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

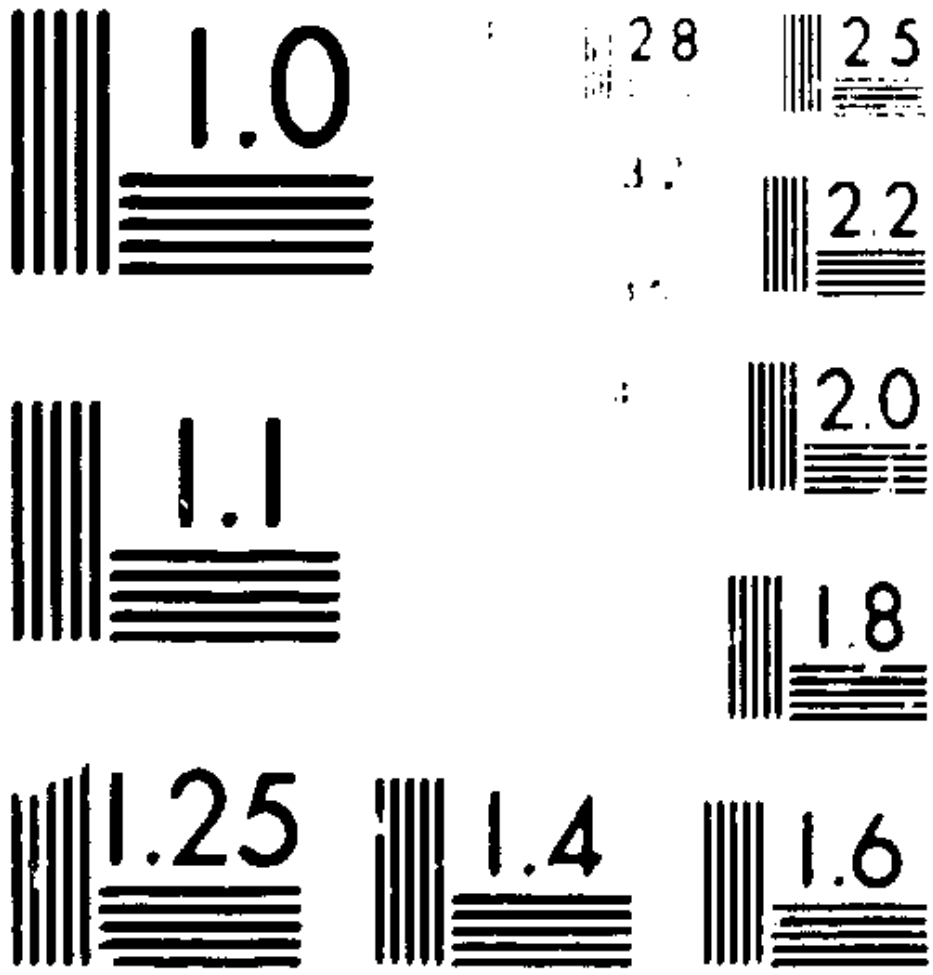
FAIR USE POLICY

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


1.0
2.8
2.5
2.2
1.1
2.0
1.8
1.25
1.4
1.6

09466

UNIDO UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

METAL PRODUCTION DEVELOPMENT UNITS

METAL FORMING

FIAT ENGINEERING SpA

OCTOBER 1979

C O N T E N T S

E X H I B I T S

Exhibit 8 - General market survey

N O T E S

All the quotations (relative to investments, costs and revenues) are in U.S. thousands of dollars.

The conversions from European currencies to U.S. dollars are based on current exchange rates for September 1979.

In the investments evaluation cost of land and transport charges are not included.

I N T R O D U C T I O N

General purposes of the tools, dies and metal pressing units for developing countries.

The main targets of the unit, described in the present study are:

- production of capital goods and spare parts through the output of proper level metal pressed pieces;
- design and production of dies, tools, fixtures as support to the production of metal pressed parts, and as commercial goods for the local market;
- development of professional capabilities in administration, marketing, engineering, technology for native graduated people;
- training of workers, not only for the production but also for highly skilled tasks as pattern making, precision machining, maintenance, general installation control, etc.;

In this way, not only the unit will be self-sufficient and independent of overseas know-how, but it will be possible to supply local existing industries with engineering and workshop or die making services, obtaining - at the same time - an additional profit for the factory.

The unit is - generally speaking - profit and market oriented: but this aspect is only one of the components of a broader and more important goal, as social improvement and promotion of side activities.

A general market survey referring to needs arising from market demand (also taking into account development plans) is reported in exhibit 8: opportunities for a Metal Production Development Unit in ACP countries may be thus roughly estimated.

1. FOREWORD

The basic forming technologies include:

1.1. SHEET METAL COLD FORMING

1.1.a. Basic forming technologies

Forming is the whole of mechanical processes by which a sheet is subjected to one or more transformations, using dies mounted on pressing machinery, in order to obtain a product with given geometrical shape.

Different steps of forming operations are often referred to as "drawing". As main equipment the process makes normally use of mechanical or hydraulic presses: in more advanced methods other sources of energy are involved, as in explosive forming, electrohydraulic or electromagnetic forming, hydrostatic forming, ultrasonics applications (deepdrawing) etc.

Drawing tool installed on a press consists of three main parts:
the punch, the die and the blank holder

Punch and die give rise to inside and outside contours of stamped item, while the blank holder, (pressing the metal against the die) avoids foldings and controls sheet slinding along the punch.

1.1.b. Solicitations models (see sketches page 5)

Drawing of a part is presented as a continuous dual effect between two basic modes of solicitation:

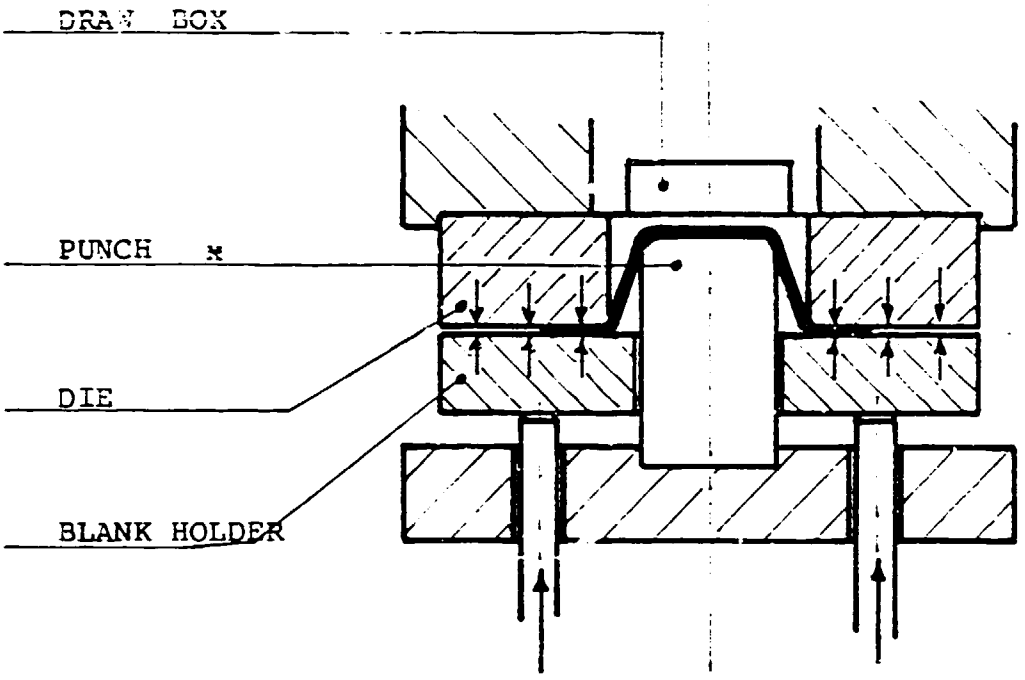
- stretching when the metal, pressed between die and blank holder, is blocked and undergoes expansion caused by the punching action
- shrinking when the sheet flows to feed the metal drawn by the punch

Between these two extreme modes, an intermediate one may be singled out, when the blank holder only restrains the flowing metal on a part or on the whole surface.

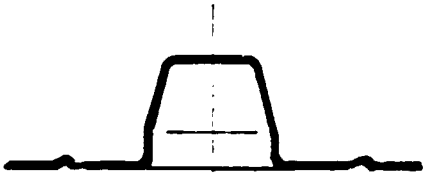
1.1.c. Critical points of forming operations

Comparing the data resulting from detailed studies upon different types of deformation some main points in the processes have been focused and must be outlined:

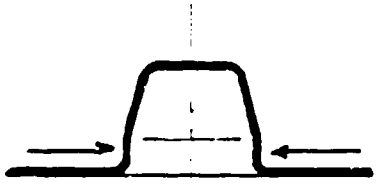
1. Safety margin of forming
2. Choice for more economic material
3. Weak points suggesting to redesign the die or to improve lubrication
4. Influence of forming speed and lubrication
5. Deformation paths and right sequence of strains to be applied



DIE FOR DRAWING



For stretching, metal is blocked between die and blank holder



Through shrinking, metal flows between die and blank holder

1.1.d. Steps in forming sequence

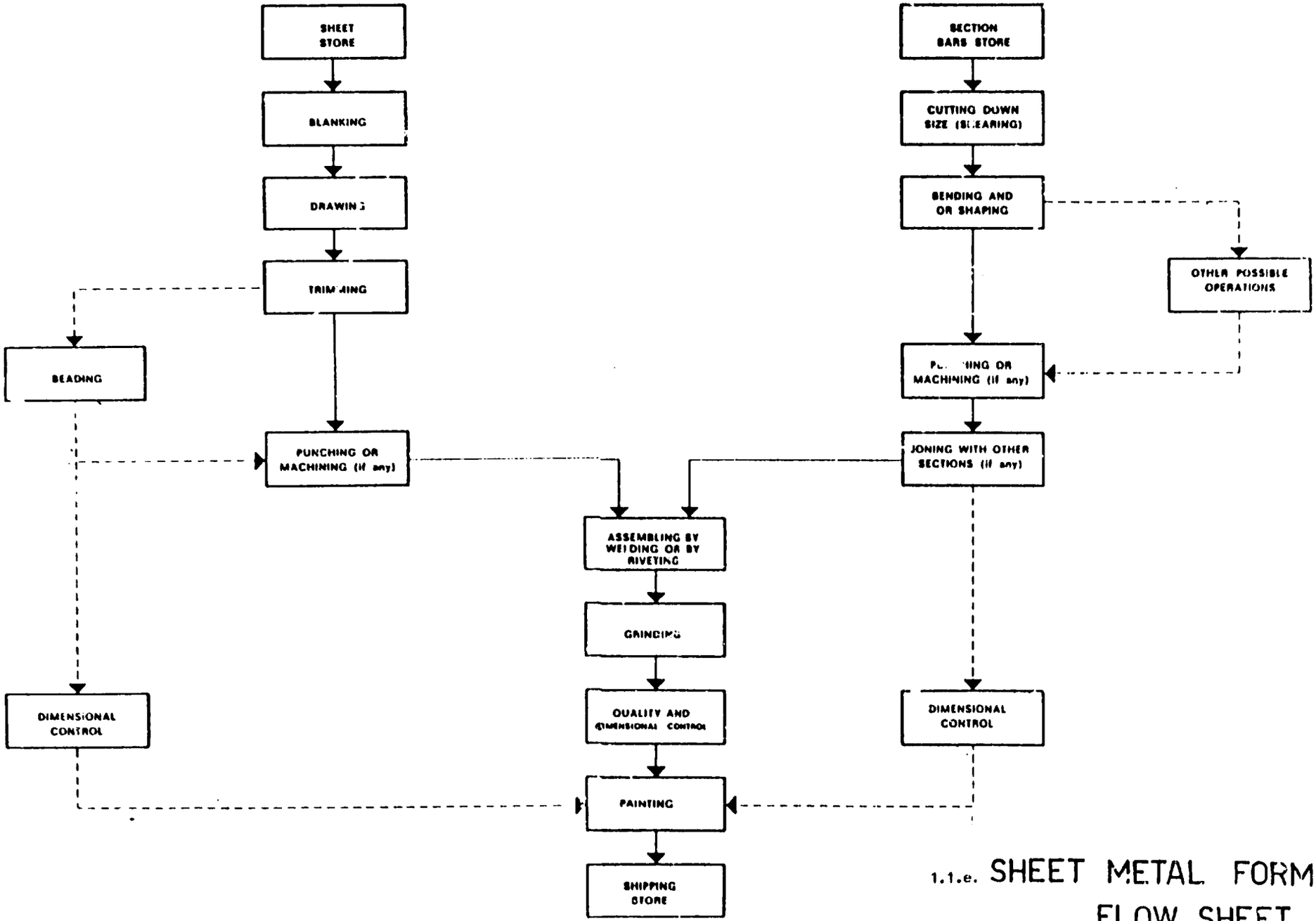
A typical operating sheet metal sequence may be sketched as follows:

blanking, forming (bending, drawing etc.) trimming, restriking, punching, beading, flanging, coining, checking.

Sometimes two or more of these pieces shall be joined together (by means of rivetings, snap-rivetings, welding, spot weldings ....) and make - up sub - assemblies of more complex products.

As an alternative, some components can be obtained from pipes or from section irons, through cutting and subsequent shaping (carried-out with press and suitable dies) or rolling or bending.

The possible main stages of the process are visualized in the annexed flow-sheet.



1.1.e. SHEET METAL FORMING FLOW SHEET

1.2. OUTLINE OF DIES TECHNOLOGY

With the word "DIE" we refer to a very broad class of tools, designed to give shape to liquid, hot or cold, materials (mainly metals or plastics).

The die consists normally of a set of parts to be used jointly or in succession, depending on their function and on the planning of the whole process.

The material used for dies can vary from rubber (for tinned cans), to sintered carbides (shears of progressive dies in the production of magnetic steel sheets), to special maraging steels (light alloys pressure die casting): raw material and machining costs are normally high.

Tool design is critical for all forming operations. It can be accomplished only after the determination of the forming cycle and can be outlined in the following steps:

1. Determination of work piece size, materials, required accuracy
2. Number of pieces to be produced by one set of dies
3. Required productivity
4. Skill of the personnel involved in cold forming

To get a general picture, it might be useful to refer to the tables in exibit 1, in which the main types of die used in the sheet pressing department are drafted simply. However, as we mentioned above, other types of dies may be built for outside customers and different technologies (molds for plastic materials injection or blowing, gravity or pressure light alloys die castings). They shall be prepared with the machinery and equipment provided for cold forming dies.

In schematic line, a die consists of the elements shown in figure 1 for which the operations of table 1 are to be foreseen. It is interesting to note that the machines required are the ones which are usually necessary for a qualified mechanical equipment workshop: consequently, with such machines it is possible to manufacture not only dies but also a good number of tools and fixtures. With the same machines it will be possible to carry out most of the maintenance operations for the works and tc manufacture fixtures, both for internal use and for outside sales.

TABLE 1

OPERATIONS REQUIRED FOR THE DIES MANUFACTURE

Part	Denomination	Lathe turning 1	Milling 2	Drilling 3	Boring 4	Tapping 5	Heat treating 6	Grinding 7	Vertical grinding 8	O.D.grinding 9	I.D.grinding 10	Sharpening 11	Marking 12	Spark erosion machining 13	Notes
1	Movable plates		X	X	X	X		X	X		0		X		
2	Tongs hold	X	0		0		X			X		0		0	
3	Punch	X	0				X	0		0	0	X		0	
4	Spring guide pins	X	X												
5	Columns	X					X			X					
6	Blank holders		X	X	X	X	X	X	X				X		
7	Bushings	X	X							X	X				
8	Positioner for sheet iron		X	X			X		X						
9	Clamping elements	X		X				X							
10	Die		X	X	0		X	X	X	0	0	X	X	0	
11	Die holder		X	X	X	0	X	0	X			X	X	0	

X = Operation required
0 = Operation to be executed only in some case

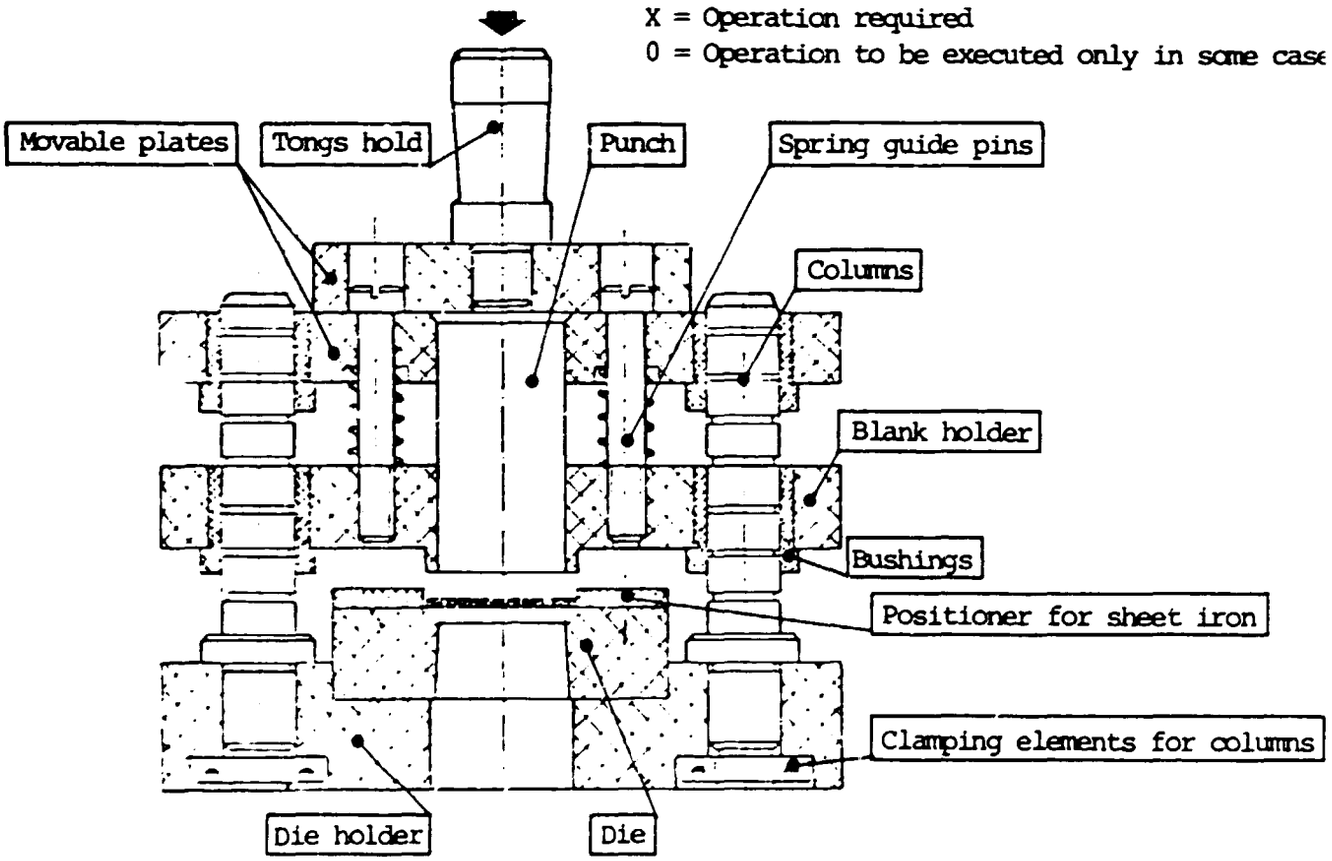
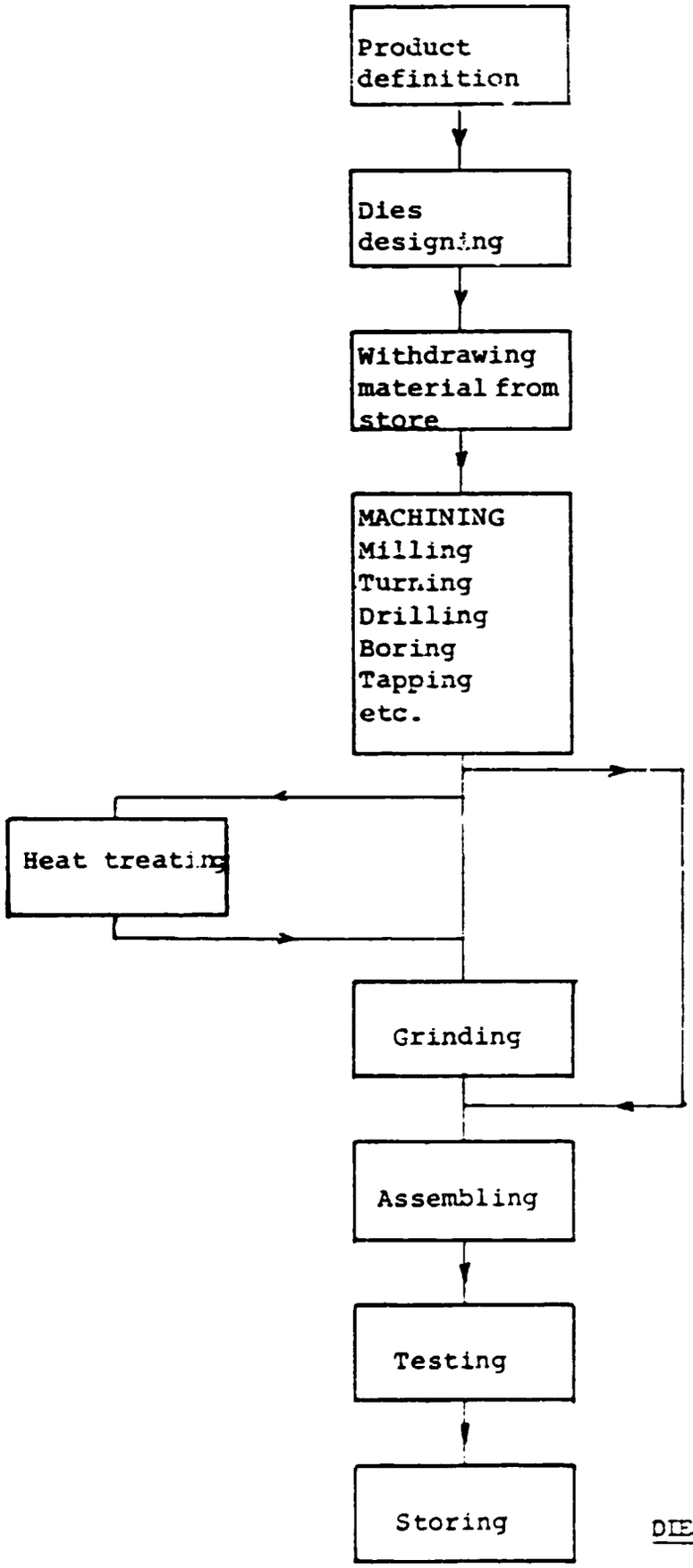


FIGURE 1

The stages for manufacturing die are indicated in the flow diagram below:



DIES MANUFACTURING FLOW-SHEET

1.3. OUTLINE OF FORGING TECHNOLOGIES

Metal, if heated to maximum plasticity temperature and subjected to gradually increasing or even suddenly acting external forces, will deform, after a short period of elasticity, in a permanent way to take on a shape which may be imposed, through hammers or presses, by a proper skilled hand work or using suitably designed dies.

The material particles, subjected to deformation load, flow over one another, being displaced, compressed and aligned, according to the direction of flow forming fibres and refining microstructures. This gives forged steel better mechanical properties than rolled steel in which the fibres run parallel to the direction of rolling deformation.

Strains act on the hot workpiece through different kinds of forging pressure imparted by different types of equipment:

- impact pressure, applied through the forging hammer and depending on the velocity and weight of a falling mass
- push pressure - a low velocity pressure normally applied and maintained in motion hydraulically, limited by increasing metal's resistance to flow
- combination of impact and push pressure, normally imparted by high speed mechanical forging presses that are used on closed die forging work

During pressing operation pressure force increases while velocity of stroke decreases.

Forging operations may be grouped in two general types of processes:

1) smith die forging including many different forging forms using flat facing dies and other auxiliary tools. The result largerly depends on the skill of the smith for size and shape: the methods are also known as open die forging, hand or hammer forging and normally require a very long period of workers training

2) impression die forging (or closed die forging, drop forging) making use of cavities in proper metal dies that match together to press the workpiece from any direction. The metal to be shaped (a piece of red hot steel) has previously been cut to length to provide the volume needed plus some allowance for flash.

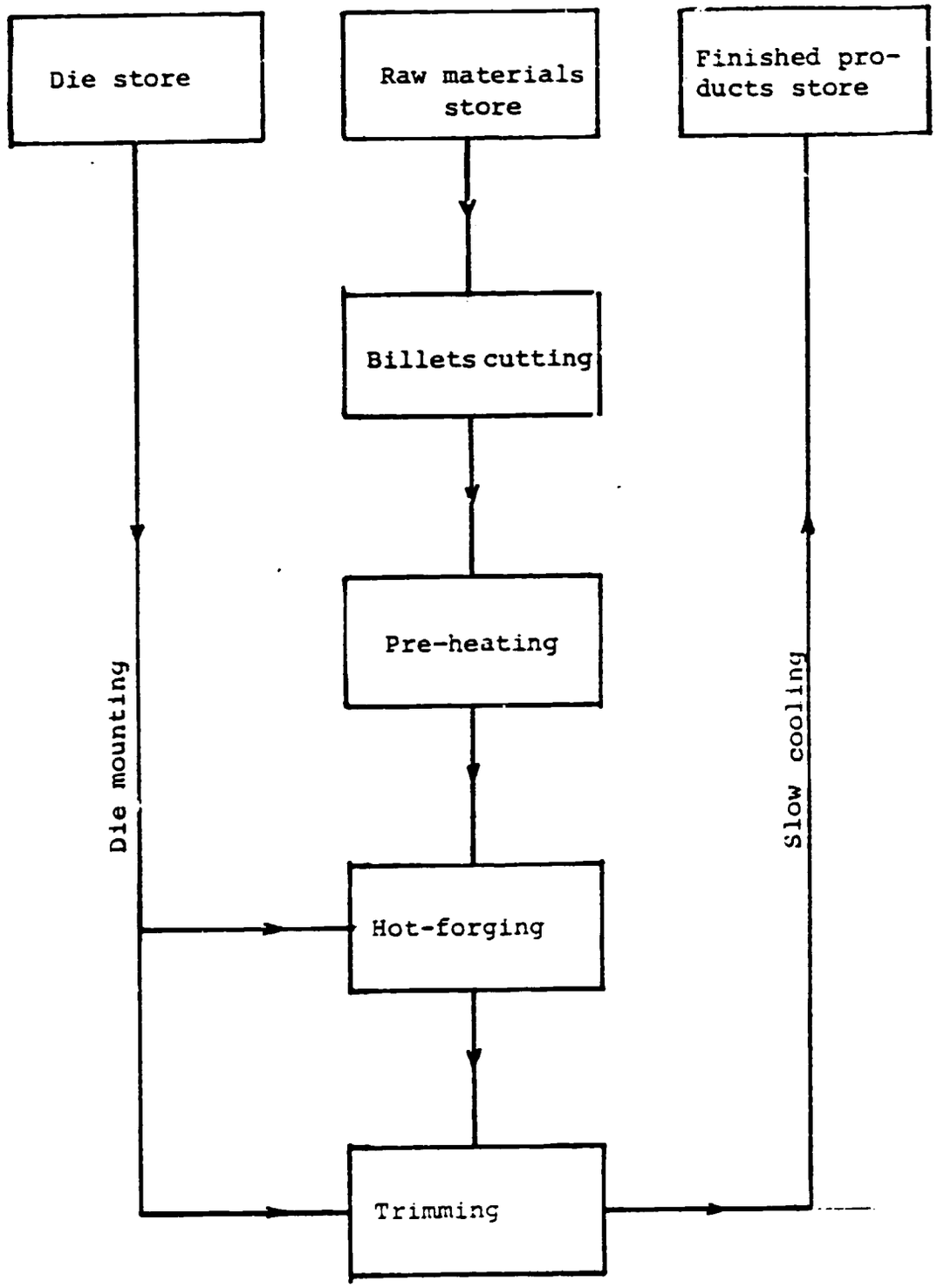
After the designing of forged item (starting from finished product design) the number of forging steps is dependent on the size and shape of the part, on quantities requested and on the type of metal to be worked. Basically we can condense the whole process in cutting to size billets, pre-heating to forging temperature, deforming by press or hammer, trimming.

In most cases the forged item (a semifinished pro-

duct) is later machined.

The main steps of a closed (or impression) die forging process are shown in the next page flow sheet.

CLOSED DIE FORGING FLOW-SHEET



1.4. PRODUCT TYPES

This technology can replace more expensive processes in the production of many kinds of items.

Only recently, thanks to increased knowledge of the atomic structure metals, the problem of materials formability has been scientifically studied: manufacturers of sheets, machinery, lubricants and utilizers have begun to work in close connection with each other and with laboratory experts.

The main factors influencing results are die design, lubrication and materials.

Sheet metal cold forming is one of the fundamental operations for many metal constructions of the mechanical industry, either elementary (such as shovels, buckets, hinges) or complex (such as stators and rotors for electric motors, mufflers for motor-vehicles, components for electrical instrumentation ...). For instance, the production may be directed towards:

- agricultural machines (carts, wagons, wheel borrows, harrows, sowing machines, ...)
- building industry (locks, hinges, padlocks ...)
- domestic utensiles (casseroles, stoves, fans ...)
- street and road elements (panels, signals ...)
- railroad and lifting systems

2. GENERAL CRITERIA IN DECISION AND EVALUATION

2.1. SUBDIVISION OF THE PRODUCTION UNIT

The production unit here outlined is fundamentally of mechanical type.
It is subdivided into two departments respectively assigned

- sheet forming (with structural work and assembling of parts)
- manufacturing of tools, dies and fixtures and machinery maintenance

In this way the unit is well balanced and the two departments are mutually integrated. However possibilities of enlarging the plant are foreseen in order to extend it with the installation of equipment for the hot-forging.
Next to the tools and dies department a workshop has been planned for the practical training of the workers and of the technicians. The theoretical lessons shall be given in rooms located in the office building.

2.2. GUIDELINES FOR EVALUATION

The guide lines for evaluating the sheet metal pressing unit are·

A) Investment - quite moderate per head especially when compared to the rolling plants.

B) Workers training - short term especially when compared to hot-forging and machine tools training

C) Product type - cold formed parts may be aimed at industry or directly at market and can easily penetrate market because of wide product range

D) Technology - up to date but not over-mechanized (quality and quantity of production levels are guaranteed even without mechanical and automatic application systems).
From this point of view the unit may be considered as labour intensive

E) Dies and tools supply - the problem of dies supply is overcome by providing a special tool department.

2.3. DECISION AND EVALUATION CRITERIA CONCERNING THE TOOL AND DIE DEPARTMENT

The manufacture of the dies represents an indispensable support for a sheet metal pressing unit. It must be entrusted to qualified workers, assisted by a technicians and planners team having good experience. The high cost of personnel training for the designing and the constructing of the tools, dies and fixtures, finds its justification in the following elements:

- high number of dies required (two, three, four dies may be necessary for a same component)
- high cost of the dies (a die having average dimensions have a cost of 4 to 5,000 dollars)
- necessity of construction within a brief period (to assure the customers rapid deliveries)
- necessity of rapid repair of damaged dies and of machinery maintenance
- opportunity to sell engineering and to supply or to modify dies and fixtures, for other industries, including the usual buyers of pressed items.

Afterwards, it is opportune to remark that, in its entirety, the production unit demands two distinct levels of training for "sheet metal pressing" workers and for "tool and dies department" workers.

This allows on one hand to reach the "break even point" within a reasonable brief time. on the other to form a large number of skilled workers, with a good "multiplication factor".

2.4. GENERAL CRITERIA OF DECISION AND EVALUATION CONCERNING THE HOT PRESSING DEPARTMENT

Where high mechanical properties are requested, pieces are mainly obtained from hot pressed steel undergoing then heat treatments in order to reach high yield strength and resistance to torsion, bending, compression, and other dynamic stresses acting in combined way.

Forging items attain the maximum mechanical properties with the minimum of dimensions.

The economical advantage of establishing a hot pressing department is closely connected to the local conditions of industrial production and of the market absorption. So, at the present stage of the project, we have not been able to state an economic calculation. However the following considerations are valid:

a) descriptions and calculations constitute a sepa-

rate context (allowing for ease of evaluation with - and without -)

b) investments and personnel employed are quite minimal and do not affects significatively the whole amount of the unit

c) the occupied area is limited and can be utilized in any case as an open shed for tempcrary storages.

3. THE WORKS

3.1. GENERAL CONDITIONS

These presuppositions are assumed:

- the ground is leveled
- the road system reaches the fence
- water and electric energy are available at the border of the occupied area. The electric energy is available at high voltage, for which, in works area an electric station for the transformation to the utilization voltage is planned in the plant area
- prohibitions do not exist for what concerns the noise and the vibrations
- the eventual installation of a power hammer for the hot-pressing dept, will request the creation of appropriate foundations which will absorb the vibrations (in order to not compromise the production quality of the tool machines)
- purification and draining water systems (both industrial and sewage waters) have not been taken into account.

3.2. BUILDINGS AND INSTALLATIONS

The offices are located in a separate building (see exhibit 2.1) having a surface of about 1,000 Sq.mts. 100 meters are of inner patio (mainly devoted to training halls that face on it).
They include (see exhibit 2.2):

- entrance
- waiting - room
- management room with secretarial area
- book-keeping department
- engineering department
- archives
- two halls for the theoretical training of the workers
- hall for the instructors
- canteen
- surgery
- services for the staff.

The productive works (see exhibit 2.2) cover a surface of about 3.000 sq. mts. Nearly half of the surface is assigned to the tool and dies department. This in turn is divided in 2 areas by a wide aisle which allows manoeuvre space for the fork-lift trucks.

The first area includes the machine-tools and the die fitter's benches assigned to the production. Next to the die fitter benches some space is set

aside to keep dies and equipment being repaired or built on stands.
As usually, in tool and die workshops, not having mass production machines with similar characteristics have been grouped together.

The second area is the one set aside for training the newly hired workers.
There is less free space in this area beacause there are fewer products to be handled. In front of this area a little room with glass walls is set aside for instructors.

A tools distribution center has been placed suitably near the sharpening machinery and wide areas accessible from both departments are used for storing the new dies, the ones overhauled and ready to be used again as well as the ones yet to be reconditioned.

The pressing department groups the presses and the other machines for sheet metal machining. The aisles for in-plant moving are wide because of the large quantities of materials moved and because of the large stocks of pieces near the machines. Quite often it is required that the pressed pieces go through surface treatments (for aesthetical and protective reasons).
Therefore, there is a room for phosphating, painting and parkerizing.

The handling of the pieces is carried-out:
- manually (for the most reduced weights)
- with small hoist machines (for the heavier pieces)
- with mechanical or magnetic pliers (for safety reasons).

The in-plant moving is done by fork lift trucks carrying containers or pallets. The trainees may make those containers during a training exercise. The pallets are made of wood.

A compressed air system (6 kg/mm2) feeds the presses and all other machine-tools as well as the fitting benches.

The electrical system and the lighting system use fixed ducts with the necessary safety sockets. To reduce the high voltage, an electric station with two transformers (one for service, and a smaller one for supply) is located outside the building for safety purposes.

The tools and dies department as well as the offices have an air-cooled system in order to guarantee comfortable living conditions and to control at some extent any thermal changes which might affect the accuracy of the machines.
There is no air-conditioning system, because the machinery does not need to be kept at an exact constant temperature.

To prevent fires, easily accessible powder and foam fire extinguishers are provided. Only the painting room has a small automatic sprinkler system because of highly inflammable vapours.

N.B. The plant has a structure which would permit an eventual enlargement.

We may enlarge:

- any department individually by the addition of a 16 m x 16 m shed (behind - for production departments; on the left side - for store houses) or:
  the entire plant by the addition of a 64 m x 16 m shed, built behind (therefore both the production departments and the store house area would be enlarged).

3.3. PLANT DIMENSIONS

Table two shows the workshop and other areas. The latter are divided into three production departments according to their expected use. The horizontal row indicate what happens in the various areas; whereas the columns indicate the total amount which must be attributed to the three departments when calculating investments or depreciations.

TABLE 2

	Pressing department	Tool and dies department	Hot forging	Total
	Sq. m.	Sq. m.	Sq. m.	Sq.m.
Fenced area				12000
Covered area				
- Pressing dept.	640	-	-	640
- Tool and dies dept.	-	720	-	720
- Hot forging	-	-	80	80
- Training areas(1)	-	420	-	420
- Stores(1)	450	90	20	560
- Painting(1)	60	-	-	60
- Heat treatments(1)	-	55	-	55
- Services and transit areas(1)	270	345	-	615
Total	1420	1630	100	3150
- Offices(1)	300	650		950
Covered area total	1720	2280	100	4100

1 - Notes: Divided among three departments according to their use.

3.4. PERSONNEL

Hiring and training of new personnel increase yearly during initial period and becomes fully operational in the fifth year. At that time the personnel shall be proportioned as follows in table 3.

TABLE 3

ESTIMATED PERSONNEL FOR THE FULL PRODUCTION

	Total	Cold pressing	Tool and dies	Hot pressing (eventual)
Management and staff	11	5	6	-
Engineers	14	-	14	-
Foremen/surveyors	14	6	8	-
Sheet pressing workers	34	34	-	-
Toolmaker workers	50	-	50	-
Hot pressing workers	5	-	-	5
Unskilled workers	15	7	8	-
Total	143	52	86	5

4. MACHINERY

4.1. GENERAL CONSIDERATIONS ABOUT THE MACHINERY

The following paragraph summarizes the type and quantity of the machines needed for the three departments. The principles followed in establishing the type of machines are the following:

A - The machines make pieces having the following dimensions and weights (rough figures):

Machined pieces	lgth m.	surface sq. m.	volume cu. m.	weight kg.
Pressed sheet metal items	-	0.5	-	-
Pipes bars and structural shapes	1.8	-	-	-
Dies, fixtures and their details	-	-	0,25	500

The metal sheet thickness will be determined each time according to machine power, and

- to punched profile perimeter; or
- according to the size and type of the fold; or
- according to the type and depth of the drawn.

In any case we are dealing with thin sheet metal, it will not be more than 1 to 2 mm , and 5 to 6 mm thick for smaller parts.

B - The machinery is the universally and traditionally used type.

We have tried to limit over mechanization and over sophistication for reasons of cost, easy maintenance, and wider use. In addition its universal characteristics makes it possible to use it in machining operations that are not closely connected to die manufacturing.

C - Worker safety is a basic consideration: all machines which may be risky to personal safety, even only hypothetically risky, have been systematically left out. For example we have preferred friction clutch presses rather than dog clutch presses. All presses have 2 push button commands to avoid squashing fingers; the lathes have a cover on the self-centering chucks; all lathes, milling and drilling machines have plastic screens for chips, ...

D - Every machine is provided with equipment and attachments (vices, tail stocks, indexing heads, fixed and moving rests, 3 and 4 jaws self-centering chucks .....). This equipment has been considered with some largeness in order to make the machines more "universal" and adaptable so that various machining operations can be carried out. Specific equipment (dies, pliers, special jaws .....) has not been provided for because to do this, it is firstly necessary to know the shape and dimension of the machined piece,and, on the other side, it maybe not economically convenient (at least in this country's stage of development) when considering the current labour costs.

See exhibit 3 for detailed information on machines and for machine list.

4.2. THE SHEET METAL PPESSING DEPARTMENT MACHINES

	Tot.	Years 0-1	2	3	4	5
Presses	12	1	6	3	2	-
Guillotine shears	2	1	-	1	-	-
Disk shear	1	-	-	-	-	-
1000 mm. arm shape notching machine	1	-	-	-	1	-
Bending machine	2	1	-	-	1	-
Rolling machine	1	1	-	-	-	-
Pipe bending machine	2	-	1	-	1	-
Spot welding machine	2	1	-	1	-	-
Submerged arc welding	1	-	-	-	1	-
Miscellaneous						

Miscellaneous indicates:

1) Demagnetizer device
2) Fly press
3) Measuring and checking instruments
4) Safety equipment (pliers, gloves, ...)
5) Transpallets
6) Fire extinguishers
7) Metal containers

For further detailed information on machine specifications and quotations see exhibit 3.1.

4.3. MACHINES FOR TOOLS AND DIES DEPARTMENT

The tables shows the machines number installation times during initialization.

		YEARS				
	Tot.	0-1	2	3	4	5
Lathes	19	11	6	-	1	1
Milling machines	10	-	3	6	1	-
Drilling machines	9	5	4	-	-	-
Boring machines	2	-	-	1	1	-
Surface grinders	3	1	2	-	-	-
Round grinders	2	1	1	-	-	-
Sharpeners	3	-	2	-	-	1
Spark erosion machine	1	-	-	-	1	-
Benches for toolmakers	40	10	10	10	10	-
Furnaces	3	3	-	-	-	-
Different machine	19	6	9	3	-	2
Miscellaneous						
Total	111					

Miscellaneous refers to:

1) Shelves for tools and fixtures (1 for every machine)
2) portable grinding wheels and drilling machine
3) Tools, wheels, Band saw
4) Gauges, measurement instruments, surface plates
5) Safety equipment (safety glasses .....)
6) Transpallets - jib crane
7) Fire extinguishers.

For more details on machine specification and justification see exhibit 3.2.

4.4. MACHINES FOR THE HOT-FORGING DEPARTMENT (EVENTUAL)

The table shows the necessary machines. They are planned to be installed in the fourth year.

Power hammer	1
Trimming Press	1
Miscellaneous	

"Miscellaneous" includes:

- disk saw
- pre-heating furnace
- measurement and check instruments
- safety equipment (pliers, safety gloves, safety glasses, ...)
- transpallets
- fire extinguishers
- metal containers.

For more details on machine specifications and justifications see exhibit 3.3.

5) INVESTMENTS

Planned investments are summarized in sections 5.1, 5.2, 5.3 and 5.4.

5.2 does not take land cost into account; in 5.3 it is understood that the power and water supply reach the plant's boundaries, machinery investments (5.4) are related to planned production and trainee work force, whereas building and utility investments are concentrated in 0 - 1 years.

We based our estimates on standard quality machines of different firms in the European markets, well known for their reliability. Prices refer to September 1979 and include "TROPICALIZATION" which means equipment designed for high temperature environments.

5.1 - INVESTMENT SUMMARY IN 000 $ U.S.A.

Investment	Cold-pressing dept.	Tool and dies dept.	Hot forging dept.
Buildings	225	315	15
General instal.	135	203	12
Machineries and equipment	1,200	1,500	480
1° Total	1,560	2,018	507
Total		3,578	507

5.2 - BUILDING INVESTMENTS

These investments relate to building structure (000 $ USA)

	Pressing dept.	Dies and fixtures dept.	Hot forging dept.	Total
Works	180	217	15	412
Offices	45	98	--	143
Total	225	315	15	555

5.3 - INSTALLATION INVESTMENT PLAN (000 $ USA)

	Tot.	Pressing dept.	Dies and fixtures dept.	Hot pressing
1) Air compressed system	90	45	40	5
2) Electric energy system (includes electric station)	110	45	60	5
3) Lighting	30	10	18	2
4) Air cooling system (office facilities, and tool and dies dept.)	35	5	30	-
5) Sprinkler system (only painting facilities)	5	5	-	-
6) Furniture	55	25	30	-
7) Transports	25	-	25	-
Total	350	135	203	12

Cold pressing dept.

Year	0-1	2	3	4	5
Machines (1)	71	175	275	285	192
Set-up (2)	19	35	55	55	38
Total	90	210	330	340	230
Progressive	90	300	630	970	1200

Tool and dies dept.

Year	0-1	2	3	4	5
Machines (1)	242	396	308	170	66
Set-up (2)	63	104	92	40	19
Total	305	500	400	210	85
Progressive	305	805	1205	1415	1500

Hot forging dept. (if necessary)

Year	0-1	2	3	4	5
Investment	-	-	-	480	-
Progressive	-	-	-	480	-

(1) Machines, accessories, equipment in Exhibit 4 are included

(2) Shipment, customs and set-up are included

6. THE TRAINING

6.1. GENERAL TRAINING REQUIREMENTS

One of the most important aims of the unit is training, in order to make the plant as independent of overseas expertise and know-how as possible.

When planning a training program, different types of needs and possibilities must be considered:

- Overseas training (through direct contact with similar technologies)
- Technical assistance program (through overseas experts integrated with counterpart trainers, accomplished during the first stages of unit production)
- In plant training for upgrading personnel

Different training programs are pointed out below:

- training for managers
- training for engineers and counterparts
- training for counterpart trainers (future technicians or foremen)
- training for toolsmakers and mechanics
- training for sheet metal and forging workers

Exhibit 5/3 quotes detailed figures for different types of training.

6.2. Summarizing training costs (00 $ U.S.A.)

Looking at exhibit 5, we may estimate the training costs in an approximate but reliable way.

A) Overseas training cost (exhibit 5/2)

- In plant group training for managers engineers, counterpart trainers 000 $ US 156

- Upgrading of engineers and counterpart trainers 000 $ US 156

B) Technical assistance program (exhibit 5/3)

- For 5 years: 45 man years 000 $ US 3,771

C) Local training costs (exhibits 5/4,5/5,5/6)

Sheet metal pressing dept.	(000 $)	142
Tool and die shop	(000 $)	298
Hot-forging dept.	(000 $)	19
Total		000 $ US 459

D) Estimated total training cost 000 $ US 4,542

The costs are spaced out over a period of more years according to the type of training.

In exhibit 5/1 a general scheme is shown outlining the principles of skilled worker training programmes for the unit.

7. VIABILITY - PRELIMINARY PLAN

7.1. GENERAL

The viability study has been formulated by comparing the estimated production revenues (yearly increasing with the training of the labour force) to the operating costs.

It is based on the following elements estimated for 5 start-up years of the factory.

- production implementation
- estimated cost for materials
- personnel, wages and salaries
- training costs
- investments - depreciations
- estimated products prices - Revenue
- operating costs
- net income statement and cash result

The study has been subdivided into three sections concerning

- sheet metal pressing department
- tool and die department
- hot-pressing department

7.2. SOME INFORMATION ABOUT COSTS AND INCOMES

A) Estimated cost figures for materials.

Any type of material (i.e.):

- raw materials

- auxiliary materials
- maintenance materials
- expendable materials

has been considered at 20% higher than European levels

B) Personnel, wages and salaries

Employees will be hired over a period of five years. Full quota to be reached in the fifth year. The employees cost has been calculated by totaling the cost of the different job grade levels which vary in the years according to the tables seen in exhibit 6.4.

C) Production implementation

Production starts only in the 2nd year; only some services with very low efficiency are considered for 0 - 1 years which are dedicated mainly to training personnel.
The hot forging department production shall start only from the 4th year.

D) Training costs (see exhibit 5)

Local training costs are added to the operating costs, but a training subsidy should be paid by outside sources and will be considered an income.

Technical overseas experts and fellowship training abroad are not included in the operating costs at the moment, supposedly they will be financed

through EEC or bilateral funds.

E) Investment - depreciation (see exhibit 7)

To estimate investment depreciation, the following interest rates have been used:

4 percent per year for buildings

5 percent per year for general systems

10 percent per year for machinery and equipment

F) Loan interests

Financial charges have been added to operating costs. They refer only to cash financing operations and are estimated at about 5 percent of operating costs.

Financial charges on investment have been added to the net income statement and are estimated at about 2% of the total investment.

G) Estimated prices for products

Prices of the local markets have been considered as 30 percent higher than actual European price for:

- sheet metal
- hot pressing

7.3. SHEET METAL PRESSING DEPARTMENT VIABILITY

A - Production implementation

Production shall start only in the 2nd year (the first two years are dedicated to training). Estimated average production should be 19.5 Kg. per hour/machine; this average can be reached by gradually improving efficiency.
Sheet metal tons produced are:

Estimated tons of sheet metal

Year	0-1	2	3	4	5
Efficiency	training	0.2	0.4	0.6	0.7
Tons		98	323	610	835

B - Personnel, wages and salaries (see exhibit 6.1 and 6.5)

Employees will be hired over a period of five year and the following structure will be reached in the 5th year:

Management and staff	5
Foreman, surveyor	6
Sheet metal line workers	34
Auxiliary (unskilled workers)	7

The personnel cost in the different years is quoted in exhibit 6.5 and is summarized below:

Wages and salaries

Year	0-1	2	3	4	5
Wages and salaries 000 $	24	47	78	111	139

C - Local training costs

Local training costs can be estimated by calculating direct cost of employees undergoing training.

- Staff and management: training only in the first year
- Foreman counterpart sheet metal trainers during the 5 years
- Sheet metal workers are trained during the first 3 years
- General workers are trained in the first 2 years

Total cost of local training in the different years is quoted in the exhibit 5.4 and is summarized below:

Local training cost

Year	0-1	2	3	4	5
Local training cost 000 $ USA	24	32	33	23	30

D - Investment - depreciation

Figures of depreciation incidence in the different years are reported in exhibit 7.1

E - Revenue from sheet metal shop

Revenue equals tons produced, valued at market price (about 2 $ USA/Kg.)

Sheet metal revenue

Year	0-1	2	3	4	5
Tons	-	103	339	640	876
Revenues 000 $ USA	-	205	678	1,281	1,753

SHEET METAL PRESSING DEPARTMENT OPERATING COSTS

(000 $ USA)

Table 4

No.	SPECIFICATION / YEAR	0-1	2	3	4	5
1	Raw materials	23	124	406	704	876
2	Auxiliary and expendable materials	2	12	40	70	87
3	Power	1	4	14	25	35
4	Direct labour -	5	17	35	52	68
5	Auxiliary labour	8	15	23	32	43
6	Managers and employees	11	15	20	27	28
7	General costs	4	18	50	91	110
8	Financial burdens	2	8	22	42	60
	T o t a l	56	213	610	1,043	1,307

SHEET METAL PRESSING DEPARTMENT NET INCOME STATEMENT AND CASH

(000 $ USA) Table 5

No.	SPECIFICATION / YEAR	0-1	2	3	4	5
INCOME						
1	Sale of production	-	205	678	1,281	1,753
2	Sales of engineering services	24	32	33	23	
3	Training subsidy	24	32	33	23	30
	TOTAL INCOME	24	237	711	1,304	1,783
COSTS						
4	Operating costs	56	213	610	1,043	1,307
5	Depreciation charges	26	47	80	114	137
6	Loan interests	12	25	25	25	25
	TOTAL COSTS	94	285	715	1,182	1,469
7	PROFIT (loss)	(70)	(48)	(4)	122	314
8	CASH RESULTS	(44)	(1)	76	236	451

7.4. TOOL AND DIE DEPARTMENT VIABILITY

A) Production implementation

The tool and die shop production is based on direct labour of the available hours (machinists, toolmakers, fitters etc.) The production will start only i . the 2nd year (the first two years are only for training). Starting from the 2nd year direct labour gradually improves efficiency level and the marketable hours are:

Available hours-workshop

Year				
Efficiency	0,2	0,4	0,6	0,8
Available hours	7,200	21,600	43,200	72,000

B) Personnel, wages and salaries (exhibit 6.2 - 6.6)

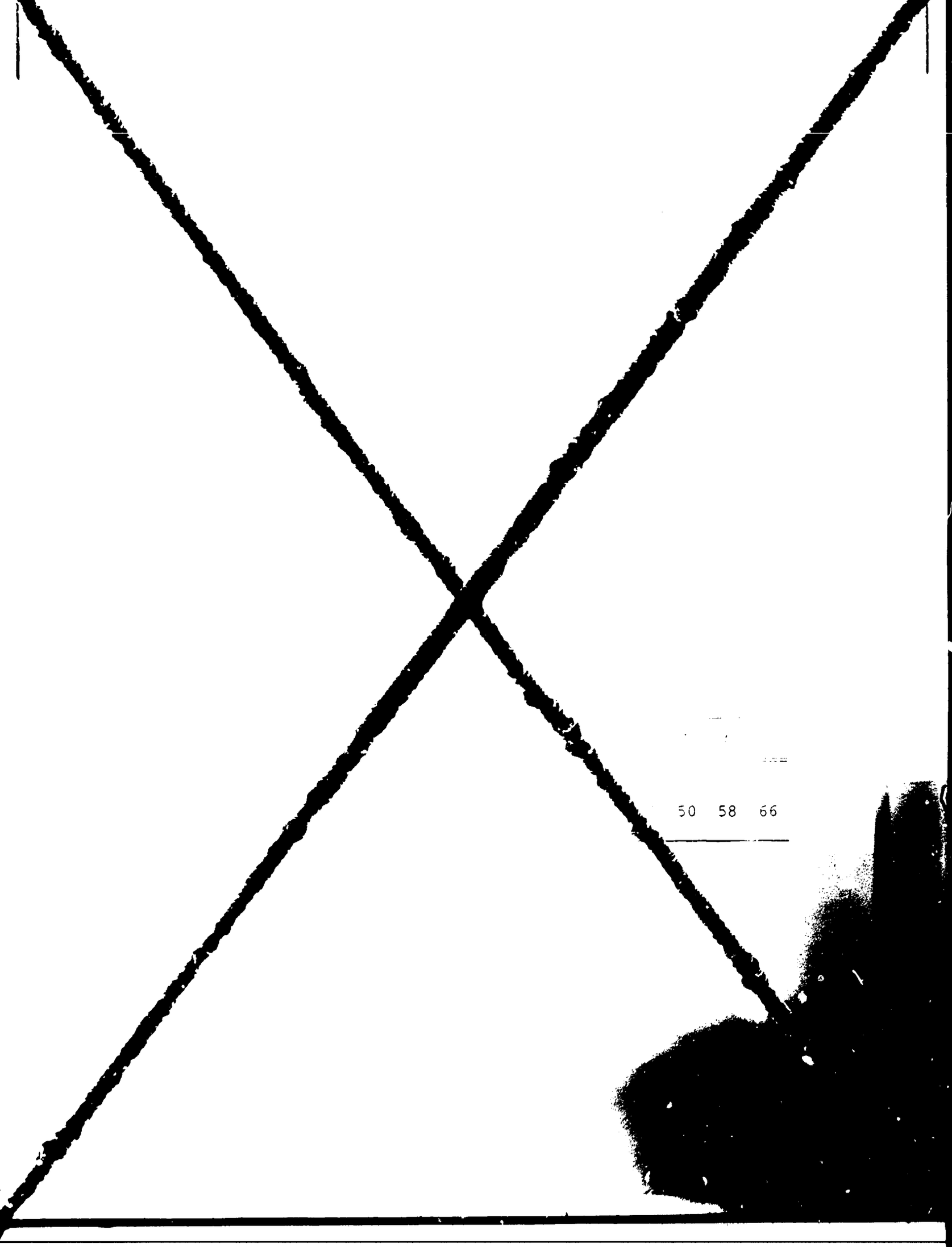
Personnel will be hired over a period of five years, in order to reach the following structure by the fifth year

Management and staff	6
Engineers	14
Foreman, surveyor	8
Toolmaker workers	50
General workers	8

Personnel costs have been calculated on the cost of the different job levels, variable through the years. Personnel costs in the different years are quoted in exhibit 6.6. and are summarized below.

Wages and salaries

Year	0-1	2	3	4	5
Wages and salaries 000 $ USA	74	122	178	245	315


50 58 66

C) Local training costs

Local training costs are estimated by considering the direct cost of employees undergoing training. We have:

- staff and management: training only in the first year
- Counterpart toolmaker: trainers trained during the 5 years
- Counterpart engineers: trained during one year
- Toolmaker: trained during two years
- General work force: are trained in the first year

The local training cost in the different years is quoted in exhibit 5.5. and is summarized below:

Local training cost

Year	0-1	2	3	4	5
Local training cost 000 $ USA	74	50	50	58	66

D) Investment - depreciation

Figures of depreciation incidence in different years are reported in exhibit 7.2.

E) Revenue from machining and workshop

As to the tool and die department, since raw materials are not part of costing, revenue equal to marketable hours are valued at a market price of 8 $ USA per hour (i.e. about 12,000 $ USA per year per person/per machine)

Workshop revenues

Year					
Available hours	=	7,200	21,600	43,200	72,000
Workshop revenue 000 $ USA	=	57	173	346	576

F) Revenue from service (Engineer service)

These revenues equal to the working hours of the engineers valued at 10 $ USA per hour (about 18,000 $ USA per year per head) with efficiency being variable through the years.

Engineer service revenues

Year	0-1	2	3	4	5
Total hours	=	14,400	18,000	21,600	25,200
Efficiency		0.2	0.3	0.4	0.5
Engineering service revenues 000 $ USA		29	54	87	126

TOOL AND DIE DEPARTMENT OPERATING COSTS

(000 $ USA)

Table 6

No.	SPECIFICATION / YEAR	0-1	2	3	4	5
1.	Raw materials					
2.	Auxiliary and expendable materials	7	14	21	34	57
3.	Power costs	3	6	8	13	22
4.	Direct labour	12	32	57	88	125
5.	Auxiliary labour	15	24	32	43	54
6.	Managers and employees	47	66	89	114	136
7.	General costs	8	14	21	29	40
8.	Financial burdens	4	7	10	15	20
	T o t a l	96	163	238	336	454

TOOL AND DIE DEPARTMENT NET INCOME STATEMENT AND CASH

Table 7

No.	SPECIFICATION / YEAR	0-1	2	3	4	5
INCOME						
1.	Sale of production	=	57	173	346	576
2.	Sales of engineering services	=	29	54	87	126
3.	Training subsidy	74	50	50	58	66
	TOTAL INCOME	74	136	277	491	768
COSTS						
4.	Operating costs	96	163	238	336	454
5.	Depreciation charges	55	105	145	166	174
6.	Loan interests	15	30	30	30	30
	TOTAL COSTS	166	298	413	532	658
7.	PROFIT (loss)	(92)	(162)	(136)	(41)	110
8.	CASH RESULTS	(37)	(57)	9	125	274

7.5 - HOT FORGING DEPT.

A) Production implementation

The production shall start only in the 4th year. The average estimated production is 60 kgs per hour per machine but it can be attained gradually due to the improved efficiency levels.As a consequence the marketable tons are:

Estimated tons of forging

Year	0-1	2	3	4	5
Efficiency	/	/	/	0,2	0,4
Tons	/	/	/	29	86

Nota bene: Because of the high investment costs we have considered obtaining the above mentioned production by means of two shifts on the power-hammer.

B) Personnel, wages and salaries (Exhibit 6.3 and 6.7)

For this department only the line personnel has been taken into account.

. Foreman, surveyor 1

. Forging workers 5

The personnel cost in the different years is quoted in Exhibit 6-7 and is summarized below:

Wages and salaries

Year	0-1	2	3	4	5
Wages and salaries OOO $ USA	/	/	/	7	12

C) LOCAL TRAINING COST

The local training cost in the different years is quoted in Exhibit 5.6 and is summarized below:

Local training cost

Year	0-1	2	3	4	5
Local training cost 000 $ USA	/	/	/	7	12

D) INVESTMENT - DEPRECIATION

Figures of depreciation incidence in different years are reported in Exhibit 7.3.

E) REVENUE FROM FORGING SHOP

The revenues consist of the tons produced by the workshop valued at a market price of about 2 $ USA per kg.

Forging revenue

Year	0-1	2	3	4	5
Tons					
Revenue 000 $ USA	/	/	/	58	172

Table 8

HOT FORGING DEPARTMENT OPERATING COSTS

NO.	SPECIFICATION / YEAR	0-1	2	3	4	5
1	Raw material				20	60
2	Auxiliary and consumption materials				2	7
3	Power				7	10
4	Direct labour				4	8
5	Auxiliary labour				3	4
6	Managers & Employees				/	/
7	General costs				4	10
8	Financial burdens				2	5
Total					42	104

Table 9

HOT FORGING DEPARTMENT NET INCOME STATEMENT AND CASH

NO.	SPECIFICATION / YEAR	0-1	2	3	4	5
INCOME						
1	Sale of production				58	172
2	Sales of engineering services					
3	Training subsidy				7	12
	TOTAL INCOME				65	184
COSTS						
4	Operating costs				42	104
5	Depreciation charges				50	50
6	Loan interests				9	9
	TOTAL COSTS				101	163
7	PROFIT (loss)				(36)	(21)
8	CASH RESULTS				14	29

EXHIBIT 1

Types of dies

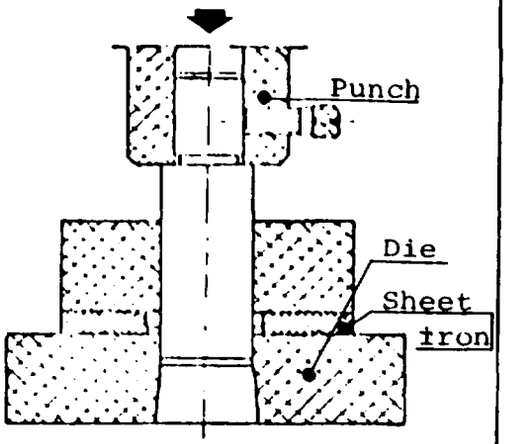
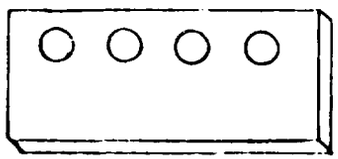
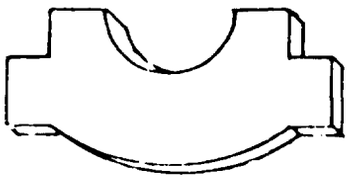
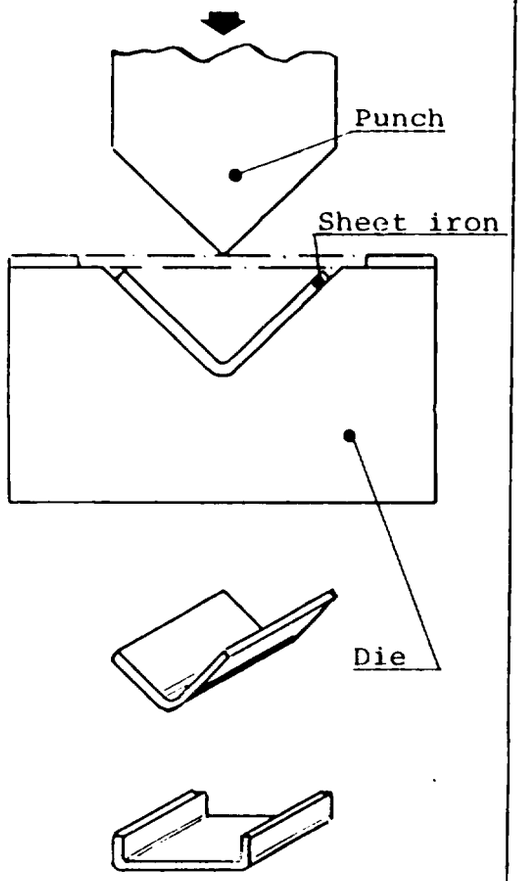
NO.	SKETCH	DENOMINATION	REMARKS
		Blanking die	The "male punch" can exactly be introduced in the die hole; die and punch can have the most various profiles
	 Example of obtained profiles		
			
			

Exhibit 1/1

TYPES OF DIFS MAINLY USED IN THE SHEET METAL PRESSING DEPT.

Exhibit 1/2

NO.	SKETCH	DENOMINATION	REMARKS
		Bending die	The die has a groove which passes right through it. The punch driven by the "P" force, pushes the sheet iron which bends at a sharp angle or with the planned radius.

TYPES OF DIES MAINLY USED IN THE SHEET METAL PRESSING DEPT.

Exhibit 1/3 pg.

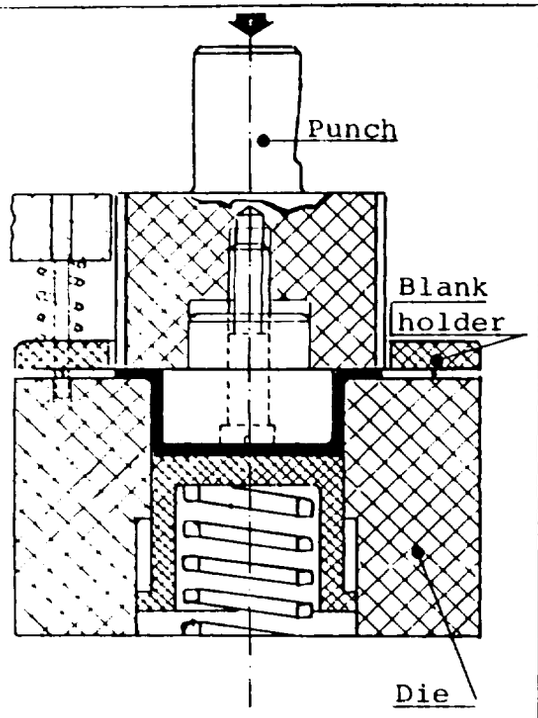
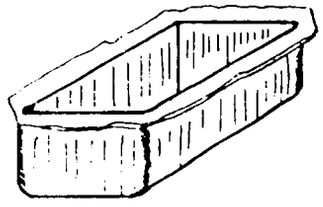
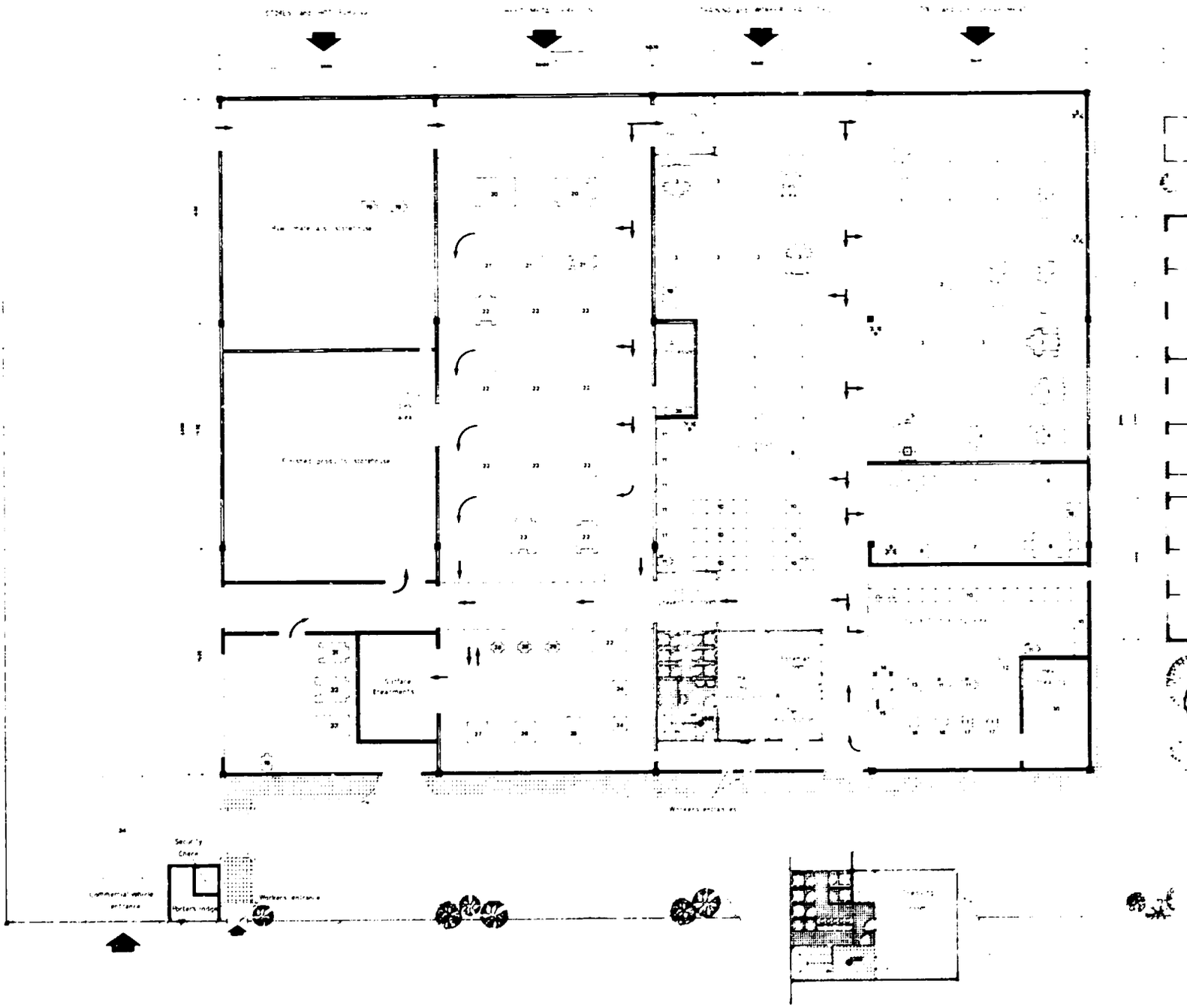
NO.	SKETCH	DENOMINATION	REMARKS
	 	Drawing die	The die has a cavity of a suitable depth rather than a through hole as in the previous example. Likewise, the punch reproduces the die profile not only in a flat section, but also in all the relief of the form. The metal sheet is put on the die, clamped by means of the blank holder spring. The punch is pushed by the force "P" and makes the sheet iron reproduce the entire die profile.

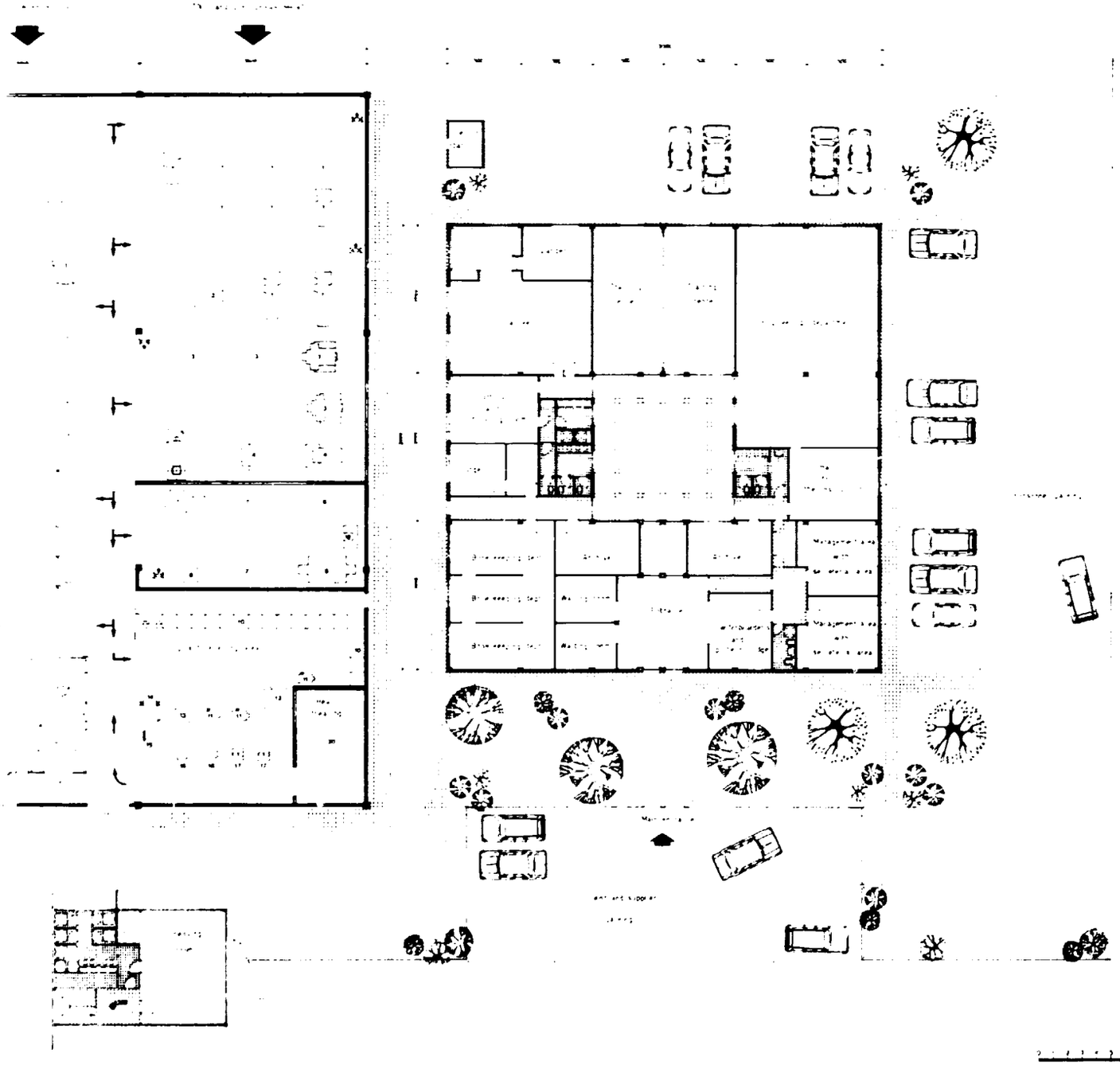
EXHIBIT 2

Layouts



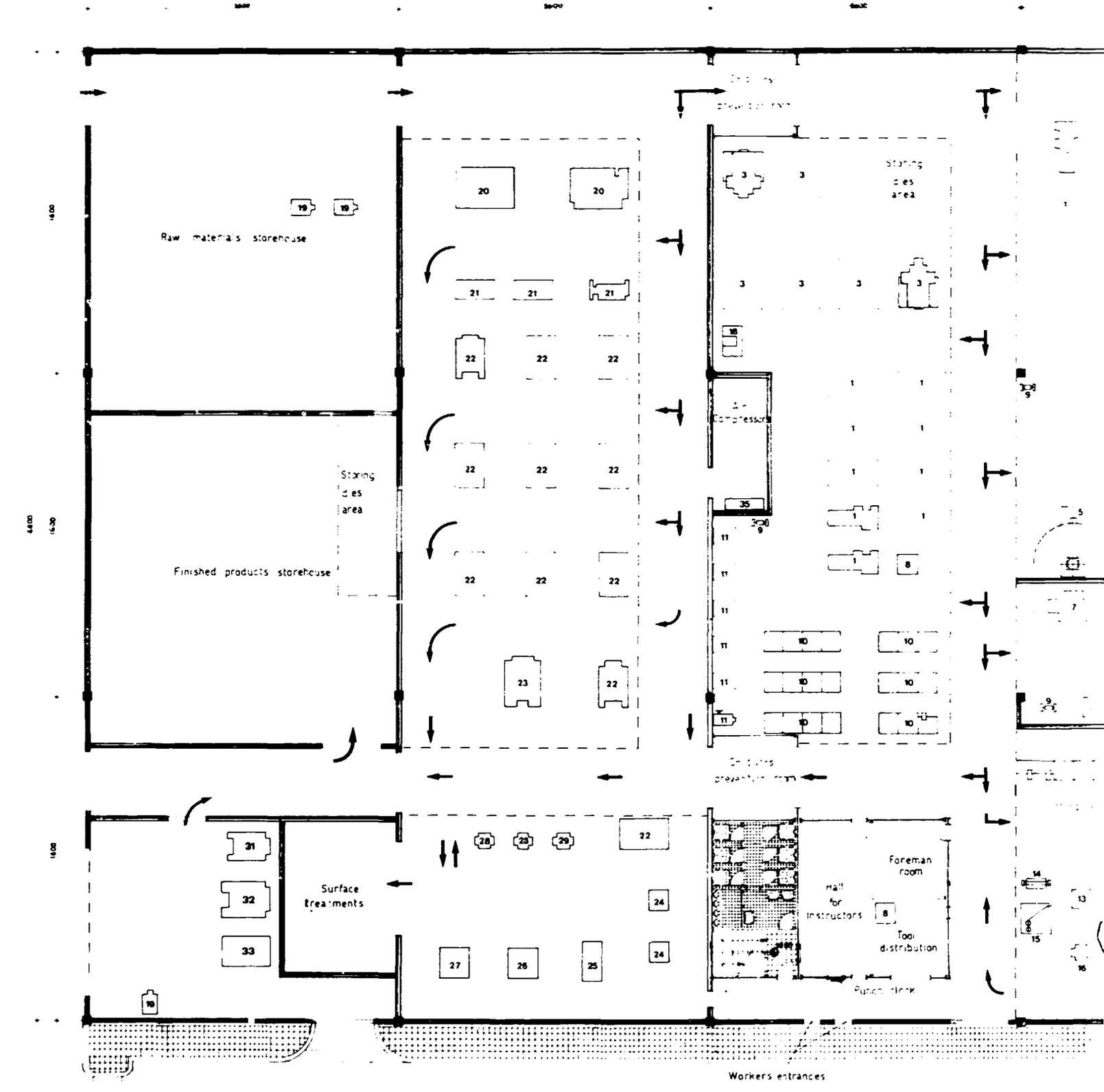
SECTION 1

EXHIBIT 2/1

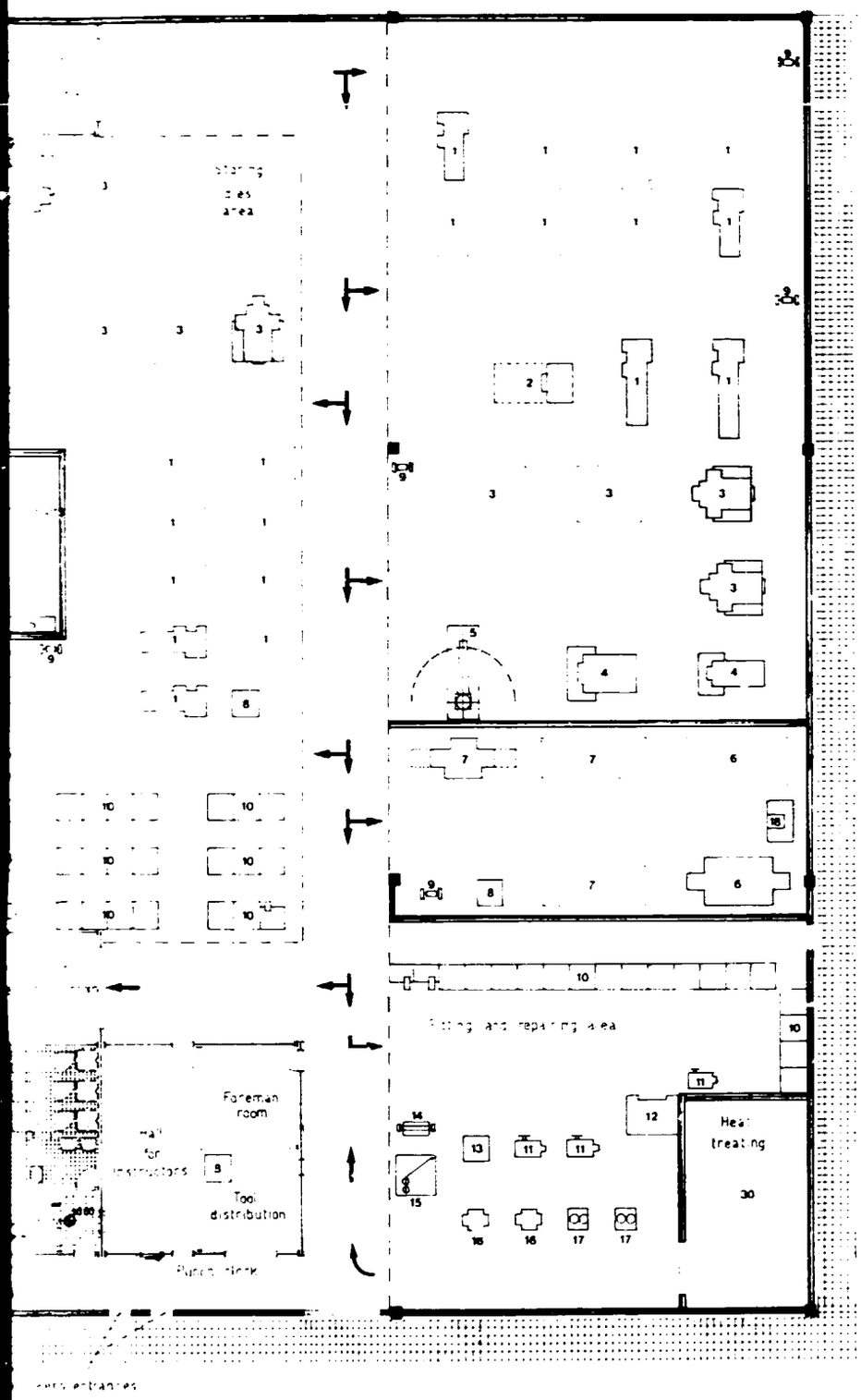


FENCED AREA AND GENERAL PLAN

SECTION 2


Raw materials storehouse
Storing cles area
Finished products storehouse
Air compressors
Surface treatments
Hall for instructors
Foreman room
Tool distribution
Workers entrances
Security Check
Porters lodge
Workers entrance

SECTION 1

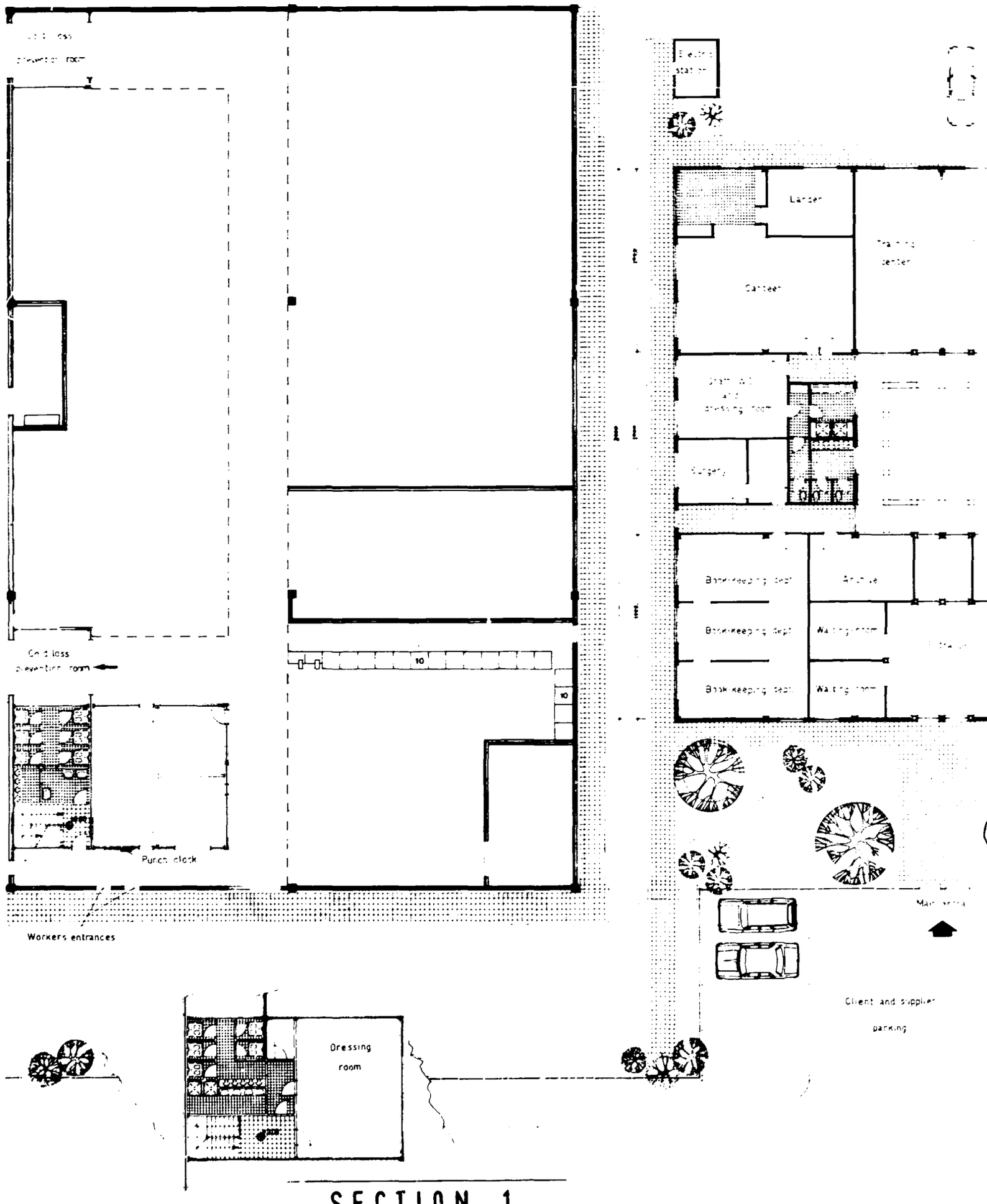


N°	CORRESPONDING MACHINE
1	Parallel lathe
2	Facing lathe
3	Milling machine
4	Horizzonthal boring machine
5	Radial drilling machine
6	Cylindrical grinding machine
7	Surface grinding machine
8	Universal sharpening machine
9	Upright twin-wheel grinding machine
10	Fitting bench
11	Hand operated drilling machine
12	Plunging spark erosion machine
13	Profile optical comparator
14	Hand operated screw press
15	Pantograph marking machine
16	Arc welding set
17	Blowpipe soldering set
18	Honing machine
19	Hack sawing machine
20	Guillotine shears
21	Folding press
22	Mechanical press
23	Hydraulic press
24	Pipe bending machine
25	Notching machine
26	Three rolls bending machine
27	Disc shearing machine
28	Spot-welding machine
29	Submerged arc welder
30	Heat treating furnaces
31	Trimming press
32	Press hammer
33	Preheating furnace
34	Weighbridge
35	Battery recharger

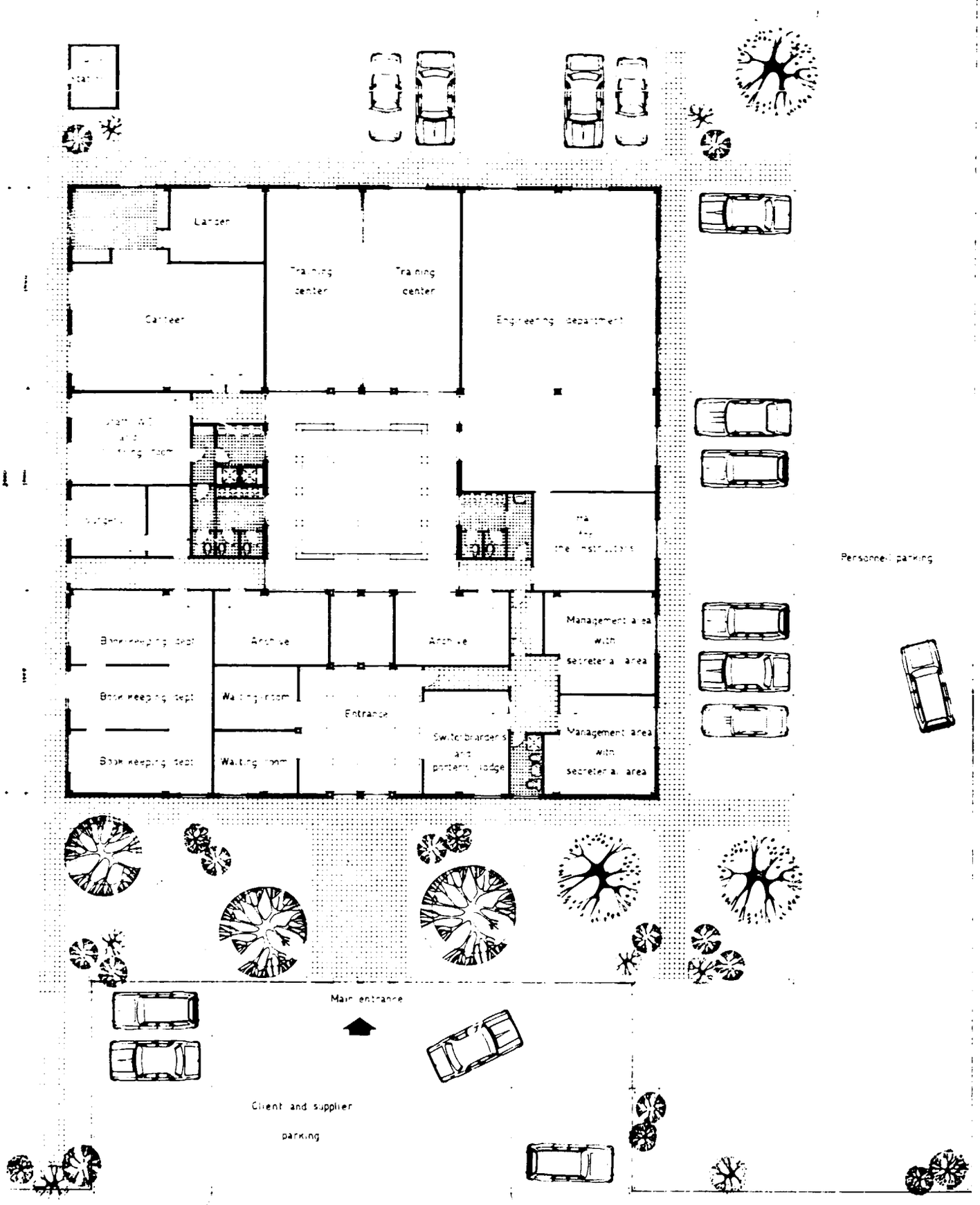
WORKSHOP PLAN WITH LAY-OUT

0 1 2 3 4 5 6 7 8 9 10

SECTION 2


Canteen
Surgery
Bookkeeping dept
Bookkeeping dept
Bookkeeping dept
Archive
Waiting room
Waiting room
Punch clock
Workers entrances
Dressing room
Client and supplier parking

SECTION 1



SECTION 2

OFFICE PLAN

EXHIBIT 3

Machinery

MACHINERY FOR PRESSING DEPT.

NO.	MACHINES PRESCRIPTION	Unit data		Q.ty	Totals	
		Sq.m	kw		Sq.m	Kw
1	250 ton hydraulic press	11.88	48.75	1	11.88	48.75
2	100 ton mechanical press table 1000 x 550	8.00	12.75	2	16.00	25.50
3	80 ton mechanical press table 880 x 480	7.56	10.50	3	22.68	31.50
4	50 ton mechanical press table 800x500	7.00	9.00	5	41.00	45.00
5	30 ton mechanical press table 380x700	5.00	8.50	1	5.00	8.50
6	Guillotine shears lgth = 2050	17.64	4.50	2	35.28	9.00
7	Bending press	8.97	6.38	2	17.94	12.76
8	Hand-operated bender	3.00	==	1	3.00	==
9	Pipe bending machine	11.88	38.25	2	23.76	76.50
10	Spot-welding machine	2.40	21.83	2	2.40	21.83
11	Notching machine	1.50	3.00	1	1.50	3.00
12	Disc shearing machine	2.80	0.50	1	2.80	0.50
13	Three rolls bending machine	3.50	5.00	1	3.50	6.00
14	Inert gas welder	3.50	25	1	3.50	25
	TOTALS				203.24	331.34

Exhibit 3/1

3.1 - MACHINE JUSTIFICATION FOR SHEET METAL PRESSING DEPT.

Presses are machines which press down the moving section (usually the punch) against the fixed section, which generally is the die. This is done by a slow moving slide, either mechanically or hydraulically powered.

Our single stage machines can be grouped into the following basic types. Below we note the strong and weak points of said machinery.

Type	Strong points	Weak points
Hydraulic press	-Force applied to piece during the run is constant -Drawing is possible -Easily regulated runs	-High cost -Ramming at end of run is not positive -Low number of cycles per min.
Friction clutch mechanical press	-Ramming at end of run positive with excellent bending results -Blanking and bending are highly productive	-Work speed varies during operation -Few types of drawing possible
Dog clutch	-Like friction clutch mechanical press	-Like friction clutch mechanical press -Ratchet gear clutch and clamp wear easily and slide might fall down at end of run

We opted for friction clutch mechanical presses rather than dog clutch presses because they are safer. We chose a more expensive hydraulic press to do all kinds of drawing operations.The work tables vary from a minimum size of 380x700 mm to a maximum of 550x1000 mm. It is therefore possible to machine pieces in the sizes mentioned previously. (The dies are always larger than the workpiece).

The force of nine machines does not go over 80 tons; two machines go up to 100 tons and the hydraulic press reaches 250 tons. This means that the pressing department can do a wide range of jobs, while still mainly working on "light" pressing jobs, and it keeps the machinery cost down thanks to their low power.

The machine "fleet" includes the following types of machines. Operation and uses are explained below.

No.	Type	Operating features	Use
1	Guillotine shear	A cutter (the same length of the machine) shears the sheet metal into 2 sections in one step	All straight line shearing done on standard European metal size sheet
2	Disk shear	Two touching sharp disks shear the sheet metal, which is manually pushed and driven	Sheet metal may be cut into disks, concentric rings, and profiles with wide radii
3	Notching machine	Opposed cutters, a few mm in length, make a sequence of small notches, cutting the sheet metal which is manually driving and pushed.	Irregular profiles are made also with corners

No.	Type	Operating features	Use
4	Folding machine	A male punch and female die are as long as the machine	Folds, corrugated forms, straight ribs are made by a sequence of operations
5	Bending machines for pipes and profiles	A manually and mechanically driven pushing device moves the piece against the forming block	Tubes having up to a 50 mm diam. (and the corresponding profiles) can be bent with a big or small radius
6	Spot welding machines	Two metal sheets are compressed together between two electrodes. The current passing through them melts the metal in the compressed section, and spot welding occurs	Final joining of pressed, profiled or formed pieces
7	Inert gas welding	A continuous wire inert gas welder's electrode protected from oxidation in the welding area by means of an inert gas during machining	Stainless steel, high alloyed steels and non ferrous metals can be welded

These machines are justified because they:

- machine pieces that are larger than those obtained by presses
- machine small batches, when a die would be too costly
- shape pipes and profiles to be mounted on a complex product (ex. handles for wheel-barrows)
- assemble various items.

No.	MACHINES DESCRIPTION	Unit data		Q.ty	Totals	
		Sq.m	kW		Sq.m	kW
1	Parallel lathe (h point 250x2000)	6.71	9.00	2	13.42	18.00
2	Parallel lathe (h point 180x800)	2.68	3.75	5	13.40	18.75
3	Parallel lathe (h point 180x1200)	4.02	3.75	1	4.02	3.75
4	Parallel lathe (h point 100x500)	1.68	3.75	10	16.80	37.50
5	Facing lathe (diam. 830x1120)	5.00	15.71	1	5.00	15.75
6	Reproducing milling machine (table 1200x280)	1.95	9.13	1	1.95	9.13
7	Toolroom milling machine(table 1100 x250)	10.20	4.61	8	81.60	36.88
8	Vertical milling machine (table 680 x 2000)	22.50	17.40	1	22.50	17.40
9	Radial drilling machine (30 mm diam. drilling)	6.57	4.13	1	6.57	4.13
10	Hand-operated drilling machine (40/50 mm diam. drilling)	0.92	2.40	2	1.84	4.80
11	Hand operated upright drilling machine	0.32	0.50	6	1.92	3.00
12	Small jig borer die-sinker adapted	7.40	2.85	1	7.40	2.85
13	Horizontal boring machine table 1000 x500x500	28.94	7.50	1	28.94	7.50
14	Horizontal spindle surface grinding machine table 400x1000	20.93	4.50	1	20.93	4.50
15	Vertical spindle surface grinding machine table 280x600	18.00	4.50	1	18.00	4.50
16	Tool room grinding machine table 200x300	11.15	2.30	1	11.15	2.30

MACHINERY FOR DIE AND FIXTURES DEPARTMENT

Exhibit 3/2

No.	MACHINES DESCRIPTION	Unit data		Q.ty	Totals	
		Sq.m	kW		Sq.m	kW
17	Cylindrical grinding machine (h point 180x1000)	24.00	12.00	1	24.00	12.00
18	Cylindrical grinding machine (h point 120x700)	20.00	10.50	1	20.00	10.50
19	Universal sharpening machine	13.20	2.00	2	26.40	4.00
20	Small universal sharpening machine	12.20	1.10	1	12.20	1.10
21	Plunging spark erosion machine table 500x500	10.50	24.00	1	10.50	24.00
22	Fitting bench table 1000x700	2.10	==	40	84.00	==
23	Upright twin-wheel grinding machine diam. 250x30	0.37	0.23	5	1.85	1.15
24	Pantograph marking machine	6.00	1.30	1	6.00	1.30
25	Electric etcher	==	1.00	1	==	1.00
26	Honing machine (350 mm diam. table)	==	1.00	1	==	1.00
27	Automatic tapping machine (M 10 max)	3.00	4.00	1	3.00	4.00
28	Hack sawing machine	2.53	1.99	2	5.06	3.98
29	Over-finishing machine	2.80	2.00	1	2.80	2.00
30	Trichloroethylene degreasing furnace	2.60	5.00	1	2.60	5.00
31	Hand operated screw press	1.00	==	1	1.00	==
32	Arc welding set	==	15.00	2	==	30.00

MACHINERY FOR DIE AND FIXTURES DEPARTMENT

Exhibit 3/2

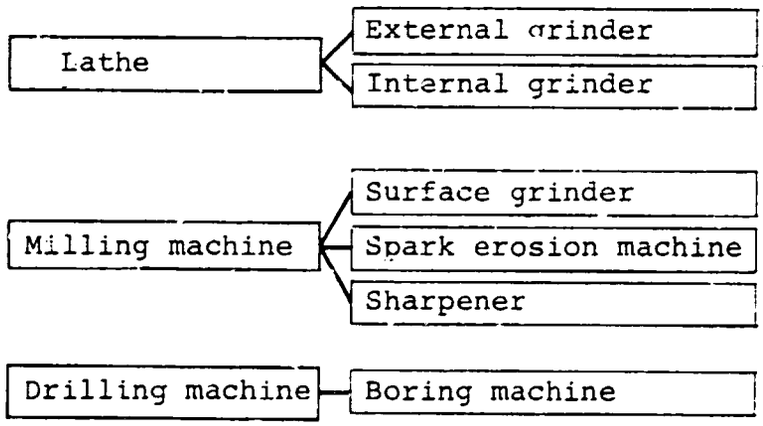
NO.	MACHINES DESCRIPTION	Unit data		Q.ty	Totals	
		Sq.m	kw		Sq.m	kw
33	Blowpipe soldering set	==	==	2	==	==
34	Salt bath furnace with pyrometric equipment	==	100.00	1	==	100.0(
35	Muffle furnace with pyrometric equipment	==	35.00	1	==	35.0(
36	Tempering furnace with pyrometric equipment	==	35.00	1	==	35.0(
37	Profile optical comparator	6.00	0.20	1	6.00	0.2(
	TOTALS			111	460.85	461.97

3.2. Machine justification for tool and die dept.

The ratio between lathes, milling machines, drilling machines, fitting benches and the rectifiers and sharpeners is much wider than the one found in an average European production workshop. This difference exists because of the following reasons:

A) Lathes, milling and drilling machines are basic machines in training a qualified worker.

The principles that govern their operation also govern that of more expensive and precise machines according to following diagram

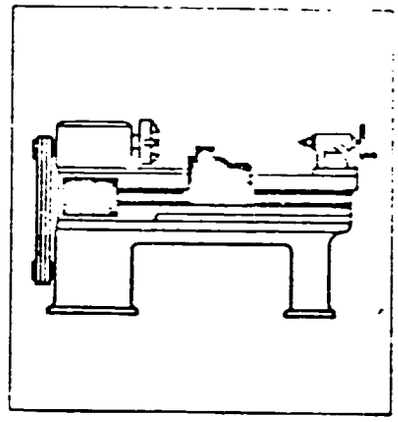


The number of training hours of these machines is consequently higher than that of other machines.

B) In all machining operations, lathe, milling, drilling machines always carry out the first indispensable operations. Possible working

overloads can be easily absorbed by these machines. In high accurancy operations (borings) and "after heat treatments" (grinding) two working shifts/ day can be used.

C) By means of simple and cheap changes it is possible to transform these basic machines into machines which specifically deal with medium batch products (example: adding a copying device on to the lathe, or special gears on to the milling machine for building cams). The large number of machines serves as a stock for this purpose.



A) The lathes were chosen on the basis of this table

No.	Type	Operating features	Comments
1	Center lathe	The piece revolves on itself and is mounted between points or lock by a self-centering chuck. The controls are mechanical, and are manually operated.	It's the simpliest and most universal of lathes. It machines billets and blanks that have been already cast, forged or machined.
2	Face lathe	Same as above but used for wide and short pieces	Same as above but more expensive because it results with a bigger head.
3	Copying lathe	Hydraulically driven stylus follows the profile of a master piece and controls the tool, which copies the profile on to the machined piece	Hydrocopying device requires regular maintenance. Machine is used for medium size batch production, limited to certain size pieces.

No.	Type	Operating features	Comments
4	Capstan lathe	Built like a center lathe, it has a hexagonal turret which faces the self-centering chuck and rotates around a vertical axis. This turret has various tools on it, each for a different operation which is commanded manually.	It's quite a sophisticated, complicated and expensive medium size production machine.
5	Numerically controlled lathe	Saddle movement, speed and feed are electronically controlled by magnetic or punched cards or tapes	Very expensive sophisticated and delicate machine for a small or a medium size production
6	Automatic bar lathe	Long bars machined by it pass through a spindle. A set of tools and cams are needed to produce each single piece. The last cam cuts the piece off from the bar	Only used for large size production because each workpiece requires expensive equipment. Only small diameter pieces from bars can be obtained

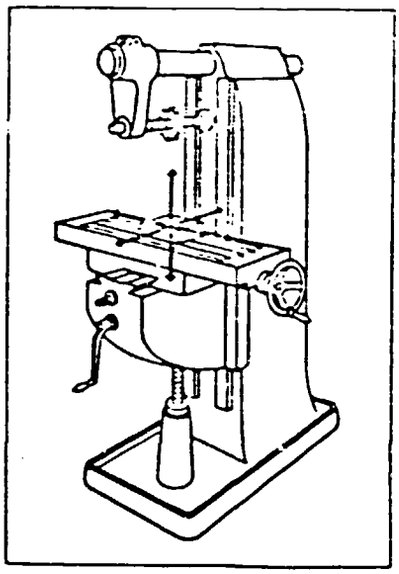
No.	Type	Operating features	Comments
7	Multi-spindle automatic lathe	6 or 8 revolving bars are mounted. Each one faces a tool station for 1 operation. The revolving bar drum shifts the bars to a new tool station for the subsequent machining operation	For very large size production because of very costly tools and equipment. It only machines workpieces from bars. The machine itself is very expensive

Multi - spindle automatic lathes and automatic bar lathes are excluded because of our small-size production. The NC lathes are too sophisticated and require, in this case, an unjustified staff of programmers.

The copying and capstan lathes are also used in medium-size production, (it is necessary to amortize the template cost on the one hand and the tool set-up on the other). We finally opted for the traditional centre lathes, with the following characteristics:

- Flexibility - i.e. easily adapts to widely differing machining operations.
- Economical - a face lathe is considered indispensable for two operations:
  building die carrying plates, mounted with circular dies,
  refinishing of wheels and fly wheels during maintenance

B) Milling machine specifications



No.	Type	Operating features	Comments
1	Horizontal milling machine	Milling cutters mounted on a horizontal spindle	Needed for flattening and straight tunnelling various forms
2	Universal milling machine	Developed from the horizontal milling machine. Uses horizontal and vertical spindle mounted cutters	Makes many different milled forms including helicals
3	Vertical milling machine	Comes with a swinging vertical spindle	Used for straight or circular tunneling, forming and for flattening. Less costly than the above machine but the operations are limited

No.	Type	Operating features	Comments
4	Universal tool room milling machine	Developed from the universal machine; features a swiveling table around a horizontal shaft	
5	Planer-type milling machine	Operates with one or more cutters mounted on one or more shafts. Very strong	Used for large production
6	Copying milling machine	Copying occurs with a device leaning on a master piece and driving the milling cutter	Complex and irregular profiles

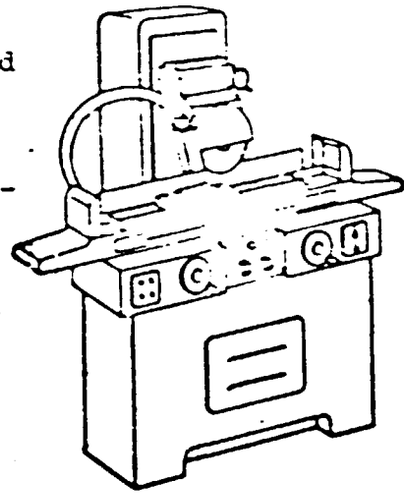
Tool-room universal milling were chosen for their wide spread use. We excluded the horizontal milling machine because of its limited field of application as well as the planer - type because it is used for other kinds of production.

A vertical milling machine with quite a large size table (680x2000) was held to be indispensable for heavy-duty flattening because of its remarkable rigidity.

A copying milling machine is essential in building hot-forging and chilling moulds (also moulds for plastic).

C) Grinding machine pieces with limited tollerance and high surface finish.

The universal type, which we are interested in (since automatic special machines are used for very large production) has various kinds of controls.



Movement	Control		
	Hydraulic	Mechanical	Manual
Travelling table	Precise, reliable, continuous speed control. May rest at every end of run	Precise, reliable but obsolete today because of maintenance difficulties and limited speed control (it operates step by step)	Movement may be irregular and with vibrations
Rapid return to piece (only on circular grinders)	Precise, very fast	===	Takes a long time to approach piece and difficulties arise when measuring operations are frequent
Feed	Precise, continuous control. Expensive	Precise	Cheap

Movement	Control		
	Hydraulic	Mechanical	Manual
Wheel dressing	Movement is uniform and regular	Precise	Quite precise and cheap

In the light of the above-mentioned information, both the circular and surface grinding machines have been designed with a hydraulically driven travelling table (for greater precision) and a manually driven feed and dressing device (for greater saving).

Circular rectifiers come with a rapid hydraulic approach because the batches are made of few pieces, (sometimes only 1 piece) and therefore measuring operations are frequent.

D) The two precision boring machines (one is small sized, the other has a 1000x500 mm table) are indispensable for a mechanical workshop dealing with precision machining. We can use them whenever necessary:
- to bore holes with limited tolerances (fig.a)
- to precision bore holes at a strictly defined distance (fig. b)
- to observe tolerances between different surfaces (fig.c)

Die holder and various flat items can be manufactured, repaired and/or reconditioned in this way.

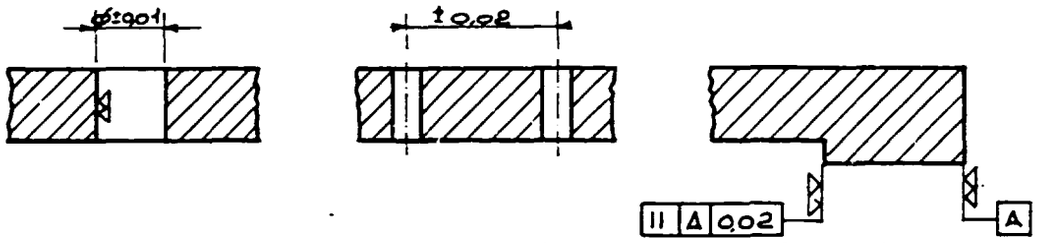


Fig. a) fig. b) fig. c)

E) The universal sharpeners come with a wide range of equipment (tail stocks, indexing heads, swiveling vices, concave and convex radius dressing devices, etc.) and so they carry out grooving and forming, chamfering and so on.

F) The plunge spark erosion machine makes possible punch or die manufacture with remarkably complex profiles that otherwise could not be produced (spare parts, dies, profiles with undercut, concave shapes with small radii). It is quite a sophisticated machine which however can multiply the workshop's production range and acquaint workers with the possibilities of modern technology.

G) A compressed air spray gun is used to spray a nitro type paint. The spray booth will include a water curtain with two exhaust fans for vapors. Phosphatizing will be carried out manually in six tanks of 500x600x600 mm.

The entire floor area will be covered by a wood platform. A tank for hot "parketization" is also provided.

H) The parts making-up the dies undergo heat treatment. It includes 3 furnaces: one is a salt bath type and two are muffle types. Although they are few they assure the execution of:

1) Box carburizing
2) Hardening
3) Tempering
4) Stress relieving
5) Normalizing
6) Annealing

MACHINERY FOR HOT PRESSING DEPARTMENT

Exhibit 3/3

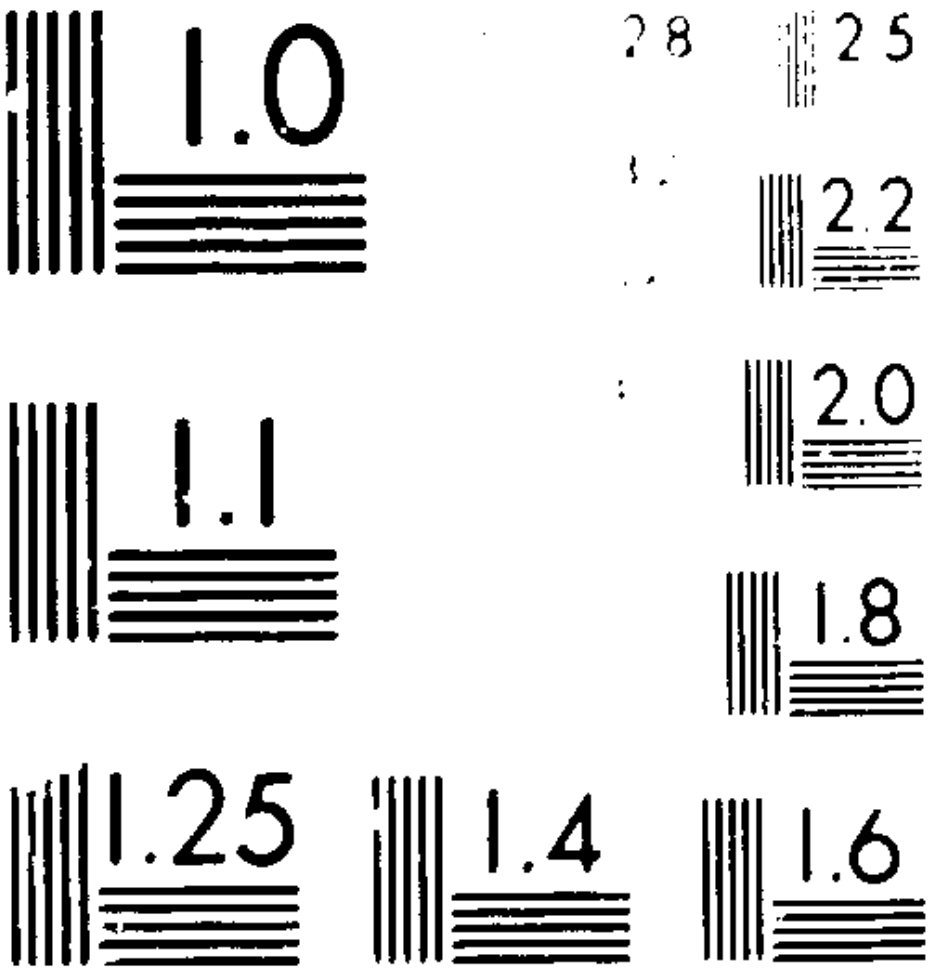
NO.	MACHINES DESCRIPTION	Unit data		Qty	Totals	
		sq.m	Kw		sq.m	Kw
1	Press hammer 1500 Kg.	10	45	1	10	45
2	Trimming press	8	20	1	8	20
3	Preheating furnace	6	35	1	6	35

3.3. The hot forging department may possibly be fully operational in the 4th or 5th year. It consists of a guided press hammer (1,500 Kg.ram) which allows the production of small-medium size pieces up to 2.5 Kg. It is a completely equipped machine with all necessary attachments. A trimming press assures the finish. Heating is obtained through an electric furnace (a fuel oil furnace would mean installing a fuel tank). We have preferred these machines which are able to employ the dies instead of an open frame power hammer which needs highly skilled workers with a long job experience.

Below is a list of the machines weak and strong points:

Types	Operating features	Comments
Eccentric press	An eccentric powers the ram and gives rise to difficulties when mounting dies, and limits machining speed. The piece and die are together for a long time and the heat trasmitted shortens die-life	High cost, limited versatility, rapid die wear
Friction press	Specifications are same as above. Friction press cuts down piece and die contact time. Makes die mounting easier; to obtain desired thickness it is possible to ram the same piece various times	Moderate cost, limited versatility, die wear is irregular
Hydraulic press	The hydraulic system makes the use of multi-ramming dies and production diversification possible. It is an independent work center in the plant	Rather high cost, excellent versatility, low die cost

The trimming press we chose has the same characteristics of the hydraulic forging press, but the former is less powerful than the latter.


1.0
2.8
2.5
2.2
1.1
2.0
1.8
1.25
1.4
1.6

The advantages of the electric furnace to the fuel-oil fired furnace are:

- greater temperature precision
- greater "cleanliness" of the piece (little oxidation)
- less complicated systems

The disadvanteges are:

- greater energy consumption
- danger blackout

There are no special observations on the hack saw machine. Since this is a traditional machine, it can be found on the market. It has all the features required for the machining operations (the main parameter is the number of pieces to be cut).

3.4. Transportation

Material handling is carried out:

- by means of manually operated transpallets inside the various departments and stores; a 5 ton small jib crane lifts heavy pieces in the tool and die dept,
- by means of two fork lift trucks for moving production materials to and from stores and production depts.

The plant will also be provided with a pick-up truck (Rover, Volkswagen, Toyota, Ford or similar) for transporting small loads and possibly also trainees.

EXHIBIT 4

Machinery Investments

Exhibit 4/1

MACHINE INVESTMENTS

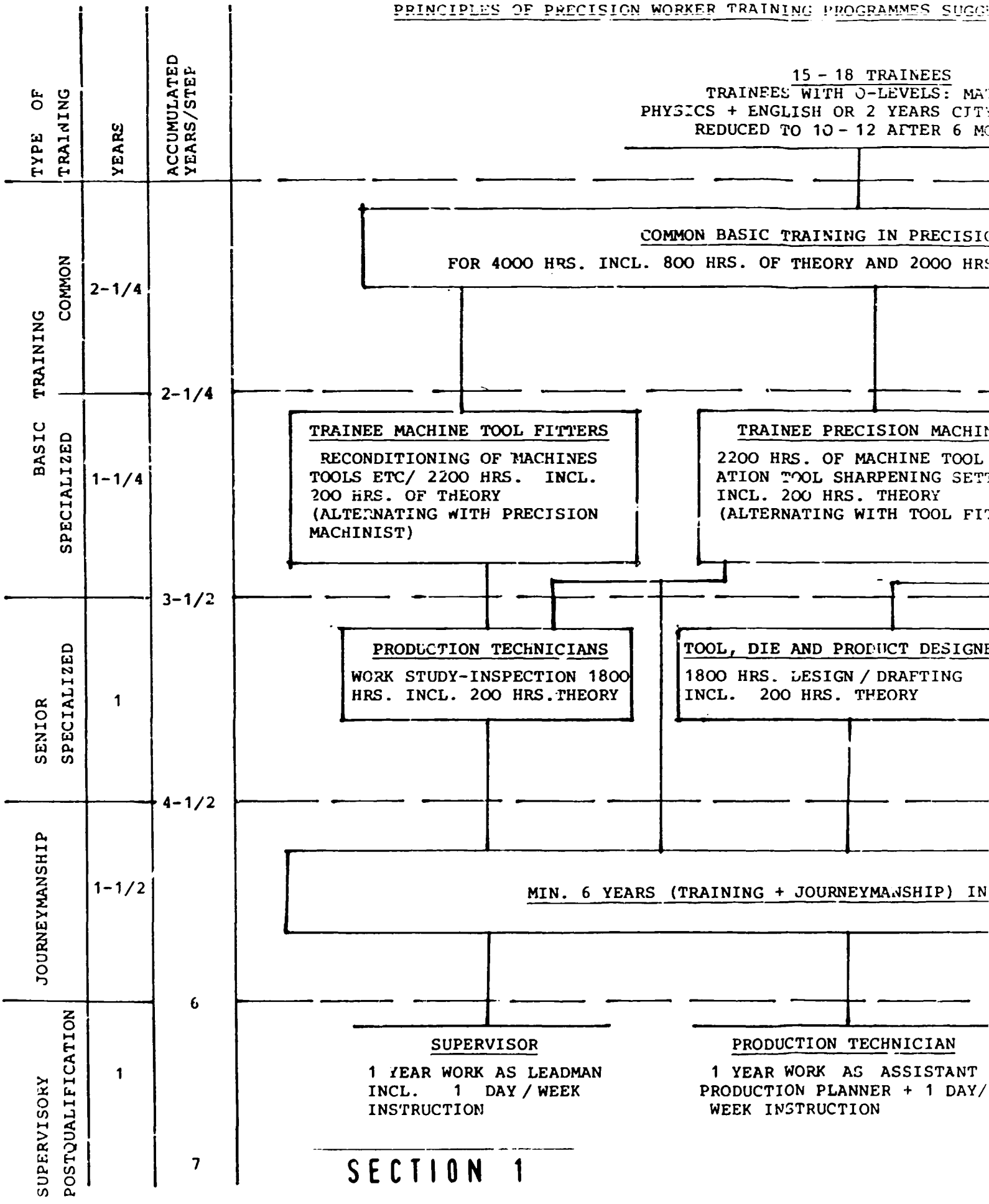
Sheet metal pressing department. (US $)	
- Presses	514
- Devices for above	118
- Other machines	134
- Miscellaneous	234
- Crating and F.O.B. Genoa	135
- Installation at site	65
	1,200

Tool and dies department	
- Tool machinery	892
- Devices for above	170
- Fitting benches	40
- Other machines	52
- Systems and equipment	29
- Miscellaneous and fixtures	12
- Crating and F.O.B. Genoa	210
- Installation at site	95
	1,500

Hot forging department (if needed)	
- Production machinery	360
- Shop equipment	10
- Other machines	25
- Crating and F.O.B. Genoa	50
- Installation at site	35
	480

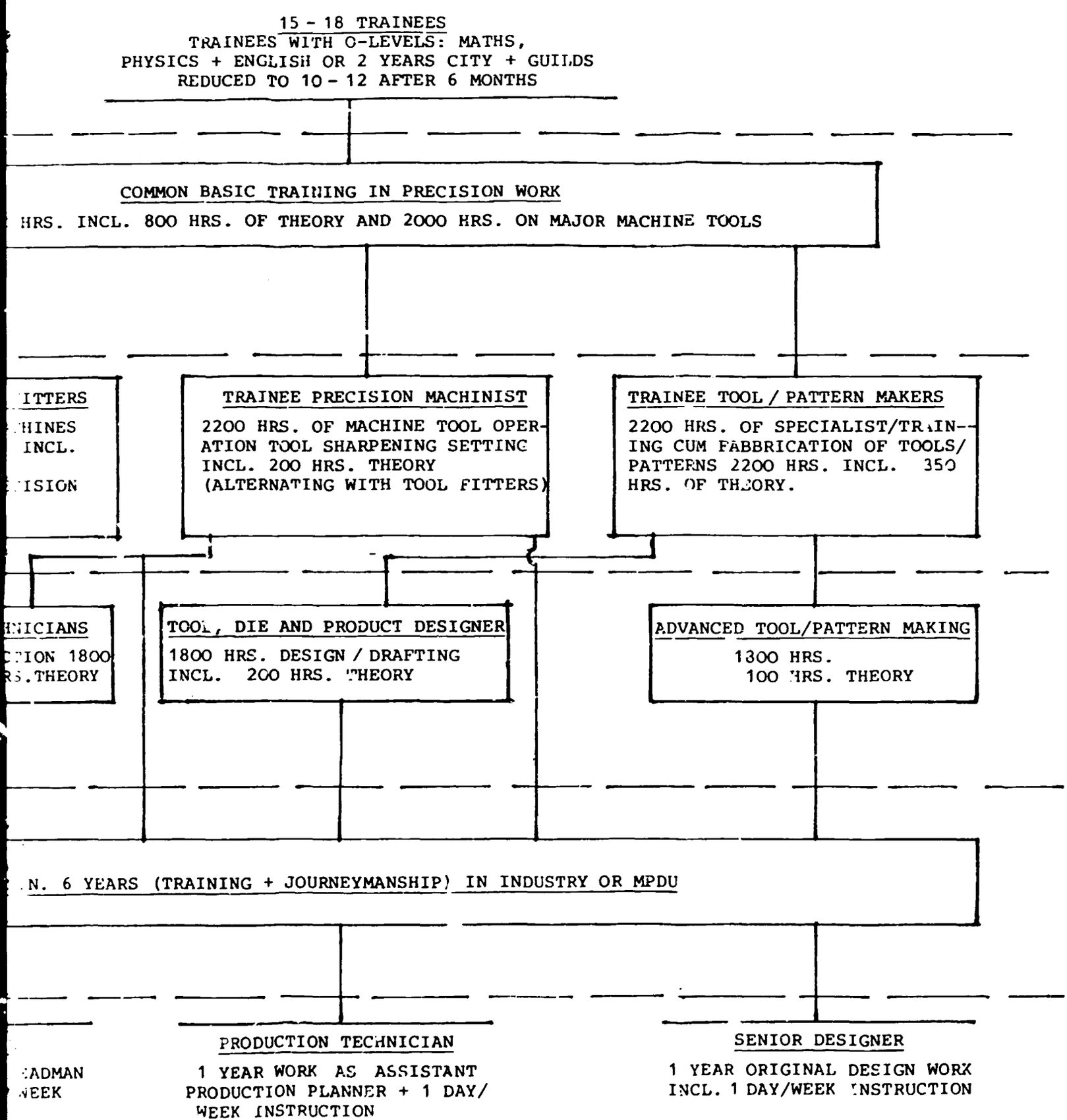
EXHIBIT 5

GENERAL TRAINING REQUIREMENT


PRINCIPLES OF PRECISION WORKER TRAINING PROGRAMMES SUGG
TYPE OF TRAINING
YEARS
ACCUMULATED YEARS/STEP
15 - 18 TRAINEES
TRAINEES WITH O-LEVELS: MA
PHYSICS + ENGLISH OR 2 YEARS CIT
REDUCED TO 10 - 12 AFTER 6 M
BASIC TRAINING
COMMON
2-1/4
COMMON BASIC TRAINING IN PRECISIO
FOR 4000 HRS. INCL. 800 HRS. OF THEORY AND 2000 HR
2-1/4
SPECIALIZED
1-1/4
TRAINEE MACHINE TOOL FITTERS
RECONDITIONING OF MACHINES TOOLS ETC/ 2200 HRS. INCL. 200 HRS. OF THEORY (ALTERNATING WITH PRECISION MACHINIST)
TRAINEE PRECISION MACHIN
2200 HRS. OF MACHINE TOOL ATION TOOL SHARPENING SET INCL. 200 HRS. THEORY (ALTERNATING WITH TOOL FI
3-1/2
SENIOR SPECIALIZED
1
PRODUCTION TECHNICIANS
WORK STUDY-INSPECTION 1800 HRS. INCL. 200 HRS. THEORY
TOOL, DIE AND PRODUCT DESIGNE
1800 HRS. DESIGN / DRAFTING INCL. 200 HRS. THEORY
4-1/2
JOURNEYMANSHIP
1-1/2
MIN. 6 YEARS (TRAINING + JOURNEYMANSHIP) IN
6
SUPERVISORY POSTQUALIFICATION
1
SUPERVISOR
1 YEAR WORK AS LEADMAN INCL. 1 DAY / WEEK INSTRUCTION
PRODUCTION TECHNICIAN
1 YEAR WORK AS ASSISTANT PRODUCTION PLANNER + 1 DAY/ WEEK INSTRUCTION
7
SECTION 1

PRECISION WORKER TRAINING PROGRAMMES SUGGESTED FOR MPDUS

Exibit 5/1



SECTION 2

Exhibit 5/2

OVERSEAS TRAINING COSTS

A - Introductory in plant group training for:

6 Counterpart trainers

4 Engineers

2 General Managers/Deputy designate

for a total of 12 people for 4 months

Costs (for full period)	(000 $)	
- travel 3000x12 =	"	36
- per diem 4000x12 =	"	48
- training 6000x12 =	"	72
Total cost	"	156

B - Upgrading of Engineers and Counterpart trainers with overseas in-plant training for:

6 Counterpart trainers

6 Engineers

for a total of 12 people for 4 months

Total cost for full period (000 $) - 156

TECHNICAL ASSISTANCE PROGRAM - MPDU (SHEET METAL)

Table 2

Expertise required	Duration	Application in year (costs thousands $)					Approx.total cost 000 $
		1	2	3	4	5	
Project Manager-3 first years acting as General Manager	5 years	80	90	90	100	100	450
Chief Workshop Trainer/manager	4 years	35	80	80	90	45	330
Sheet Metal Plant Engineer	2 years	70	80				150
Sheet Metalwork Trainer	3 years	30	70	70	40		210
Precision Worker/Toolmaker Trainer I	3 years	30	70	70	40		210
Precision Worker/Toolmaker Trainer II	3 years		70	70	80		220
Precision Worker/Toolmaker Trainer III	3 years		35	70	80	40	225
Precision (Machine tool)Mechanic Instructor	3 years			80	90	90	250
Sheet Metal Product Designer	3 years	35	80	80	45		240
Tool and Die Designer I	3 years	35	80	80	45		240
Tool and Die Designer II	3 years		40	80	90	45	255
Industrial Engineer/Economist	3 years	35	80	80	45		240
Marketing Engineer	2 years	70	81				151
Short term (4-6 months) Engineering Experts - e.g; Quality Control, Heat Treatment, Specialist Plant and Tool Design 5 man years	5 years		40	120	135	135	430
Preparatory Project in year O (Equipment Purchasing, local construction activity, recruitement, etc.)							150
Total Technical Manpower Assistance	45 man/years	420	896	970	880	455	3771

EXHIBIT 5/4

SHEET METAL PRESSING DEPARTMENT LOCAL TRAINING COST

Table 10

	YEAR	0-1		2		3		4		5	
	SPECIFICATION	N	000$	N	000$	N	000$	N	000$	N	000$
1	General Manager	1	8								
2	Company Secretary/chief Accountant										
3	Assistant Accountant	1	2.5								
4	Foremen/Counterpart Trainer	2	6	3	10.5	4	16	5	22.5	6	30
5	Counterpart engineers/ Technicians										
6	Sheet metal workers	5	5	14	16.8	14	16.8				
7	Toolmakers and mechanic										
8	Hot forging workers										
9	Auxiliary unskilled workers	2	2	4	4.8						
	Tot.		23.5		32.1		32.8		22.5		30
	Rounded tot.		24		32		33		23		30

TOOL AND DIE DEPARTMENT LOCAL TRAINING COST

Table 11

	YEAR	0-1		2		3		4		5	
	SPECIFICATION	N	000$	N	000$	N	000$	N	000$	N	000$
1	General Manager	1	8								
2	Company Secretary/Chief Accountant	1	6								
3	Assistant Accountant	1	2.5								
4	Foremen/Counterpart trainer	4	12	5	17.5	6	24	7	31.5	8	40
5	Counterpart engineers/ Technicians	6	30	2	10	2	10	2	10	2	10
6	Sheet metal workers										
7	Toolmakers and mechanic	10	12	20	15	20	16	20	16	20	16
8	Hot forging workers										
9	Auxiliary unskilled workers	3	3	5	6						
	Tot.		73.5		49.5		50		57.5		66
	Rounded tot.		74		50		50		58		66

EXHIBIT 5/6

HOT-FORGING DEPARTMENT LOCAL TRAINING COST

Table 12

	YEAR	0-1		2		3		4		5	
	SPECIFICATION	N	000$	N	000$	N	000$	N	000$	N	000$
1	General Manager										
2	Accountant										
3	Secretary Accountant										
4	Foremen/Counterpart trainer							1	3.5	1	4
5	Counterpart engineers/ technicians										
6	Sheet metal workers										
7	Toolmakers and mechanic										
8	Hot forging workers							3	3.6	5	7.5
9	Auxiliary unskilled workers										
	Tot.								7.1		11.5
	Rounded tot.								7		12

Exhibit 5/7

	SUMMARIZING TRAINING COSTS (000 $)					Table 13
YEAR	0-1	2	3	4	5	TOTAL
Overseas introduction in plant group training	156					156
Overseas up-grading of Engineers and Counter-part trainees	156					156
Technical assistance programmes	570	896	970	880	455	3771
Local training						
- tool and die shop	74	50	50	58	66	298
- sheet metal	24	32	33	23	30	142
- forging				7	12	19
Total training cost	980	978	1053	968	563	4542

EXHIBIT 6

PERSONNEL IMPLEMENTATION WAGES AND SALARIES

EXHIBIT 6.1

SHEET METAL PRESSING DEPARTMENT PERSONNEL TABLE 14

N.	SPECIFICATION	Year 0-1	2	3	4	5
1	General manager	1	1	1	1	1
2	Company secret./chief accountant	-	-	-	-	-
3	Assistant accountant	1	2	3	4	4
4	Foreman/Counterpart trainer	2	3	4	5	6
5	Counterpart engineers/Technicians					
6	Sheet metal workers	5	14	23	29	34
7	Toolmakers and mechanics					
8	Hot-forging workers					
9	Auxiliary unskilled workers	2	4	5	6	7
	Tot.	11	24	36	45	52

EXHIBIT 6.2

TOOL AND DIE DEPARTMENT PERSONNEL

TABLE 15

N.	SPECIFICATION	YEAR 0-1	2	3	4	5
1	General manager	1	1	1	1	1
2	Accountant	1	1	1	1	1
3	Secretary/Accountant	1	2	3	4	4
4	Foremen/Counterpart trainer	4	5	6	7	8
5	Counterpart engineers/ Technicians	6	8	10	12	14
6	Sheet metal workers					
7	Toolmakers and mechanics	10	20	30	40	50
8	Hot-forging workers					
9	Auxiliary unskilled workers	3	5	6	7	8
	TOT.	26	42	57	72	86

HOT-FORGING DEPARTMENT PERSONNEL

EXHIBIT 6.3

Table 16

N.	SPECIFICATION	YEAR O-1	2	3	4	5
1	General manager					
2	Accountant					
3	Secretary/Accountant					
4	Foremen/Counterpart trainer				1	1
5	Counterpart engineers/ Technicians					
6	Sheet metal workers					
7	Toolmakers and mechanics					
8	Hot-forging workers				3	5
9	Auxiliary unskilled workers					
	TOT.				4	6

EXHIBIT 6.4

UNITARY PERSONNEL COST INCREASE THROUGH THE YEARS (000 $ U.S.)

N.	SPECIFICATION	YEAR O-1	2	3	4	5
1	General manager	8,000	9,000	10,000	11,000	12,000
2	Company secret/chief accountant	6,000	7,000	8,000	9,000	10,000
3	Assistant accountant	2,500	3,000	3,500	4,000	4,000
4	Foremen/Counterpart trainer	3,000	3,500	4,000	4,500	5,000
5	Counterpart engineers/Technicians	5,000	5,500	6,000	6,500	7,000
6	Sheet metal workers	1,000	1,200	1,500	1,800	2,000
7	Toolmakers and mechanics	1,200	1,600	1,900	2,200	2,500
8	Hot-forging workers	-	-	-	1,200	1,500
9	Auxiliary unskilled workers	1,000	1,200	1,400	1,600	1,800

EXHIBIT 6.5

SHEET METAL PRESSING DEPARTMENT PERSONNEL COST

(000 $ U.S.)

Table 18

N.	SPECIFICATION	YEAR 0-1	2	3	4	5
1	General manager	8	9	10	11	12
2	Company secret/chief accountant					
3	Assistant accountant	2.5	6	10.5	16	16
4	Foremen/Counterpart trainer	6	10.5	16	22.5	30
5	Counterpart engineers/ Technicians					
6	Sheet metal workers	5	16.8	34.5	52.2	68
7	Toolmakers and mechanics					
8	Hot-forging workers					
9	Auxiliary unskilled workers	2	4.8	7	9.6	12.5
	TOT.	23.5	47.1	78	111.3	138.6
	Rounded Tot.	24	47	78	111	139

EXHIBIT 6.6

TOOL AND DIE DEPARTMENT PERSONNEL COST (000 $ U.S.)

TABLE 19

N.	SPECIFICATION / YEAR	0-1	2	3	4	5
1	General manager	8	9	10	11	12
2	Accountant	6	7	8	9	10
3	Secretary/Accountant	2,5	6	10.5	16	16
4	Foremen/Counterpart trainer	12	17.5	24	31.5	40
5	Counterpart engineers/Technicians	30	44	60	78	98
6	Sheet metal workers					
7	Toolmakers and mechanics	12	32	57	88	125
8	Hot-forging workers					
9	Auxiliary unskilled workers	3	6	8.4	11.2	14.4
	TOT.	73.5	121.5	177.9	244.7	315.4
	Rounded Tot.	73	122	178	245	315

EXHIBIT 6.7

HOT-FORGING DEPARTMENT PERSONNEL COST (000 $ U.S.) TABLE 20

N.	SPECIFICATION / YEAR	0-1	2	3	4	5
1	General manager					
2	Accountant					
3	Secretary/Accountant					
4	Foremen/Counterpart trainer				3.5	4
5	Counterpart engineers/ Technicians					
6	Sheet metal workers					
7	Toolmakers and mechanics					
8	Hot-forging workers				3.6	7.5
9	Auxiliary unskilled workers					
	Tot.				7.1	11.5
	Rounded tot.				7	12

x - Chosen in table 17 from column n. 2 (2nd year)

xx - Chosen in table 17 from column n. 3 (3rd year)

EXHIBIT 7

INVESTMENTS - DEPRECIATIONS

EXHIBIT 7.1

SHEET METAL PRESSING DEPARTMENT INVESTMENT AND DEPRECIATION
(000 $ U.S.A.)

TABLE 21

N.	YEAR SPECIFICATION	0-1	2	3	4	5
	BUILDINGS					
1	Investment	258				
2	Depreciation	10	10	10	10	10
	GENERAL SYSTEMS					
3	Investment	135				
4	Depreciation	7	7	7	7	6
	MACHINERY					
5	Investment	90	210	330	340	230
6	Depreciation	9	30	63	97	120

EXHIBIT 7.2

TOOL AND DIE DEPARTMENT INVESTMENT AND DEPRECIATION
(000 $ U.S.A.)

TABLE 22

N.	YEAR SPECIFICATION	0-1	2	3	4	5
	BUILDINGS					
1	Investment	342				
2	Depreciation	14	14	14	14	14
	GENERAL SYSTEMS					
3	Investment	203				
4	Depreciation	10	10	10	10	10
	MACHINERY					
5	Investment	305	500	400	210	85
6	Depreciation	31	81	121	142	150

EXHIBIT 7.3

HOT-FORGING DEPARTMENT INVESTMENTS AND DEPRECIATION
(000 $ U.S.A.)

TABLE 23

N.	SPECIFICATION / YEAR	0-1	2	3	4	5
	BUILDINGS					
1	Investment	-	-	-	15	
2	Depreciation	-	-	-	1	1
	GENERAL INSTALLATIONS					
3	Investment	-	-	-	12	
4	Depreciation	-	-	-	1	1
	MACHINERY					
5	Investment	-	-	-	480	
6	Depreciation	-	-	-	48	48

EXHIBIT 8

GENERAL MARKET SURVEY

FOREWORD

Metal production development units must meet specific features deriving from the actual needs of the market: productive programs were thus formulated on detailed components s.c. defined by outline, weignt and general dimension.

Indication of the main market areas to be supplied with new plant's products

The general indication of the multiannual plans, associated with the remarks and information gathered during the two investigations, suggest to address the M.P.D.U. production towards specific market fields, namely:

1 - Agriculture.
2 - Off-road transportation.
3 - Parts for power means.
4 - Metal working and mining industries.
5 - Food and miscellaneous industries.
6 - Building and town planning.
7 - Home and sanitary uses.
8 - Conveyance of industrial utilities.
9 - Electrification and telephone lines.

The "product families" and the "sample components" have been detected in the above fields and they are intended to serve as a pattern in the formulation of conceptual projects.

Condensed Products' lists

The detailed list of items proposed to supply the market may be summarized taking into account the type of technology and the field where the end products are used.

1 - AGRICULTURE

Though bearing in mind the remarkable incentive towards motorization noticed in the different countries, lack of manual work and equipment for animal traction has been remarked. The dimensioning of the demand in the agricultural field has been made, lacking market researches, taking a yearly supply of implements on statical basis as reliable: production scheduling has been avoided for items that can be locally produced in appreciable quantities.

a) Manual agriculture

This equipment requires surface hardness, toughness and high elasticity limit, or elementary implements for transportation means, normally using welding at some extent.

The basic material is steel, the main technology is forging with possible adaptations of shaped plate properly sharpened and treated.

Production of the following has been considered:

- miscellaneous implements (not locally produced) mainly forged;
- material handling means (shaped and assembled sheets);
- parts for drums and brackets for pails.

b) Animal traction equipment

The equipment can be generally identified as tool-carrying structure on wheels to be fitted with blades to cut into the ground.

Again, the material is steel: main technology is assembling of section iron and plate for the supporting structure (with possible introduction of nodular cast iron castings).

Forging is always essential in the farm equipment field but there is also room for some cast iron castings , especially nodular cast iron.

The amount of the demand has been proportioned yearly with reference to the house hold groups considered as productive average in the agriculture in each country.

The productive lot consists of:

- traditional plow (forged - structural steel work)
- rotary blade harrow (forged - castings - structural steel work);
- rings rollers (forged-structural steel work-castings);
- zig-zag harrows (forged - structural steel work);
- seeder with dispenser (shaped plate - cast iron castings);
- bearing and other parts for animal-drawn carts;
- carts - animal drawn for farms and general transport.

c) Equipment for power traction cultivators

After chosing some very popular equipment (harrows, seeders, graders, clod smashers, sawing machines, etc.) containing cast as well as forged and cold machined parts with subsequent welding, the production has been set up assuming to supply same of the active household groups.

The production includes:

- spare parts for power cultivators (mainly forged);
- tractor implements:
  . sawing machine (cast or forged parts);
  . ground graders (mainly assembled plate);

. cold smasher roller (mainly assembled plate);
. seeder harrow & cultivator (stamped plate, castings, structural steel work);

- components for sprayers (aluminium castings).

The number of the required components has been correlated to the expected average number of tractors for an A.C.P. country. A considerable role is played by the spare parts for implements.

d) Irrigation

The production of a sufficient number of separate parts for centrifugal pumps, connections and bends has been foreseen to supply about one hundred units.

More complex technologies are involved in this field, among which the casting of non-ferrous metals and special cast iron, which shall be integrated by mechanical machining and outside purchases.

Typical products in this area are:

- components for centrifugal pumps on trolley (all technologies under study are involved);
- connections and bends (mainly aluminium and no ferrous alloy, in general);
- components for hand pumps;
- components for sprayers;
- panels for water reservoirs/roof tanks.

2 - OFF-ROAD COLLECTIVE TRANSPORTATION
(Railroad and navigation)

The volume of the components to be manufactured takes into consideration the surveys made during the visits to the maintenance plants.

About thirty components have been selected among the most significant ones and representing the imported spare parts share available for local production.

Among these, brake shoes for railway cars are of major importance for the considerable wear affecting the great number of shoes fitted on each car.

For naval spare parts only some components have been considered.

Without dwelling in a detailed description, these can be summarized as follows:

- parts of railway wagons, new and reconditioning;
- components for railroad (forgings or cast iron castings);
- miscellaneous external components in the railcar (assembled and welded shaped plate);
- bushings and covers (nodular cast iron castings);
- traction components (forged or shaped metal work);
- brake components (cast iron cast);
- boat propellers (non-ferrous alloys);
- mooring bitts (nodular cast iron);
- hooks, turnbuckles, clamps, etc. (mainly forged).

3 - PARTS FOR POWER EQUIPMENT

Putting together the spare parts for motor-cars, trucks, tractors, earth moving machines and industrial conveying - hoisting equipment, the wear components have been selected for production referring to the estimate that the visits to governement storehouses enabled to make.

To these vehicle components subject to easy breakdown (pulley system, fans, traction hook and miscellaneous plate optionals) have been added.

The figures refer to the consumptions based on the vehicles in circulation as concerns drums, brake disks, pistons, etc., while other figures do not exceed one thousand set each.

The following has been selected as representative items:

- brake disks and drums (pig iron);
- oil tight covers, oil sumps, pistons (aluminium alloys);
- fans (aluminium alloys and stamped plate);
- lights and tool kits (aluminium alloy and stamped plate);
- trolley roof (stamped plate and structural steel work)
- hubs for tractor and trolley front and rear wheels (cast iron);
- trailer traction components, articulated joints, etc. (mainly forged and of nodular cast iron with plate components);
- track links (forged).

4 - METAL WORKING AND MINING INDUSTRIES

The components of metal containers, conveyors, gears, specific tools and fixtures, supplies for tracks and Decauville cars, pulleys, electric motor casings, etc. have been chosen as guide production.

Typical products are:

- plate bins (shaped plate);
- components for rolling conveyors (plate or cast iron castings);
- components for overhead conveyors (forgings);
- pulleys and gears (cast iron castings - forgings);
- equipment for ingot mold pit (cast iron castings);
- blacksmith or melter equipment (all technologies);
- miscellaneous tools (mostly forged).

5 - FOOD AND MISCELLANEOUS INDUSTRIES

Due to the different technological stages of the processes in different countries and from plant to plant in the same country, generic products (crusher components, stainless plate containers) have been chosen, which the definition of the country and the details may suggest to replace with specific manufactured articles, according to the progress stage and the technologies of the local industry.

Among the chosen types:

- components for cereal crushers (mainly plate);
- components for seed oil presses (only cast iron cast parts);
- containers for food liquids (normally stainless steel stamped parts);

- dies for glass (cast iron special alloys);
- stainless steel vats, tables, containers, etc., for food processing plants;
- wire products (baskets, shelves, dish drainers, etc.);
- metal hanging panels (incl. filler);
- cookers, water heaters, solar heaters.

6 - BUILDING AND URBAN INFRASTRUCTURES

Considering the large expenditure margin the many Government plans allocate to these facilities of which many construction details can be detected, a considerable part of the basic list has been devoted to these productions: they often consist of simple castings imported in whole or in part from abroad. Also the building yard machines and tools have been found to be essential means where the domestic production could replace imports.

Consideration was given, to mention only the main groups, to the following:

- building yard equipment (for rod shaping) (mostly forged);
- scaffolding material (mostly casted);
- mason tools (mostly forged);
- components for building yard machines (cast parts are considered);
- implements for rolling shutters or window screening (shaped plate);
- components for door framing (cast or stamped in plate);
- indoor and road reflectors (cast in aluminium or stamped in plate);

- drain covers, grates, road drain wells (cast iron castings);
- piping, elbows and unions for drains (cast iron castings);
- components for valves, gate valves, unions, etc. for drinkable and service water (cast iron castings);
- street and road signs, road fencing;
- fire hydrants.

7 - PRODUCTION FOR HOUSEHOLD USE

The present utilization already covered in part by the domestic handicraft market, has been integrated with the scheduled inclusion of elementary components which shall be replaced, as soon as the market allows it, by a more sophisticated product capable of supplying the assembly of equipment in the same field so far imported, thus avoiding damages to the small local manufacture through an illogical competition.

The component considered refer to:

- bath tubs, showers and sanitary equipment (mostly cast iron cast);
- taps (non-ferrous alloy cast);
- miscellaneous household fixtures and equipment (cast iron and aluminium castings shaped sheet);
- brassware e.g. sanitary fittings, stop-cocks, water taps, etc.

8 - INDUSTRIAL UTILITIES CONVEYANCE
(valves for liquids or gas)

The purpose of the small production scheduled for the first three years is the training and the approach to the problems that the specific field involves.

Productions are almost exclusively in nodular cast iron and concern the components of gate valves and fittings of methane pipeline and oil pipelines. These can also include the components of small rotary compressors and radial fans which however employ mostly shaped plate castings.

Cast iron pipes, centrifugally or statically cast, must also be taken into account.

9 - ELECTRIFICATION AND TELEPHONE LINES

Under different aspects, more than the plans disclose, the countries are on the threshold of expansion in the demand of power.

Main consideration has been given to forged and cast components for connection and supply equipment.

As concerns the telephone lines, some components for supply equipment have been selected.

We mention here the following items as illustration:

- connection, support and mooring clamps for power lines (cast iron and aluminium castings);
- accessory for overhead line supports (aluminium castings and forgings);
- cable junction boxes (cast iron and aluminium castings);
- waterproof feeder boxes (cast iron and aluminium castings).