  - . Drilling (210 h)
  - . Turning (400 h)
  - . Milling (400 h)

PHASE 2

- Theoretical approach (220 h)
  - . Drawing (20 h)
  - . Technology:
    - = Turning (60 h)
    - = Milling (50 h)
    - = Grinding (90 h)
- Practical training (2,030 h)
  - . Practical exercises in making parts or simple production assemblies

PHASE 3

- Specialization of machine tool fitters
  - . Theoretical approach (220 h)
  - . Practical training (2,030 h)
- Specialization of precision machinists
  - . Professional technology (220 h)
  - . Practical training (2,030 h)

- Specialization of toolmakers and diemakers

  . Theoretical approach (220 h)
  . Practical training (2,030 h)

Annex G

JOB DESCRIPTIONS (FOREIGN EXPERTS)

G.1 - Chief trainer - Mechanical technology instructor

G.2 - Machine tool instructor

G.3 - Basic toolmaking instructor

G.4 - Mould, die, pattern designer

G.5 - Tool designer

G.6 - Part and product designer

G.7 - Industrial and plant engineer

G.8 - Techno-economic analyst

G.1 - CHIEF TRAINER - MECHANICAL TECHNOLOGY INSTRUCTOR

Responsibility and duties

He is responsible for the organization of Training Dept. and for planning its activities, directly reporting to MPDU Manager.

Therefore, he shall:

- develop technology instruction required for machine tools, fitting and tooling;
- evaluate the results achieved by trainees;
- develop training programmes;
- check the instructors' activities;
- provide for purchase of equipment and materials necessary to carry on the scheduled training programmes;
- promote initiatives meant to improve the efficiency and effectiveness of training activity;
- monitor the final overall results of training group.

Age : 40 years minimum.

Education : University degree in Engineering.

Experience : At least 15 years experience in mechanical factories, and 2 years in personnel training.

G.2 - MACHINE TOOL INSTRUCTOR

Responsibility and duties

He is responsible for the training area he is in charge of, reporting to Chief trainer.
Therefore, he shall:

- have the expertise and the capabilities required to carry out the execution of items as per drawing on: center lathe, universal milling machine, gear cutting machine. vertical boring machine, universal grinding machine, universal sharpening machine, pillar drill, shaping machine, with standard equipment;
- develop programmes on drawing, mathematics and technology, relevant to his field of activity;
- establish and request equipment and materials necessary to develop the scheduled programmes;
- evaluate the results achieved by trainees;
- cooperate in the drawing-up and modification of training programme and relevant teaching material.

He will be responsible for supervision, training, record keeping, maintenance of equipment and work area and control and use of training materials.

Age : 35 years minimum.

Education : Minimum 12 years at school, of which 3 + 4 of technical/professional training.

Experience: At least 8 years of work in Precision Mechanic, with experience at supervisory level in a Precision Mechanic shop;some experience as instructor preferable.

G.3 - BASIC TOOLMAKING INSTRUCTOR

Responsibility and duties

He is responsible for initiating the basic instruction of tool makers and precision workers, reporting to Chief Instructor.
Therefore, he shall:

- demonstrate and carry out cutting operations, filing, drilling, manual threading, cylindrical and conical boring, flat and concave surface scraping, etc.;
- demonstrate and carry out oxyacetylene and electrical welding operations;
- have the expertise and capabilities required to explain operation principles, to disassemble and assemble hydraulic and pneumatic components, and to look for breakdowns on machines;
- demonstrate and carry out assembling, positioning and setting up of fixtures, etc;
- select and request equipment and materials necessary to carry out the scheduled programmes;
- evaluate the results achieved by trainees;
- cooperate in the drawing-up and modification of training programmes and relevant teaching materials.

Age : 35 years minimum.

Education : At least 12 years at school, of which 3 ÷ 4 of technical/professional training.

Experience : At least 8 years experience in the fields of filing and bench working; electrical and oxyacetylene welding; hydraulics and pneumatics; tool making.

G.4 - MOULD, DIE, PATTERN DESIGNER

Responsibility and duties

Will be part of the Engineering team, reporting to Chief Engineer, working in close cooperation with local counterparts and with Engineers /Technicians under training, to develop a broad design capability in the specific field of moulds, dies, metallic patterns for metal working industry and plastics industry.
Therefore, he shall:

- undertake designs of moulds, dies, patterns as requested by MPDU customers; initially doing most of the work himself, then having the counterparts deeply involved, with the objective of creating early ability to work on their own;
- follow the actual production of the items designed, and participate in try-outs both at MPDU and at client facilities;
- assist metal and plastics industries in their mould and die problems; inspect installed items to evaluate need for reconditioning;
- prepare lectures and seminars on the above subjects, and hold training sessions for trainees and people from industry.

Age : 40 years minimum.

Education : Degree in Mechanical Engineering, with additional studies in metal forming, and/or plastics processing.

Experience : At least 15 years of work in a mould and die factory, as designer and supervisor.

G.5 - TOOL DESIGNER

Responsibility and duties

Will be part of an Engineering team, reporting to Chief Engineer, Working in close cooperation with local counterparts and with Engineers/Technicians under training, to develop a comprehensive design ability in the specific field of Tools, Jigs, Fixtures for metal working industry.
Therefore he shall:

- undertake designs of tools, jigs, fixtures, as requested by local industries; initially working him self, then gradually involving the counterparts, with the objective of making them able to work at the soo nest on their own;
- follow the actual manufacture of tools designed and participate in try-outs at client factories;
- assist industries in general in their tool design problems;
- assist Engineering department and other industries in Product design, from tooling stand point;
- prepare lectures and seminars on the above subjects, and hold training sessions for trainees and people from industry.

Age : 35 years minimum

Education : Degree in Mechanical Engineering

Experience : 15 years of engineering activity, 10 of which at least in Manufacturing Engineering (Methods) and in tool design.

G.6 - PART AND PRODUCT DESIGNER

Responsibility and duties

Will be part of an Engineering team, reporting to Chief Engineer, working in close cooperation with local counterparts and with Engineers/Technicians under training, to develop a comprehensive Engineering capability in various areas of Product design, both for MPDU and for the Sudanese industry.
Therefore he shall:

- participate in identification of suitable parts and products for the metal working industries in Sudan and for MPDU own production;
- undertake personally initial design of metal parts and products, as requested, then taking the lead of a local group to develop detailed design for MPDU and for local industries; this work has to be carried on more and more by counterparts, that will eventually be able to work on their own;
- prepare special training programs for engineers and technicians on subjects related to metal product design, to material/process combination, to standardization.

Age : 40 years minimum.

Education : Degree in Mechanical Engineering.

Experience : at least 15 years in Product Engineering 10 of them preferably in steel plate and sheet; some experience in tool and die design will be an advantage.
Some years in a supervisory position with a design engineering department is mandatory.

G.7 - INDUSTRIAL AND PLANT ENGINEER

Responsibility and duties

Will be in charge of industrial analysis, layout design, production planning for metal working industries. As part of a team of Product and Manufacturing Engineers, he will work in close cooperation with local counterparts to develop an Engineering capability in various areas of metal industry development in Sudan.
In particular he shall:

- evaluate plant layouts, machine tool selection, installation and equipment design, both for MPDU and for other Sudanese industries;
- assist in study and implementation of appropriate production methods, in relation to available equipment and local labour costs, both for MPDU and for client factories on request;
- recommend and establish basic Production Planning and follow-up Control system;
- establish Quality Assurance and Inspection minimum requirements.

Age: : 40 years minimum

Education: : Degree in Mechanical Engineer, or equivalent

Experience : minimum 15 years in Metal working shops, with at least 10 years in Manufacturing Engineering, 5 of them in a supervisory position.

G.8 - TECHNO-ECONOMIC ANALYST

Responsibility and duties

The expert will lead a group of engineers working as Industrial Economists and as Marketing Engineers. He will support them in their effort to identify and study new industrial opportunities for metal working in Sudan, and also in sorting out product and market opportunities for MPDU, including export to other appropriate countries.

Therefore he shall:

- identify new product possibilities for MPDU, as well as for metal working, engineering and plastics industries;
- undertake techno-economic analysis for MPDU own activity, and for related industrial sector
- carry-on viability analysis for new products and new manufacturing initiatives
- promote and develop product planning system
- assist Manufacturing department in investment analysis
- prepare proposals and quotations for products to be manufactured, and also for Manufacturing Services and Engineering Services offered by MPDU to other industries
- examine and develop export market possibilities for MPDU products to North African and Arabian countries
- collect and evaluate demand figures from potential markets for MPDU products and services
- support forecasting and budgeting activities of MPDU management
- promote and Keep liaisons with national and international institutions related to metal production
- train local counterparts in the above activites, leaving them gradually work on their own in the various specific areas.

Age : 45 to 50 years

Education : Degree in Business and Administration, or Industrial Economics, or Industrial Engineering, with additional educational background in marketing and industrial management aspects.

Experience : minimum 15 years (20 preferable) in business and marketing activities, 10 of which in work related to metal industry. Experience in industrial development and consultancy services for similar type of industry will be a major asset.

Annex H

ECONOMIC DATA

H.1 - M P D U Sales

H.2 - Training costs

H.3 - Personnel

H.1 - M P D U SALES

In order to forecast the MPDU sales in the first 6 years of activity, they have been divided in three categories:
- Engineering sales,
- Tool & Die Workshop sales,
- Metal Forming Workshop sales.

For each category certain assumptions have been adopted.

a) Engineering sales. This department will start with 8 engineers and will grow up to 14 people in three year time. Skill and experience will also increase in the years and therefore the charge for a MPDU engineer working day shall grow accordingly.
240 workdays per year have been considered, and 75% of same should be sold (partly to external customers and partly to the MPDU itself).
The three year work of the 5 foreign experts in the Engineering department has not been considered.

ENGINEERING DEPARTMENT							
YEAR		1	2	3	4	5	6
Engineers		8	13	14	14	14	14
Workdays available		1920	3120	3360	3360	3360	3360
SALES (days)	Total	1400	2400	2800	2800	2800	2800
	Internal (MPDU)	800	1000	500	200	200	200
	External	600	1400	2300	2600	2600	2600
Daily charge - US$		120	140	160	180	200	200
Sales : US$ (000)		72	196	368	468	520	520

b) Tool & Die Workshop sales.
The type of activity that must be performed in this shop being extremly specialized, the yearly growth of sales has been estimated rather limited. The material utilized in this shop represent only a small percentage of the product final value wich is on the contrary mostly influenced by labour.
Consequently extreme care should be taken in the production planning since, in order to obtain acceptable results, the difficulty of the parts to be manufactured must be tooned to the level of the workers skilfulness.

c) Metal Forming Workshop sales.
The activity of this shop, on the contrary, shall involve quite a large amount of material and therefore sale figures will be rather impressive.
Furthermore the type of operations performed generally can be efficiently organized and can give high productivity and good profit.

Material prices have been considered 40 to 50% higher than european ones; labour cost has been evaluated in each case combining wage levels and productivity.

M P D U - S A L E S (000 $)							
		year 1	2	3	4	5	6
Tool & Die Shop	Min	-	-	160	350	500	650
	Max	-	-	200	440	640	800
Metal Forming Shop	Min	-	-	350	760	1050	1400
	Max	-	-	400	880	1200	1600
Engineering	Min	50	150	300	380	420	450
	Max	70	190	360	450	520	520
TOTAL	Min	70	190	870	1560	2070	2570
	Max	-	-	960	1840	2360	2920

H.2 - TRAINING COSTS

As already specified in Section 4 - Training - the staff required for operation of departments, plants and working equipment of M.P.D.U., as well as for development of relevant organizational, technical and commercial activities, will include the following:

a) - foreign experts, who will stay at M.P.D.U. for the time required for regular development of the execution and starting schedule of production unit and for training of local staff to be assigned to key positions;

b) - local staff, to be trained both abroad and with the assistance of experts as per previous item a);

c) - local staff, trained in the Training Dept., to meet specific requirements of M.P.D.U. and of other industries that are going to be established in Sudan after the creation of M.P.D.U..

Special financing schemes have been foreseen in order to implement the above programme, and more specifically (see Tables 1, 2, 3, 4):

- A Technical Assistance Programme

  for experts and counterparts - see items a) and b);

- A Local Training Subsidy

  (see item c) that includes:

  1) all salaries of counterparts trainers;
  2) first year salary/wage for engineer/technician trainees and operator trainees;
  3) first three years wages for precision worker trainees.

H.2 - TECHNICAL ASSISTANCE PROGRAMME COST					Table 1
Type of training	Description	N°of people	Cost	Notes	Total cost(000$)
Technical assistance programme	Experts for Management Experts for Training Experts for Engineering Experts for Manufacturing Other professional improvements	1 3 5 4 n. d.	Medium cost of man year 83000$	Total 46 man years (see 4.08)	3.800
Overseas Key positions and counterparts training	Management Engineers Technicians Other professional improvements	2 9 9 n. d.	Cost per mount 3700 $ Travel, and training included (each trainee)	Total 80 man mounths (see 4.08)	300
Preparatory project in year 0 (Equipment purchesing, local construction activity, recruitment, etc.)					150
Total cost of Technical assistance programme					4.250 $ USA

H.2 - LOCAL TRAINING SUBSIDY - NUMBER OF PERSONS								Table 2
	year 0	1	2	3	4	5	6	7
Chief trainer	1(*)	1	1	1	1	1	1	1
Trainers	1(*)	4	4	4	4	4	4	4
Trainees:								
. Precision workers	-	16	32	48	44	40	36	36
. Engineers	-	6	3	3	3	3	3	3
. Technicians	-	6	9	9	9	9	9	9
Managers	1	3	-	-	-	-	-	-
Engineers	2	9	7	2	-	-	-	-
Technicians	4	1	6	4	-	-	-	-
Operators	-	-	15	15	10	-	-	-
(*) Only for 1 quarter								

H.2 - LOCAL TRAINING SUBSIDY COST (.000 $ US)								Table 3
	year 0	1	2	3	4	5	6	7
Chief trainer	1	4	4,5	5	5,5	6	6,5	7
Trainers	2,5	10	12	14	16	18	20	22
Trainees:								
. Precision workers	-	3,2	8	33,6	32,8	31,6	25,2	25,2
. Engineers	-	12	6	6	6	6	6	6
. Technicians	-	9	13,5	13,5	13,5	13,5	13,5	13,5
Managers	7	21	-	-	-	-	-	-
Engineers	8	36	28	8	-	-	-	-
Technicians	10	2,5	15	10	-	-	-	-
Operators	-	-	13,5	13,5	9	-	-	-
TOTAL	28,5	97,7	100,5	103,6	82,8	75,1	71,2	73,7
Rounded Total	28	98	100	104	83	75	71	74

Table 4

H.2 - TRAINING COSTS SUMMARY

(First five years)	(000 $ USA)
- Technical assistance programme	4.250=
- Local training subsidy (rounded total)	500=
Total	4.750=

NOTE The following items are not included:

. overheads

. materials

. depreciations

since already considered in the M P D U overheads and depreciations.

Table 1

H.3 - M P D U Personnel - Payroll

Specification	year 0	1	2	3	4	5	6	7
- Managers		1	4	4	4	4	4	4
- Engineers		2	11	18	20	20	20	20
- Technicians		4	5	11	15	15	15	15
- Clerks	2	6	6	6	6	6	6	6
- Common Clerks			4	7	7	7	7	7
- Senior Toolmakers						4	8	8
- Precision Workers					16	28	37	37
- Skilled Workers					16	16	12	12
- Operators				15	30	40	40	40
- Unskilled Workers		5	5	10	15	15	15	15
TOTAL	2	18	35	71	129	155	164	164

Table 2

H.3 - General Management, Administration & Personnel, Training-Personnel -Payroll

Specification	year 0	1	2	3	4	5	6	7
- Managers			2	2	2	2	2	2
- Engineers		2	2	2	2	2	2	2
- Technicians		4	4	6	6	6	6	6
- Clerks	2	3	3	3	3	3	3	3
- Common Clerks			2	3	3	3	3	3
- Senior Toolmakers								
- Precision Workers								
- Skilled Workers								
- Operators								
- Unskilled Workers								
TOTAL	2	9	13	16	16	16	16	16

Table 3

H.3 - Manufacturing Department Personnel - Payroll

	year 0	1	2	3	4	5	6	7
- Managers			1	1	1	1	1	1
- Engineers				2	4	4	4	4
- Technicians			1	5	9	9	9	9
- Clerks		1	1	1	1	1	1	1
- Common Clerks			1	2	2	2	2	2
- Senior Toolmakers						4	8	8
- Precision Workers					16	28	37	37
- Skilled Workers					16	16	12	12
- Operators				15	30	40	40	40
- Unskilled Workers		5	5	10	15	15	15	15
TOTAL		6	9	36	94	120	129	129

Table 3.1

H.3 - Manufacturing Department Personnel - Management and Services -Payroll

Specification	year 0	1	2	3	4	5	6	7
- Managers			1	1	1	1	1	1
- Engineers				2	2	2	2	2
- Technicians			1	3	3	3	3	3
- Clerks		1	1	1	1	1	1	1
- Common Clerks			1	2	2	2	2	2
- Senior Toolmakers							2	2
- Precision Workers						2	2	2
- Skilled Workers								
- Operators				2	4	7	10	10
- Unskilled Workers		5	5	5	10	10	10	10
TOTAL		6	9	16	23	28	33	33

Table 3.2

H.3 - Manufacturing Department Personnel - Tool and Die Workshop -Payroll

Specification	year 0	1	2	3	4	5	6	7
- Managers								
- Engineers					1	1	1	1
- Technicians				1	3	3	3	3
- Clerks								
- Common Clerks								
- Senior Toolmakers						4	6	6
- Precision Workers					16	26	30	30
- Skilled Workers					16	16	12	12
- Operators				4	10	10		
- Unskilled Workers				2	2	2	2	2
TOTAL				7	48	62	54	54

Table 3.3

H.3 - Manufacturing Department Personnel - Metal Forming and Heat Treatment Shop - Payroll								
	year 0	1	2	3	4	5	6	7
- Managers								
- Engineers					1	1	1	1
- Technicians				1	3	3	3	3
- Clerks								
- Common Clerks								
- Senior Toolmakers								
- Precision Workers							5	5
- Skilled Workers								
- Operators				9	16	23	30	30
- Unskilled Workers				3	3	3	3	3
TOTAL				13	23	30	42	42

Table 4

H.3 - Engineering Department Personnel -Payroll

	year 0	1	2	3	4	5	6	7
- Managers		1	1	1	1	1	1	1
- Engineers			9	14	14	14	14	14
- Technicians								
- Clerks		2	2	2	2	2	2	2
- Common Clerks			1	2	2	2	2	2
- Senior Toolmakers								
- Precision Workers								
- Skilled Workers								
- Operators								
- Unskilled Workers								
TOTAL		3	13	19	19	19	19	19

Table 5

H.3 - Personnel cost increase through the years (000 $ USA)

Specification	year 0	1	2	3	4	5	6	7
- Managers	7	8	9	10	11	12	13	14
- Engineers	4	4,5	5	5,5	6	6,5	7	7,5
- Technicians	2,5	3	3,5	4	4,5	5	5,5	6
- Clerks	2	2,2	2,4	2,6	2,8	3	3,2	3,4
- Common Clerks	1	1,2	1,4	1,6	1,8	2	2,2	2,4
- Senior Toolmakers	2,5	3	3,5	4	4,5	5	5,5	6
- Precision Workers	1,5	1,7	1,9	2,2	2,5	2,8	3,1	3,4
- Skilled Workers	1	1,2	1,4	1,6	1,8	2	2,2	2,4
- Operators	0,9	1	1,2	1,4	1,6	1,8	2	2,2
- Unskilled Workers	0,8	0,9	1	1,1	1,2	1,3	1,4	1,5

Table 6

H.3 - MPDU Personnel Cost (000 $ USA) - Payroll

Specification	year 0	1	2	3	4	5	6	7
- Managers		9	34	38	42	46	50	54
- Engineers		9	50,5	87,5	105,5	115,5	125,5	135,5
- Technicians		12	17	37,5	55	62,5	70	77,5
- Clerks	4	12,4	13,6	14,8	16	17,2	18,4	19,6
- Common Clerks			4	7,4	8,1	8,8	9,5	10,2
- Senior Toolmakers						5	16	24
- Precision Workers					12	39,2	59	71,9
- Skilled Workers						8	8	8
- Operators				7,5	33	54,4	54,8	74,2
- Unskilled Workers		4	4,5	9	14	15,5	17	18,5
TOTAL	4	46,4	123,6	201,7	285,6	372,1	428,2	493,4
Rounded Total	4	46	124	202	286	372	428	493

Table 7

H.3 - General Management - Administration & Personnel, Training Cost - Payroll (000$ USA)

Specification	year 0	1	2	3	4	5	6	7
- Managers			16	18	20	22	24	26
- Engineers		9	10	11	12	13	14	15
- Technicians		12	14	22	25	28	31	34
- Clerks	4	6,4	7	7,6	8,2	8,8	9,4	10
- Common Clerks			2	3,2	3,5	3,8	4,1	4,4
- Senior Toolmakers								
- Precision Workers								
- Skilled Workers								
- Operators								
- Unskilled Workers								
TOTAL	4	27,4	49	61,8	68,7	75,6	82,5	89,4
Rounded Total	4	27	49	62	69	76	83	89

H.3 - MANUFACTURING DEPARTMENT PERSONNEL COST (.000 $ US) -PAYROLL Tab. 8

Specification	year 0	1	2	3	4	5	6	7
- Managers			8	9	10	11	12	13
- Engineers				9	19	21	23	25
- Technicians			3	15,5	30	34,5	39	43,5
- Clerks		2	2,2	2,4	2,6	2,8	3,0	3,2
- Common Clerks			1	2,1	2,3	2,5	2,7	2,9
- Senior Toolmakers						5	16	24
- Precision Workers					12	39,2	59	71,9
- Skilled Workers						8	8	8
- Operators				7,5	33	54,4	54,8	74,2
- Unskilled Workers		4	4,5	9	14	15,5	17	18,5
TOTAL	-	6	18,7	54,5	122,9	193,9	234,5	284,2

H.3 - MANUFACTURING DEPARTMENT PERSONNEL COST - MANAGEMENT AND SERVICES (.000$US)PAYROLL

Tab. 8.1

Specification	year 0	1	2	3	4	5	6	7
- Managers			8	9	10	11	12	13
- Engireers				9	10	11	12	13
- Technicians			3	9,5	11	12,5	14	15,5
- Clerks		2	2,2	2,4	2,6	2,8	3	3,2
- Common Clerks			1	2,1	2,3	2,5	2,7	2,9
- Senior Toolmakers							5	6
- Precision Workers						3	3,4	3,8
- Skilled Workers								
- Operatcrs				1	4,4	9,6	11	16
- Unskilled Workers		4	4,5	5	9,5	10,5	11,5	12,5
TOTAL		6	18,7	38	49,8	62,9	74,6	85,9
Rounded Total		6	19	38	50	63	75	86

H.3 - MANUFACTURING DEPARTMENT PERSONNEL COST - TOOL AND DIE WORKSHOP (.000 $US)-PAYROLL Table 8.2

Specification	year 0	1	2	3	4	5	6	7
- Managers					4,5	5	5.5	6
- Engineers				3	9,5	11	12,5	14
- Technicians								
- Clerks								
- Common Clerks								
- Senior Toolmakers						5	11	18
- Precision Workers					12	36,2	52,6	60,2
- Skilled Workers						8	8	8
- Operators				2	10,8	14		
- Unskilled Workers				1,6	1,8	2	2,2	2,4
TOTAL				6,6	38,6	81,2	91,8	108,6
Rounded Total				7	39	81	92	109

H.3 - MANUFACTURING DEPARTMENT PERSONNEL COST - METAL FORMING AND HEAT TEATMENT SHOP(.000$US)PAYROLL

Table 8.3

Specification	year 0	1	2	3	4	5	6	7
- Managers								
- Engineers					4,5	5	5,5	6
- Technicians				3	9,5	11	12,5	14
- Clerks								
- Common Clerks								
- Senior Toolmakers								
- Precision Workers							3	7,9
- Skilled Workers								
- Operators				4,5	17,8	30,8	43,8	58,2
- Unskilled Workers				2,4	2,7	3	3,3	3,6
TOTAL				9,9	34,5	49,8	68,1	89,7
Rounded Total				10	35	50	68	90

H.3 - ENGINEERING DEPARTMENT PRESONNEL COST (.000 $ US)-PAYROLL Table 9

Specification	year 0	1	2	3	4	5	6	7
- Managers		9	10	11	12	13	14	15
- Engineers			40,5	67,5	74,5	81,5	88,5	95,5
- Technicians								
- Clerks		4	4,4	4,8	5,2	5,6	6	6,4
- Common Clerks			1	2,1	2,3	2,5	2,7	2,9
- Senior Toolmakers								
- Precision Workers								
- Skilled Workers								
- Operators								
- Unskilled Workers								
TOTAL		13	55,9	85,4	94	102,6	111,2	119,8
Rounded Total		13	56	85	94	103	111	120