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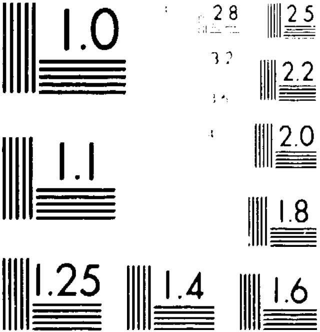
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UNITED NATIONS INDUSTRIAL
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PRODUCTION PLAN FOR THE ARAB PHARMACEUTICAL INDUSTRY IN SELECTED ARAB COUNTRIES*

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Volume three: Medical appliances

Prepared for the Arab Company for
Drug Industries and Medical Appliances (ACDIMA)
by the United Nations Industrial Development Organization

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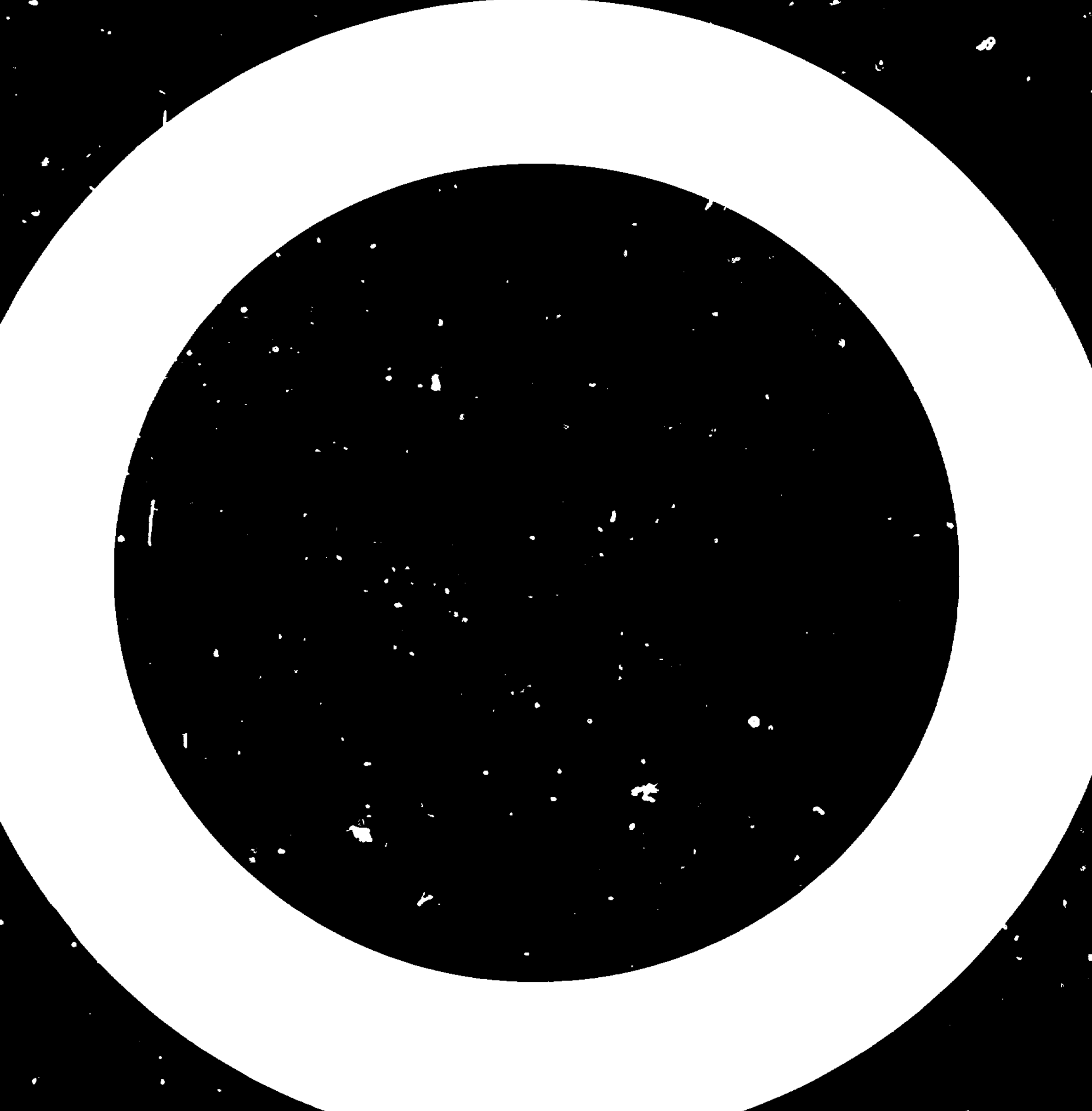

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XVII. ASSESSMENT OF EXISTING FACILITIES AND PRE-INVESTMENT ANALYSIS FOR THE PRODUCTION OF MEDICAL APPLIANCES IN ARAB COUNTRIES

A. Summary

1. The UNIDO commissioned the services of the authors of this report to study and assess the available facilities and infrastructure in the member-states of the Arab company for drug industry and medical appliances(ACDIMA) and "to make production plans to produce medical appliances for Arab countries". The authors fulfilled the assignment during the period 14th July 1977 to 25th November 1977 - 3 months covered by the UNIDO contract and the subsequent period under the Special Services Agreement.

2. For this purpose, the authors visited Cairo, Baghdad, Kuwait, Khartoum for about 2 months and later worked at Delhi for the preparation of industrial profiles of special lines of production in consultation with the Indian consultants appointed for the purpose. The report is now submitted incorporating the details of survey, findings, industrial profiles and the recommendations thereof.

3. In order to assess the depth of medical facilities existing in the Arab countries, the extent of sophistication in equipment and appliances being used at different points of Medical Care Delivery and the design preferences of the medical profession, the authors visited nine representative hospitals and medical institutions and had discussions in depth with a number of physicians, surgeons and health administrators. The authors also had the benefit of detailed discussions with the Ministries of Health in different states and were able to collect information on the various national health programmes. The authors had

the opportunity to visit seven factories and industrial establishments and hold discussions with a number of engineers and technicians. This helped in assessing the technical support facilities that are available in different States for establishment of the proposed medical appliances units. Facilities for training of workers and supervisory staff were also noted. The procurement agencies in the different States for medical appliances, both in governmental and non-governmental sectors were personally contacted and considerable data was collected during these visits and discussions. This report bases itself on the totality of such information.

4. Health Services

A careful analysis of the facilities in the countries visited by the authors reveals that generally, there are three levels of financial inputs for health programmes - Kuwait in the higher bracket; Egypt and Iraq at a middle level; countries like Sudan have comparatively lower inputs. By the same token, Kuwait is more exposed to world's best instruments and appliances in their hospitals. The emphasis in all the countries, however, is on child and mother care, preventive action in combating diseases, effecting qualitative improvements in the existing hospitals and dispensaries and the elimination of the regional imbalances with respect to availability of reasonable medical care facilities. Most of the countries will contemplate building of new facilities by way of additions to the hospitals, only in the areas of specialisation, where there is total inadequacy at present. Production programmes for the new medical appliances units, will therefore, have to fit in with the Government plans to provide reasonable medical facilities to the maximum cross-section of the population; the units should also be versatile enough to provide comprehensive range of products for the medical services.

5. Technical Support

Among the Arab countries visited by the authors, Egypt has the technical know-how and expertise in a wide range of technology Training facilities for technicians and supervisory services as well as engineers exist in Egypt and to some extent in Iraq. Iraq has also taken a number of steps for building up a light engineering base. The authors were impressed by the objectives of the Special Institute for engineering industries being organised in Baghdad. The planned efforts that are being made in Iraq to develop a complex for light engineering production will in due course be found suitable as ancillary support for the medical appliances production units (other than electronic medical equipment).

6. Electronic Industry

The Benha Electronic Company in Cairo is the only facility that has the maximum range of technological inputs required for medical electronics. The skills and the experience available in this factory will be useful for development of electronic medical equipment.

7. Production Units for medical appliances

After taking into consideration all aspects of the government plans for health programming, probable requirement of instruments, appliances and equipment in Arab countries at different levels and the available technical infrastructure in the region, the authors recommend the development of medical appliances industry in the following manner:

i) Simple designs of the commonly used appliances for preventive and curative aspects of medical care should be taken up for production in the initial stages. Such products should enable qualitative improvements in health services in rural and semi-urban areas, where there is much scope for improvement.

ii) Simultaneous steps should also be taken to develope certain essential technical infrastructure within the organisation of ACDIMA, in order to prepare for erection and commissioning of equipment and production and marketing of medical appliances.

iii) The production units should have functional lay out and be versatile enough to include in the production programme, a wide range of products within the same technology.

8. The authors recommend the following units to be taken up for production in the Arab countries:

i) Thermometers
ii) Light engineering complex for medical appliances and equipment (other than electronic) including stethoscopes, blood pressure apparatus, hospital appliances and surgical instruments.

iii) Microscopes, overhead projectors and allied products
iv) Electronic Complex:
   a) ECG, Hearing Aids and other electronic medical equipment.

   b) Laboratory equipment, including PH Meter, Colorimeters, Flame Photometers and spectro-photometers.

   c) Analytical balances.

v) X-Ray Films

9. Industrial profiles for the different products as prepared by the Consultants are given in section C. the report.

10. The details of the investment and the returns on investment as per this programme at the capacity ratings are indicated in the following table.

11. In the light of the ACDIMA's objectives to disperse medical appliances units to the extent possible and the overall impressions gained by the authors on the available infrastructure, the following recommendations are made on possible location of the proposed units:-

i) Thermometers

Production of thermometers could be automated substantially, provided there is steady market demand for 10 to 50 million pieces per annum. For capacities in the lower ranges, the technology recommended is more labour intensive and will have to be in the small scale sector. Technically, the unit could be located in any of the States, except in places where the wages are high, considering that Sudan does not offer the necessary infrastructure required for other lines of production for medical appliances, it is recommended that this small scale unit should be located in Khartoum, Sudan.

ii) X-ray films

The proposal for manufacture of X-ray films is for a conversion unit from jumbo rolls, which could be imported in the early stages. Since the environmental conditions for the X-ray films production could b

FINANCIAL SUMMARY

	Investment	Turnover capacity	At Rated Capacity	Return on Investment
	(U.S.Dollars in thousand)			
1. Thermometers	600	1860	2 Mil.	30%
2. Light Engineering complex				
a) Stethoscope				
b) Blood pressure Apparatus	2336.5	7483.5	18900 No.	21.0%
c) Hospital apparatus			10400 No.	
			51390 No.	
d) Surgi. Inst.	415.3	571.0	300,000 No.	14.2%
3. Microscopes	1922.4	1317.5	9500 No.	17.5%
4. Electronic complex				
a) E.C.G.	521.2	2592.0	3000 Nos.	20.5%
b) Hearing Aids	106.2	230.0	5000 Nos.	30.2%
c) Lab. Equipment				
i) pH Meter	308.5	508	2300 Nos.	27.6%
ii) Spectro photometer	1243.4	2204	2550 Nos.	34.5%
iii) Balances	674.1	1900	11000 Nos.	31.6%
5. X-Ray Film	1650	23750	5 Mil.Sq.mt.	36.30%
Total	9777.6 (approx. 9.8mil dollars)	43556.0 (approx. 43.56 million dollars)	Average	26.34%

Note: 1. Return on investment is before taxation.
2. Cost of land is not included in the estimates.

partly taken care of by air conditioning etc. the location of the conversion plant for X-ray film could be in any place accessible to sea port/air port. It is assumed that normal rail and road communication is assured. However, it is evident that too much extreme climates will make the air conditioning expensive. Hence, among the Arab countries, the Syrian Arab Republic could perhaps be the choice.

iii) Electronic Complex

The electronic complex is best located in Cairo where the Benha Electronic Company could provide the base. This unit will produce ECG, hearing aids, laboratory equipment including balances(electronic base).

iv) Light Engineering Complex

In view of the considerable planning and initial preparations that has already gone in for development of light engineering base in Iraq, the location of the Light Engineering Complex for medical appliances is recommended to be in Baghdad. This unit will produce blood pressure apparatus, stethoscopes and all types of electro medical equipment (other than electronic), hospital appliances and surgical instruments.

v) Microscopes, overhead projectors and allied products

Production of microscopes and other allied products, though dependent on optics, is essentially related to light engineering production process. As such, it is recommended to be located reasonably close to the light engineering complex that is planned in Iraq.

12. Additional technical facilities to be provided for production of medical appliances.

i) Tool Room

A compact, self/supporting tool room exclusively for the development of the medical appliances industry is very necessary. It may be located in Cairo where it is easier to get suitably trained personnel. Also among the Arab countries, Egypt has the maximum level of industrialisation which could benefit by this tool room in addition to ACDIMA's own projects. (Profile, given in section C)

ii) Medical Appliances Repair Workshop

A small self supporting repair workshop for electronic based medical and laboratory equipment is an urgent necessity as defective maintenance in the hospitals has led to considerable waste of capital lying unused. Also such a Workshop will become the after sales service unit for ACDIMA's electronic medical equipment. Moreover, this unit would ultimately serve to train service engineers. This unit may be located in Cairo where it could draw assistance from Benha Electronic Company. (Profile, given in section C)

13. Medical disposables

During the visits and discussions with the specialists in all the countries, there was unanimous opinion that medical disposables should be taken up for production by ACDIMA. Considerable data on pricing of syringes and other pre-sterilised products were obtained in Iraq; they are given in this chapter.

Priority had to be given to the products listed by ACDIMA and some of the products considered important to provide a full range of minimum facilities for the health services. It is recommended that a more careful study on medical disposables be undertaken at a later stage. Probably ACDIMA is already siezed of this aspect.

14. Plaster bandages

On the items listed on priority by ACDIMA, two items have not been considered for preparation of profiles; As regards plaster bandages, while the authors agree on the need to develop production facilities for this product in order to fill the gap in the range, the data collected does not appear to be economical for production. Unless a more comprehensive study is undertaken by ACDIMA and authentic projections made, it would not be advisable to enter this field which is dominated by a few well established companies in the west.

15. Dental Requisites

As for the dental requisites, the range is so wide and quantitative demand in individual products so limited that it will not be feasible to take up all the items for manufacture. However, dental chairs have been included under 'medical appliences'; Tooth Extraction forceps and hand instruments for dental surgery are included under 'Surgical instruments'.

B. General

It is evident that among the Arab Countries, Egypt perhaps has the expertise and production facilities for a larger range of technologies. It is also apparent that the other Arab States look to Egypt for providing them the base for training and development of personnel cadre and the infra-structure for their own industrialization programmes. That there is great inter-reaction between the Arab countries through mutual help and cooperation is seen by the financial inputs being made by the Gulf States into Sudan for agriculture, transfer of experienced farmers from Egypt to Iraq and the growing spectacle of Cairo and Kuwait becoming the trading gateways of the Arab world. The patriotic identification of the different Arab States into a single Arab brotherhood is another factor in favour of an integrated development of the medical industry.

Liaison with the medical profession

There have been earlier attempts in Egypt for the manufacture of a wide variety of surgical instruments and appliances. The Military Factory 54 in Cairo had produced a variety of surgical instruments, hospital appliances, including sterilizers, theatre lamps, hypodermic needles, stethoscopes etc. But they failed and these lines have since been abandoned. The main reason for the failure has been lack of communication and collaboration between the engineers and the medical profession. Marketing of these products had also been taken up along with other products which had no relation with the type of follow-up that is required in the marketing of medical instruments, appliances, and equipment.

Production facility

In the section D in this report, the different technologies involved in the manufacture of the medical instruments, appliances and equipment are discussed. These include mechanical, electrical, electronic, plastic and optics. While almost all the Arab States have embarked on development of their engineering base, they are all in the early stages of commencement. They have barely touched the periphery of the problem. Egypt is the only country which has moved into the operational stage. The second country that has taken concrete steps towards building up of light engineering industry in a scientific and planned manner is Iraq. When the present plans of the Government of Iraq fructify, there would be a string of light engineering production units, including a self-sufficient forge shop. a ferrous and non-ferrous industry production units for ball bearings, electric motors, transformers and other auxiliaries. In the oil-rich countries, the current plans to develop and expand the petro-chemical industry should boost the plastic industry. Sudan is more likely to concentrate on becoming the granary of the Arab world; industrialisation, as applicable to the medical industry is non-existent.

Technical Support

Operational expertise in light and medium engineering industry exists in a great measure in Egypt. The machine tool construction company, the military factories, the Benha electronic company, El Nasr forge shop and the foundry unit constitute the hard core of this expertise. However, certain aspects of production management that need to be attended to for a rapid building up of the medical industry are detailed below:

a) Design group and tool room

While there are pockets of design activity in the different factories, they are only related to the immediate requirements of production in those units; most of the activity is restricted to detailing. [illegible] Designers in the different units work in isolation; there is no inter-action between different specialisation and hence no sharing of experience. While production design is thus restricted in its depth, tool design is much less developed. There is need to encourage the tool designers, even if their initial attempts do not give off the productivity performance on the shop floor, as effectively as the imported tools. Lastly, there is scope for better coordination between the designers and the shop floor. The tool rooms are themselves far and few. While a general purpose tool room has certain advantages of economy, lack of accurate and modern technology finishing equipments cripples the shops into shying away from accepting technological challenges. Medical industry, comprising of various technologies, will pose several such challenges and continuous dependence on foreign assistance by way of designs etc. will inhibit rapid growth of the medical industry.

b) Technology Group

Each of the major units does have its own technical supporting facilities. But for a successful implementation of the new projects in the medical industry, the existing facilities for evaluation of technology, production planning and industrial engineering will not suffice. Unless the engineers and Technologists are exposed to the functional aspects of medical appliances, the inter-relationship of different technologies, and the latest advances in production, local talent cannot make contribution.

c) Skills and Training

It is evident that the necessary skills for certain areas of the proposed manufacturing programming exist in Egypt and Iraq. These areas include assembly of electronic components, precision machining, grinding, polishing and assembly of surgical instruments and appliances etc. Training schools and institutes also exist in the machine tool construction company, Benha electronic company and elsewhere also. These will be useful in preparing the technicians for the shop floor. But there is need to reorient the training programmes for their effective participation in the medical industry. Medical industry calls for a blend of the engineering science with functional and aesthetic requirements of the medical profession and the finesse in products cannot come only by engineering drawings.

d) Labour Costs

While the profiles are being prepared on Egyptian conditions, suitable adjustments will have to be made if the units are located in other countries, particularly, in the Gulf States.

Power

The Arab States oviously have no problems with fuel - electrical power, furnace oil or gas, though transmission of electricity to remote areas seems to be a matter of concern in places like Sudan. However, since the proposed units will have to be located close to other supporting facilities and hence in already developed areas, it is presumed that adequate power will be provided.

Communication

While communication is quite a problem in Sudan and certai parts of other Arab States, the current efforts that are being made in developing new roads and railways, particularly those connecting the ports with strategic areas should eliminate this problem in due course. From the information given to the Experts, there seems to be a need to depend heavily on road transport, particularly for distribution of the products into the interior. The experts are assured that there will be no difficulty.

Building and erection of projects

In Egypt there is a separate organisation for building of factory constructions, erection and commissioning of electrical and mechanical equipments. However, the costs indicated to the Experts appear to be high.

Water

Except for the factory for X-Ray films, the industrial requirement of water is not a major criterion for the medical appliances industry. It is, however, assumed that the normal requirements of water will be met, particularly in areas ear-marked by the Governments for industrial development.

Drainage

There will be no serious problems of effluent disposal in the projects for medical instruments, appliances, and equipment as one would expect in the case of drugs and pharmaceuticals manufacture.

By the very nature of ACDIMA's overall objectives, factories will have to be dispersed in different Arab States. Except in the Mediterranean Shores, the hot weather in Summer and Minimum rainfall, will make air-conditioning unavoidable, even in areas of factories, where normally, in other countries, it is a luxury.

Productivity and discipline

The team is not able to comment on the levels of productivity prevalent in the States. It would require more detailed study on the shop floor to make any positive statements. Generally, the shops are clean and one would assume that the morale is satisfactory. A comment was, however, made by one of the senior executives in the factories that the 'discipline' among the workers was an important factor affecting the growth of the industry. The workers' force did look pleasant mannered and the team found them very willing to answer questions and project the image of their plants and hence the team is inclined to accept them as good as anywhere else in the developing countries. But perhaps, there are a number of extraneous distractions to their work schedules and hence job application leaves much scope for improvement. These distractions are of social origin and will need some period of adjustment to imbibe satisfactory industrial culture. This is not exclusive only to the Arab countries, but in fact applies to all developing countries in the transition stage from the leisurely pace of rural and agricultural environment to a more time bound industrial discipline.

In Summary, the authors of this Report are convinced that there is fine material for building the medical appliances industry in Arab States through selective exploitation of the experience gained in other developing nations.

C. Compendium of data

Statement No. - 1 Thermometers imported in Egypt during 1977-78

Item	Quantity required	Quality and Specification	Manufacturers	FOB Price (F.C.)	PRICE in L.E. (Egyptian pound)	Quantity purchased	Total F.C.	Total L.E.	
1.	1000,000 (one million)	Clinical thermometer prismatic type centigrade from 35°C to 42°C graduation at 0.1 degree; oral use in each case.	0.5.0 N F.R.G.	1.25 DM each	0.195/ea				
			SANKYO" Japan	0.2017 $ each	0.08/ea	800,000	$ 161360.00	64000.00	
			National China	C&F CIF £ 1.65 Doz.	0.097/ea	200,000	£ 27600.00	19400.00	
			TERUMO Belgium	358.86 $	0.142/ea			Total	83400
2.	100,000	Clinical thermometer flat oval type, centigrade from 35°C to 42°C graduation at 0.1 degree in each case.	WALTER F.R.G.	1.35 e/aDM	0.211/ea				
			TERUMO Belgium	340.57 $ per 1000	0.135/ea	50,000	$ 17050.00	6750.00	
			MEDEXPORT USSR	0.45/ea$ (C.I.F.)	0.178/ea	50,000	$ 22500.00	8900.00	
								Total	15650
									99050

Note:- During the year 1976-77, the imports were 10% less. 900,000 thermometers of Prismatic type and 90,000 of Flat Oval type were imported and the prices were almost the same in above table. The projection for future, according to Dr. Wahbi, is that the Quantity will increase by 10% every year.

Statement No. 2 - Stethoscope

Item	Manufacturer	Specifications	Qty	Foreign Currency	U. Price in F.C	U.Price in E.C	Total in F.C	Total in E.C.
I	China National (China)	Combination Stethoscope: This stethoscope is complete with metal spring binuaral, latex tube and a combined double-way outlet chest piece. The chest-piece is equipped with a valve to facilitate the use of either the diaphragm or the bell type in conducting heart and lung examination or ordinary diagnosis.	20000	Cl. Sterling	2.72	1,849	54400.-	36980,-
2	Rud Riester F.R.G.	Littmann Combination Stethoscope Duplex, Light metal Alloy	8000	D.M.	13.10	2,213	104800.-	17704,-
3	3M (U.S.A)	The Littmann Brand combination Stethoscope(Adult Model)	2000	$	16.50	6,521	33000.-	13042,-
								67726,-

Statement No. 3 - BLOOD PRESSURE APPARTUS, SPHYGOMONOMETER

Item	Manufacturer	Specifications	Qty
1	China National (China)	Sphgomomanometer Blood Pressure Mercurial Type, with self-adhering Nylon Strips Armband	13000
2	Samellie (Japan)	Sphygomomanometer Blood pressure Aneroid Model with armband	6000

Foreign Currency	U. Price in F.C.	U.Price in E.C.	Total in F.C	Total in E.C.
Cl. Sterling	5.95	4,046	77350.-	52590.-
$	6.03	2,383	36180.-	14298.-
				66896.-

Statement No. 4 - BALANCES

Item No	Name of Instrument & Specif.	Company & Country	Quantity Imported		Unit price F.C	Unit price L.E	Total price F.C	Total price L.E	Remarks
1	Analytical Balance TG 528	China	500	C&F	£ 71.65	48.703	35825,-	24351,506	
2	Analytical Balance TG 626 A cap 2509	"	100		63.70	43.299	6370,-	4329,912	
3	Leavy duty Balance TG 65	"	50		153.40	104.271	7670,-	5213,567	
4	Analytical balance automatic constant load cap 200 g + 20 g tara reading accaracy 0.05 mgm. 2 wedghind vessels automatic loring of vessels type WA 32	Labimex	500	FOB $	484,-	191,286	242000,-	95642,756	
5	Ditto type WA 33	"	1000		401,50	158,680	401500,-	158630,027	
6	Ditto Semi-micro cap 100 g 20 g tane reading accuracy 0.01 mgm two weighing vessels, automatic taring of vessels type WA 35	"	500		561,-	221,717	200500,-	110858,649	
7	Ditto type WA 34	"	500		511,50	202,154	255750,-	101077,044	
8	Table balance model EC-TP 11-50-500 g	China	500	C&F £	28.40	19,504	14200,-	9652,237	
			3650,-					509805.698	

Statement No. 5 - MICROSCOPES

No	Type	Specifications	Main F & Country	Quantity	Unit Price F.C	Unit Price L.E	Total Price F.C	Total Price L.E
I	Microscope MS-8M	Microdcope MS-8W with built-in illuminator 220V, mechanical stage NK-4, achromatic Obyectives 5x, 10x spring loades 40x spring loaded, oil immersion 100 X, Huygonian eyopieces 5X, 10X, 15X rack - and pinion ABBE Condenser wooden Cabinet.	Labimex	1000	132,50 US $	52,366	132500, US$	52366
I A	Spare Bulbs for MS, 8M	Spare bulbs for MS-8W, 220V, 15W	Labimex - Poland	8000	0,40 US $	0,158	3200 US $	1264
I B	Research Microscope	Research Binocular microscope, MB - 30 Objectives 5X, 10X, spring loaded 50X spring loaded, oil immersion paired Huygenian eyepieces 5X, 10X, 15X and orthoscopic eyopieces 12,5X, mechanical stage, rack and pinion ABBE condenser, built-in illuminator, low - voltage transformer	Labimex - Poland	25	318.00 US $	125,679	7950 US $	3141.975
I C	(spare parts) Oil-immersion	Oil immersion, spring loaded, achromatic achromatic objective 100X	Labimex - Poland	50	21.90 US $	8,655	1095 US $	432.750
ID	Eye piece	Huygenian eye pieces 10X	Labimex - Poland	50	3.15 US $	1,245	157.50 US $	62.250
I E	Eye piece	Huygenian eye pieces 15X	Labimex - Poland	50	3.15 US $	1,245	157.50 US $	62.250
2	Student microscope	Student monocular microscope, Type A - 5	UNITED BIOLOGICAL MANUFACTURING CO.	500	250 RS	11,096	125000 RS	5548

Statement No. 5 – MICROSCOPES Continued

No	Type	Specifications	Main F & Country	Quantity	Unit Price F.C		Unit Price L.E	Total Price F.C		Total Price L.E
2 A	Oil immersion lens	Objective oil – immersion lens 100X	United Biological – India	50	1[illegible]0	RS	6,657	7500	RS	332.[illegible]50
2 B	Eye piece	Eye piece 10X	United Biological – India	50	15	RS	0,666	750	RS	33.[illegible]
2 C	Eye piece	Eye piece 15X	United Biological – India	50	15	RS	0,666	750	RS	33.[illegible]
2 D	Cathetometer	Cathetometer with votical and horizontal	United Biological – India	25	300	RS	13,31[illegible]	7500	RS	332.[illegible]75
3	Microscope Biolam S–I	Microscope Biolam S – I I – Achromatic objective 8 X 0, 20 40 X 0, 65 90 X 1, 25 2 – Eye piece 7 X 15X 3 – Condenser apert 1,2 4 – Light filters 2 pce 5 – Monoular head 6 – Mirror – illuminator 7 – Stage 8 – Stand 9 – In wooden box	MASHPRIBORINTORG,	1300	90	US $	35.570	117000	US $	46241

Total Quantities = 2825 Microscopes

Total Prices (L.E) = 107629.850

Statement No. 6 - X-RAY, FILMS 77

Item No.	Quantity	No. of Films	Name of co;	Price F.C.	Price in E.C. per 25
I	200 Boxes	5000	ORWO (GDR) 200 Boxes	CL£ 1,17/p25	0.809
	Of 25 films 4X10"		CEA Ceaverken AB (Swed) P/50	SW CR 33,50	1,505
			3M (Italy)	$ 3,50	1,383
			Dupont (ERG) P/75	DM 23,72	1,229 e foi
				DM 28,41	1,104 e out
			Agfa Gevaert (Belg)	BF 123,7	1,247
					Per 25
2	16000 Boxes	40000,-	ORWO (1200)	CL£ 1,91	1,451
	Of 25 films 6X12"		Gevaert (400)	BF 221,-	2,241
			CEA P/50	SW CR 59,00	2,650
			3M	$ 6,30	2,490
			Kodak (U.K.) P/100	£ 15,965	2,918
					Per 75
3	600 Boxes	45000,-	ORWO (200)	CL$ 5,43	4,126
	Of 75 Films 6X12"		Gevaert (400)	BF 603,-	6,115
			CEA P/50	SW CR 65,00	2,920
			3M	$ 7,06	2,790
			Kodak P/100	£ 17,615	3,220
					Per 25
4	30,400 Boxes	760000,-	ORWO (30000)	CL£ 2,10	1,596
	Of 25 Films 8X10"		Gevaert (400)	BF 246,-	2,485
			CEA P/50	SW CR 65,00	2,920
			3M	$ 7,06	2,790
			Kodak P/100	£ 17,615	3,220

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Statement No.6 - X-Ray, Films 77 Continued

Item No.	Quantity	No. of Films	Name of Co.	Price F.C.	Price in E.C. per 25
5	2400 Boxes of 75 Films 8X10"	180000,-	ORWO(2000)	CL£ 6,03	4,582 per 75
			Gavaert (400)	BF 670	6,795 "
			CEA P/100	SW CR 118,50	7,983 "
			3M	$ 20,25	8,003 "
			Kodak P/100	£ 17,615	9,660 "
6	50,800 of 25 Films 10X12"	1270000,-	ORWO(50,000)	CL£ 3,17	2,409 per 25
			Gevaert(800)	BF 370,-	3,752 "
			CEA P/100	SW CR 97,00	4,380 "
			3M	$ 10,66	4,213 "
			Kodak P/100	£ 25,795	4,715 "
7.	5,400 of 75 Films 10X12"	405,000	ORWO(5000)	CL£ 9,03	6,861 per 75
			Gavaert (400)	BF 1007,-	10,232 "
			CEA P/100	SW CR 177,00	11,925 "
			3M	$ 30,37	12,003 "
			Kodak P/100	£ 25,795	14,145 "
8	44,800 of 25 Films 12X15"	1120000,-	ORWO(44000)	CL£ 4,75	3,609 per 25
			Gevaert(800)	BF 553,-	5,608 "
			CEA P/100	SW CR 145,50	6,536 "
			3M	$ 15,93	6,296 "
			Kodak P/100	£ 38,195	6,982 "
9	4,400 of 75 Films 12X15"	330000,-	ORWO(4000)	CL£ 13,83	10,508 per 75
			Govaert(400)	BF 1510,-	15,313 "
			CEA P/100	SW CR 264,50	17,820 "
			3M	$ 45,54	17,998 "
			Kodak P/100	£ 38,195	20,946 "

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Continued

Statement No. 6 - X- Ray, Films 77

Item No.	Quantity	No. of Films	Name of Co.	Price F.C.	Price in E.E. Per 75
10	1000 Of 75 Films 13X18cm	75000,-	ORWO (1000)	CL£ 2,75	2,089
			3M	$ 9,18	3,628
			CEA P/100	SW CR 54,75	3,990
			Gevaert	BF 305,-	3,093
			Kodak P/100	£ 8,625	4,731
					Per 25
11	12,400 Of 25 Films 18X24Cm	310000,-	ORWO 12000	CL£ 1,78	1,352
			Gevaert (400)	BF 206,-	2,089
			CEA P/50	SW CR 54,50	2,448
			3M	$ 5,95	2,353
			Kodak P/100	£ 14,910	2,725
					Per 75
12	1000 Of 75 Films 18X24cm	75000,-	ORWO (1000)	CL£ 5,07	3,852
			CEA P/100	SW CR 99,50	6,705
			3M	$ 16,92	6,887
			Kodak P/100	£ 14,910	8,175
			Gevaert	BF 562,-	5,699
					Per 25
13	30,400 Of 25 Films 24X30cm	760000,-	ORWO (30000)	CL£ 2,94	2,234
			Gevaert (400)	BF 343,-	3,478
			CEA P/100	SW CR 90,50	4,066
			3M	$ 9,85	3,893
			Kodak P/100	£ 24,145	4,414
					Per 75
14	4400 Of 75 Films 24X30 cm	330000,-	ORWO (40000)	CL£8,39	6,375
			Gevaert (400)	BF 936,-	9,492
			CEA P/100	SW CR 164,25	11,067
			3M	$ 28,26	11,169
			Kodak P/100	£ 24,145	13,242

Continued

Statement No. 6 – X- Ray, Films 77

Item No.	Quantity	No. of Films	Name of Co.	Price F.C	Price in E.C Per 25
15	10,400	260000	ORWO (1000)	CL£ 5,19	3,943
	Of 25 Films		Gevaert(400)	BF 604,-	6,125
	14X14"				
			CEA P/50	SW CR 157,50	7,153
			3M	$ 17,40	6,877
			Kodak P/100	£ 41,385	7,565
					Per 75
16	1400	105000	ORWO (1000)	CL£ 14,78	11,230
	Of 75 Films		Gevaert (400)	BF 1646,-	15,692
	14X14"		CEA P/100	SW CR 286,80	19,302
			3M	$ 49,68	19,634
			Kodak P/100	£ 41,385	22,695
					Per 25
17	8400	210000,-	ORWO (8000)	CL£ 6,31	4,794
	Of 25 Films		Gevaert (400)	BF 733,-	7,433
	14X17"				
			CEA P/50	SW CR 191,25	8,591
			3M	$ 21,10	8,339
			Kodak P/100	£ 50,005	9,140
					Per 75
18	1200	90000	ORWO (800)	CL£ 17,92	17.92
	Of 75 Films		Gevaert (400)	BF 1998,-	20,262
	14X17%		CEA P/100	SW CR 347,25	23,39.
			3M	$ 60,30	23,832
			Kodak P/100	£ 50,005	27,420
					Per 25
19	1900	38500	ORWO (1500)	CL£ 0,95	0,722
	Of 25 Films		Gevaert (400)	BF III,-	1,126
	13X18cm		CEA P/50	SW CR 30,25	1,359
			3M	$ 3,24	1,281
			Kodak P/100	£ 8,625	1,577

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Continued

Statement No. 6 - X-Ray, Films 77

Item No.	Quantity	No. of Films	Name of Co.	Price F.C.	Price in £ Per 25
20	17800	445000	ORWO (17000)	CL£ 4,88	3,708
	Of 25 Films		Gevaert (800)	BF 572,-	5,80
	30x40cm				
			CEA P/50	SW CR 150,25	6,749
			3M	$ 16,47	6,749
			Kodak P/100	£ 39,385	7,199
					Per 75
21	400	30000,-	ORWO (400)	CL£ 11,95	8,080
	Of 75 Films				
	11X14"		CEA P/100	SW CR 226,-	15,228
			3M	$ 38,97	15,402
			Gevaert	BF 1296,-	13,143
			Kodak P/100	£ 32,765	17,967
					Per 75
22	2400	180000	ORWO (2000)	CL£ 13,96	10,607
	Of 75 Films		Gevaert (400)	BF 1559,-	15,810
	30x40cm				
			CEA P/100	SW CR 273,25	18,399
			3M	$ 47,07	18,603
			Kodak P/100	£ 39,385	21,597
23	6000	Photo Roll 70 mm	Gevaert (6000)	BF 560,-	5,732
			3M	$ 21,72	8,584
24	1000	Photo Roll 45 mm	Gevaert	BF 390	3,992
25	100	Photo Roll Semi For Angiography 100 FT 35 mm 90 Meter	Gevaert (100)	BF 332	3,398

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Continued

Statement No. 6 - X- Ray, Films 77

Item No.	Quantity	No. of Films	Name of Co.	Price F.C.	Price in E.C. Per 25
26	10200	Dental Films	Gevaert (9000)	BF 59,-	0,670
		3X4cm	Fil -X(Italy) (100)	$ 6,50	
			Fil -X(Italy) (100)	$ 6,-	2,371
			3M (Italy)(1000)	$ 1,93	0,763
			ORWO	£ 0,72	0,650

TOTAL = 841672,352 L.E.

Statement No. 7 - COLORIMETER

Item	Name of instruments & Specifications	Company	Country origin	Qty Imported	Unit price F.C	Unit price L.E	Total Price F.C	Total Price L.E
I	**Colorimeter :**							
1)	Sp 15 concentration colorimeter, 230 V, interference filters wave number 400 NM & 800 NM, 10MM polystyrene cells (spectral range from 400 to 800 NM)	Pye Unican	UK.	300	$ 407,10	276,607	122130,-	82902,206
2)	Baush & Lomb spectronic 20n spectrophotometer can be used as colorimeter 220 V/50 HZ Adapter for ½ square cuvette	Fisher	Swit.	300	$ 768.35	303,666	230505,-	91099,725
3)	Colorimeter, EEL 252, Complete with lamp without filters and cuvettes or samples holder	Baird Tatlock	UK.	180	£ 166.30	112.994	29934,-	20338,896
4)	Photo electric photometer Model ANA-1 cell 20 mm diameter Vinyl cover	Oriental	Japan	120	$ 169.50	66.989	19140,-	5764,475

Statemunt No. 8 - ELECTRO CARDIOGRAM
1976 - 1977

Item	Manufacturer	Secifications	Qty	Foreign Currency	U.Price in F.C.	U.Price in E.C.	Total in F.C.	Total in E.C.
1	Eisai (Japan)	Toshiba electrocardiogramgraph Model OIK with standard accessories. No available	1000		116580	173,607	116580000	173607,-
2	ECG Philips Netherlands	Cardiopen 531. Fully transistorized Portable, direct-Writing, single-channel electrocardiograph. Operated on batteries for mains or 100-117-125 150-220 and 250 V, 50 or 60 hz. Built - in batter charger. Filter for suppression of muscle tremots. Including patient Cable (5-core), four extremity electrodes with rubber fastening straps, one thorax electrod, on roll of recording paper, one shielded mains-and earth cable, on tube of electrode liquid and leathered case.	100	HFL	3154	505.586	315400,-	50558.6
								224165.6

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Statement No. 9 - <u>HEARING AIDS</u>

Item	Manufacturer	Specifications	Qty.	Foreign Currency	U.Price in F.C.	U.Price in E.C.	Total in F.C.	Total in E.C.
1	Danavox	-Body type hearing aid mod 727 WX- with Volume controls	50	D.KR	365,-	24,523	18250,-	1226,15
		-Mod 727 PPS -Frequency range 90-4300	100	"	425,-	28,554	42500,-	2855,40
2	Siemens F.R.G.	-Audiovessette 120 - 2CC-PC Hearing Complete with eartip	10	D.M	282,10	49,256	28[illegible]1,-	492,56
3	A&M (U.K)	-Hearing aid - Mercury battery type - mod MP- 312 1.5 Volt	20	£	0,12	-,082	2,40	1,64
		-Hearing aid type AMX	150	"	7,72	5,248	1158,-	787,20
		- " " " AMI	100	"	7,72	5,248	772,-	524,80
		- " " Supermaster PP	50	"	32,-	21,752	1600,-	1097,60
		- " " Mod AM 101 (Green and gold)	125	"	16,-	10,876	2000,-	135 ,50
4	Phonic eair (Denmark)	- Phonic eair bodyworn with charger- ear phone N type-incorporated 53 transistors	50	D.KR.	630,-	42,328	31500,-	2116,40
5	Philips Netherlands	-Body worn hearing aid AVC type	50	H.FL.	175,-	28,453	8750,-	1422,65
		-Body worn " " -puxh. pull type	100	"	205,-	33,331	20500,-	3333,10
								15207,60

Continued

Statement No. 9 - HEARING AIDS

Item	Manufacturer	Specifications	Qty.	Foreign	U.P. Price in F.C.	U.Price In E.C.	Total in F.C	Total in E.C.
6	Viennatone	-Body worn hearing aid mod - "Regina	50	A SH	670,-	13,922	28500,-	696,10
	Austria	AC. - Complete with cord - interensic						
		Batteries						
		-Body worn hearing aid push pull type	250	"	1020,-	24,913	255000,-	6228,25
		-Vienna lone conduction H.aid-push pull						
		With telephone coil	10	"	1550,-	37,858	15500,-	378,58
		-Spectacles mod. Kontaht apiziol	2	"	2728,-	66,630	5566,-	133,260
		Supper K.SS. (stereophonic with						
		telephone coil)						
7	Oticon	-Body worn hearing aid (Box type)	150	D KR.	273,-	18,342	40950,-	2751,30
	(Denmark)	-Mod 371 (stransistor)	150	"	205,-	13,773	30750,-	2065,95
		-Mod 370 (Super)	150	"	290,-	19,484	43500,-	2922,60
		-Ear level hearing aid	150	"	355,-	23,851	53250,-	3577,65
		-Behind the ear type:						
		-Mod E16U (3 transistor)	150	"	375,-	25,195	56250,-	3779,25
		-Ey-Glass hearing aids mode. 835						
		VX Monoaural						
			1867					37739.94

Statement No. 10 – SPECTROPHOTOMETER

Item No.	Name of instrument & Specifications	Company	Country of origin	Quantity imported	Unit Price F.C	Unit Price L.E	Total Price F.C	Total Price L.E	Total Value
II	Spectrophotometer								
A Ia	Photo-electric Spectrophotometer Model ANA-72, Wavelength range 340-900 NM	Oriental	Japan	60	801,15 $	316,629	48069,-	18997.734	
2a	Sp6-200 Spectrophotometer working range of 325 to 1000 NM 10 mm glass cell with lid	Pye Unicam	UK.	90	744,3 £	505,721	66987,-	45514,853	
B	UV – Spectrophotometer								
1B	SP6-400 UV Spectrophotometer Range 220-1000 NM	Pye Unicam	UK.	60	1165,50 £	791,908	69930,-	47514,498	
2B	"TK" UV Spectrophotometer Model ANA-72-V Wavelength and width 200-900 NM, Detector: Phototube R-330	Sanko	Japan	30	1480 $	584,923	44400,-	17547,679	
3B	Spectronic 21 UVD	Bausch & Lomb	U.S.A.	60	2195 $	867,504	131700,-	52050,211	
4B	SP6-400 UV Specttrophotometer Range 220-1000 NM Complete with standard accessories sampling cells and an external recorder	Pye Unicam	UK.	12	2469,71 £	1678,064	29636,52	20136,771	
5B	Spectronic 21 UVM-Recorder-Patch cord	Bausch & Lomb	U.S.A.	12	2305 $	910,977	27660,-	10931,730	
6B	Model 634S UV-Vis double beam spectrophotometer Wavelength range 190-900NM, Model 9176 basic single pen recorder	Varian	Switzerland	6	8150 $	3221,027	48900,-	19326,160	

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Statement No. 10 - Spectrophtometer Continued

Item No.	Name of instrument & Specifications	Company	Counctry of Origin	Quantity imported	Unit Price F.C	Unit Price L.E	Total Price F.C	Total Price L.E	Total Value
C	I. R Spectrophotometer								
1C	SP 1025 IR Spectrophotometer Complete with an IR Sampling accessory kit and recommended spare parts	Pye Unicam	UK.	6	3976,513 £	2701,874	23859,078	16211,241	
2C	Acculab II I.R Spectrophotometer for operation in the range of , 4000 to 600 CM,- double beam optics Nichrome source, grating monochromator and rotating wedge filter, three scanning speeds, with reguired and recommended supplied	Beckman	Switzerland	6	7361 $	2909,20	44166,-	17455,198	
3C	Model 197 Linear wavenumber grating Spectrophotometer an automatic double beam, filter grating monochromator covering the range 4000 CM^{-1}	Perkin Elmer	UK.	6	3954.80 £	2687,12	23728,80	16122,723	

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Statement No. 11 - FLAME PHOTOMETER

Item No	Name of instrument & Specifications	Company	Country of Origin
	Flame Photometer		
1	Model 100 Flame Photometer Complete	Corning-EEL	UK.

Quantity imported	Unit Price F.C	Unit Price L.£	Total Price F.C	Total Price L.£
200	$ 746.75	2957129	149350	59025.000

Statement No. 12 - PH METER

Item No	Name of instrument & Specification	Company
	PH Meters	
1	Laboratory PH Meter	Pye Unicam
2	Precision PH Meter GT-C	Ludwig seibold
3	Blood PH-Meter digital PHN 25	Solea
4	PH-Meter E 512	Metrohm
5	Blood PH Meter with stand built in water Thermostat	Eadiometer
6	Model HM - 7B Meter Laboratory	T-Chatani
7	Model HM - 7B PH Meter with Accessories for blood	T-Chatani

Country of Origin	Quantity Imported	Unit Price F.C	Unit Price L.E	Total Price F.C	Total Price L.E.
U.K	25	£ 243	166,885	6075.-	4172,125
Austria	250	A.SH 3960	95,625	990000.-	23906
France	50	FF 2265	882,521	112750.-	9126.050
Switzerland	75	S.FR 1230	201,689	92250.-	15126.075
Denmark	25	D.KR 12375	818,723	309375.-	20463.075
Japan	250	$ 194	76,672	48500.-	19150.-
Japan	50	$ 228	90,110	11400.-	4505.-
					96472.175

Statement No. 13 - CENTRIFUGE

Item No.	Description	Quantity	Unit Price	Total Price
1.	Centrifuge,electric,Model UNIVERSAL II	20		
	with swing-out head 8x15 ml, max. speed 3500 rpm. Continuous variable speed control. For 220 V 50 Hz. Order No. 3102		600,—	12.000,—
	Surcharge for fluid-type revolution counter for above	20	80,—	1,600,—
	Swing-out head, 8 place x 15 ml (extra spare) No.312	10	186,—	1.860,—
	V4A steel buckets 15 ml with rubber pad No. 414/715	160	15,40	2.464,—
2.	Hematocrit centrifuge for 13000 rpm, 20 capillaries of out dia 1, 5mm and length 75 mm - used to determine the percentageof red blood cells. H.Centrifuge comprises high speed electric motor, electro magnetically controlled brake rotor with cover and a transparent upper cover. Supply 220V/ 50c/s-150VA. Time switch for 0-15min.	10 sets	253.—	2.530.—
	Standard equipment - timer and microcapillary reader /10 pcs/ - 1000 pcs heparinized capillaries of 1,5dia x 75 mm /10sets/ - 4 pcs tubular fuses for 3A /10sets/			
	Total C&F Baghdad		US $	2530
			ID	743/080

Statement No. 13 - CENTRIFUGE Continued

Item No.	Description	Quantity	Unit Price	Total Price
3.	Centrifuges Universal II, 220 V, complete with head 4x15 ml, No. 3100	30	DM 556,___	DM 16.680,___

Statement No. 14 - pH METER

Item No.	Description	Quantity	Unit Price	Total Price
			DM.	DM.
1.	Direct indicating pH/mV measuring instrument pH 40 for laboratory and plant. range : pH 0-14 and/or ± 1400 mV accuracy : ± 0,06 pH and/or ± 4 mV Temp. compensation : -5^{0}C to + 130^{0}C by adjustment knob drift : ± 0,01 pH/24H, input impedance: approx 10^{12} ohms slope correction : 53-60 mV/pH asym correction : ± 1 pH, recorder output :0-1 V energy supply : 220 V 50 cycs, 3 W furnished with dust cover and service instruct.	10	750,—	7.500,—
2.	Combined pH electrodes, glass-silver/siliver chloride system. Immersion length approx. 125 mm, dia. approx. 12 mm, rugged cylindrical membrane for measurements in liquids and semi solid substances. Temp. range: 0-70^{0}C, pH range 0-12.	10	151,—	1.510,—
3.	Box of buffer solution NBS/K acc. to NBS pres criptions, accuracy ± 0,01 pH pH values : 1,68-4,00-6,88-9,22-12,63 5 bottles with each 250 ml	10	43,—	430,—
4.	Bottles KCI solution to refill pH electrodes Bottle with 250 ml, 3 mol	10	8,60	86,—

Statement No. 15 – COLORIMETER

Item No.	Description	Quantity	Unit Price	Total Price
			£	£
1.	Model 252 colorimeter, complete with lamp and instruction manual, but without filters, test tubes, cuvette or sample holders 220 Vac, 50c/s	10	192.40	1924.00
2.	Special matched test tubes 15 mm	20 Doz.	8.03 Doz.	160.60
3.	Sample holder for above.	20	6.78	135.60
4.	Ilford filters, 40 MM Band pass , 8 filters peak wavelengths 430 NM to 710 MM	20 sets	46.27	925.40
5.	Spare tungsten halogen lamps	10	1.17	11.70
6.	Heating mantles, series M 250 ml 220 Vac.	3	31.36	94.08
7.	Elgastat deioniser, wall mounted, flow rate 36 litres/hour with tropicalised meter, one Elgacan of deionising resin pack of 4 spare & dry battery.	10	54.00	540.00
		Total FOB London	£.	3791.38
			ID.	1914/547

Statement No. 15 – FLAME PHOTOMETER

Item No.	Description	Quantity	Unit Price	Total Price
1.	Flame Photometer, complete with Air Compressor for 220V. with set of filters and required replacement parts for maintaining to work for 5 years. Model ANA-10AL	10 sets	$ 1,299.00	$ 12,990.00
	Total C&F Baghdad via Basrah in US Dollars			$ 12,990.00 ID 3845/040

Statement No. 17 – WATER DISTILLATION APPARATUS

Item No.	Description	Quanity	Unit Price	Total Price
1.	Glass water distillation 8 L/hour with stand for wall and table Reference . 51275000	10	FF 2 856.00	FF 28 560.00
	Total C&F Baghdad		FF.	28560
			ID	1713.600
2.	Water Distilling Apparatus, Type 2008 electrically heated, capacity 8 ltrs/ hr. made of stainless steel, storage tank capacity 16 ltrs., (built-in) with electronic water level regulator. For 220 volt AC, 50c/s.	10	DM 1.455,__	DM 14.550,__
3.	Spare heating elements, 220 volts, 2000 watts.	30	DM 34,80	DM 1.044,__
4.	Contacts	10	DM 27,__	DM 270,__
5.	Thermometer	20	DM 10,__	DM 200,__

Statement No. 18 - BIONCULAR MICROSCOPE

Item No.	Description	Quantity	Unit Price	Total Price
			US $	US $
1.	Olympus Bioncular microscope for ordinary laboratory work, Model KHS (in-base illuminator 220V 25W and variable light control by SCR) complete in wooden storage case :	20 sets	451.80	9,036.00
	Oc : BiWF10x (Paired)			
	Ob : Ach. 4x (N.A0.10)			
	Ach.10x (n.A.0.25)			
	Ach. SA40x(N.A.0.65, Spring)			
	Ach. SA100x(N.A.1.30, Spring, Oil immersion)			
	(Model KHS as specified attached brochure MISC-776X.)			
	With following spare Bulbs & Objectives :			
	Spare bulbs, KHS220V25W SB (6 pcs. $3.00)		18.00	360.00
	Spare objectives :			
	Ach.SA40x(N.A.0.65,Spring)		30.30	606.00
	Ach.SA100x(N.A.1.30,Spring Oil immersion)		46.00	920.00

Sea freight :

FOB. Yokohama : US $ 10,922.00

900.00

C&F. Baghdad via Basrah : US $ 11,822.00

Microscopes & Accessories herein are; ID. 3499/312

Statement No. 19 - BALANCES

Item No.	Description	Quantity	Unit Price	Total Price
1.	Analitical balance	10	$ 434	$ 4340
	As per model DA of our catalogue			
	capacity 200 gm.			
	Sensitivity 0'1 mgm.			
	With rider slide scale ± 10 mgm.			
	Air damping			
	Lig'. metal housing			
	Agata Knife edges and flat bearings			
	Shock absorbing feet			
	With magnifier lens			
	Frong and side slide doors			
	With set of weights model P.D. - 1 mgm.			
	to 100 gm.			
	Total C&F Baghdad			$ 4340
				ID. 1284.640
2.	Seca - Weighing Machines infant with	100	DM 102.00	DM 10.200.00
	sliding weights model 725			
	Capacity : 16 kgm			
	graduated : 10 gm			
	Reading : 5 gm			
	Total C&F Baghdad by train			DM 10.200,00
	" " " " "			ID. 1.286,322
3.	Precision Balances. Beam of aluminium.	10 sets	DM 256,__	DM 2.560.__
	Knife edgesof steel, rests of agate.			
	Detachable pans of bakelite with spout.			
	Mounted on plastics base with levelling			
	screws and circular spirit level. Cap.			
	250 gms. Sensitivity 1 mg.BOSCH Model No.169			
	complete with set of precision weights, from			
	1 mg to 200 gms, total content 611 gms,			
	polished brass. In a polished hard wood box			
	with lid, with forceps. No.401.			

Statement No. 19 - BALA-NCES Continued Sheet 2

Item No.	Description	Quantity	Unit Price	Total Price
4.	Table balances, cap. 3 kg, sensitive to 1 gm, two pans of nickel plated brass with complete set of weights in wooden black (1-5000 gm)	20	DM 406,__	DM 8.120,__

Statement No. 20 - WATERBATHS

Item No.	Description	Quantity	Unit Price	Total Price
			DM.	DM.
1.	Waterbaths Model W 350 r 100 12 Litres capacity, with sloping cover made of stainless steel No. 4301.	10 sets	374.___	3.740.___
	Cabinet made of stainless steel No. 4301 350 x 270 x 125 mm Temperature range from + 25°C to + 100°C. Housing made of stainless steel No. 4301. Voltage : 220 V., A.C., 50 cycles.			
	IN ADDITION :			
	Spare Thermometers.	10 pcs.	16.___	160.___
	Pilot Lamps	10 pcs.	2.15	21,50
	Total FOB		DM.	6421,50
			ID.	810/168

Statement No. 21 - SPECTROPHOTOMETER

Item No.	Description	Quantity	Unit Price £	Total Price £
1.	SP6-200 Spectrophotometer meter display-range 325-1000 NM	5	720.00	3600.00
2.	Accessory lid for SP6	5	8.80	44.00
3.	Test tube holder for SP6	5	8.25	41.25
4.	Photocell (blue)	2	20.12	40.24
5.	Set of spectro.methods clincical/ metals and alloys	2	5.00	10.00
6.	Test tube	40	0.30	12.00
7.	Pack of 1000 disposable 10mm polystyrene cells	2	25.00	50.00
			Total	3797.49
	Air freight Charges/Baghdad		185.00	185.00
		Total additions		185.00
		Total natt		3982.49

Statement No. 22 - HYPODERMIC GLASS SYRINGES

Item NO.	Description	Quantity	Unit price $ (per 1000)	Total Price $
1.	"Top" Brand Hypodermic Glass Syringes Interchangeable, each in individual box Boro-Silicate Heat Resisting, Shock-Proof.			
	1 ml Tuberculin, Luer Lock Tip 1/100cc & min.	5000pcs	433.50	2,167.50
	"Top Brand Hypodermic Metal Hub Needles Luer Lock Type, 11mm Square Hub			
			per one doz.	
	20G x 1"	10,000 doz	0.23	2,300.00
	21G x 1"	30,000doz.	0.23	6,900.00
	22G x 1"	50,000 doz	0.23	11,500.00
	23G x 1"	30,000 dox	0.23	6,900.00
	19G x 1½"	5,000 doz	0.25	1,250.00
	20G x 1½"	20,000 doz.	0.23	4,600.00
	21G x 1½"	20,000 doz.	0.23	4,600.00
	22G x 1½"	20,000 doz.	0.23	4,600.00
	23G x 1½"	10,000 doz.	0.23	2,300.00
	16G x 2"	200 doz.	0.29	58.00
	17G x 2"	300 doz.	0.29	87.00
	18G x 2"	600 doz.	0.27	162.00
	20G x 2"	600 doz.	0.25	150.00
	21G x 2"	600 doz.	0.25	150.00
	25G x ½"	5,000 doz.	0.23	1,150.00
	25G x 3/4"	3,000 doz.	0.23	690.00
		Total C&F BAGHDAD	$	49564.50
		" " "	ID.	14674.030

Continued

Statement No.22 - HYPODERMIC GLASS SYRINGES

Item No.	Description	Quantity	Unit Price SW.FR.	Total Price SW. FR.
2.	"HYPODERMIC SYRINGES" - "SANITEX ETERNA MATIC" ALL GLASS - WITH LUER-LOCK FITTINGS - INTERCHANGEABLE - 200°C - CLEAR GLASS BARRELS - WITH CLIPS TO PREVENT SLIPPING OF THE PLUNGER			
	120'000 pieces - 5CC - Luer-Lock C/N		-.82	98'400.—
	30'000 pieces - 2CC - Luer-Lock C/N		-.76	22'800.—
	80'000 pieces - 10cc - Luer-Lock C/N		1.02	81'600.—
	30'000 pieces - 20cc - Luer-Lock		1.29	38'700.—
	5'000 pieces - 50cc - Luer-Lock C/N		2.46	12'300.—

Total Price C&F Baghdad SW.FR 253800.00

ID. 29520.790

3. Interchangeable glass injection syringes "lux-bloc" made in Italy Brand.

Description	Quantity	Total
metal Luer-Lock tip, with metal brake, 100 cc. central nozzle	5000 Qty. \$ 210,70% (per 100 syringe)	10.535,00

Total C&F Baghdad \$ 10.535,00

ID. 3113.960

Statement No. 23 – MEDICAL DISPOSABLES

Item No.	Description	Quantity	Unit Price $ per pcs	Total Price
1.	Disposable Spinal Needles			
	i) "TOP" Brand disposable Spinal Needles			
	20 G x 3-1/2"	30,000 pcs	0.22	6,600.00
	21 G x 3-1/2"	80,000 pcs	0.22	17,600.00
	22 G x 2"	30,000 pcs	0.22	6,600.00
	ii) "TOP" Brand Surgical Face Masks.			
	With Non-Woven Fabric Tie strings, adjustable nose band.	400,000 pcs 88.60 (per 1000)	88.60 (per 1000)	35440.00
	Total C&F. Baghdad US $			65240.00
			ID.	19615.042
2.	Disposable stomach tube			
	i) Size 12 ch.	15,000	1,03	15,450,00
	size 14 ch.	16,000	1,03	16,480,00
	size 16 ch.	16,000	1,03	16,480,00
	Size 18 ch.	15,000	1,03	15,450,000
	ii) Disposable Ryles tube			
	size 12 ch.	5,000	1,62	8,100,00
	size 14 ch.	6,000	1,62	9,720,00
	size 16 ch.	6,000	1,62	9,720,00
	size 18 ch.	5,000	1,62	8,100,00
	Total amount CIF Baghdad in French Francs			99 500, 00
			ID.	5975.258
3.	Disposable Urine Bags			
	Bresco Dispsable plastic urine Bag. for pediatric use, sealed packed and sterile, max. Capacity 200 c.c. in box of 100 pcs. Quality of bag as per sample.	100,000	0.06	6,000
			Total C&F Baghdad via Basrah US $	6,000
			" ID	1776.300

Statement No.23 - MEDICAL DISPOSABLES Continued

Item No.	Description	Quantity	Unit price $ per pcs	Total Price
4.	Disposable Scalp Vein Set			
i)	Disposable scalp vein set sterilized by E.G. gas packed in peel-open-pack. 100 pcs. in 9 box 2,000 pcs in an export carton 25Gx3/4"	5,000	0.133	665.00
ii)	ditto. G24 x 3/4"	10,000	0.133	1,330.00
iii)	ditto G23x3/4"	150,000	0.133	19,950.00
iv)	ditto G22x3/4"	100,000	0.133	13,300.00
v)	ditto G21x 3/4"	100,000	0.133	1,330.00
	Total C&F Baghdad. via Basrah			$ 35,575.00
	" " " " "			ID. 10,528.028
5.	Disposable Syringes			
i)	Sterile Disposable Plastic Syringes, E.G. Gas Sterile "MEITOPIEA" (20 cc.without needle. (packing per export carton 1000 pcs. 2.25")cft.	300,000	8.35	25,050. -
ii)	Disposable Wooden Tongue depressors (6" x 3/4" x 1.6 mm in box of 500 pcs.) (1.2cft)	1,000,000	0.284	2840.00
	Total F.O.B.			US.$ 27390. 00
	(FOB.YOKOHAMA)			ID. 8258.810
iii)	1 cc W/N Disposable syringes with needle G23K1	200,000	47.59	9,518.00
iv)	2 cc W/N Disposable syringes with 22 Gx 1½ - 1¼	1,500,000	44.47	66,705.00

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Statement No.23 - MEDICAL DISPOSABLES Continued

Item No.	Description	Quantity	Unit price $ per pcs	Total Price
5.	Disposable syringes with needle			
v)	5 cc W/N 22G x 1¼ - ½	6,000,000	53.14	318,840.00
vi)	10 cc W/N 21G x 1	3,000,000	72.64	217,920.00
vii)	18G and 19G. to fix the above item	50,000,898	15.26	763.00
	20G to 25 G	1,542,000	14.30	22,050.60
	TotalC&F Baghdad by Sea via Basrah		US.$	635795.60
			ID.	188272.606
viii)	(8881-550125 Brunswick sterile disposable, Luer-lock 60 ml. syringe.	10,000	0.227838	2,278.38
	C&F. Baghdad		US.$	2278.38
			ID.674.675	
6.	<u>Disposable Blood Administration Sets</u>			
i)	Terumo Sterile Disposable Blood Administration Sets, with airway needle, pyrogen free, flexible drip chamber with large filter, roller type flow control clamp, with good quality self sealing rubber tube for mixed injections, Luer fitting needle adaptor, vein needle 18G x 1½", 135cm PVC tubing Each 50 sets packed in a carton box.	1.000.000	295.00	295,000.00
ii)	Terumo Sterile Disposable Blood Donor (Collecting) Sets, pyrogen free, with 70cm PVC tubing, Donor (Patient) Needle 16Gx1½", bottle needle 16G x 1". each 100 sets packed in a carton box.	200.000	147.00	29,400.00
	Total Price		US$	324,400.00
	C&F Baghdad		ID.	96,051.593

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Continued

Statement No. 23 - MEDICAL DISPOSABLIES

Item No.	Description	Quantity	Unit price per pcs Sw.Fr.	Total Price Sw. Fr.
7.	Disposal polythene gloves, 5-fingers, packed 100 in a plastic dispenser bag ladies' and men size (aqual quantities)	1'000'000	1.75	17'500.-
			FOB. Swiss Francs	17500.—
			ID	2091.550
8.	Surgical Gloves 8230 56.5 anatomic shape, with rolled 8229 57..5) edge, in welded envelope, Gamma-sterilized, with rough surface. size 6½,7,7½,8	400,000	4,70	1,880.000,-
		Total C&F Baghdad	A.S.	1880 000/-
			ID.	33368.239
9.	DISPOSABLE HOSPITAL CAPS IN PACKETS OF 50 200 Cases of 1000 large.		39.59	7918.00
		Total C&F Baghdad	£.	7918 /-
			ID.	4025.420

Statement No. 24 - PH - METERS

1.	General purpose direct reading PH - Meter, rang 0-7-14 + 0.3 pH, temp. range - 5 · 102^{0}C 220 V.	50	185.670
2.	General purpose direct reading pH - Meter, rang 0-7-14 + 0.3 pH, temp. range - 5+ 120^{0}C 220 V (digital)	50	644.900
3.	Analogy pH-meter w/expanded range (pH) & m V range 220 V. 50 Hz. pH 0:14 0....+ 1400 m V 4:10 0....- 1400 m V temp. 0 - 100^{0}C small size	25	-
4.	Research pH - meter range 0.5 - 14.5 m V+ 50 : 1450 temp. 0+100^{0}C 220 V comp.	24	4248.443
5.	Blood pH system 220 V comp W/micro pH system, capillary pH system, and micro specificion system	20	532.185

Statement No. 25 - ARTICLES MANUFACTURED LOCALLY

ANNUAL CONSUMPTION	ARTCILE	PRICE
	DRUMS STERILISING CUPPER MADE CHROME PLATED	
250	Size 22X8	8.250
400	Size 22X22	14.000
150	Size 26X23	15.000
270	Size 25X32	19.000
300	Size 27X36	27.00
	ELECTRIC STERILIZER CUPPER MADE CHROME PLATED	
400	Size 22 cm	8.500
800	Size 28 cm	10.200
400	Size 42 cm	17.000
	ALCOHOULIC STERILIZER CUPPER MADE CHROME PLATED	
50	Size 22 cm	7.650
50	Size 28 cm	9.350
50	Size 42 cm	15.725
200	Side lamp on stand with Flexible Shaft One Bulb	20.000
50	CHIRON LAMP STANF FOR E.N.T	50.000
50	SIMPLE TROLLAY FOR PATINET	19.5[illegible]
	STERILLIZER ELECTRIC ON STAND WITH THERMOSTAT AND 2 HEATER	
30	Size 30X 60 X 30	260.000
30	Size 40X 40 X 16	140.000
	without stand	

Statement No. 26 - OVENS

1	Standard oven capacity 12 litres, temprature 40 - 180° C	120	80.000
2	Standard oven capacity 25 litres, automatically adjustable temprature 30 - 180° C (regulation + 0.5°C), can be used at 37°C as inculator and at 56°C as a parafin oven.	100	(FOB) 171.000
3	Standard oven capacity 90 litres 40 - 200°C (regulation ± 0.5°C) with mechanical convoction.	50	(FOB) 277.200
4	Standard oven capacity 36 litres 40 - 210°C, + 0.7°C		

Statement No. 27 - <u>DENTAL SECTION</u>

Quantity	Name	Price per Unit
50	DENTAL UNIT WITH AIRTURBINE	957.360
250	- DITTO - W/O " "	541.360
100	MOTOR ON STAND	015.568
200	DENTAL CHAIR OIL PUMB	144.077
30	- DITTO - ELECTRIC	357.382
50	AIRTOR COMPLETE	343.003
100	TECHNICAL MOTOR	129.234
50	LATHE " "	36.101
25	CAVITRON	375.583
50	SILIMATE	12.327
600	EXTRACTING FORCEPS NO. 1	
400	EXTRACTING FORCEPS NO. 2	
600	EXTRACTING FORCEPS NO. 7	
600	EXTRACTING FORCEPS NO. 17	
600	EXTRACTING FORCEPS NO. 18	
400	EXTRACTING FORCEPS NO. 22 Each	3.525
300	EXTRACTING FORCEPS NO. 29	
400	EXTRACTING FORCEPS NO. 30	
300	EXTRACTING FORCEPS NO. 33	
600	EXTRACTING FORCEPS NO. 51	
300	EXTRACTING FORCEPS NO. 51 A	
500	EXTRACTING FORCEPS NO. 73	
500	EXTRACTING FORCEPS NO. 74	
2000	EXAVATORS ASS.	0.471
1000	PROBES S/E ASS.	0.589
2000	PROBES D/E ASS.	0.589
2000	PLASTIC FILLING ASS.	0.378
5000	SCALERS ASS.	0.500
2000	ELEVATORS ASS.	4.273
500	AMALGAM CARRIER METAL	0.513
2000	TWEEZER COLLAGE ASS.	0.326
1000	HANDLES FOR DENTAL MIRRO	0.085
250	PLASTER KNIFE	0.352
250	PLASTER SPATULA	0.347
500	WAX KNIFE LARGE	0.575
500	WAX KNIFE SMALL	0.475
2000	WAX-CARVER & LE CRONE	0.230
3000	TRAYS IMP. FULL & PERFORATED ASS.	0.315
2000	BONE FILE ASS.	0.650
500	BONE CUTTING FORCEPS ASS.	2.502
2000	SPATUIA METAL D/E ASS.	0.451
1000	SPATUIA METAL S/E ASS.	0.345
2000	MANDRELLS H/P/.	0.094
1000	MANDRELLS R.A	0.094
200	ARTICULATOR FOR FULL SET TEETH	0.782
100	ARTICULATOR FOR POSTERIOR TEETH	0.443
100	ARTICULATOR FOR ANTERIOR TEETH	0.443

Statement No. 28 - HYPODERMIC NEEDLE

ANNUAL CONSUMPTION	(ARTICLE)	UNIT		PRICE
4000	HYPODERMIC NEEDLE NO.1	LOCAL	Doz	.400
8500	HYPODERMIC NEEDLE IMP		Doz	.148
5000	HYPODERMIC NEEDLE NO.2	LOCAL	Doz	.400
9900	HYPODERMIC NEEDLE IMP		Doz	.148
15000	HYPODERMIC NEEDLE No.12	LOCAL	Doz	.400
43000	HYPODERMIC NEEDLE IMP		Doz	.148
30000	HYPODERMIC NEEDLE No.14	LOCAL	Doz	.148
10000	HYPODERMIC NEEDLE No 16	LOCAL	Doz	.148
10000	HYPODERMIC NEEDLE NO.18	LOCAL	Doz	.148
5000	HYPODERMIC NEEDLE No.20	LOCAL	Doz	.148
30000	ALL GLASS SYRINGE 2cc	LOCAL	Pcs	.093
30000	ALL GLASS SYRINGE 5cc	LOCAL	Pcs	.127
30000	ALL GLASS SYRINGE 10cc	LOCAL	Pcs	.148
500	ALL GLASS SYRINGE 20cc	LOCAL	Pcs	.211
32000	METAL TIP SYRINGE 2cc	LOCAL	Pcs	.256
38000	METAL TIP SYRINGE 3cc	LOCAL	Pcs	.263
75000	METAL TIP SYRINGE 5cc	LOCAL	Pcs	.285
70000	METAL TIP SYRINGE 10cc	LOCAL	Pcs	.365
30000	METAL TIP SYRINGE 20cc	LOCAL	Pcs	.478
300	ALL RECORD SYRINGE 2cc	LOCAL	Pcs	.237
4000	ALL RECORD SYRINGE	IMP		
9000	ALL RECORD SYRINGE 5cc	LOCAL	Pcs	
4000	ALL RECORD SYRINGE	IMP		.278
2500	ALL RECORD SYRINGE 10cc	LOCAL		
2000	ALL RECORD SYRINGE	IMP	Pcs	.354
2000	ALL RECORD SYRINGE 20cc	LOCAL		
1000	ALL RECORD SYRINGE	IMP	Pcs	.439
723500	DISPOSABLE SYRINGE 2cc	IMP	Pcs	.014
802000	DISPOSABLE SYRINGE 5cc	IMP	Pcs	.019
417000	DISPOSABLE SYRINGE 10cc	IMP	Pcs	.024
408500	CLINICAL THERMOMETER	IMP	Pcs	.123
55000	SURGICAL BLADES SIZE	IMP	Doz	.246
2700	HANDLE FOR BLADES	IMP	Pcs	.436

Statement No. 29 - MICROSCOPES

Item No.	Description	Annual consumption		Price
1.	Student monocular microscope W/Coarse adjustment W/o mecanical stage - Oil immertion ten W/primary Condenser & 3 objectives 4X, 10X and 40X, & 2 eyepieces 10 X and 15 X type L-2	Erma	500	45.617
2.	Student monocular microscope W/ out fine adjustment, mechanical stage or oil immersion W/ primary condenser & movable arm. with 3 objectives 40 X, 10X, 4X and 2 eyepieces 7.5 X, 10X model ST.	Olym	500	53.287
3.	Biological monocular microscope W/ mechanical stage, fine adjustment & oil immersion and 3 objectives 10 X, 4 X & 100X and 3 eyepieces 5 X, 10 X & 15 X	Erma	2000	124.132
4.	High class biological binocular microscope W/ built-in light source with regulator and mechanical stage and 4 objectives 4 X, 10X 40X, 100X, and 8i WF 10X, paired eyepiece and condenser Abbe N.A. 1.25 filter 32.5 C (cobalt) model KHS	Olymytus	50	284.797
5,	Ditto but with non-regulated light source.		50	238.131
6.	Polarizing standard microscope with Lucigen illuminator		15	1023.505

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Item No.	Description	Annual consumption		Price
7.	Steroscopic microscope magnification 40	Erma	200	139.045
8	Stereoscopic microscopic Stero ZOOM model AVB-84. 110 volt	B&L	5	-
9	Academic 254 microscope 110 volt	B&L	5	-
10	Research microscopes models	Zeiss		
	1. Laboval	G.D.R.	50	318.685
	2. Ergaval		10	450.281
	3. Amplival		15	842.899
10	Fluorescance microscope type fluoval	"	10	1812.862
12	Fluorescance microscope type Fluoval	Tiyoda	10	1426.840

Statement No. 30 - DENTAL MATERIALS, INSTRUMENTS AND EQUIPMENTS

Item	Unit
Cement powder & Liquid 100 gm.No.1,2.	Set
Ditto 250 gm.No.1,2.	Set
Cement powder only	Bottle
Ditto liquid only	Bottle
Zinc oxyph cemat liquid 50 gr.	Bottle
Zinc oxyph cement powder only detray	Bottle
Zinc oxyph cement liquid only detray	Bottle
Temporary filling paste	Jar
Silicate cemnt pc. & liquid	Set
Porcelain filling powder shades 1,2,3,4,5	Bottle
Silicophosphate cement	Set
Calcium hydroxide	Set
Amalgam powder 1 on (Alloy)	Bottle
Ditto 5 oz (Alloy)	Bottle
Silver Amalgam platinum gold 1 oz.	Bottle
Silver Alloy tablets 68% tube agestan box.25	Box
Oxpara root canal filling powder & liquid	Set"
Cavity lining varnish	Set
Gutta percka sticks	Box
Ditto points assorted	Box
Paper points	Box
Tricresol formaline	Bottle
Eugenol pure 10cm/500 , 125gr/1000	Bottle
Iodcforme paste	Jar
Ivoseal S.R	Set
Detartrine paste tubes	Tube
Alvogyl paste jars	Jar
Detartrol Ultra	Bottle

Quantity	In Leo	Country
1000	,596	CZECHOSLOVAKIA
1500	,993	CZECHOSLOVAKIA
500	,415	U. S. A.
1800	,341	F.R.G.
500	,192	SWITZERLAND
1000	,418	U.K.
1000	,305	U.K.
1500	,267	F.R.G.
600	,415	U.K.
2000	,740	CZECHOSLOVAKIA
800	,795	F.R.G.
500	,271	CZECHOSLOVAKIA
5000	1,062	F.R.G.
2000	9,694	F.R.G.
1500	2,309	F.R.G.
2000	10,214	U.K.
1000	,406	CZECHOSLOVAKIA
500	,231	U.K.
500	,338	F.R.G.
500	,729	JAPAN
1000	2,371	FRANCE
1500	,226	CZECHOSLOVAKIA
500	,190	ITALY
700	,361	CZECHOSLOVAKIA
300	2,144	SWITZERLAND
5000	,395	FRANCE
4000	,640	FRANCE
500	,395	FRANCE

Statement No. 30 - DENTAL MATERIALS, INSTRUMENTS AND EQUIPMENTS

Item	Unit
Opthocroma	Bottle
Recestypine cord fill	Box
Septomixine	Tube
Largal Ultra	Bottle
Cresopate Som	Tube
SEPTO pack	Jar
Rockless Normal No. 4, 8 . essential - 25 25	Set
Ditto caustique Normal	Bottle
Endoporox	Bottle
Calcipulpe	Syringe
Oxicap B 3 pack	Set
Analcap 150 Normal pack No.1,2,3	Box
Cervine No. pack	Pack
Polycap	Box
Ledermix combination kits	Kit
Lamell powder & Liquid 500 500	Kit
Hand piece ease lubricant	Tube
Hand piece case tubes	Tube
Mouth wash tablets	Bottle
Powder for polishing pumice pckg 5 lb.	PEG
Compound Imp. in cakes	Box
Compound Imp. ivory	Box
Plaster Impression 2 lb Gysogum or equiv	Tin
Alginate Imp. C.A. 37 refile 4 151mp, Tin 251mp 9000 8000	Tin
Hardener Liq. optosil 25 ml	Set
Hardner Liq. xantopren	Bottle
Sil 21 complete	Set
Dupli sil 21 complete	Set
Dupli sil 21 hardner	Bottle
Rubber Jel regular Base tube,Catalyst tube 250 300	Tube

Quantity	In Log	Country
100	,534	FRANCE
100	,750	ITALY
50	2,055	FRANCE
50	,902	France
100	1,391	FRANCE
250	1,277	FRANCE
50	1,244	FRANCE
25	1,244	FRANCE
200	1,699	FRANCE
150	1,528	FRANCE
100	1,769	SWITZERLAND
1000	3,258	SWITZERLAND
1000	,802	SWITZERLAND
1500	3,127	SWITZERLAND
100	2,589	FRANCE
1000	,526	SWEDEN
600	3,826	F.R.G.
500	,463	F.R.G.
1000	1,028	U.K.
100	1,399	U.K.
4000	,300	Netherlands
500	,348	F.R.G.
4000	1,055	U.K.
2000	,937	Netherlands
400	,750	F.R.G.
150	,438	F.R.G.
1500	1,354	Netherlands
1000	4,188	Netherlands
250	,313	Netherlands
750	,707	U.S.A.

Statement No. 30 - DENTAL MATERIALS, INSTRUMENTS AND EQUIPMENTS

Item	Unit
Tissue conditong Imp. materid	Set
Zinc oxide & eugenol Imp. paste	Set
Hard stone in pack of 4½ kg Molderoc	Drum
Modelling wax sheets in box of 1 lb.	Box
Ditto Thoughened	Box
Ivory inlay wax box of 12	Box
Base plate upper lower in box of 12X100 4500 2500	Box
Celluloids strips assorted	Box
Cellulied crown forms assorted box of 12 24 36 60 500 500 500 500	Box
Acrylic crowns forms assorted	Box
Crown scissors straight & curved	Pcs
Articulating paper thick in box of 12 books	Box
Cotton roller No. 2 3 Box of 500 rolls 1500 1500	Box
Absorbent pape points fine	Box
Dental floss silk in spools of 12 yar 24 yar 5000 5000	Jar
Acrylic denture base material pink	Set
Ditto clear O	Set
Self curing acryl pink AE E stellon	SET
Sovriton cavity seal	Set
Low fusible metal for students per box	Box
Low fusible metal for inlays per box	Box
Palladent Discs 0.25MM thick 18MM 20MM 22MM 24MM 1000 1000 5000 5000	Pcs
Porcelain teeth comb set of 16 gold upper & lower	Set
Ditto set of 28 Nickel pins & gold pins	Set
Ivory Matrix retainer No. 8Pcs & No. 1 2500 3000	Pcs
Ditto Bands for matrix No. 8 roll	Pcs
Dental cleaning white Brushes round 021 MMH	Box

Quantity	In Leg	Country
300	4,070	U.S.A.
1500	,716	Netherlands
400	1,453	F.R.G.
5000	,338	Netherlands
200	,320	U.S.A.
200	,963	F.R.G.
3500	2,029	Netherlands
500	,216	U.K.
1000	1,557	U.S.A
20	17,073	LEBANON
1000	1,052	F.R.G.
500	,526	U.S.A.
3000	,650	U.K.
1000	1,660	U.S.A
5000	,305	F.R.G.
150000	1,967	CZECHOSLOVAKIA
5000	1,967	CZECHOSLOVAKIA
4000	,722	CZECHOSLOVAKIA
500	,532	U.K.
1000	1,276	JAPAN
400	,432	JAPAN
3000	,524	F.R.G.
5000	,724	JAPAN
5000	2,859	F.R.G.
1500	,011	F.R.G.
500	,166	F.R.G.
3000	5,41	U.K.

Statement No. 30 – DENTAL MATERIALS, INSTRUMENTS AND EQUIPMENTS

Item	Unit
Dental cleaning white Brushes cup length	Box
Polishing brush round black 80 MM 4 rows	Pcs
Muslin polishing wheel W/metal center 060 MM. MM3 1/8: 085 MM 3⁄8 600 each	Pcs
Felt cones Hard 20x10MM (3⁄8 x 3/8), 25X15MM (1X1 /8)	Pcs
Felt wheel hard 40X12MM (1⁄8X½) round 60X12MM (2 3/8 X 4/8) round 5000 / 2000	Pcs.
Felt mount point No. 144 HP, No.145 HP / 2000 2000	Pcs.
No. 158 / 1000 assorted	Pcs.
Cotton wool polishing weel wooden centre 50X50 M 80X40 MM3 1/8X1, 60X30 MM 95X45MM3 ⅜ X 1, 70Z30 MM 2¼X1	Pcs
Wax kinife	Pcs.
Wax carvor	Pcs
Wrist slip joint 220V. 5 cy A.DE 4	Pcs
Contra angle assorted speeds	Pcs
Straight Handpiece assorted speeds	PCS
Handpiece for airotors	Pcs
Spare Head for above	Pcs
Contra angle doriot 4	Set
Dental lathe motor 2 speeds 220V 50 cy.	Set
Dental lathe laboratory motor 12000 r.p.m. 220V. 50cy.	Set
Cable arm for laboratory motor	Set
Electric model trimmer 220V. 50 cy.	Set
Coarse grit spare wheel	Pcs
D.Laboratory motor 16,00 r.p.m. 220V. 50 cy.	Set
Vibrator Normal & large 220V. 50 cy.	Pcs
Laboratory hand piece	Pcs
Dental foot engine cable endless belt	Pcs
Electric engine on stand complete 10.000 r.p.m. 220V. 50 cy	Set

Quantity	In Leg	Country
3000	5,41	U.K.
6000	15,39	U.K.
1500	,135	F.R.G.
10000	,034	ITALY
3500	,100	F.R.G.
5000	,051	F.R.G.
2000	,3[illegible]1	F.R.G.
1000	,395	HUNGARY
1500	,579	JAPAN
350	2,778	JAPAN
5000	1,893	JAPAN
5000	4,387	JAPAN
50	41,963	F.R.G.
150	28,440	CZECHOSLOVAKIA
200	2,134	JAPAN
100	31,617	BULGARIA
250	18,33	ITALY
750	4,113	ITALY
15	53,316	U.K.
30	4,096	U.K.
100	19,931	ITALY
25	10,804	JAPAN
50	16,189	SWITZERLAND
1000	15,566	F.R.G.
10	98,805	JAPAN

Statemont No. 30 - DENTAL MATERIALS, INSTRUMENTS AND EQUIPMENTS

Item			Unit
Dental Unit complete w.compressor			Set
Mobile Borden airator w/o compressor complete			SET
Belt for electric engine 320 cm			Pcs
Belt for electric engine 340 cm			Pcs
Forceps for Upper laterals & caninos N.1			Pcs.
Ditto uppe laterals N.2			Pcs
Ditto for upper Bituspies E.side No.1			Pcs
Forceps left N.18			Pcs
Ditto for lower molars E.side N.22			Pcs
Ditto for children lower Molar N.22 S			Pcs
Forceps for upper roots of front teeth No.29			Pcs
Ditto for upper roots for E.Sides No.30			Pcs
Ditto for upper roots E.sides No.51			Pcs
Ditto No.52			Pcs
Ditto for upper widom E.sides No.67			Pcs
Ditto for lower molars E.sides No.73			Pcs
Ditto for lower root E.sides No.74			Pcs
Ditto for molars for children No.157			Pcs
Ditto for upper contrals children NO.163			Pcs
Bone cutting forceps slichtly curved			Pcs
Ditto meal			Pcs
Root elevator straight			Pcs
Root elevator winter fig 1 fig 2	fig 1	fig2	SET
Ditto winter solid handle left & right 500 500	1000	1000	
Periostal elevator assrtod			Pcs
Gum lancet straight No.1			Pcs
Ditto curved No.2			Pcs
gingivectomy knife kirkland N.F.K12,K13,K14,K15 K16, 30 each			Pcs
Ditto orban No.1 30 No.2 30			Pcs
Gum scissors very fine pattern straight 11 cm			Pcs
Gum scissors very fine pattern curved 11 cm			Pcs
Carpule syringe for cartridge all metal 1.8 ml			Pcs
Carpule needle long for cartridge 17/42 doz			Pcs
Rubber bulb for chip syringe small size			Pcs

Quantity	In Lev	Country
15	706,586	JAPAN
20	227,752	JAPAN
15000	12,566	F.R.G.
1600	15,566	F.R.G.
2000	2,25	HUNGARY
400	2,25	HUNGARY
500	2,25	HUNGARY
1000	2,25	HUNGARY
1000	2,25	HUNGARY
400	4,37	F.R.G.
500	2,25	HUNGARY
500	2,25	HUNGARY
500	2,25	HUNGARY
500	2,25	HUNGARY
500	2,25	HUNGARY
1000	4,37	HUNGARY
4000	4,37	HUNGARY
500	2,998	JAPAN
500	2,98	JAPAN
200	3,98	JAPAN
50	6,505	ITALY
1500	2,580	F.R.G.
1000	3,130	F.R.G.
200	1,650	F.R.G.
1000	,514	JAPAN
1000	,514	JAPAN
150	,925	F.R.G.
30	1,749	F.R.G.
400	1,086	JAPAN
500	1,086	JAPAN
500	1,265	JAPAN
5000	,146	JAPAN
1000	,130	JAPAN

Statement No. 30 - DENTAL MATERIALS, INSTRUMENTS

Item	Unit
Ship syringe canulo w/small cap 16 MM nicklap.	Pcs
Hot air syringe canula w/small cap. 16 MM	Pcs
Piles root canal box of 6 ref 99	Set
Ditto ref 67 Hedostroom	Set
Reamers Nerve canal Box.Ass ref.63 set of 2	Set
Norve breaches long serrated No.1	Set
Flat nose plier short beaks (200)	Set
Ditto for bending w/1 groove / 200 , 3 grooves / 200	Pcs
Flat Nose plier pease	Pcs
Ditto Nipper cutting	Pcs
Ditto curved nose	Pcs
Mouth mirror plane boilable 20MM wide size 3	Box
Ditto 24 MM wide size 5	Box
Mouth Magnifying boilable 20MM wide size 3	Box
Ditto Magnifying 22MM wide size 4	Box
Ditto Magnifying 24MM wide size 5	Box
Treys opal C-6	Set
Dappen glass different colours	Pcs
Modisement Bottles different colours assorted	Set
Probes S/E S.S. assorted	Pcs
Ditto double D/E S.S. assorted	Pcs
Excovators double D/E S.S derby S.S. assorted	Pcs
Scalers standard S/E No. 1,2,3,4 200 each	Pcs
Scalers coushing 53,54,55,56 S/E 200 each	Pcs
Scalers kirgland S/E 12K,13K, 14K, 100 each	Pcs
Scalers cunine D/E No. 152	Pcs
Ditto osto mitchle D/E N.4	Pcs
Spatula cement metal D/E and full curved No.PP	Pcs
Spatula cement agate D/E	Pcs
Mercury holder wood	Pcs
Amalgamator for mixing silver/A Mercury 220V	Pcs.
Plastic filling S/ENo. 1,2,3,4,5 1000 each	Pcs
Dental surgical Surs fig. 141, No.8,10.12,18,20 1000 each	Pcs
Steel Burs R.A. roong fig1 B3 No.4 No.6 500 each steel burs fissure R.A. & H.P. 1-6	Doz.

AND EQUIPMENTS

Quantity	In Leg	Country
3000	,358	JAPAN
1000	,1336	JAPAN
250	,440	F.R.G.
100	,440	F.R.G.
100	,440	F.R.G.
1000	2,301	F.R.G.
300	1,146	JAPAN
300	1,146	JAPAN
200	1,364	JAPAN
500	1,541	JAPAN
500	1,226	F.R.G.
1500	,079	JAPAN
2000	,099	JAPAN
3000	,139	F.R.G.
2000	,099	JAPAN
3000	,139	F.R.G.
1000	,182	JAPAN
1000	,091	JAPAN
1000	,150	JAPAN
5000	,279	ITALY
1000	,870	F.R.G.
3000	,379	JAPAN
800	,312	JAPAN
1600	,312	JAPAN
400	,626	F.R.G.
5000	,466	JAPAN
5000	,466	JAPAN
4000	,450	JAPAN
1000	,537	JAPAN
200	,541	F.R.G.
100	37,940	U.S.A.
5000	,387	JAPAN
7000	13,260	F.R.G.
6000	3,040	F.R.G.

Statement No. 30 - DENTAL MATERIALS, INSTRUMENTS AND EQUIPMENTS

Item	Unit
Carbide base R.A. cone plane No. $\frac{1}{500}$ $\frac{4}{1000}$ $\frac{5}{3000}$	Pcs
Diamond points foR.A. fig.837 No.4 No.5	Pcs
Ditto fig 840 No.21	Pcs
Diamond points for R.A.Fig 841 No.14	Pcs
Ditto fig. 812 No.21	Pcs
Ditto fig. 815 6,8	Pcs
Ditto No.817 No.23	Pcs
Ditto No. 821 No.40	Pcs
Ditto No. 823 No.40	Pcs
Diamond points for R.A. 802 No. 3,5 200 each	Pcs
Ditto 806 No.6	Pcs
Ditto 815 No.10	Pcs
Ditto 820 No.20,22 100 each	Pcs
Diamond F.G. round fig ID size 1,2,3,4 60 each	Pcs
Ditto fig OID siz 1,2,3,4 60 each	Pcs
Ditto cone fig 2 D size 2,3,4 100 each	Pcs
Diamond cylinder fig 7D 1,2,3,4 100 each	Pcs
Ditto fig 7 D1 size 2,3 100 each	Pcs
Ditto cone fig 9DL size 2,4 100 each	Pcs
Ditto fig 9 D size 1,2 100 each	Pcs
Diamond wheel & Duses 22MM fig 362	Pcs
Ditto 13MM fig 382	Pcs
Ditto 17MM fig 384	Pcs
Sand paper discs fine 5/8 Box of 100	Box
Ditto ¾ Box of 100	Box
~~Ditto~~ Sand paper 7/8 Box of 100	Box
Sand paper discs Medium 5/8 Box of 100	Box
Ditto ¾ Box of 100	Box
Ditto 7/8 Box of 100	Box
Ditto Coarse 5/8 Box of 100	Box
Ditto Coarse ¾ Box of 100	Box
Ditto coarse 7/8 Box of 100	Box
Ditto assorted size of 100	Box
Polishing strips coarse 6 long 5/32 with Box 100	Box
Ditto 7/32 width box 100	Box

Quantity	In Leg	Country
200	22,502	F.R.G.
100	,412	F.R.G.
50	,601	F.R.G.
50	,601	F.R.G.
150	,837	Austria
150	22,100	Austria
50	,608	Austria
200	1,100	Austria
150	1,100	Austria
200	,234	Austria
200	22,100	F.R.G.
100	,447	Austria
150	,837	Austria
200	,234	Austria
240	22,100	F.R.G.
150	,239	Austria
200	,234	Austria
200	,234	Austria
100	,411	F.R.G.
100	,234	Austria
300	1,434	Austria
200	132,632	F.R.G.
100	132,632	F.R.G.
100	,325	U.K.
100	,325	U.K.
100	,325	U.K.
100	,325	U.K.
100	,325	U.K.
100	,325	U.K.
100	,325	U.K.
100	,325	U.K.
100	,325	U.K.
500	,514	F.R.G.
100	1,285	F.R.G.
100	1,285	F.R.G.

Statement No. 30 - DENTAL MATERIALS, INSTRUMENTS AND EQUIPMENTS

Item	Unit	Quantity	In Leg	Country	
Diamond Burs round R.A. No. 3,6 100 each	Box	100	,234	Austria	A
Ditto cone R.A. assorted	Box	100	1,406	Austria	A
Ditto wheel No.6	Box	100	22,100	F.R.G.	F.G.R
Ditto cylinder No. 3,4,5 500 each	Box	200	,234	Austria	A
Ditto flame assorted	Box	100	,562	Austria	A
Acrylic teeth cross linked set of 28	Set	5000	,658	ITALY	
Ditto set of 14 uppers	Set	5000	,329	ITALY	
Ditto set of 14 lowers	Set	5000	,329	ITALY	
Ditto set of 6 upper & lowers fronts	Set	5000	,329	ITALY	
Ditto set of 8 upper & lower posteriors	Set	2000	,329	ITALY	
Disposable needles ling 7142 in box	Pcs	1600	2,85	F.R.G.	
Ultra sonic prophyloxsis unit (like cavitron 660 -700-1010 220V)	Set	100	186,096	U.K.	
Composite filling material	Set	200	3,127	SWITZERLAND	
Silamat or eqiv 22V.	Set	150	34,482	SWEDEN	
Denture fixative powder	Box	5000	1,068	U.K.	
Denture cleaning powder or pellets	Box	3000	1,340	U.K.	

Statement No.31

OPERATION THEATRE INSTRUMENTS

Sl.No.	DESCRIPTION	Country of origin	Quantity Con. in a year	Price Rs.	Price Ps.	Total Cost Rs.	Total Cost Ps.
1.	Aspirator Potain	U.K.	30	10	000	300	000
2.	Bag Ice Circular	"	200		600	120	000
3.	Basin Lotion Stainless Steel	"	100	1	000	100	000
4.	Basin Lotion 1-Enamelled	"	2000		200	400	000
5.	Box dressing with metal Lid.	"	200	2	000	400	000
6.	Cabinet instrument size 60"x30"x10"	"	20	200	000	400	000
7.	Catheters India rubber	"	70000		100	7000	000
8.	Catheters Self retaining	"	20000		150	3000	000
9.	Clamp Intestinal	"	200	6	000	1200	000
10.	Clamp Stomach	"	200	30	000	6000	000
11.	Cylinder Oxygen 20 feet	"	600	40	000	21000	000
12.	Cylinder Oxygen gauge	"	200	10	000	2000	000
13.	Depressor Tongue metal	"	1000	1	200	1200	000
14.	Dilator Cervic Set of 16	"	30	8	000	210	000
15.	Drill Bone Set	"	10	30	000	300	000
16.	Forceps Artery Small 5"	"	20000	2	000	40000	000
17.	" " Large 7"	"	5000	2	500	12500	000
18.	" " Kocker Box joint	"	2000	2	500	5000	000
19.	" Dressing 3"	"	2000	2	000	4000	000
20.	" Dissecting Small 5"	"	8000	2	000	16000	000
21.	" " Large 7½	"	7000	2	500	5000	000
222	" " Rat tooth 4"	"	8000	2	000	16000	000
23.	Tissue	"	2000	3	000	6000	000
24.	" Sinus Lanes.	"	2000	2	000	4000	000
25.	" Vulussellum Straight	"	1000	3	000	3000	000
26.	" Medicine glass 2 Ozs. glass	"	20000		500	10000	000
27.	Jar Dressing 1. Enamelled	"	6000	3	500	21000	000
28.	Jug Graduated 1.E. 20 ozs.	"	2000	2	000	4000	000
29.	Knives bard porker	"	100000		060	6000	000
30.	" " handle for No. 3 & 4	"	5000	2	000	10000	000
31.	Needle Hypodermic	"	700000		020	14000	000
32.	" Serum	"	100000		030	3000	000
				Sub Total C/f.		29760	000

Statement No.31

OPERATION THEATRE INSTRUMENTS

Sl.No.	DESCRIPTION	Country of origin	Quantity Con. in a year.	Price Rs.	Price Ps.	Total cost Rs.	Total cost Ps.
33.	Needle Lumbar puncture	U.K.	600		050	30	000
34.	Needle Suture Tasingular Straight	"	10000		020	200	000
35.	Needle Suture " " Curved	"	20000		020	400	000
36.	Needle Suture round bodeied Mayo's	"	5000		020	100	000
37.	Irrigator 2 Pint 1 Enamelled	"	4000	2	000	8000	000
38.	Irrigator 2 Pint Volcanite taps (nozzle)	"	2000	1	000	2000	000
39.	" Rubber Tubing in yards	"	6000		500	3000	000
40.	Percussor (Hammer)	"	1000	2	500	[illegible]	000
41.	Pump breast	"	1000		600	600	000
42.	Scale Weighing Infant	"	200	50	000	10000	000
43.	Scale Weighing personal.	"	100	70	000	7000	000
44.	Scale Dispensing	"	200	20	000	4000	000
45.	Scissor Straight blunt 5"	"	15000	1	500	[illegible]	000
46.	Scissor Straight sharp	"	20000	2	000	40000	000
47.	" Curved Sharp.	"	20000	2	000	40000	000
48.	" " blunt.	"	10000	2	000	20000	000
49.	" Ward	"	20000	2	500	50000	000
50.	" Deep wound	"	6000	3	000	18000	000
51.	Splint thigh Thomas	"	600	5	000	3000	000
52.	Syring Record 2 CC.	"	6000		400	2400	000
53.	Syring Record 5 CC.	"	6000		500	3000	000
54.	Syring Record 10 CC.	"	3000		700	2100	000
55.	Syring Record 20 CC.	"	1000	1	000	1000	000
56.	Tray Dressing Kidney Shape 8" I.E.	"	2500	1	500	3750	000
57.	" " " " 12" I.E.	"	2500	1	500	3750	000
58.	Tray Dressing Square I.E.	"	2000	2	000	4000	000
59.	Stool operating, to raise and lower with concealed screw. 50 to 80 Cms.	"	600	7	000	4200	000
60.	Trolley for Stecther	"	200	20	000	4000	000
61.	Anesthetic Table size height 85 cms. width 50 cms. Length 50 Cms.	"	200	30	000	6000	000
62.	Shadowless operating ceiling lamp Nine reflectors.	"	60	400	000	24000	000
63.	S " " mobile lamp four reflectors.	"	70	200	000	14000	000
				Total C/F.		[illegible]	[illegible]

Statement No.31 -

OPERATION THEATRE INSTRUMENTS

Sl.No.	Description.	Country of origin	Quantity Con. in a year.	Price Ls.	Price Ms.	Total Cost Ls.	Total Cost Ms.
64.	Table Instruments Rectangular size of height 85 Cms.	U.K.	160	60	000	9600	000
65.	Length 60 with (front to back) 50 Cms. with five castores	"					
65.	Table Instrument Curved with glass shelves and four castors 150 cms corner to corner 40 cms width.	"	100	40	000	4000	000
66.	Mayo's Stand, to raise and Lower with Stainless Steel Tray Size 60x38x3 Cms. mounted on four castor.	"	100	30	000	3000	000
67.	Operation Table for General Surgery Complete with	"	20	500	000	10000	000
68.	Electro surgical unit with Suction with all facilities to operate on 220/250 V. AC. 50 Cycles.	"	30	700	000	21000	000
69.	Vertical Steam pressure sterilizer electrically heated 220/250 AC 50 cycles.	"	20	1200	000	24000	000
70.	Sterilizer Electric Small 220/250 AC. 50 cycles.	"	500	90	000	45000	000
71.	Suction Unit electric 220/250 AC. 50 Cycles.	"	100	70	000	7000	000
72.	Drum Sterilize small	"	400	10	000	4000	000
73.	Drum Sterilizer med.	"	200	20	000	4000	000
74.	Drum Sterilizer large.	"	200	22	000	4400	000
				Grand Total:		669290	000

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OPERATION THEATRE INSTRUMENTS

Sl.No.	Specification	Country of origin	Quantity con. per year.	Price Rs.	Price Ps.	Total cost Rs.	Total cost Ps.
1.	Thermometers Clinical	China	100,000		100	10000	000
2.	Sphygmomanometer mercury Type	China	500	5	000	2500	000
3.	Hearing Aid (Stethescope)	China	2000	2	000	4000	000
4.	E.C.G. Machine 220/250 V. Three Channel..	Japan	20	500	000	10000	000
5.	Microscope Complete	Japan	100	250	000	25000	000

DENTAL EQUIPMENT

DENTAL

Sl.No.	Specification	Country of origin	Quantity con. per year.	Price Rs.	Price Ps.	Total cost Rs.	Total cost Ps.
1.	Electric Engine Mobile model 220/250 V. AC 50 cycles	Japan	30	400	000	12000	000
2.	Dental Chair oil pump.	U.K.	100	500	000	50000	000
3.	Operating Light model 220/250 W AC.50 cycles.	Japan.	30	300	000	9000	000
4.	Waste receiver	U.K.	50	15	000	750	000
5.	Stool operating.	"	100	30	000	3000	000
6.	Syring for dental	"	200	10	000	2000	000
7.	Elevators Assorted	"	300	10	000	3000	000
8.	Scalers Assorted	"	1000	4	000	4000	000
9.	Probes	"	1000	2	000	2000	000
10.	Mirrors.	"	5000		300	1500	000
11.	Mirrors handles	"	600	1	000	600	000
12.	Needles for syring	"	10000		030	300	000
13.	Amalgam Carrier	"	500	2	000	1000	000
14.	Burs Carbide.	"	10000		050	500	000
15.	Glass slabs	"	200	1	000	200	000
16.	Water Syringe.	"	200	1	000	200	000
17.	Forceps Dental Assorted (Complete Set)	" Rs.150	200	30000	000	6000000	000
						6141550	000

Statement No.31: Eye Instruments and Blood Bank.

Sl.No.	Description	Country of origin.	Quantity	Price Ls.	Price Ms.	Total Cost. Ls.	Total Cost. Ms.
1.	Slit Lamp Complete	U.K.	20	1800	000	36000	000
2.	Ophalmoscope	"	60	100	000	6000	000
3.	Retinscope	"	20	80	000	1600	000
4.	Trial set complete with Trial fram	"	20	120	000	2400	000
5.	Binocular Loop	"	100	20	000	2000	000
6.	Angle poised Lamp	"	600	20	000	12000	000
7.	Madox Wing	"	20	10	000	200	000
8.	Tonometer	"	50	30	000	1500	000
9.	Rotating Box	"	50	70	000	3500	000
10.	Catract Knive	"	1600	10	000	16000	000
11.	Keratomes Curved knives.	"	200	10	000	2000	000
12.	Castrovigous Needle holder	"	200	15	000	3000	000
13.	Barraguoris Needle holder	"	200	15	000	3000	000
14.	Iris Scissor	"	1100	10	000	1000	000
15.	Cryo Unit	"	10	800	000	6000	000
16.	Chalozion knive.	"	100	10	000	1000	000
17.	Cilia forceps	"	1200	5	000	6000	000
18.	Lacrimal Probe.	"	300	5	000	1500	000
19.	Triangular Tray	"	200	5	000	1000	000
	BLOOD BANK INSTRUMENTS & EQUIPMENTS.						
1.	Refrigerator Tropicalized with recording thermometer alarm. and light signal.	U.K.	10	2000	000	20000	000
2.	Water Bath Shallow Compete with lid	"	60	150	000	9000	000
3.	Electric Centrifuge Swing out head	"	60	150	000	9000	000
4.	Hot air oven high capacity	"	60	200	000	12 00	000
5.	Colourmeter for Hb.	"	30	300	000	9000	000
6.	Shaking machine orbital	"	30	70	000	2100	000
7.	Interval Timer with alarm	"	120	15	000	2800	000
8.	Incuba or 37°C Complete	"	60	400	000	2400	000
9.	Analytic Balance.	"	30	200	000	6000	000
	Grand Total					190600	000

Statement No. 31 : LABORATORY EQUIPMENTS.

Sl.No.	Description
1.	Micro haematocrit high speed centrifuge with built-in-pre-set timer and manual controlled breake complete with Lid and hood to accomodate 24 capillary tube of 75 mm. long.
2.	Albuminometer Esbach Complete with tubes, rubber stopper case 4 feet.
3.	Balance weight 200 gm. polished brass with aluminium and nickel-silver fraction set-arranged in 1-2-5 system.
4.	EEL, Flame photometer comple.
5.	Volumetric flask plain neck Assorted 75 ml. 25 ml. 50 ml. 100 ml. 250 ml. 1000 ml. (each size 200)
6.	Beakers pyrex graduated 250 ml. capacity, 500 ml.(each size 500)
7.	Haemocytometer complete with counting chamber and pipettes.
8.	Haemoglobinometer complete (Sahli)
9.	Measuring glass graduated 2 ozs. 4 ozs. 8. ozs. 10 ozs. 16 ozs. (each size 200)
10.	Test tubes rimless 75 x 5/8.

Country of origin	Quantity con. in a year.	Price Ls.	Price Ms.	Total cost. Ls.	Total cost. Ms.
U.K.	10	200	000	2000	000
U.K.	50	3	000	150	000
U.K.	10	50	000	500	000
U.K.	10	250	000	2500	000
U.K.	1200	3	000	3600	000
U.K.	1000	3	000	3000	000
U.K.	1200	10	000	12000	000
U.K.	1200	8	000	9600	000
U.K.	1000	2	000	2000	000
U.K.	100000		010	1000	000
				36350	000

Statement No. 31 : X-RAY FILMS AND BONDAGES

S.No.	Description
1.	X-Ray Screen film size 14" x 17"
2.	" " " " 12" x 15"
3.	" " " " 10" x 12"
4.	" " " " 8" x 10"
5.	" " " " 24 cm x 30 cm
6.	" " " " 18 cm x 24 cm
7.	" " Rolls size 70 mm x 3 mm
8.	" " Single films size 7 cm x 24 cm
9.	" " Dental films size 1¼" x 1 5/8"
10.	" " " " Occlusal size 2¼" x 3"
11.	X-Ray Radiation monitoring films size 13 mm x 41 mm
12.	X-Ray non-Screen films size 10" x 12"
13.	X " " " " " 8" x 10"
	Crepe Bondages 7.5 cm x 4.5 metres (Stretched)
	Crepe Bondages 15 cm x 4.5 metres (stretched)
	Plaster of Paris bandages (Low plaster loss) 10 cm x 3 meters
	" " " " " " " 15 cm x 3 metres.
	" " " " " " " 20 cm x 3 metres
	Orthopaedic Bandages 10 x 90 cm
	" " 15 x 90 cm
	" " 20 x 90 cm
	Extension plaster 7.5 cm. x 3 metres.

Country of Origin.	Quantity con. in a year.	Price Ls.	Price Ms.	Total Cost Ls.	Total Cost Ms.
	Numbers				
Japan	10,000			3,400	000
"	4,00,000			98,500	000
"	4,00,000			65,900	000
"	25,000			28,100	000
"	5,000			774	000
"	5,000			472	000
"	5,000			4,630	000
"	5,000			170	000
"	50,000			1,793	000
"	5,000			689	000
"	6,700			415	000
"	50,000			25,000	000
"	1,00,000			50,000	000
	20,000			4,200	000
	25,000			6,800	000
	1,20,000			3,500	000
	1,00,000			40,300	000
	50,000			26,300	000
	15,000			20,250	000
	25,000			54,900	000
	10,000			7,000	000
	15,000			13,300	000
	Grand Total			4,56,410	000

Total List No. 3	6,69,200	000
" " " 4	61,41,550	000
" " " 5	1,90,800	000
" " " 6	36,350	000
" " " 7	4,56,410	000
Grand Total	74,94,400	000

Statement No. 30

Private Sector imports by Iraq Office, Cairo

Sl.No.	Quantity	Description
1.	800 Box	Dispenser box of 100 pcs sterile disposable dental needle
2.	1400 doz	Hypodermic needles
3.	34000 pcs	Clinical thermometer
4.	3000 pcs	Metal syringe cases
5.	3000 doz	Hypodermic glass synringes
6.	6000 box	Cotton bud
7.	4780 box	Medical x-ray films
8.	20	Cautery for opthalmology
9.	2000	Sphygmomanometers
10	200 sets	Electronic blood pressure
11	10	Portable cycle exercises
12	5	Cyclette
13	5	Crowing chain
14	90	Wheel chair
15	2000 pcs	Torch
16	2000 pairs	Wooden Axilla Crutches
17	1000 pcs	Cervical collars
18	100 pcs	Adjustable elbow crutch
19	100 set	Diagenostic sets
20	15	Ripple Bed
21	600 unit	Massoche electronique
22	100 units	Stimulo senis
23	2000 pairs	Sonex hearing protoctor
24	1000000	Disposable syringes
25	5000	Stethoscope
26	-	Surgical higature andconning fluid
27	1800	Round sterilizing box
28	-	Power wheel Chair
29	15	Electro cardiograph
30	5000	Dissecting sets

31	15 sets	Dental x-ray apparatus
32		Metal Cartridge syringe
33	20	Electro cautery
34	Solid Oral scaler	
35	100 box	Carborumdun disc
36	10 pcs	Dental Pump Chair
37	40 ccs	Electric Cautery appdratus
38	50	Suspension engine
39	-	Dental x-ray films
40	10	Servo Electronic speech aids
41	-	Tongue depressors
42	-	Baumanometer
43	-	Autopolymerizators
44	180	Dry luated sterilizers
45	20 sets	Dental equipment
46	-	General set
47	-	Tracheoctomy sets
48	-	Gall Bladder sets
49	-	Cheat Aspiration set
50	-	Vaginal sets
51	-	Genital Tract sets

Statement No. 35

1. Vertical autoclave for steam sterilization - Chamber dimension: 400 mm dia x 654 mm length	75	255.594
2. -do- Horizontal	75	155.010

Statement No. 34

Incubators	Annual Consumption		Price per piece for London
1. Bacteriological incubators 220 V cap- 10/15 litres temp 25-100 C	150 nos	LE	82.167
2. -do- with four, forced air circulation thermostate control, temp 0-100°C Capacity	50		not given
3. -do- 120 lit	50	LE	518.67
4. Heating and cooling inculators capacity 120-200 lit- thermostatically controlled	15	LE	599.083
5. Water jacketed incubators - cap - 80-120 litres - 220 volts temp 0-100°C	30	LE	267.613

Statement No. 35

(Gumhoria figures given in Jan 77)

Centrifuges	Annual Consumption	F.O.B. + customs and other levy	Total
1. Centrifuge - electrically operated - small - 5000 RPM with head 8 x 15 ml- 220 V	200	LE 72.00	LE 14,400
2. Universal centrifuge - Small complete with swinging head 4x15 ml and angle head 6x15 ml with built in 4 step switch for speed control 5500 RPM 220 v.	150	LE 72.00	LE 10800
3. Mino-haemotocrit centriguge with haemotocrit head for 36 capilary tube reading graph, angle head for 12 appendrof tube 3 ml Angle head for 18 x 1 ml Timer ranger 0-15 min	75	LE 146.190	LE 10964.25
4. Electric laboratory bench type centrifuge 220V, 5000 rpm with 120 min timer stepless speed control electricrevolution counter, electric brake inter lock for smooth starting with swinging head 4 x100 ml with 1x50 ml adopter (set of 4) angle head 8 x25 ml with 1x15 ml in 25 ml (set of 8)	100	LE 95.135	LE 9513.5
5. Costing centrifuge -30 to + 50°C with high speed 220 v.	15	LE 3008.4	LE 45127.065

Statement No. 36 Price indications and types/sizes of surgical instruments obtained from Gumhoria

1. Gillies Scissors with needle holder combined $6\frac{1}{2}$" S.S.	Medicon	DM 29
2. Cairre's Artery forceps, curved on side - Box joint 5.3/4"	Down	£ 5.55
3. - do - Straight- Box Joint 5.3/4"	Down	£ 5.30
4. Mckenjie's clipapplying foreceps with curved jaws - box joint $5\frac{1}{2}$"	Medicon	DM 14.95
5. Adson's Bayonet shaped dressing foreceps with fine serrated jaws 7"	Stille	SW Lr.95
6. Adsons' Bayonet shaped dissecting forceps 1 x 2 teeth $7\frac{1}{2}$"	Medicon	DM 18.45
7. Mcindoes dissecting foreceps serrated - points 7"	-do-	DM 32.70
8. Metzen baum's Scissors curved with rounded blades, conical joints $9\frac{1}{2}$"	-do-	DM 33.10
9. -do- $10\frac{1}{2}$"	-do-	DM 39.40
10. Metzenbaum scissors, curved extra light 7"	-do-	DM 19.60
11. Hegar's needle holders 6"	~~xxxx~~ Lanton	DM 20.40
12. Sems duckbill specula double ended small size 13/16 x 15/16" S.S.	Medicon	DM 16.55
13. Cusco's veginal speculam, Chromium plated Large, 4.3/8" long x 1.3/8" wide	-do-	DM 18.00
14. -do- medium 4" long X 3/16" wide at distal end	-do-	DM 18.[illegible]0
15. -do- small 3.3/4" long X 1" wide at distal end	-do-	DM 18.00
16. -do- extra small 3.7/8" long x 11/16" wide	-do-	DM 18.00
17. Simpsons obstectrik foreeps, short model	Down	£ 22.20
18. Uterine scissors, straight D/B joint 8"	-do-	£ 4.26
19. -do. curved on flat 8"	-do-	£ 4.85
20. -do- curved on flat 9"	-do-	£ 5.88
21. Mayo uterine scissors, straight 9" with diamond ~~xxx~~ edge	Medicon	DM 57.00
22. Dunhills' Artery forceps, curved on flat box joint 5"	Seward	UK£ 2.42
23. Kocher's Artery forceps, straight 14 cm	Poland	£ 3.25
24. -do- 16 cm	-do-	£ 3.54
25. -do- 20 cm	-do-	£ 4.71

26.	Artery forceps, mosquito curved		Lanton	DM	11.34
27.	-do- -do- Straight	14xcm	Chiron	DM	7.40
28.	-do- -do- -do-	14 cm	Seward UK	£	2.35
29.	-do- -do- -do-	16 cm	-do-	£	2.68
30.	-do- -do- -do-	18 cm	-do-	£	2.90
31.	-do- -do- -do-	20 cm	-do-	£	3.12
32.	-do- -do- curved	16 cms	Chiron	DM	9.20
33.	-do- curved flat	18 cms	Poland	$	4.07
34.	-do- -do-	20 cm	-do-	$	4.53
35.	Little wood's tissue forceps, Box joint 2 x 3 teetch - 7½"		Seward	£	3.96
36.	Cheatle's sterilizer forceps, extra large for bowls and utensils Screw joint		Allied India	£	0.85
37.	Mayo's (dunhills) needle holder box joint 6.1/4"		Medicon	DM	22.70
38.	Mayo's needle holder with wide jaws boxjoint 7.1/4"		Chiron	DM	16.50
39.	-do- narrow jaws box joint 7.1/4"		-do-	DM	16.50
40.	Dressing scissors - straight 5½" S.S.			DM	8.00
41.	Pean's Haemostatic foreceps, curved 16 cm - chiron		Chiron	DM	9.20
42.	Lane's forceps 6"		Lanton	DN	12.96
43.	Surgical blades size 10,11,15,20,21,22, 23 Swan Norton		Swan Norton	£	1.09
44.	Handles for surgical blades - size 3,4		-do-	£	1.94
45.	Scissors straight 18 cm b/b		Pland	£	4.02
46.	-do- curved 20 cms		Lanton	DM	14.31
47.	-do- curved on flat 5½" Down			£	2.32
48.	-do- 5" Down		£	£	1.30
49.	Towel forceps, backhaus 3½"	Allied India,		£	0.30
50.	-do- 5½"	-do-		£	0.30

Statement No. 37

Details provided by Surgical Equipment Store

S.No.	Description	Balance	Supplier's Co. Name
1.	Electro-cardiograph	10	Al.KHALDIYA HEWLEIT PACKARD
2.	Blood Pressure Apparatus	89	Holborn [illegible]gical U.K.
3.	Stethoscope (Binural)	208	Holborn Surgical U.K.

Statement No. 38

List of Medical Appliances imported by Kuwait

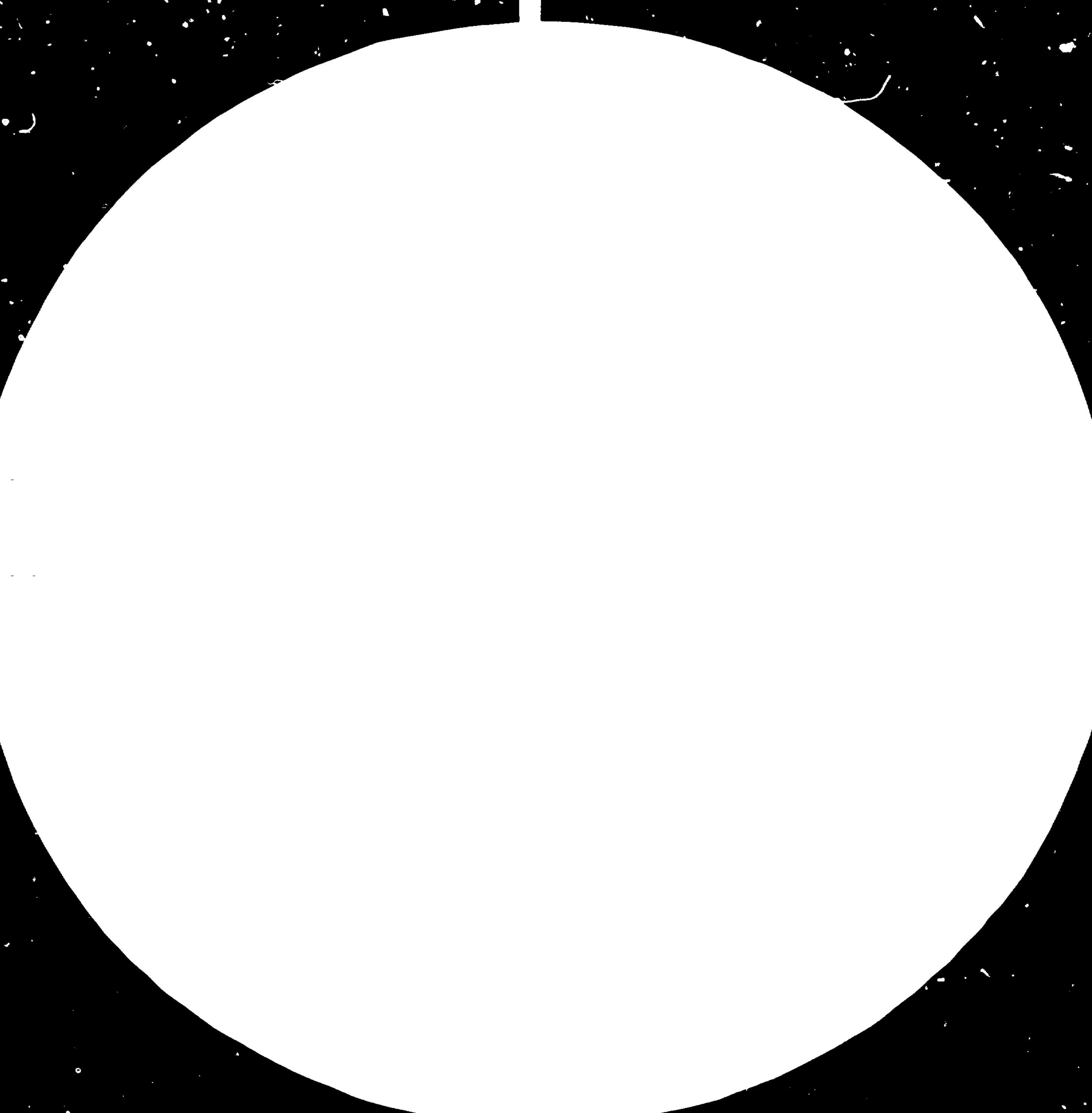
Details produced by Rubber Store

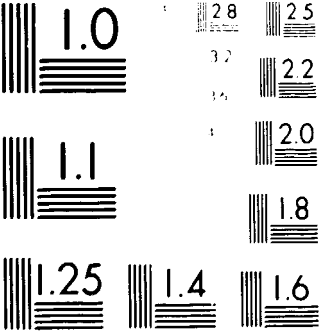
S.No.	Specifications		Balance	Suppliers
1.	Thermometer	Oral	23,600	Terumo Co.
2.	-	Rect	11,800	(Japanese

The price are not available and it is with financial department of the Govt.

Statement No. 39 ECONOMIC INDICES USED IN THE REPORT

1.	Cost of construction	100 L.E per Sq met.	
2.	Cost of water supply	3 P.T per cu. met	Data from Benha
3.	Electrical specs	220 V.50 c/s. 8KVA.	Electronic comp.
4.	Cost of electricity	3 P.T. per unit	Cairo
5.	Erection of heavy equip	150 L.E. per tonne	Data from Erection and Industrial Service Comp. Cairo
6.	Erection of light equip of Higher delicateness	250 L.E. per tonne	
7.	Insulation with firebrick	75 L.E. per tonne	
8.	Insulation with glass wool or mineral wool	50 L.E. per tonne	
9.	Covering the above with sheet of steel or Al.	4 L.E. per sq. met	
10.	Erection of electrical equip like transformers, switch gears, motors etc.	250 L.E. per tonne	
11.	Laying of power cables	500 L.E. per tonne	
12.	Erection of lighting equip	750 L.E. per tonne	
13.	Erection of control equip	1000 L.E. per tonne	
14.	Erection of control cables	1200 L.E. per tonne	
15.	Air conditioning cost	150 L.E. per sq.met	
16.	Wages to a 'new' worker	25 L.E. per month	
17.	wages to skilled worker with five to 10 years experience.	50 L.E. per month	
18.	Wages to foreman/supervisor in the middle level	70/80 L.E. per month	
19.	Manegers	125/150 L.E. per month	

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Statement No. 40 - **POPULATION ESTIMATES IN ARAB COUNTRIES**

000's

Country	1974	1973	1972	1971	1970
Jordan	2660	2577	2497	2417	2348
Syrian Arab Republic	7121	6890	6673	6451	6305
Iraq	10765	10413	10074	9750	9440
Egypt	36417	35519	34839	34076	33329
The United Arab Emirates	238	222	211	200	190
Sudan	17324	16901	16489	16087	15695
Somalia	3106	3022	2940	2860	2791
Kuwait	925	873	826	781	739
Libyan Arab Jamahiriya	2390	2291	2196	2105	2017
Mauritania	1272	1245	1218	1189	1160
Yemen	6365	6217	6062	5911	5760
Democratic Yemen	1640	1590	1510	1470	1440
Bahrain	261	248	234	216	210
Tunisia	559	5327	5278	5179	5074
Algeria	14900	14387	13955	13523	13096
Saudi Arabia	7013	8433	8195	7964	7740
Oman	743	721	700	680	660
Qatar	137	130	123	117	111
Lebanon	3146	3051	2959	2870	2490
Morocco	16800	16309	15704	15379	15520
Total	138382	136466	132683	129235	126031

Statement No. 41 – AREA AND POPULATION DENSITY IN ARAB COUNTRIES

9174

Country	Dens/km	T.area(km^2)	P. 1000
Jordan	27	97740	2660
Syrian Arab Republic	38	185408	7121
Iraq	25	434924	10765
Egypt	36	1001449	36417
The United Arab Emirates	3	83600	238
Sudan	7	2505813	17324
Somalia	5	637657	3106
Kuwait	52	17818	925
Libyan Arab Jamahiriya	1	1759540	2390
Mauritania	1	1030700	1272
Yemen	33	195000	6365
Democratic Yemen	5	287683	1640
Bahrain	420	622	261
Tunisia	33	163610	5459
Algeria	6	2381741	14900
Saudi Arabia	3	2149690	7013
Oman	4	212457	743
Qatar	6	22014	137
Lebanon	302	10400	3146
Morocco	38	446550	16800
Total	10	13624416	138682

Statement No. 42 — ANNUAL PRODUCTION OF ELECTRICITY IN ARAB COUNTRIES

Million kw/hour

Country	1974	1973	1972	1971	1970
Jordan	310	281	249	210	187
Syrian Arab Republic	1366	1154	1273	1049	947
Iraq	3255	2919	2358	2261	1909
Egypt			7999	7247	6976
The United Arab Emirates	874	764	255	210	140
Sudan					
Somalia					
Kuwait	4092	3668	3295	4636	2213
Libyan Arab Jamahiriya		394	265	400	229
Mauritania	86	36	26	61	
Yemen,	29	22	19	13	
Democratic Yemen	134	136	133	127	115
Bahrain		330	276	258	243
Tunisia					
Algeria			2013	1900	1701
Saudia Arabia	1220	1163	999	802	724
Oman		289	222	120	80
Qatar		419	360	351	277
Lebanon		1791	1547	1375	1320
Morocco	3068	2790	2470	2193	

Statement No. 43 - CUSTOM DUTY IN EGYPT ON IMPORTATION OF

Custom Duties	Item	Custom Dutis	Item
10 %	Carbon & alloy stee	10-20 %	Auxilliary, grinding abrasves, polishing compounds, buffing weels, salts for electroplating & heat treatment baths
10-30 %	Non-ferrous metals		
25 %	Plastic - basic		
30 %	Plastic - Processed		
No. Customs	Metal cutting furma	2%	Measuring & Drawing Instruments
	Process control	2%	Small tools & cutting tools
		2%	Special tools Jigs & Ficturs
10 %	Laboratory Instruments	2 %	Machinery spares.

D. Pre-investment analysis

Product identification - rationale

The requirement of medical appliances, equipment and instruments will generally depend on the following considerations:

(a) Population - to identify the magnitude of the problem of health care;

(b) Health personnel - availability of physicians, surgeons, qualified nurses and other para-medical staff and their planned increases over a period of time to assess the effective utilization of the products in use;

(c) Hospitals and beds - the existing distribution and pattern of development to assess the extent of medical services available and the sophistication thereof;

(d) National objective - to understand the thinking of the respective Governments regarding national prioriti in health planning and the overall plans for the development of the institu.ional set-up for health care;

(e) Requirements of the specialists - to identify sophisticated equipment that would be required in major hospitals, irrespective of cost, to enable e.g. surgeons to carry out their work efficiently.

It is now proposed to examine each of the above aspects in the light of data collected by the Indian experts and seek to evolve the parameters for a quantitative evaluation of the future demand for different types of applicances and equipment.

Population

The 1970-1974 estimates of the population in Arab countries are given in statement No. 40. For purposes of the report it is assumed that the population is currently around 150 million. There is, however, a widely varying population density in the different countries (see statement No. 41), a factor which could cause fluctuations in demand. There are also considerable differences in population distribution within each country. In Egypt, 60% of the total population lives in rural areas. In Iraq only 40% of the population lives in rural areas; nearly 30% lives in and around Baghdad and another 30% in other urban areas. Sudan has an extensive land surface with poor infrastructure and a low population density. Problems of health care in the Sudan are accentuated by the nomadic population which contributes to serious shifts in population density. In the Gulf States there are entirely new conditions: low population density, poor infrastructure, but availability of the world's best medical appliances and equipment which can be afforded due to a high level of wealth and prosperity.

Health personnel

The following table obtained from an Arabic translation of a WHO-document dated September 1977, gives the number of physicians in various countries as related to the respective population. Some figures which were not indicated in the original document have been filled in by interpolating. The figures in the brackets are taken from the Statistical Yearbook for Arab Countries. In this report the figures in brackets, where available, have been used.

Country	Population (in millions)	No. of physicians		Population/ physician	
U.K.	49.00	60,000		820	
U.S.A.	202.00	316,400		640	
USSR	202.00	477,449		420	
F.R.G.	61.50	105,976		580	
Brazil	70.00	47,250		19,950	
Ghana	6.70	667		14,000	
Algier	12.12	1,698		7,850	
Lebanon	2.70	1,831		1,470	
Saudi Arabia	7.70	770	(1,268)	10,000	(6,658)
Syrian Arab Republic	10.00	1,623	(2,666)	3,760	(2,771)
Egypt	34.00	13,077	(25,797)	2,600	(1,536)
Jordan	6.50	2,912	(763)	2,225	(2,477)
Morocco	15.52	1,200		13,000	
Iraq	8.00	1,726	(4,094)	4,635	(2,630)
Tunisia	5.00	694		3,634	
Sudan	15.00	1,066	(1,214)	14,000	(14,270)
Yemen	(6.36)	(265)		(24,019)	
Democratic Yemen	(1.64)	(143)		(11,468)	
Libyan Arab Jamahiriya Jamahiriya	(2.39)	(2,130)		(1,122)	
Kuwait	(0.93)	(1,019)		(907)	

From the above table can be seen that in the member states of ACDIMA, there are approximately 39,280 physicians for a total population of 90.958 thousand, giving an average of approximately 2,322 people per physician. Aiming at a ratio of 1,000 persons per physician would mean raising the number of physicians to at least 90.958. In fact, for all Arab countries with 150 million people the need would be 150,000 physicians, while the current number is about

50,000. At the present rate of turnout of physicians in the Arab countries (approximately 4,000 per year in Egypt and about 2,000 in the other countries), it would appear a gigantic task for the next two decades. However, the present trend seems to be to recruit specialists from other developing countries to man the services until local talent will take over. This report assumes that in ten years there will be 100,000 physicians.

Nurses

The data collected are inadequate to determine the number of qualified nurses and other paramedical staff available in all Arab countries. This report mainly depends on two documents: the Statistical Compass of the Directorate of Vital and Health Statistics of the Government of Iraq and the National Health Programme Document of the Sudan. In Iraq, for a total of about 4,095 physicians, there are 3,535 qualified nurses. In Sudan, for about 1,214 physicians, there are 4,438 nurses. While in Egypt, Iraq and Kuwait, the emphasis is more on qualified physicians and nurses, in Sudan there is also an emphasis on paramedical staff. According to the National Health Programme document of the Government of Sudan, they seem to aim to have at least three medical assistants for every practising physician i.e. at least one nurse for a physician, apart from other assistants. It is therefore assumed that there would be 100,000 nurses at the end of a decade.

Hospitals and beds

The data obtained for the Arab countries as a whole were incomplete so that it would be unrealistic to project any targets based on these figures. The following information extracted from the documents from Iraq and Sudan gives a clue to possible future growth rates:

(a) In Iraq the number of hospitals rose from 173 in 1973 to 187 in 1975 i.e. by approximately 8% in two years. In the same period the number of beds increased from about 21,800 to 22,942 i.e. by 5.3%;

(b) In Sudan the number of hospitals rose from 90 in 1970 to 133 in 1974 i.e. by approximately 48% in four years. In the same period the number of beds increased from 13,891 to 15,670 i.e. by approximately 12.8% in four years.

In the discussions, it became apparent that in future the emphasis will not be so much on increasing the number of hospitals and hence the costs for infrastructure, but more on making the best use of the existing ones through qualitative improvements and suitable addition of beds. It was mentioned e.g. that in Sudan not even one new hospital was built in the last year. However, this report assumes that the present planning efforts in Arab countries will gain momentum and eventually this sector eill reach an average growth rate of 10% every year.

National objective and institutional set-up

It is evident that the bulk of the Government funds will go towards equipping the medical institutions in line with the national objectives. The objective of any Government in a developing country would be to reach an acceptable standard of health service which is available to the maximum number of people at the most economic cost to the exchequer. Over the past years the concept of separate planning for various health schemes has been abandoned for integrated development schemes, covering health, education, rural development, environmental hygiene, transportation etc. The combined unit in Egypt is an example of this integral approach for community development. For this type of planning a clear definition of priorities is required.

The guidelines found in the terms of reference issued by the Ministry of Health of the Government of Sudan for the National Health Programming Committee 1975, indicate certain priorities which are relevant for all Arab countries, and, in fact, for all developing nations countries of the world. These guidelines specify:

(a) Preventive and social medicine are considered top priority, especially the control or eradication of endemic and epidemic diseases and the improvement of environmental health conditions. In this respect, special attention is to be given to maternal and child health and school health services;

(b) Strengthening or rural health care facilities to ensure a fair distribution of basic health care for the entire population;

(c) Provide training facilities for all levels of professional, technical and auxilliary health manpower;

(d) Consolidate existing curative health care facilities to provide better services for the population and allow for some expansion of these facilities in the less developed areas;

(e) Direct medical research towards health problems according to their priorities.

In the Government of Sudan's National Health Programme document these priorities are analyzed with reference to plan and achievements and the following observations are made which are not only typical for a developing country but directly serve to define the demand for different medical facilities (instruments, appliances and equipment): "In the field of curative health services, the policy is to consolidate the existing institutions by the provision of efficient and modern ancillary services such as X-ray services, blood banks, laboratory services, operating theatres and modern equipment. New hospitals are only built in places where such services are already deficient, or to meet an urgent need for a specialized service which has been non-existent."

From the above it is evident that the procurement policy of a Government would depend on the type of health care wanted i.e. on the number of clinics, dispensaries, hospitals etc. throughout the country and the type of service expected from them. Leaving aside the requirements of sophistication in the major hospitals in the first instance, the pattern of institutional set-up described above would provide a guideline for an evaluation.

Institutional set-up

From all Arab countries visited by the experts, Sudan has defined the various health care delivery points most clearly in its National Health Programme. These are:

Hospitals	Health centres
Dispensaries	Dressing stations
Blood banks	Specialist hospitals
School health services	Nursing schools
Midwives	Health visitors schools
Medical assistants	P.H. laboratories
P.H. offices	Endemic diseases centres

Though the name of the different health delivery points may change from country to country, it is evident from the study of the team that there is a lot in common in the overall objectives, in the type of health care delivery points and even in the number of people that each unit is expected to serve.

The present concept can be summarized as follows:

(a) Egypt:

(i) Rural health units for a population of 5,000 residing not more than 3 km away from the unit;

(ii) One health centre constituting a referral unit for three health units;

(iii) Health centres to be gradually transformed into rural hospitals;

(iv) District and other hospitals (state insurance, railways, military, province, capital etc.);

(b) Sudan:

(i) Primary health care units to cover a population of 4,000 dispensaries;

(ii) Primary health care complex for a population of 2[illegible],000;

(iii) Health centres, rural hosiptals;

(iv) District hospitals, railways, military, province or capital hospitals.

Considering the existing health programmes and their implementation in the Arab countries, we may conclude that at the end of a decade the medical care system will show the structure described in the following list:

Class	Type	Health care provided	Number
IV	Rural and semi-urban units	Basic health care Mass screening Vaccination Mother/child health care	30,000
III	Referal units	Limited surgery Specialized treatment of cases referred from class IV units	6,000
II	District hospitals	Wider range of specialities Surgery	1,500
I	Provincial hospitals Special hosiptals (insurance, military, railways)	Specialized care Major surgery	500

An estimated 100,000 doctors (including surgeons) and 100,000 trained nurses would be necessary to operate these units. It is expected that 2.6 times the amount of equipment currently in use will be needed by 1980.

Disease pattern in the Arab countries and health programming

Having identified the different levels of health care delivery points, it is now proposed to examine the disease patterns in Arab countries to the extent surveyed by the team so as to combat disease and any complications arising thereof.

The main thrust in all the countries is for mother and child care. While mother care refers to the pregnancy and child birth, child care encompasses a variety of aspects, including school hygiene and immunization against communicable diseases. The overall emphasis is a control of diseases with a concerted action on care, supported by curative steps. The instruments, appliances and equipment required for child and mother care will be taken up later under other standard needs of hospitals.

The communicable diseases generally faced in the region include the following:

Bilharzia

Diarrhoea

Gastro-enteritis

Malaria
Diabetes and its complications
Tuberculosis
Sleeping sickness
Yellow fever (mainly in the Southern part of Sudan)

Steps being taken to combat these diseases include:
Investigation
Data recording
Mass screening for tuberculosis
Mass inoculation
Collection and examination of sputum, urine and stool
Environmental protection through spraying of insecticides
Curative treatment
Education of the population, particularly children, on personal hygiene
Protection and supply of clean drinking water

The equipment necessary for this aspect of health programming is given below.

Gastro-enteritis, dysentry, diarrhoea, bilharzia

The health programme for these diseases will weight heavily in favour of preventive action, stressing the importance of clean drinking water, protected water surfaces, community hygiene, social education and, in fact, all aspects of community development. Taking an overall view of the preventive and curative aspects of the programme, the following would be needed:
Insecticide spayers
Audio-visual educational aids
Venessection sets
Microscopes (monocular and binocular)
Balances (laboratory and adult-child)
Rehydration units
Syringes and injectibles
Simple laboratory equipment

Malaria

Malaria control is an important factor in Sudan and in other Arab countries in Africa. The programme for combating malaria would involve continuous spraying of DDT and other insecticides, rigorous monitoring of incidents and treatment through drugs. Insecticide sprayers of different types, monocular and binocular microscopes and simple laboratory equipment would be necessary.

Tuberculosis

The campaign against tuberculosis, including investigational, preventive and curative aspects, is an important factor in health programming in most Arab countries. The following equipment for media preparation, culture preparation and reading, sterilization and autoclaving etc. would be relevant:

Vaccination aids for BCG
Fuel/gas burners
Centrifuge
Incubator
Autoclave
Weighing balances (laboratory and hospital, for adults and infants)
Hot-air oven
Water still
Microscope (monocular and binocular)
500 MA X-ray units (14" x 17", 12" x 15", 10" x 12" and 8" x 10" films)
200 MA X-ray units
100 MA mini-micro radiography unit (70 mm films)
100 MA mini-micro radiography unit in an ambulance van
Tuberculine syringes
Fluorescence microscopes
Laboratory equipment

Diabetes

Though not in the category of a major disease, there is concern about the incidence and the resultant complications of diabetes, particularly among the affluent sections. Excluding the research institutions from consideration, the following apparatus would be relevant:

Glucose test strips
Reflomat system for blood sugar analysis
Distilled water plant
Colorimeters
Sodium and potassium flame photometers
Centrifuges
Flask shakers
Microscopes (monocular and binocular)
Auto analyser
Laboratory equipment

In addition to the equipment listed above, the following would be required at the different levels of health programming:

Thermometers

Stethoscopes

Blood pressure apparatus

Scale (for weighing adults)

Scale (for weighing infacts)

Infant scale (spring, Salter type, portable)

Balance (capacity, 500; sensitivity, 1 g)

Analytical balances (capacity 100 g and 200 g, sensitivity, 1 mg)

Insecticide sprayers (fan type, stirrup, hand pumping, portable)

Fuel-heated water stills (capacity 2 l/h)

Water distilling apparatus (capacity 8 l/h heated), (220 V.AC, 50/60 c/s)

Kerosene stoves, single and four burners

Gas burners

Centrifuge 8 x 15 milli litre Tube head (220 V,50/60 c/s)

Centrifuge 4 x 15 milli litre tube head (-220 v,50/60 c/s)

Centrifuge, hand driven

Microscopes (simple, clinical, monocular)

Microscopes (binocular with oil immersion lens etc.) 100 X

Microscopes for students

Fluoresence phase contrast, dark field, tissue culture microscopes

Incubators

Hot-air ovens

Autoclaves

Sterilizers and drums

Hypodermic syringes and needles

Hypodermic syringes and needles (disposable, presterilized)

X-ray units and X-ray films

Colorimeters

Suture needles

Flamephotometers

Reflomat system for blood sugar analysis

Surgical instruments

Serological bath (electric)

Tissue flotation bath (electric)

Inpatient facilities and operating-theatres

It is envisaged that only the class I and II units will have well-organized inpatient and operating-theatre facilities, the quality of services in the class I unit being higher than in class II units. Only 50% of the 6,000 class III referral units will have theatres for general surgery, with some scope for other specializations, e.g. like gyenacology and obstetrics, dental and eye clinics; in the remaining referral units surgery could be inadvisable due to inavailability of electricity, inaccessible roads, and also the shortage of qualified surgeons, especially of those willing to serve in remote areas. It is assumed that no surgery will be performed in the 30,000 basic units.

During the team's visits to hospitals and clinics in the Arab countries, a number of types and designs of hospital and laboratory appliances were observed; an abbreviated list of the most important ones is given in appendix II.

A list of equipment and instruments generally required for inpatient and operating theatre facilities is given below:

Stretchers, army type
Stretchers, combination wheel and assy
Patient trolleys
Invalid chairs, adult
Invalid chairs, infant
Examining table, folding, two section with pads
Incubator for premature infants (220 v 50 c/s)
Oxygen tent, large, without regulator
Oxygen tent, medium, without regulator
Oxygen tent, infant, without regulator
Resuscitator
Infusion stand and set
Instrument tables and trolleys
Obstetrical tables
Anaesthesia apparatus
Suction apparatus
Surgical lamps and stands
Operating tables, simple
Operating tables, major
Oxygen administration system
Pumps, infusion
Pumps, perfusion
Dental chairs

Dental engines
Sterilizers
Autoclaves
Surgical instruments

Class I units would require more sophisticated equipment, including medical electronic equipment. The most important items would be:

Audiometer
Electrocardiograph
Electroencephalograph
Electromyograph
Foetus monitor
Pacemaker (external)
pH meter
Defibrillator
Auto analyser
Equipment for surgical diathermy
Equipment for shortwave and microwave diathermy
UV/IR lamps
Equipment for ultrasonic therapy
Patient monitor
Artificial kidney machine
Heart-lung machine
Paging system
Spectrophotometer (visible, UV/IR)

In summary, production programmes for medical instruments, appliances and equipment in Arab countries will have to fit the broad parameters of health programming given above. The types of appliances to be produced will have to be carefully selected.

Market survey and demand projection

The following difficulties should be borne in mind when making a market survey and long-term demand projection of medical appliances in developing countries:

(a) The field is so wide that it is impossible to cover it in a short-term survey without omitting important items;

(b) Hospital records are often inaccurate or incomplete with regard to specifications or quantities;

(c) Because appliances are used beyond their normal life span due to budgetary limitations an estimation of replacement demand potential is difficult;

(d) A large number of rural health programmes in developing countries are based on aid from UNICEF; through its central procurement agency UNICEF provides equipment. Thus, new manufacturing units in developing countries may find it difficult to get into the market until local products establish credibility with UNICEF;

(e) Lastly, it is difficult to estimate demand for a new product.

Keeping in mind these problems, the present survey has been conducted not merely to obtain data but also to "feel" the aims and objectives of the health planners and the medical profession in the Arab countries. The report bases its demand projections on the following premises:

(a) Initial production should be for products of simple design for specific purposes that can be manufactured in large quantities. Designs of greater refinement and versatility could be progressively introduced to keep pace with the development of technical infrastructure;

(b) As far as possible, the designs should be close to the types indicated by Goumhoria; as for other products envisaged in this report, the designs will have to be close to the UNICEF kits and other internationally accepted designs.

Subject to the above considerations, the equipment to be produced will be classified as under:

(a) Consumable products include products that are likely to fail or break more frequently in use;

(b) Products for personal use - those owned by the physicians and nurses;

(c) Products for institutional use - that is, hospitals, clinics etc. (sometimes these may overlap with item (b) above;

(d) Specialized products - to be used by class I and II units only.

It was noted that there was a lack of documentation as regards quantities of equipment required. There are no guidelines for quantitative evaluation; however, based on the health care services to be offered in each type of unit, and on the experience of the authors, a tentative schedule of probable requirements of different items has been made and is given in appendix III. This provides the yardstick for quantitative evaluation of medical appliances.

Based on the requirements given in appendix III, a list of quantities of each medical appliance that would probably be in use at the different levels of health service in the Arab countries at the end of a decade is given in appendix IV.

While new production units should be given adequate government protection in the early years in order to give them time to settle down and face competition from foreign manufactures who have the advantage of a long-standing reputation, a total ban on imports of any product is not likely to find favour with hospitals, surgeons and health administrators who might favour importing better-known types and designs of appliances with a view to providing good service. Imports would also serve to stimulate greater quality consciousness among local manufacturers. Hence, it is assumed in this report that 30% of the appliances in use at the end of the decade would still be purchased from abroad and 70% purchased from local production. It is evident that the proposed production units should have adequate capacity to supply this demand. The consultants were asked to plan for the first five years only, but to provide enough infrastructure to expand capacity for the second five years. The industrial profiles prepared by the consultants predict that the units should normally show a profit in the second or third year of operation. In a few cases, this is expected in the first year. A summary of the capacities envisaged for profitability, and the need to review the demand in the local and export market for further increases in production (through additional staff and marginally additional equipment) are given in appendix V.

Demand projections should be reviewed continuously and preventive action must be taken from time to time.

Planning and organization of production units

In determining the optimum capacity of new production units many factors must be taken into consideration. The health services programme cannot be expected to expand at an even pace, hence local demand cannot be easily predicted. The minimum quantity of an item that can be produced at an economically viable level must be determined; if this exceeds local demand, exports should be encouraged. Not only will repalcement demand be low for non-consumable items, but, also, the market for certain items can be expected to be saturated by the fifth year of operation. It would thus be inadvisable, for the most part, to produce the same items year after year; a concept of diversification and versatility should be built into the organizational structure of a production unit from its inception.

To facilitate the study, a statement has been prepared covering the medical products, highlighting the inter-relationship of the technologies involved. This is given in appendix VI. With reference to the products identified for manufacture in this report, a more elaborate analysis of the production facilities required for each product (excluding X-ray films) has been shown in appendix VII.

From an examination of the appendix VII, the following conclusions could be drawn:

(a) Almost all the products would need a well-organized design cell for product as well as tooling. While certain products may have to be manufactured under licence to well-known manufacturers in order to be acceptable to the medical profession, a large number of products from the list could be more economically manufactured from designs developed in the unit. A production facility for tooling has to be built into the layout of the manufacturing unit. While the first set of tools may in the case of licensed products, have to be imported from the collaborator, continuous dependence on external sources for duplication of tools and further development of new products will be uneconomical;

(b) Certain critical raw materials and components for some of the commercially attractive products in the list will have to be imported, e.g., mercury and capillaries for the thermometers, optics for microscope and for the sophisticated versions of laboratory equipment, standard electrical and electronic components;

(c) Certain production facilities (heat-treatment, electroplating, painting, pressing and sheet metal fabrication etc.) could be economically pooled in the early stages of production provided they are located reasonably close to each other.

It is recommended that the medical appliances factories in the Arab countries be set up in two stages.

During stage I essential service facilities, including estimating, design, technology and industrial engineering and certain essential process facilities like the tool room, heat treatment, electroplating, presshop etc., should be set up in a suitable location, with small- and medium-scale production units for specific products located nearby. It may also be desirable at this stage, to introduce medical electronics as an additional line of production in the existing factory in Egypt.

Stage II should consist of re-grouping so that production flows from one unit to the next. This should be done as soon as the external infrastructure in the Arab countries can provide the necessary ancillary support and when the market demand, both internal and export, becomes reasonably consistent.

It is proposed to set up the following production units in the Arab countries:

Thermometers

Light engineering complex for medical instruments, appliances and equipment

Microscope-cum-optics

Electronic complex for medical equipment and sophisticated laboratory equipment

X-ray film

Medical appliances repair workshop

Tool room

Production for export

In view of the anticipated fluctuations in demand for medical appliances, instruments and equipment, it will be necessary, for certain products, to augment the quantities needed for economic batch production through aggresive export marketing. No manufacturer of medical appliances has succeeded in being self-sufficient with his own national demands. Export marketing is, therefore, of vital importance to this industry.

However, development of the export market has the following problems:

(a) There are no standard international price levels. It is frequently noted that the same products are often marketed at different price levels in different countries. Prompt decisions on pricing have to be taken depending on the circumstances. There are also no well-defined standards and specifications to facilitate comparison of durability - only the reputation a brand enjoys as regards quality. A new entrepreneur in medical instruments has, initially to face severe competition from well-known, reputable manufacturers until he establishes credibility;

(b) Instruments, appliances and equipment that could be produced with simple technology and of simple designs are priced at lower levels; more sophisticated products attract higher prices. The number of lower-priced products on the market is higher than that of the higher-priced products, but the latter has a larger share monetarily. Export marketing for the more sophisticated equipment is particularly difficult, as this field is more or less monopolized by international manufacturers of long standing;

(c) In most of the countries, imports of medical appliances, instruments and equipment are regulated by either trade agreements or aid programmes or through international agencies such as UNICEF. UNICEF, for example, has its own procurement agency and a new entrepreneur is bound to take some time before he establishes credibility with UNICEF and caters to this market.

Under these circumstances, considerable preparation will be necessary to achieve substantial export targets. As already indicated, most of the proposed production units will reach the break-even point in the third or fourth year of operation, if not earlier. At that stage, it will also become necessary to diversify production or supplement production quantities with export to enable units to maintain their profitability levels.

Diversification

As a part of their guidelines, the consultants were asked to suggest second lines of production in each unit. Primarily, such diversification will be related to other requirements of the medical profession and health services. However, the units could also manufacture non-medical engineering products of a consumable nature. An example would be the addition of overhead projectors and visual-aid equipment in the unit producing microscopes. Each production unit, upon reaching the stage where diversification could be economically viable, should take into account available skills, surplus equipment, capacity and manpower resources to make the diversification programme economically viable.

Diversification, however, raises certain problems specific to developing countries. Gillet of the United Kingdom, Hewlett Packard of the United States and Carl Zeiss of the Federal Republic of Germany, with their strong marketing and technological base, have been able to easily diversify their production into medical products. Similar attempts in some of the developinf countries have not succeeded, mainly becsuse of the lack of adequate supporting infrastructure. Hence, the decision to diversify will have to be carefully considered.

E. Management and Organization

The total proposed investment for medical appliances production in the first stage will be about $US 9.8 million, which is less than the estimates for drugs and pharmaceuticals. However, medical appliances should not be considered merely a part of a widely varying set of production lines. The special characteristics of the industry will need to receive serious attention at the corporate level.

These special characteristics are shown in figure I, which is a flow chart of activity during the life of a medical appliances project. The four main stages shown in the figure can be summarized as follows:

Stage 1: Close liaison with the government, the medical profession and the general public

Stage 2: Close co-operation between the company's top management and marketing and finance sectors

Stage 3: Close liaison between the prototype facilities in the plant, external facilities for prototype manufacture, the plant's design and technology group and the medical profession and hospitals

Stage 4: Close co-ordination between the production and marketing sectors and the general public

It is proposed, in this section, to restrict the discussion to the requirements of the organization in the corporate sector. The individual profiles given in the volume II of the report indicate the organization required in each of the prodcution units. The estimates of personnel requirements, given in the profiles, should be taken only for the purpose of assessing the economic viability of the project. As and when the projects are decided upon for investment and commissioning, a detailed project rport will have to be made to finalize the staffing pattern.

Figure II shows the infrastructure and organization proposed for a medical appliances plant.

Advisory Council

Constant consultation between the heads of the divisions, the medical profession, government personnel in the ministries and the procurement agencies will be necessary for successful implementation of the project. A semi-permanent advisory council to advise the Chief Executive will be useful. A probable composition of the advisory council would be:

Figure I. Flow chart of a medical appliances project

Government plans for health programmes; government policies and international trade agreements; fund allocations and procurement policies

Design preferences, professional priorities, functional requirements of the medical profession; innovations in ideas and liaison with industry as regards new developments; qualitative assessment and certification

Stage 1

Reaction and response of the general public, who are the actual beneficiaries of the industry

Product identification; tentative plans for development and eventual commercial exploitation

Company's marketing expertise; local and export potential; quantitative evaluation of the demand perspective

Stage 2

Company's financial status; estimate of profitability

Decision on experimental production; prototypes; finalization of the tentative product design; qualitative evaluation of prototype

Company's design and technology group; prototype workshop; liaison with external sources for prototype production

Stage 3

Modification and improvement; finalization of the product design; experimental production and test marketing; assessment of professional and public response

Decision on commercial production; instructions to the works

Stage 4

Production

Marketing

Figure II. Proposed organizational structure of a medical appliances plant

Advisory Council

Consultants/consultancy groups, export marketing, production engineering, instrumentation, different technologies as and when required

Chief executive
(Medical appliances production)

Div. 1
Head of the Central Technology Division

Div. 2
Head of the Central Tool Room

Div. 3
Head of the marketing

Div. 4
Head of the Finance

Div. 5
Head of Repair Workshop

Div. 6
Head of Manufacturing Unit

Unit 1
Thermometer

Unit 2
Light engeneering complex

Unit 3
Microscope

Unit 4
Electronic complex

Unit 5
X-ray film

Dept. 1
Stethoscope

Dept. 2
B.P. apparatus

Dept. 3
Medical appliances and equipment (other than electronics)

Dept.4
Surgical instruments

Dept. 1
E.C.G.

Dept. 2
Hearing aids

Dept. 3
Laboratory equipment

	Number
Chief Executive	1
Head of the Divisions	5
Senior surgeon	2
Senior physicians	2
Representatives of the Ministries	2
Representatives of the procurement agencies	2
Representative of the Private Sector	1

Note: Since ACDIMA represent different countries it may be necessary to co-opt individuals in turns.

This council should meet at least once in three month to review the progress of the production units with repsect to targets, sales, quality, market reaction and to guide the production and organization.

Consultants/consultancy groups

Because, owing to the widely varied types of technology needed, it would be impossible to provide each unit with specialist staff, it is recommended that specialists in different technologies be retained by ACDIMA for consultation. In the initial stages, until ACDIMA's own expertise is developed, it may be necessary to enlist the services of consultants/consultancy groups in the following fields:

Production engineering
Instrumentation
Export marketing

In selecting the consultants, ACDIMA may profitably benefit by choosing suitable personnel from both the developing and developed countries.

Marketing and distribution

Even though medical appliances and drugs and pharmaceuticals are meant for the same customers - medical profession and hospitals - it may not be advisable to combine the marketing of medical appliances with that of drugs and pharmaceuticals. The former will need a technical bias, particularly for after-sales service. Also, medical appliances will in general be of non-consumable nature and hence continuous review of the demand potential and identification of new products or possibilities for diversification will be necessary, as will a constant comparison with competitive prices. Export marketing of medical appliances will also be of vital importance. The methods of distribution, stocking and pricing will be dependent on the individual situation in each country with respect to each product.

Thus, it is recommended that the marketing of medical appliances should be treated as a separate function. If, for the sake of effective co-ordination or marketing for the entire ACDIMA operation, medical appliances should be treated along with drugs and pharmaceuticals, a separate division under a high-level executive (director) in the company should be considered imperative.

F. Quality control

Quality control, as an arrangement to control, check, test, calibrate and standardise the quality of the industrial products, serves a vital role in the management of an enterprise. The success of the quality control department will depend on its ability to integrate the quality consciousness and efforts of the production staff with the fact-finding and fault-recording functions of the inspectors into a helpful and purposeful team activity so as to improve the performance of the unit and hence its profitability. Ultimately, the quality control's performance is judged exclusively by the reputation of the company's products for their quality among the customers who, in the case of the medical appliances, are the medical profession.

Essentially, the quality control efforts relate to inspection of the components in process; if this is taken care of, then the final product is likely to go through quality standards at the finished stage more easily.

Inspection of the operations in progress at strategic points, rather than cent per cent inspection at all points, will enable spotting the defective parts in the right time. A systematic and properly organised reporting system, however, will be necessary.

As is the case with any other manufacturing enterprise, the medical appliances industry heavily depends on the quality control department for a variety of jobs that react with almost all other functions in the organisation. As such, the head of the quality department has to be a good all-rounder. A successful quality control engineer perhaps has the nearest opportunity to succeed the chief executive in the hieararchy.

In order to appreciate the special problems of quality control in this industry, it may be pointed out that generally the medical appliances may be classified as under:

a) Those which have well defined physical and functional characteristics, which are measurable, e.g. Thermometers.
b) Those which have certain, elements which defy precise measurement, e.g. surgical sharpness.
c) Those which are multi-component assemblies with a variety of technologies involved, hence dependant for its final quality on the individual quality of the components that are often bought out from sources other than the production unit concerned.

As a result of the above inherent elements in manufacture, the industry mainly depends on pre-purchase standards and not on durability standards as are available in other industries. This explains the heavy dependence of the purchaser on the 'brand name' i.e. the reputation of the manufacturer.

In the light of the above, the quality control department has to inter-act with the following:

a) Medical profession: Constant liaison is vital with the medical profession, both for seeking their reactions to the functional quality of the manufactured products, as well as or their ideas for new development. The quality control engineer will then be the bridge between the designers and the production personnel and medical profession.

b) International standards Organisations: In spite of the variety of problems of technology, preferences etc., a number of countries have finalised outlines of specifications. Their standards have a great bearing on the acceptance of the products, particularly for export marketing. These generally specify the basic material, process technology in brief and test details. The Quality control department has to be familiar with the international standards. A new dimension in export marketing is also the specifications acceptable to world organisations like the UNICEF which have significance in marketing. Thus one has to be watchful on this aspect also.

c) Specialist institutes: Since the role of the quality control department is to check and encourage the quality efforts of the production departments, it becomes necessary for it to keep abreast with the latest techniques in processing. Intimate association with specialist institutes and participation in their seminars and technical sessions should be an important function of the higher level officers of the quality control department. Since the functional characteristics of the medical appliances etc. are still only vaguely known in the industry, active association with the newly established departments of BIO-medical Engineering has to be encouraged.

Apart from the special characteristics of the industry dealt with above, the quality control department has to be vigilant on the usual practice of inspection. These include:

a) Viewers : To observe, check with production documents and identify the 'defective' components; the earlier they are identified in the sequence of operations, the better, for unnecessary costs would not be incurred.

b) Flying squad: This consists of experienced inspectors who are constantly on the move round the entire sequence of operations, select random samples in a definite pattern and check on quality. This is particularly important in multi-component products. These personnel are also empowered, irrespective of their rank in the heirarchy, to stop production at any stage, if they are not satisfied with the quality.

c) Assembly inspectors: The inspectors who are to work with the assembly operations need to have an additional ability. Not withstanding all the precautions taken in the preceding operations, there is bound to be an element of human error and since the bulk of the costs of conversion would have been incurred by the time the materials come to the assembly line, the production staff have a ticklish problem on their hands- whether to re-work on some of the components and assemble into an acceptable product or to reject it outright. The inspector has a very vital role in taking this decision; he has to be practical and not wooden; he cannot also succumb to pressure and accept defective products.

d) Final acceptance: The inspector at this stage is not expected to be weighed with any other consideration except the insistence of the highest quality as specified in the production documents. His is the last option and opportunity in stopping a defective product, reaching the customer.

An independent check on the performance of the Quality control department would be the Statistical Quality control unit, that normally functions independent of the Chief of the Quality control department and reports directly to the Chief executive of the Unit. However S.Q.C. is possible only if the information system is thorough.

Figure III below gives a pattern of quality control organization that could apply to all the projects for the medical appliances considered in this report; detailing of the strength of the organization at different levels will have to depend on the structure of each unit. This will form an important part of the preparation of the detailed project report which is outside the scope of the current exercise:

Figure III. Organization of a quality control department

Chief Executive

Chief of the Q.C.

Data recording and feed back

S.Q.C

Deputy to Chief Q.C.
(preferably with high academic distinction)

Standards room
Laboratory
Liaison with professional bodies. - medical
Technological
Participation in seminars and sessions of the specialist associations.
Supervision over all incoming materials and bought out components.
Specialist advice to the production services.
High level attention to customers' complaints

Quality control Engineer
(preferably with prior experience in production techniques and leadership qualities, in addition to thorough familiarisation with Inspection procedures)

Shop

Final acceptance

Components production

Assembly

Appendix I

PRODUCTION OF MEDICAL INSTRUMENTS, 1966/67-1976

Ser.	Product name	Symb.	Production per year 66/67	67/68	68/69	69/70	70/71	71/72	1973	1974	1975	1976	Total	Remarks
1	Sterilizers elect. heated 22'28'41 Cm.	Qty	1360	3095	53	-	-	820	1142	2250	4180	5450	18350	
		Value	18608	40520	752	-	-	8814	18108	26772	46546	108950	268670	
2	Sterilizers with E.k burn 22'28'42 Cm.	Qty	735	1028	52	-	-	430	245	400	450	400	3740	
		Value	8519	14702	498	-	-	3682	3540	4059	3846	5050	44686	
3	Record syringes 2'5'10'20 Cm.	Qty	35980	55628	66600	36673	12981	-	-	-	-	-	207870	
		Value	17176	31438	32266	12068	3852	-	-	-	-	-	96800	
4	Artery forceps 14'16'18' bent'Pean' Koch 20 Cm.	Qty	1405	6966	350	2872	4435	4717	5437	3367	215	3120	35034	
		Value	6847	13237	612	4090	6196	6406	8314	4786	516	8947	61751	
5	Thumb & hooked forceps 14.5'16'18 Cm.	Qty	1364	-	7323	10100	1339	-	[illegible]	2528	1328	-	24008	
		Value	1980	-	9401	11371	1568	-	809	2645	2201	-	30035	
6	Syringe sterilizers 18 Cm.	Qty	5000	5000	9250	-	-	-	-	1975	-	5000	26205	
		Value	3750	3750	6937	-	-	-	-	1481	-	7620	23538	
7	Hypodermic needles R 1'2'12 & S 4' S 5	Qty	10788	312124	189490	241604	311412	448720	3663144	407240	141480	-	2421002	
		Value	180	5202	3158	4027	5190	7467	6052	6704	4716	-	42696	
8	Surgical Scissors 14'x16' 18'20 cm.	Qty	586	-	1319	3118	3414	5372	1861	1356	3719	983	21728	
		Value	823	-	1855	4547	4557	7512	2568	2944	4677	1081	36560	
9	Drum sterilizers 8 diff sizes	Qty	-	-	1397	2403	2294	5472	2184	3023	2960	2876	22609	
		Value	-	-	13770	10630	10590	38915	19400	29207	51416	44014	225938	

Ser.	Product name	Symb.	Production per year										Total	Remarks
			66/67	67/68	68/69	69/70	70/71	71/72	1973	1974	1975	1976		
10.	Electric Lamp	Qty	-	-	7	300	175	504	224	600	1042	1008	3860	
		Value	-	-	105	4500	2625	10080	4480	12000	20840	20160	74790	
11	Larynge scopewith 3 blad	Qty	-	-	1	224	100	526	72	360	250	100	1633	
		Value	-	-	30	5936	2600	15016	2160	10800	7500	3000	47042	
12.	Uterine curotte Sharp & Blunt 1/4'3/8'1/2	Qty	-	-	29	-	-	-	92	-	-	627	748	
		Value	-	-	116	-	-	-	368	-	-	2508	2992	
13.	Dressing forceps 14 cms	Qty	-	-	-	460	-	2357	607	2954	448	46	6872	
		Value	-	-	-	460	-	2457	607	2954	851	88	7317	
14.	Rib dilator	Qty	-	-	-	110	-	98	92	57	-	-	357	
		Value	-	-	-	1650	-	2450	2300	1425	-	-	7825	
15.	Tongue depressor	Qty	-	-	-	-	6128	4977	189	124	-	-	11390	
		Value	-	-	-	-	1532	1244	47	36	-	-	2859	
16.	Chiron lamp	Qty	-	-	-	-	217	152	60	150	-	-	579	
		Value	-	-	-	-	6510	7600	3000	7500	-	-	24610	
17.	Anaesthetic apparatus Boyle model (F)	Qty	-	-	-	-	5	14	-	81	-	58	158	
		Value	-	-	-	-	1200	3360	-	16200	-	11600	32360	
18.	Surgical knife handle	Qty	-	-	-	-	-	-	210	-	-	-	210	
		Value	-	-	-	-	-	-	210	-	-	-	210	

Ser.	Product name	Symb	Production per year 66/67	67/68	68/69	69/70	70/71	71/72	1973	1974	1975	1976	Total 1976	Remarks
19	Stethoscope	Qty	-	-	-	-	-	-	3	-	-	-	3	
		Value	-	-	-	-	-	-	4.5	-	-	-	4.5	
20	Dissecting set large and small	Qty	-	-	-	-	-	-	-	-	3434	571	4005	
		Value	-	-	-	-	-	-	-	-	9726	1290	11016	
21.	Nichol wound clips 16'18'20'22' mm	Qty	1900000	-	-	-	-	-	-	-	-	-	1900000	
		Value	2050	-	-	-	-	-	-	-	-	-	2050	
22.	Surgical knife 4'8'	Qty	232	-	-	-	-	-	-	-	-	-	232	
		Value	217	-	-	-	-	-	-	-	-	-	217	

Appendix II

CLASSIFICATION OF APPLIANCES/EQUIPMENT IN TERMS OF OVERALL TECHNOLOGY

Technology	S.No.	Name of the Appliances/ Equipment
Electronics	1	Electro Cardiograph.
	2	Electro Cardioscope.
	3.	Electro-Encphalograph.
	4.	Echo-Encphalograph.
	5.	Electro-Myograph.
	6.	Biological Oxygen Monitor.
	7.	Oximeter.
	8.	Ultrasonic foetus Monitor.
	9.	Homoglobin Detector
	10.	Audio Meter.
	11.	Electronic Temperature Monitor
	12.	Pulse Rate Monitor.
	13.	Blood Flow Meter.
	14.	Multichannel Recorder.
	15.	Spectrophotometer.
	16.	PH Meter.
	17.	Blood Cell Counter.
	18.	Gas Chromatograph.
	19.	Electrophoresis Apparatus.
	20.	Cardiac Defibrillators.
	21.	Cardiac pace Maker.
	22.	Sleep Inducing Machine.
	23.	Eye Magnet.
	24.	Hearing Aid.
	25.	Electro-Surgical Unit.
	26.	Short-Wave & Microwave Diathermy Machines.
	27.	Electro-Convulsive Therapy Machine.

28. Ultrasonic Therapy Machine.
29. Pulse Stimulators.
30 Selective Treatment Unit.
31. Chronexie Meters.
32. Progressive Treatment Unit.
33. Oscillo flux.
34. Audio Power Amplifier.
35. Closed Circuit Television.
36. Tape Recorders.
37. Video Tape Recorder.

OPTICS/ ELECTRO-OPTICS

1. Colorimeter.
2. Flourimeter.
3. Turbidity Meter.
4. Nephlometers.
5. Polarimeter.
6. Densitometer.
7. Urethoscope.
8. Microscope
9. Opthalmoscope.
10. Retinoscope.
11. Opthalmic Microscope
12. Perimeter.
13. Auriscope
14. Viscoscope
15. Slide Projector.
16. Overhead Projector.
17. Video Camera

18. Tape-Slide Synchronizer.

19. Syhoptophere.

<u>ELECTRICAL</u>

1. Centrifugal pump
2. Ultra Centrifuge.
3. Sterlizer.
4. Muffle Furnace.
5. Oven.
6. Distilled Water Plant.
7. Constant Temp. Bath.
3. Spark Cap Cautery Unit.
9. Infra-Red Therapy Machine.
10. Ultra-violet Therapy Machine.
11. Auto-Clave.
12. Incubator.
13. Wax Bath.
14. Deionised Water Plant.

<u>MECHANICAL</u>

1. Mechanical Blood Cell Counter.
2. Microtome.
3. Artificial Respirator.
4. Blease Pulmufrator.
5. Aneasthesia Machine.
6. Oxygen Inhauling Apparatus.
7. Dial Blood Pressure Gauges.
8. Stethoscope.

<u>GLASS</u>

1. Clinical Thermometer.

2. Blood Pressure Apparatus

3. Microscope Slides.

4. Periferial Glass.

5. Concave Glass

OPTO-
Electronics

1. Photo Flourographic Machine.
2. Dental X-Ray Machine.
3. X-Ray Diagonstic Machine.
4. Image Intensifier.
5. Tomograph.
6. X-Ray Therapy Machine.

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Appendix III

SCHEDULE OF MEDICAL APPLIANCE REQUIREMENTS IN THE TENTH YEAR OF THE PLAN

Sr. No.	Description	Class I 500 Nos.	Class II 1500 Nos.	Class III 6000 Nos.	Class IV 30,000	Physicians 100,000	Nurses 100,000	Population 150,000,000	Replacement %
1.	2.	3	4	5	6	7	8	8	10
1.	Thermometers	4 Doz. per unit	3 Doz. per Unit	3 Doz. per Unit	1 Doz per unit		-	10%	20%
2.	Stethoscopes	2 Doz. per Unit	1 Doz. per Unit	6 No. per Unit	3 Nos. per Unit	100%	20%	-	1%
3.	Blood Pressure Apparatus.	6 No. per Unit	4 NO. per Unit.	3 No. per Unit	2 No. per Unit	50%	10%		1%
4.	Microscopes - Student.	---------- 10,000 Nos.---------- Teaching Institutions.			-	-	-	-	1%
5.	Microscopes - Monocular.	4 per Unit	3 per Unit	1 Per Unit	-	1%	-	-	1%
6.	-do- Binocular - oil immersion lens	4 per unit	3 per unit	1 per unit in 50% of total	-	-	-	-	1%
7.	Fluorescency Microscopes.	1 per unit	-	-	-	-	-	-	1%
8.	Table Balances	1 per unit	1 per unit	1 per unit	1 per unit	-	-	-	1.0%
9.	Weighing Machine - Infant.	1 per unit	1 per unit	1 per unit	1 per unit	-	-	-	1.0%
10.	-do- Adult	2 per unit	2 per unit	1 per unit	1 per unit	-	-	-	1.0%
11.	Analytical Balances	2 per unit	2 per unit	1 per unit in 50% of the total.	-	-	-	3000 Nos. in Schools, Colleges etc.	1.0%
12.	Centrifuge Hand driven.	4 per unit	2 per unit	1 per unit 50% of total	1 per unit 25% of total	-	-	2000 Nos. in Labs. etc.	1.0%
13.	Centrifuge - Electrical.	4 per unit	2 per unit	1 per unit in 50% of	-	-	-	5000 in Labs etc.	1.0%

1.	2.	3.	4	5	6	7	6	9	10
14.	Haemotractit Centrifuge	1 per unit	–	–	–	–	–	–	1.0%
15.	Water Still 2 Litre-fuel heated.	–	–	1 per unit	1 per unit	–	–	–	1.0%
16.	Distilled water unit -Electrical	2 per unit	2 per unit	1 per unit in 50% of total	–	–	–	2000 Nos. for other uses.	1.0%
17.	Wheel Chair Invalid, Adult	4 per unit	3 per unit	2 per unit	1 per unit	–	–	5000 Nos. in Gen.use	1.0%
18.	-do- Child	4 per unit	3 per unit	1 per unit	–	–	–	500 in Gen. use.	1.0%
19.	Table Examining	4 per unit	3 per unit	1 per unit	1 per unit	–	–	–	1.0%
20.	Stretcher -Army type.	4 per unit	3 per unit	4 per unit	1 per unit	–	–	–	1.0%
21.	-do- Combination wheel & carrying, Assembled.	4 per unit	3 per unit	1 per unit	–	–	–	–	1.0%
22.	Dental Chair	4 per unit	4 per unit	2 per unit in 50% of total.	–	–	–	–	1.0%
23.	Operation Table for Gen.Surgery (simple).	4 per unit	4 per unit	2 per unit in 50% of total.	–	–	–	–	1.0%
24.	Operation table major-all movements	4 per unit	2 per unit	–	–	–	–	–	1.0%
25.	Suction unit, foot operated.	4 per unit	6 per unit	1 per unit in 50% of total.	–	–	–	–	1.0%
26.	Suction Units Electrical.	4 per unit	6 per unit	1 per unit in 50% of total.	–	–	–	–	10%
27.	Anaesthesia apparatus	4 per unit	3 per unit	1 per unit in 50% 2	–	–	–	–	1.0%

1.	2.	3	4
28.	Sterilizer Dresses (Assorted types)	4 per unit	3 per unit
29.	Sterilizer, Electric (Assorted types)	16 per unit	12 per unit
30.	Portable pressure Sterilizer	8 per unit	6 per unit
31.	High Pressure Sterilizer (Cylindrical & Rectangular)	8 per unit	6 por unit
32.	Autoclaves (V)	4 per unit	3 per unit
33.	Mayo's stand for instruments.	16 per unit	12 per unit
34.	Operation Threater Lamp-Ceiling needle with circular Track.	8 per units	6 per units
35.	Operation Theater Lamp Ceiling needle with circular Track Motorised stand.	8 per unit	6 por unit
36.	500 MA X-Ray Unit	4 per unit	2 per unit
37.	200 MA X-Ray unit	2 per unit	1 per unit
38.	100MA-X-Ray unit Heated Van Ch.	-	-
39.	Resustator	4 per unit	4 per unit

5	6	7	8	9	10
1 per unit in 50 units	1 per unit in 25 per unit.	-	-	-	1%
4 per unit in 50% of total.	1 per unit	-	-	-	1%
2 per unit in 50% of total	-	-	-	-	1%
1 ~~per unit~~ in 50% of total.	-	-	-	-	1%
-	-	-	-	-	1%
4 per unit in 50% of units.	1 per unit	-	-	-	1%
-	-	-	-	-	1%
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
1 per unit in 50% of Total.	-	-	-	[illegible]	-
2 per unit in 50% of total.	-	-	-	[illegible]	-

1.	2.	3	4	5	6	7	8	9	10
40.	Ph.Meters	3 per unit	2 per unit	1 per unit in 20% of total.	-	-	-	-	-
41.	Colorimeter	4 per unit	2 per unit	1 per unit 33.1/3% of total.	-	-	-	-	
42.	Spectrophotometer	-	-	2.6 forces					
43.	Flame photometer	----------	----------	2.6 times the current import	----------	----------	----------	----------	----------
44.	E.C.G.	5 per unit	2 per unit	1 per unit in 50% 2 units.	-	-	-	-	-
45.	Hearing Aids	-	-	2.6 Litres the pressure unit			-	-	-
46.	Insecticide Sprayers	-	-	6 per area covered as unit.			10,000	-	-
47.	Hot Air Oven	4 per unit	2 per unit	-	-	-	-	-	-
48.	Incubators	2 per unit	1 per unit	1 per unit in 50% of total.	-	-	-	-	-

Appendix IV

MEDICAL INSTRUMENTS, APPARATUS AND EQUIPMENT EXPECTED TO BE IN USE AT THE END OF THE DECADE

Sl.No.	Description	Requirements related to hospitals								Replacement demand	Grand Total
		Class I	Class II	Class III	Class IV	Physicians	Nurses	Population	Total		
1	2	3	4	5	6	7	8	9	10	11	12
1.	Thermometer	24,000	54,000	216,000	360,000	-	-	15,000,000	156,54,000	31,30,900	18,784,800 (19 MILL.)
2.	Stethoscopes	12,000	18,000	36,000	90,000	100,000	20,000	-	2,76,000	2,760	2,78,760 Nos. (2.7 Lakhs) 0.28 Mill.
3.	Blood Pressure Apparatus	3,000	6,000	18,000	60,000	50, 000	10,000	-	1,47,000	1,470	1,48,470 No. (0.15 MILL)
4.	Microscopes Student.	--	—	20,000 No. in different tracking institions					20,000	200	20,200 Nos.
5.	Microscopes Biological Monocular	2,000	4,500	6,000	-	1,000	-	-	13,500	135	13635 Nos. (13600 No.)
6.	Microscopes, biological Binocular	2,000	4,500	3,000	-	-	-	-	9,500	95	9595 No. (9600 No.)
7.	E.C.G.	2,500	3,000	3,000	-	-	-	-	8,500	85	8585 No. (8600)No.
8.	Hearing aids.	------	--------	2-6 times the current level of imports (i.e.2.6 x 5601) ---- ----					--------------		14562.6 (14600)
9.	Table Balances	500	1,500	6,000	30,000	-	-	-	38,000	380	38380 (38500)
10.	Weighing machine.	500	1,500	6,000	30,000	-	-	-	38,000	380	38380 (38400)
11.	Scale Physician.	1,000	3,000	6,000	30,000	-	-	-	40,000	400	40400 (40400)
12.	Analytical balances.	1,000	3,000	3,000	-	-	-	-	7,000	70	7070 (7100)
13.	Centrifuge hand-driven	2,000	3,000	3,000	7,500	(--- 2000 No. in non medical lab)			17,600	175	17675 (17700)
14.	Centrifuge electrical	2,000	3,000	3,000	-	(--- 5000 No. in non Medical lab.)			13,000	130	13130 (13130)
15.	Water-still - fuel heated.	-	-	6,000	30,000	-	-	-	36,000	360	36360 (36400)
16.	Distilled water apparatus Electrical	1,000	3,000	3,000	-	(3000 No. for domestic and non-medical institutions)			10,000	100	10100 (10100)
17.	Ph.meters	1,500	3,000	1,200	-	(2000 No. for non-medical labs.)			7,700	77	7777 (7800)
18.	Colorimeters	2,000	3,000	2,000	-	(500 No. in non-medical labs)			7,500	75	(7575 (7600)
19.	Spectrophotomer	---	----	------ 2.6 times the current level of imports (i.e. 2.6 x 1044) -- -- --- - - - - - - - - -							2714

1	2	3	4	5	6	7	8	9	10	11	12
20.	Flame photometer	-----	-----	-----	2.6 times the current levelof imports (ie2.6 x 600)				-----	-----	1560 (1600)
21.	X-ray film										
	a)	-----	-----	----- --	2.6 times the current level of imports i.e. 2.6 x 23.44)				----	----	60.944 (61[illegible])
	b) Rolls 70 mm.	-----	-----	-----	2.6 times the current level of imports i.e. 2.6 x 18000 Boxes)					----	46900 (50,000 Boxes)
22.	Suction apparatus Foot-operated.	2,000	9,000	3,000	-	-	-	-	14,000	1409	14140 (14200)
23.	Suction apparatus Electrical.	2,000	9,000	3,000	-	-	-	-	14,000	140	14140 (14200)
24.	Hospital steriliser, Table model. (Boiling water type] electrical.	8,000	18,000	12,000	30,000	--	-	-	68,000	600	68600 (67000)
25.	-do- Bowl and utensil sterilizer Electrical.	2,000	4,500	3,000	[illegible],500	-	-	-	17,000	170	17170 (17200)
26.	Portable pressure sterilizer - Electrical	4,000	9,000	6,000	-	-	-	-	19,000	190	19190 (19200)
27.	Steam sterilisor-(Pressure type)vertical	2,000	4,500	-	-	-	-	-	6,500	65	6565 (6600)
28.	Steam sterilizer Horizontal, Cyl. & Rech. types.	4,000	9,000	3,000	-	-	-	-	16,000	160	16160 (1620[illegible])
29.	Bacteriological incubator.	1,000	1,500	3,000	-	-	-	-	5,500	55	5555 (5600)
30.	Operation Theatre Table Hydraulic operated.	2,000	3,000	-	-	-	-	-	5,000	50	5050 (5100)
31.	Operation Threatre Table - Gen.purpose, non-hydraulic.	2,000	6,000	6,000	-	-	-	-	14,000	140	14140 (14200)
32.	Table-examining	2,000	4,500	6,000	30,000	-	-	-	42,500	425	42925 (43000)
33.	Wheelchair-invalid, Adult.	2,000	4,500	12,000	30,000	-	-	-	48,500	485	[illegible] (49000)
34.	Mayo's stand for instruments	8,000	18,000	12,000	30,000	-	-	-	68,000	600	69600 (69000)
35.	Stretcher.	2,000	4,500	24,000	30,000	-	-	-	60,500	605	60605 (61,[illegible]
36.	Stretcher trolley.	2,000	4,500	6,000	-	-	-	-	12,500	125	12625 ([illegible])
37.	Dental chair(power operated)	2,000	6,000	6,000	-	-	-	-	14,000	140	14140 (14200)
38.	Insecticide Sprayers.			36,000	-	-	-	10,000	46,000	460	46460 (46500)

Appendix V

ESTIMATED MARKET SHARE OF LOCAL PRODUCTS AND PRODUCTION CAPACITY FOR PROFITABILITY

.No.	Description	Total Quantity Expected to be in use after a decade.	Share of local products (70% of col.3)	Local production to supply demand in first 5 years.	Annual production capacity for profitability - Industrial Profiles.	Remarks
	2	3	4	5	6	7
.	Therumometers	19 MILL Nos.	13.3 MILL	6.95 MILL	2. MILL	A
.	Light Engineering Complex					
	i) Stethoscopes	0.28 Mill Nos.	0.196 Mill	90000 Nos.	18900 Nos.	B
	ii) Blood Pressure Apparatus	0.15 MILL Nos.	0.105 MILL	52500 Nos.	10350 Nos.	B
	iii) Medical Appliances:					
	a) Weighing machine - Infant.	38500 Nos.	26950 Nos.	13475 Nos.	2700 Nos.	B
	b) Centrifuge-hand driven	17700 "	12390 "	6195 "	1200 "	B
	c) Centrifuge - Electrical	13130 "	9191 "	4594 "	900 "	B
	d) Water-Still - Fuel heated.	36360 "	25452 "	12726 "	2550 "	B
	e) Distilled water Apparatus - Elec.	10100 "	7070 "	3535 "	675 "	B
	f) Suction Apparatus - Foot operated.	14200 "	9940 "	4970 "	1050 "	B
	g) Hospital Sterilizers Table Model (Boiling Water type) -Electrical.	69000 "	48300 "	24150 "	4000 "	B
	h) -do- Bowl & Utencil Sterilizer - Electrical.	17200 "	12040 "	6020 "	1200 "	B
	j) Suction Apparatus - Electrical.	14200 "	9940 "	4970 "	1050 "	B
	k) Portable Pressure Stabilizer Elec.	19200	13440	6720 "	1350	B
	l) Steam Sterlizier, Pressure tye-Vert.	6600 "	4620 "	2310 "	450 "	B
	m) -do- Horizontal,Cylindrical and Rectangular.	16200 "	11340 "	5670 "	1125 "	B
	n) Bacteriological Incubator.	5600 "	3920 "	1960 "	390 "	B
	o) Operation Theatre Table (Major)	5100	3570 "	1785 "	360 "	B
	p) -do- (non-hydraulic)	14200 "	9940 "	4970 "	997 Nos.	B
	q) Table Examining.	43000 "	40100 "	15080 "	3000 "	B
	r) WheelChair - Invalid.	49000 "	44300 "	17150 "	3450 "	B
	s) Mayo's Stand for Instruments.	69000 "	48300 "	24150 "	4800 "	B
	t) Stretcher.	61000 "	42700 "	21350 "	4200 "	B
	u) Stretcher - Trolley.	12600 "	8820 "	4410 "	860 "	B
	w) DentalChair (Power opeated)	14200 "	9940 "	4970 "	997 "	B
	y) Insecticide Sprayer.	46500 "	32550 "	22050 "	6300 "	B

2	3	4
iv) Surgical Instruments.	4.3 Million	3.00 Million
Microscopes:		
a) Microscopes - Students.	20200 Nos.	14140 Nos.
b) Microscopes - Biological Monucular.	13600 "	9520 "
c) Microscopes - Binocular.	9600 "	6720 "
Electrical Compley:		
a) E.C.G.	86000 "	6020 "
b) Hearing Aids.	14600 "	10220 "
c) pH Meters.	7800 "	5460 "
d) Colorimeters.	7600 "	5320 "
e) Spectrophotometer.	2700 "	1890 "
f) FlamePhotometer.	1600 "	1120 "
g) Analytical Balances.	7100 "	4970 "
h) Table Balance.	38500 "	26950 "
k) Scale-Physician.	40400 "	28280 "
a) X-ray films (Assorted Sizes)	61 Mill Nos.	42 MILL Nos.
b) 70 mm - Ro lls.	50000 Boxes.	35000 Boxes.

A : This capacity will be reached in second year; planned as a small unit, expansion in capacity will be through duplication and dispersal of units as and when required.

B : Expansion of capacity may be required by fourth year; within this group, changes in quantities are possible.

C

E : The production of surgical instruments will not be an economic proposition unless it is backed with aggressive export marketing; however, certain common instruments have been included in the list as the requisite skills are already available in Egypt. In the initial stages, the forging facilities available inCairo and Baghdad may be utilised. If necessary the forgings may be obtained from India. The erection of a seprrate forge shop will require a very high quantitative demand levels. The Industrial Profile therefore does not include a forge shop. Otherwise the proposal will be viable in the I/IInd year.

5	6	7
1.50 Million	0.3 Million	E
7070 Nos.	3000 Nos.	C
4760 "	1500 "	C
3360 "	750 "	C
3010 "	600 "	D
5010 "	2500 "	D
2730 "	860 "	D
2660 "	600 "	D
945 "	-	D
560 "	200 "	D
2905 "	4500 "	D
1[illegible]475 "	-	D
14140 "		D
21 Mill Nos. (2.1 MILL SQ.MET.)	3 MILL Sq.Met.	A review of capacity and commencing production of hard film may be made in 4th year.
21000 Boxes.	10500 Boxes.	B

: Though the unit is expected to reach profitability, it is through import of components and assembly review of capacity and product-mix is to be made in the fourth year when all components are made locally.

D : Capacity for profitability is reached in first or second year. But the performance should be monitered for the complex as a whole.

Appendix VI

TECHNOLOGY USED IN THE MANUFACTURE OF MEDICAL INSTRUMENTS

S.NO.	NAME OF THE TEST	ELECTRONIC	ELECTRICAL	MECHANICAL	OPTICS	TEXTILE	PAPER	GLASS	OTHER
1.	Electro Cardio scope	*	*	*	*	X	X	X	X
2.	Electro Cardiograph	*	*	*	X	X	X	*	X
3.	pH – meter	*	*	*	X	X	X	*	X
4.	Spectro Photometer	*	*	*	*	X	X	*	X
5.	Colorimeter	*	*	*	*	X	X	*	X
6.	Flame Photometer	*	*	*	*	X	X	*	Gas
7.	Gas Chromatograph	*	*	*	X	X	X	*	Gas & Chemicals
8.	Flourimeter	*	*	*	*	X	X	X	X
9.	Nephelometer	*	*	*	*	X	X	X	X
10.	Turbidity meter	*	*	*	*	X	X	X	X
11.	E.C.T. Machine	*	*	*	X	X	X	X	X
12.	Electro Surgical Unit	*	*	*	X	X	X	X	X
13.	Short Wave Diathormy Machine	*	*	*	X	X	X	X	Rubber
14.	Micro Wave Diathermy Machine	*	*	*	X	X	X	X	X
15.	Dental X-Ray Machine	*	*	*	X	X	X	*	Chemicals
16.	E.E.G. Machine	*	*	*	X	X	*	X	X
17.	E.M.G. Machine	*	*	*	X	X	*	X	X
18.	Cardiac Defibrillatos	*	*	*	X	X	X	X	X
19.	Cardiac Pace Maker	*	*	*	X	X	X	X	X
20.	Ultra-sonic Therapy Machine	*	*	*	X	X	X	X	Ceramic
21.	Ultra Voilet Therapy Machine	X	*	*	X	X	X	*	X
22.	Infra Red Therapy	X	*	*	X	X	X	*	X
23.	Pulse Stimulator	*	*	*	X	X	X	X	X
24.	Biological Oxygin Monitor	*	*	*	X	X	X	X	X
25.	Foetus Monitor	*	*	*	X	X	X	X	Ceramic
26.	Audio meter	*	*	*	X	X	X	X	Plastic
27.	Opthalmo Scope	X	*	*	*	X	X	X	X

S.No.	NAME OF THE INST.	ELECTRONIC	ELECTRICAL	MECHANICAL	OPTICS	TEXTILE	PAPER	GLASS	OTHER
29.	Oximeter	*	*	*	*	X	X	*	X
30.	Heomoglobin Detector	*	*	*	*	X	X	*	X
31.	Pulse Rate Monitor	*	*	*	X	X	X	X	X
32.	Multichannel Recorder	*	*	*	X	X	X	X	X
33.	Artificial Respirator	X	*	*	X	X	X	X	Gas
34.	Incubator	X	*	*	X	X	X	X	X
35.	Blease Pulmulfrator	X	*	*	X	X	X	X	Rubber
36.	Sleep Inducing Machine	*	*	*	X	X	X	X	X
37.	Anaesthemia Machine	X	X	*	X	X	X	X	Gas
38.	X-Ray Diagnostic Machine	*	*	*	X	X	*	*	Chemical
39.	Centrifuge	X	*	*	X	X	X	X	X
40.	Sterlizer	X	*	*	X	X	X	X	X
41.	Distilled Water Plant	X	*	*	X	X	X	*	X
42.	Densito-meter	*	*	*	*	X	*	*	X
43.	Electro-Phoresis App.	*	*	*	X	X	X	X	Plastic
44.	Thermometer	X	X	X	X	X	X	*	Chemical
45.	B.P.Apparatus	X	X	*	X	*	X	*	Rubber / Chemical
46.	Stethoscope	X	X	*	X	X	X	X	Plastic
47.	Hearing Aids	*	*	*	X	X	X	X	X
48.	Micro scope	X	X	*	*	X	X	*	X
49.	X-Ray films	X	*	*	X	X	X	X	Chemical
50.	Dental Requisites	X	*	*	X	X	X	X	X
51.	Plaster Bandages	X	X	X	X	*	X	X	Chemical
52.	Tongues	X	*	*	X	X	X	X	X
53.	Forceps	X	*	*	X	X	X	X	X
54.	Scissors	X	*	*	X	X	X	X	X
55.	Injection Needles	X	*	*	X	X	X	X	X

S.NO.	NAME OF THE INST.	ELECTRONIC	ELECTRICAL	MECHANICAL	OPTICS	TEXTILE	PAPER	GLASS	OTHERS
56.	Syringe	X	X	X	X	X	X	*	X
57.	Biopsy Needle	X5	*	*	X	X	X	*	Chemical
58.	Tuning Fork	X	*	*	X	X	X	X	X
59.	Percussion Hammer	X	*	*	X	X	X	X	X
60.	Pocket Torch	X	*	*	X	X	X	*	X
61.	Canula	X	*	*	X	X	X	X	X
62.	Rib cutting shears	X	*	*	X	X	X	X	X
63	Surgical Blades & Handles	X	*	*	X	X	X	X	X
64	Needle Sutures	X	*	*	X	X	X	X	X
65.	Surgical Guts	X	X	X	X	*	X	X	Rubber
66.	Catheters	X	X	X	X	X	X	X	Rubber
67.	Face Masks	X	X	X	X	X	X	X	Rubber
68.	Cat Guts	X	X	X	X	X	X	X	Rubber
69.	Biopsy Scrapper	X[illegible]	*	*	X	X	X	X	X
70.	Blunt Hook with crochet	X	*	*	X	X	X	X	X
71.	Cautery Blades	X	*	*	X	X	X	X	X
72.	Dissection Forceps	X	*	*	X	X	X	X	X
73.	Double Ended Dissector	X	*	*	X	X	X	X	X
74.	Hernia Director	X	*	*	X	X	X	X	X
75.	Speculum	X	*	*	X	X	X	X	X
76.	Foetoscope	X	*	*	*	X	X	X	X
77.	Viginal Depressor	X5	*	*	X	X	X	X	X
78.	Mucus Evacuator	X	*	*	X	X	X	X	X
79.	Sealp Vien Set	X	X	*	X	X	X	X	Plastic
80.	Compression clamps	X	*	*	X	X	X	X	X
81.	Disc. punches	X	*	*	X	X	X	X	X
82.	Chiusals	X	*	*	X	X	X	X	X
	[illegible]	[illegible]	*	*	X	X	X	X	X

S.NO.	NAME OF THE INST.	ELECTRONIC	ELECTRICAL
85.	Elevator & Dissector Set	X	*
86.	Spinal Manometer	X	X
87.	Amaputation Saw	X	*
88.	Femoral Head Extractor	X	*
89.	Aluminium Impactor	X	*
90.	Angled Osteo-tonnes	X	*
91.	Awl	X	*
92.	Bone Plates	X	*
93.	Spinal Elevator	X	*
94.	Surgical Hand Motor	X	*
95.	Strippers	X	*
96.	Skin grafting tool	X	*
97.	Nasal saw	X	*
98.	Dental Probe	X	*

MECHANICAL	OPTICS	TEXTILE	PAPER	GLASS	OTHERS
*	X	X	X	X	X
X	X	X	X	*	Chemical
*	X	X	X	X	X
*	X	X	X	X	X
*	X	X	X	X	X
*	X	X	X	X	X
*	X	X	X	X	X
*	X	X	X	X	X
*	X	X	X	X	X
*	X	X	X	X	X
*	X	X	X	X	X
*	X	X	X	X	X
*	X	X	X	X	X
*	X	X	X	X	X

Appendix VII

FACILITIES REQUIRED FOR THE PRODUCTION OF SELECTED MEDICAL APPLIANCES

Sl.No	Products	Qty. after a decade	Casting		Fabrication	Machining			Press work.	Finishing			Electronics.	Injection Moulding.	Optics	Glass	Electrical	Tool Room			[illegible]
			Non-ferrous	Ferrous		0	00	000		Grinding	Polishing	E.P.						0	00	000	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	Thermometer		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	•••	-	-
2.	Stethoscope		-	-	-	-	•••	-	-	•	-	••	-	•••	-	•••/000	-	-	-	•••	
3.	Blood Pressure Apparatus		••/000	-	-	-	••	-	•	•	••	••	-	•••	-	•	-	-	-	•••	
4.	Microscope-student		••	•	-	•	-	•••	•	•	••	••	-	-	•••	•	•	-	••	-	••
5.	" " Biological, Monocular		••	•	-	-	••	•••	•	•	••	••	-	-	•••	•	•	-	••	-	••
8.	" " Binocular		••	•	-	-	••	•••	•	•	••	••	-	-	•••	•	•	-	••	.	••
7.	E.C.G.		•	-	••	-	-	-	••	•	•	•	•••	•	-	•	••	-	••	-	
8.	Hearing Aids.		-	-	-	-	-	-	•	-	-	-	•••	••	-	-	••	-	..	•	
9.	Baby Balance		-	••	•	••	-	-	•	•	••	•	-	-	-	-	-	•	-	-	
10.	Weighing machine infant		-	••	•	••	-	-	•	•	••	•	-	-	-	-	-	.	-	-	
11.	Scale physician		-	••	-	-	-	•••	•••	••	••	••	-	-	-	•	-	..		•••	
12.	Analytical Balance		-	-	••	-	-	•••	•••	••	•	••	•	-	-	•	..	..	-	••.	
13.	Centrifuge, Hand-operated		-	•••	-	-	••	-	-	•	••	-	-	-	-	..	-	.	-	-	
14.	Centrifuge Electrical.		••/000	-	-	•	-	-	-	•	••	•	-	-	-	-	••	..	-	-	
15.	Water still, fuel heated.		-	•	••	•	-	-	••	•	-	•	-	-	-	-	-	•	-	-	
16.	Distill water Apparatus-Electrical.		-	-	•	•	-	-	••	•	-	••	-	-	-	..	•	•	-	-	
17.	P.H.Meters		-	-	•	•	-	-	••	•	•	•	•••	•	-	••/00	••	..	-	-	
18.	Colori meters		•	•	•	•	-	-	•	-	-	•	••	-	••	-	•	-	-	-	
19.	Spectrophotometer		•	-	-	•	-	-	•	•	•	•	•••	-	••	-	•	-	-	-	
20.	Flamephotometer		•	-	-	•	-	-	•	-	•	•	•••	-	••	-	•	.	-	-	
21.	X-Ray films		Separate process units																		
22.	X-Ray films 70 mm. Rolls																				
23.	Stretcher		-	-	•	•	-	-	•	•	•	..	-	-	-	-	-	-	-	-	
24.	Stretcher Trollys		-	-	••	-	-	-	•	••	••	-	-	-..	-	-	-	..	-	..	
25.	Dental Chair		-	•	••	-	•••	-	•	••	••	••	-	-	-	-	••	..	••	-	
25.	Operation Table Major		••	••	•••	-	•••	-	••	••	••	••	-	..	-	-	••	-	•.	..	
27.	Operation Table General.		-	-	•••	-	••	-.	••	••	••	•	-	-	-	-	-	..	-	-	
28.	Table Examination		-	-	•••	•	-	-	••	••	••	-	-	-	-	-	-	-	.	-	

S.No.	Products	Qty. after a decade	Casting: Non-ferrous	Casting: Ferrous	Fabrication	Machining: 0	Machining: 00	Machining: 000	Press work.	Finishing: Grinding	Finishing: Painting	Finishing: E.P.	Electronics.	Injection Moulding.	Optics	Glass	Electrical	Tool room: 0	Tool room: 00	Tool room: 000	[illegible]
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
29.	Wheel Chair, Invalid Adult		-	-	***	*	-	-	*	*	**	*	-	-	-	-	-	-	-	-	-
30.	Wheel Chair, Invalid Child																				
31.	Suction Pump Foot-operated		*	*	*	*	**	-	-	*	*	-	-	-	-	-	-	-	-	-	-
32.	Suction Pump, Electrical		-	-	**	-	**	-	**	**	**	*	-	-	-	**	***	*	-	-	-
33.	Hospital Sterilizer - Boiling Water type.		-	-	***	*	-	-	***	**	**	**	-	-	-	-	**	*			
34.	Bowl and utensil sterilizer.		-	-	***	*	-	-	***	**	**	**	-	-	-	-	**	*	-	-	-
35.	Steam sterilizer, Pressure type - Vertical.		*	-	***	*	-	-	***	**	**	**	-	-	-	-	**	*	-	-	-
36.	Steam Sterilizer, Pressure type Horizontal, Cyl. rectangular.		*	-	***	-	**	-	***	**	**	**	-	-	-	-	**	*	-	-	-
37.	Portable Pressure Sterilizer, Electrical		**	-	**	*	-	-	*	**	**	*	-	-	-	-	**	*	-	-	
38.	Bacteriological incubator.		-	-	**	*	-	-	**	*	*	*	-	-	-	-	**	-	-	-	-
39.	Mayo's Stand for Instrument		-	-	**	*	-	-	*	*	*	*	-	-	-	-	-	-	-	-	-

* Marginal Importance

** Fair Degree of Importance.

*** Very Important.

0 Normal Accuracy.

00 Medium Accurance.

000 Highly accurate/precision.

XVIII. INDUSTRIAL PROFILE ON SETTING UP A MANUFACTURING PROJECT FOR CLINICAL THERMOMETERS

The need for setting up a manufacturing base for clinical thermometers in a country is paramount as this is one of the basic requirements whenever a country embarks on medical care and health services. By and large the practice has been in most countries to import clinical thermometers from manufacturers located in Japan, Europe and the U.S.A. The production of clinical thermometers in U.K. was based on smallscale manufacture using the skills of glass blowers and glass technologists and only now automation has been resorted to.

Outlines of Technology: -2-

Technology involves the following processes:

1. Procurement of stores, basic raw materials
2. Blowing Section
3. Constriction Department
4. Bulb Measuring Department
5. Mercury filling Department
6. Mercury distillation Department
7. Mercury cutting Section
8. Topping and Sealing Section
9. Pointing and calibration
10. Waxing and dividing Section
11. Inspection and Packaging

Procurement of Stores. This includes:

i) Uniform glass capillary and if prismatic type of clinical thermometers are required the most popular type with an ovality and isoceles triangular cross section, can be imported from Cornings. Also glass tubing of uniform bore for making of Chambers.

ii) High-grade Mercury which could be imported from various sources such as Brazil, Chile, Italy etc.

iii) Hydrofluoric acid manufactured in most countries including developing countries like India.

iv) Bees wax for coating with a formula for composition to be provided by the source from which the technology is being obtained.

v) Fillers

Blowing Section

The process of blowing comprises of cutting capillary to size and blowing the bulb on to the capillary. The bulb itself is blown out of separate piece of tubing and Burshane, bottled gas or any other refinery or Coal gas can be used for this purpose as the glass used is generally soda glass. It is easier to work with soda glass when working manually and control the size of the bulb and the fusion process without causing any distortion in the capillary shape and size.

Constriction Department

This process involves the collapsing of the capillary under a Projection Microscope connected to vacuum lines enabling the collapsing of the section of the capillary forming constriction between the bulb which is the chamber and the capillary stem under constant view. A burner fed with gas is fitted with a flow control valve for manipulating the flow of gas and air.

Bulb Measuring Department

In this section the workers carry out the measuring of the bulb and also sealing. To ensure low rejection rate it is essential to have the bulb tubing supplied from the same source as the capillary as uniformity of size and bore not only helps in later calibration but also ensures aesthetic appearance and also enables the outward appearance to be maintained from piece to piece. The first three processes that have been described lend themselves to automation only if the alternative technology of a completely semi-automated plant is considered if the capacity established is with a minimum of 10 million pieces a year going upto 50 million pieces.

Mercury Filling Department
and
Mercury Distillation Department

Mercury filling is carried out in a separate Department. The distillation of mercury is also carried out in this Department. In this Department workers work in clean atmosphere and also it has effective exhausts and flue chambers for carrying away all mercury vapour in the atmosphere to outside open air thus minimising health hazards. The filling is undertaken using high vacuum pumping systems with filling chambers suitably designed and cut off valves and condensors as well as desiccators.

Mercury Cutting Section

As indicated above, this also involves working in a clean atmosphere free from dust; work should be done under the same conditions mentioned above.

Topping and Sealing Section

This process involves topping of the mercury after filling by placing the worked piece in chambers which are thermostatically controlled water baths. Mercury is removed and adjustment are carried out for the total scaling of the thermometers. This work is also carried out under identical laboratory conditions as the filling, that is, Flue chambers have to be provided and the workers work with the Flue chambers which have access from outside and are otherwise enclosed by glass panes. The excess vapours are also got rid of by exhaust fans into the open atmosphere.

Pointing and Calibration Department

This process involves the marking of the lower and upper fixed points and this can only be done by using High-Precision thermostatically controlled water baths with temperature controlled within $\pm$ 0.01°C. The temperature range is fixed and also the upper and lower points.

Waxing, Graduation and Dividing Section

Thermometers are now ready for being waxed and etched. Bees wax is used for waxing the stem of the thermometer and the thermometers are then placed on the dividing machines designed with limit switches to regulate the uniform marking and dividing over a fixed length of the stem. Thermometers are removed from the dividing machines and then placed on Pantographs for figuring and carried to chambers for etching by hydrofluoric acid fumes. Wax is then removed and the thermometers are ready for final etching and engraving with special compounds, which can stand usuage. The compound mixing mill with the known formula for the filter is also housed in this Department.

Grading, Checking, Inspection & Packaging

Thermometers are then checked and inspected and each thermometer is supplied with a certificate of test before it moves on to packing in individual containers and then into boxes with multiples of either 10's or dozens depending upon the unit used for marketing which varies from country to country. Bulk packages containing 100 or 144 thermometers are then got ready for marketing.

Sources of Technology

The Industry is best suited for a medium-scale unit and where labour is comparatively cheaper it is suited for providing reasonable employment potential to unskilled and semi-skilled workers. Substantial expansion in terms of doubling and trebling of basic capacity can be achieved by marginal inputs of labour as also of machinery. Units can be commenced with a minimum capacity of 2 million thermometers per year output and additional capacities added to take it upto 6 million pieces per year fairly easily and comfortably. Technology for setting up plants for capacity between 2 million and 6 million and even larger capacity does not involve automation and the processes, at least in so far as the cutting, sizing, making of the constriction and filling of the thermometer are involved, are on a manual basis. Such technology is available from even developing countries like India which has had experience with setting up plants both in the small-scale and medium-scale.

Countries like India have also set up production facilities but none of the manufacturing units have gone in for automation. It is considered feasible to have several small and medium-scale units rather than have a single automated plant, specially as there is plenty of unskilled and skilled labour at reasonable wage level available in India. Viable separate units, each of capacity of 3 to 5 million pieces annual output, can be put up as duplicate and triplicate units in the same campus.

When a unit of minimum installed capacity of 10 million pieces a year going to 50 million pieces a year is thought of as a beginning, then and then only would automation be considered. Where an automatic plant is required there also automation is generally restricted to the initial processes of cutting, sizing, blowing of the bulb and measurement of the bulb. Even in the existing manually operated plants the filling of mercury is already reasonably automated as it requires only one Foreman or Supervisor and in some countries even a skilled technician to carry out operation of filling as many as 10,000 units per day on a single shift basis by loading two plants which he can easily supervise. On double shift basis the capacity can easily be increased and multiplied by additional vacuum filling plant under the same skilled supervision by a marginal input of providing an Assistant to the Supervisor.

Production Phasing

For an initial capacity of 2 million (1 million in one shift) in two shifts the requirement of labour force on an initial recovery of 66% which, after training of the manpower over a period of six months to a year should reach 75%, is worked out as follows:

	Section	Production per man month measured in units produced	Total manpower in 2 shifts for achieving the total production capacity		
			2 million	4 million	6 million
1.	Blowing	7,500 pcs	26	52	78
2.	Constriction	18,500 pcs	10	20	30
3.	Bulb measuring	35,000 pcs	6	12	18
4.	Mercuring filling	99,000 pcs by Foreman	2	2	2
5.	Topping & Sealing.	18,000 pcs	10	20	30
6.	Mercury cutting	10,000 pcs	20	40	60
7.	Pointing and Calibration.	15,000 pcs	12	24	36
8.	Waxing and etching.	5,000 pcs	36	72	108
9.	Grading, Checking and Inspection.	15,000 pcs	12 2 Fore-men	24 2	36 2
10.	Packaging	25,000 pcs	8	16	24

Total no.of workmen required for 2 million units	140
Total no. of Foremen	4
Watch and Ward	9
Administrative Officer	1
Project Manager to commence the project during the setting up of the project.	1
Administrative Staff suited to the local conditions dependent upon labour welfare regulations.	1
Accounts Officer with supporting staff.	1

Plant and Machinery

The Plant and Machinery requirements are outlined in appendix I.

Plant Layout

Several factors have to be considered when contemplating selection of firstly the country and then the site. A country where such a unit is contemplated must have health-care centres and hospitals for domestic consumptionof 2 million units with possibility of expansion to meet the demands of the neighbouring countries.

The site to be chosen should be comparatively free from dust but this can be ensured by providing air-conditioning and positive pressure conditions in the actual production, calibration, testing and packing areas.

Minimum requirement of land would be 10,000 sq.metres. The intention is to set up an initial capacity of 2 million pieces per year based on a double shift to get a more economic use of the installed plant and machinery. It is therefore visualised to start with a small factory unit with a floor area of 1000 sq.mt. and gradully build multiple units for the additional capacities to be established at a subsequent period of time; when this is required on the same basis, e.g., if 6 million capacity is required, 3 such units will be built up with its level on plant and machinery and independent working the coordination between one or more units being possible by single Administrator; the marketing will be handled still by the same agency immaterial of the output for 2 million units or 6 million per year. Based on the floor area of 1000 sq.mt. the factory will have to be constructed as a reinforced RCC structure on a single level basis with an administrative and office block of 250 sq.mt. which may be with a split level and basement. As all the processes involved require a dust-free atmosphere, equipment will have to be provided to create a positive pressure inside the factory premises to keep dust out as also to be provided with air-conditioning to keep the inside temperature levels reasonably comfortable. Sometimes it is more effective to provide evaporative coolers for hottest period of the year for keeping the temperature and humidity at comfortable level. Supplemented by central air-conditioning due to ambient temperature at site being in excess of 45°C in the shade, it is desirable to have a supplementary source of cooling which could be provided by using what are known as evaporative coolers. These comprise of exhaust fans, drawing outside air through screens of wood shavings used as packing material in the screens. Wood shavings themselves are kept wet by having water continuously dripping on them and recirculating by water pumps from storage tanks both placed on the top and below the evaporation screens. These are very effective if the humidity is low and also help in conditioning the internal humidity of the plant. The inside area can then be more effectively air-conditioned at more reasonable costs.

The earlier consideration of selecting a site free from dust by locating in environments which were otherwise free from dust such as high altitude near the sea or with equitable climates all the year round no longer apply as with air-conditioners and positive pressure equipment now in use one can overcome these problems and provide artificial climate suitable for any industrial process.

As some of the processes involved deal with the handling of mercury distillation and filling, it will also be essential to provide at the time of construction certain areas where these processes are being carried out with exhaust dust and fuel chambers to ensure that mercury vapours are got rid of in the most effective manner without creating any health hazards either to the workers or to the environment.

A flow diagram showing the flow layout plan from Section to Section in the unit and the movement of the work is given in appendix II.

The floor area indicated above does not take into consideration the provision of facilities for the working population which are determined by legislation, which varies from country to country and State to State. The floor area required Sectionwise can be broken as follows:

1.	Stores	50	sq.mt.
2.	Blowing Section	125	" "
3.	Constriction Section	50	" "
4.	Bulb Measuring Section	30	" "
5.	Mercury Filling	125	" "
6.	Topping and Sealing	75	" "
7.	Pointing, Graduation, etc.	200	" "
8.	Inspection, grading, etc.	100	" "
		755	" " say, 750 sq.mt.

Raw materials and calculation of sales price

The cost of raw material has been given in appendix III, along with the calculated cost per piece of $0.45.

Land and Building

As already indicated above, the total area requirement is 10,000 sq.metres. The cost of land being not available, the cost of land is being excluded from estimates given below:

	Dollars
1. Cost of building based on $ 250 per sq.mt. and total constructed area at 1000 sq.mt.	250,000
2. Cost of evaporative cooling for 500 sq.mt. @ $ 125 per sq.mt.	62,500
3. Cost of air-conditioning 500 sq.mt. @ $ 375 per sq.mt.	187,500
	500,000

Note: 1. It is assumed that as far as air-conditioning is concerned, this will operate either at 440 volts 3phase supply or 220 volts 50 cycles whichever is required.

2. It is assumed that the cost of construction will take care of laying down of service lines like electricity, power and water lines. No heavy electrical equipment is needed; all equipment used in the factory can be supplied for operation from 220 Volts 50 cycles.

Electricity, water, compressed air, steam, air-conditioning

The cost on these can be broken down as follows:

		Dollars
i)	Air-conditioning	250,000
ii)	Electrical fitting	10,000
iii)	Water services	5,000
iv)	Gas lines	5,000
v)	Compressed airlines	5,000

Raw materials

As indicated earlier, the bulk of raw material is imported in which case a lead time of six months should be taken into account when working on inventories. It is also assumed that cost of raw materials is 25% of the total cost which is the experience in most countries where production on a manual technology is involved. The cost of inventories for production of 1 million pieces per year on a six-monthly stock basis would average $35,000 and semi-manufactures and finished stock would represent an inventory lock-up of another $35,000.

The major requirement of raw material would comprise of:

i) uniform glass capillary and if prismatic type of clinical thermometers are required, the most popular type with an ovality and isoceles triangular cross section, can be imported from Cornings.

ii) High-grade mercury which could be imported from various sources such as Brazil, Chile, Italy etc.

iii) hydroflouric acid manufactured in most countries including in developing countries like India

iv) Bees wax for coating with a formula for composition to be provided by the source from which the technology is being obtained.

v) Fillers with formula to be provided by the source of technology

Operating Personnel and Supervision and Management

The break-up of the operation personnel can be given as under:

	No.	Salary per month	Total wage per month
i) unskilled workmen	149	90 $	$ 13,410

	No.	Salary per month.	Total wage per month
ii) Foreman supervisors.	4	200 $	$ 800
iii) Administrator	1	500	500
iv) Managers	2	375	750
		Total	15460

This is on the basis of a unit to manufacture 2 million pcs/year.

For the training it is estimated that the Supervisor should be able to effect training to unskilled workmen to carry out the manufacturing processes involved apart from the processes involved in calibration and checking in a matter of four weeks of unskilled and two weeks semi-skilled workers. In the case of calibration this would take probably a period of eight weeks to train a skilled worker to undertake calibration independently after a period of 8 weeks.

If it is intended to take personnel from India for training, provision would be required to be made as under:

Grade 'A' Administrator	$150 a day plus hotel accommodation 5 star hotel - short periods of 8 weeks each during one year is needed
Grade 'B' Manager	$100 a day plus accommodation 3 star hotel - short durations of 6 months to a maximum of 6 months
Skilled Technician	to train local staff - $50 a day plus accommodation with canteen facilities or $ 800 a month for a period of 12 months with conveyance and canteen facilities

in addition, air fare to and fro and cost of boarding and lodging.

Inventories

Inventories would consist of:

Raw materials on 6 months basis	$ 35,000
Semi-manufactures & finished goods on 6 months basis.	$ 35,000
Salaries and wages for six months.	$ 95,000

This is based on the basis of a unit for 2 million pieces and in the case of 6 million pieces/year, this will be correspondingly increased.

Feasibility analysis

The cost per unit in the first year (the capacity is yet to be established and the second shift is yet to be started) will be $0.45 based on the production of one million pieces a year. In the second year when the second shift is working, and the capacity would increase to 4 million, the cost is likely to drop to $0.35 and when the third unit is installed the capacity would go up to 6 million within the overall supervision of same technical personnel, marketing cost will also remain same, the estimated cost per piece will be in the region of $0.30 per piece.

A summary statement is enclosed as appendix IV which will give the cost of fixed assets and working capital under major heads.

Special recommendations

The processes involved lend themselves to a diversification if required into production of chemical thermometers and special-purpose thermometers used in meteorology observations as well as special thermometers used in Industrial processes except that a small metal workshop would have to be added to prepare the metal sheaths to act as protective sheets if the mercury thermometers are to be used for Industrial processes for immersion into tanks. This can be produced with the same technological processes without any increase in investment in additional plant and machinery. The only difference would be that the raw material for glass and capillary might be of different bores and diamters suited to the types of thermometers to be manufactured.

As distribution is dependent upon marketing channels used, assuming that distribution will take place through trade channels, i.e. wholesalers and retailers, the cost of this should be estimated as 1/3 of the cost of factory cost of thermomters to arrive at the retail selling price in the market. This distribution cost can further be reduced if direct sales are made to the health service centres and to wholesalers, down to a figure of 15% of the cost.

Appendix I

PLANT AND MACHINERY REQUIREMENTS FOR A CLINICAL THERMOMETER MANUFACTURING UNIT

S.No.	Name of the Machine	Required for 2 million unit No.	Value (U.S.$)
1	2	3	4
1.	Projection Microscope		
	1. Projection Microscope	5	15,000
	2. Dyname	1	250
	3. Batteries	2	250
	4. Electric Motor	1	100
2.	Electric furnace	1	12,500
3.	Mercury diffusion pump	2	25,000
4.	Air Compressor	1	2,000
5.	Compressed air oil removal filter with pressure regulator connection.	3 sets	375
6.	Electric motor		
	1 HP - One		
	3/4 HP - Two	3	375
7.	Shadograph	15	5,000
8.	Petrol gas generating unit	2	250
9.	Water baths	3	250
10.	Water baths	4	750
11.	Water baths	4	375
12.	Pantograph	4	5,000
13.	Pantograph racks	30	2,250
14.	Pantograph plates	2	50
15.	Dividing machines	3	3,750
16.	Centrifugal machine	1	250
17.	Centrifugal machine	1	375
18.	Hand centrifuges	2	15
19.	Hand centrifuge for thermometers	1	30
20.	Electrical centrifuges	1	125

1	2	3	4
21.	Centrifuges	1	15
22.	Mercury filling system	1	1,000
23.	Mercury washing column	1	250
24.	Desiccators	2	25
25.	Filling plant	1	250
26.	Stand and clamp with above	1	25
27.	Desiccatorplate	1	12
28.	Vertical pump	1	25
29.	Desiccators	1	17
30.	Desiccators	1	45
31.	Desiccators	3	125
32.	Air Compressors	1	1,000
33.	Air compressor 7.5 H.P.	1	500
34.	Electrical furnace	1	1,000
35.	Mercury distillation Apparatus with rotary pump	1	500
36.	One set distillation apparatus	1	125
37.	One mercury distillation apparatus double stage	1	250
38.	One alcohol distillation glass apparatus	1	125
39.	Pointing baths	6	1,875
40.	Constant temperature bath with troys	3	1,500
41.	Thermometers case	2	12
42.	Electric motor 1 H.P.	1	100
43.	Electric motor 1/66 H.P.	1	20
44.	Refrigeration unit	1	1,000
45.	Vacuum pumps	1	500
46.	Electric relays	3	125
47.	Glass cutting machine	1	37
48.	Dropper case	1	12
49.	Colouring machine	1	50

1	2	3	4
50.	Voltage regulator	1	50
51.	Oxygen regulator	1	37
52.	Tullu Motor pump	1	50
53.	Worm reduction gear box	1	150
54.	Worm reduction gear box	1	125
55.	Hot plate for gas with stand	1	50
56.	Voltage Stabilizer	1	200
57.	Cane Torsing	6	12
58.	Transformers	2	125
		Total	85,639
		+ Spares @ 10%	8,564
			94,203
		Say :	95,000

Appendix II

FLOW IN A CLINICAL THERMOMETER MANUFACTURING UNIT

Stores → Blowing Section

↓

Constriction and Bulb measuring

↓

Mercury filling, topping and sealing

↓

Pointing, Graduation, inspection and grading → Packaging → Output

Appendix III

COST OF RAW MATERIALS FOR AND ESTIMATED SALES PRICE OF CLINICAL THERMOMETERS

(At minimum recovery of 66%)

Capillary	250 pallots	
	@ $ 250 per pallot	$ 62,500
Mercury	30 flasks	
	@ $ 250 per flask	7,500
Bulb glass	500 Kgs.	
	@ $ 2.5 per kg.	1,250
Hydroflouric Acid	500 Kgs.	
	$ 3.25 per Kg.	1,625
Solvent	750 litres	
	@ $ 0.40 per litre	300
Lubricating Oil	600 litres	
	@ $ 1.25 per litre	750
Miscellaneous stores		5,000
Machine repair and maintenance		2,500
	Total	$ 81,425
	Say	82,000

Cost of bare thermometer = $ 0.23 per piece

Add : Packing, forwarding & despatch expenses
@ 0.05 per piece.

Average ex-factory cost = $ 0.23 + $ 0.05 = $ 0.28

Estimated overheads = $ 0.07

Average estimated marketing expenses = $ 0.10

Average selling price per piece: = $ 0.28 + $ 0.07 + $ 0.10 = $ 0.45

Annex IV

SUMMARY OF FIXED ASSETS AND WORKING CAPITAL

Fixed capital

1.	Cost of buildings with a total constructed area of 1,000 sq.mt. ..	$ 250,000
2.	Cost of evaporative coolers and air-conditioning. ..	250,000
3.	Plant and Machinery ..	95,000
		$ 595,000
	or say	$ 600,000

Working Capital

1.	Three months wages ..	$ 47,000
2.	Raw materials - 6 months ..	35,000
3.	Semi-manufacturers & finished stock - 6 months. ..	35,000

Note: In the cost analysis done in appendix III that arrives at $ 0.35, it does not take into consideration marketing cost which we have estimated at 10% depreciation of the verious fixed assets amounting to $60,000 and interest on working capital at 15% i.e. $ 10,500/-.

XIX. INDUSTRIAL PROFILE ON A LIGHT ENGINEERING COMPLEX

A. General

Based on a detailed analysis, it was observed that the establishment of individual production units to manufacture the following would not be economical:

a) Surgical instruments including dental equipment

b) Hospital appliances

c) Blood pressure apparatus and stethoscopes

As the production processes and technology are similar in nature for all the above three groups, a combined project profile for all the above products has been worked out.

Market Demand Potential

The market demand potential for the products is listed in appendix II.

In view of the wide range of specifications and designs of the products classified for the profile, the design preferences in the Arab countries and the more popularly accepted international specifications were considered. The specifications are based mainly on the Indian Standards Institute, British standards and other internationally accepted manufacturing agencies. A list of the specifications for the products is tabulated in appendix I.

The technology of manufacture of the products mainly relates to light engineering practice, though the production of stethoscope and blood pressure apparatus interact with the technology of plastics, rubber and glass. The overall manufacture of these items would also follow the same pattern as in the case of other products in the list. Since the market off-take indicated for these two items does not appear to be attractive enough to commence unit line production it is preferred to treat these two items along with the manufacture of other products. When the marketing of ACDIMA's products improves to a satisfactory levels both in internal as well as export markets, a decision could be taken to lay out separate units exclusively for these products.

The production facilities that would be necessary for processing the bulk of the products include:

a) Ferrous and non-ferrous foundry(the present indications on the market off-take do not justify the establishment of a foundry exclusively for medical appliances. It is presumed that the castings for the perspective programme will be procured from other foundries said to be available in the Arab countries or if necessary from other developing nations).

b) Precision machining - substantial range of the products will include precision machining.

c) Some of the components/products would also need medium engineering facility for machining.

d) Substantial quantum of work will also include welding, presswork, fabrication and assembly.

e) Other operations which will be required would be electroplating, anodising, painting (oven baked) and enamelling.

f) A number of components/accessories like electro-motors, controls and general hardware may be bought out.

Based on the overall considerations of technology briefly mentioned above and the pattern of market potential indicated earlier, a phased production programme has been worked out and indicated in appendix II.

In order to assess the requirement of plant and equipment for a viable production programme that would also meet the market demand in a phased schedule, a detailed analysis of equipmentwise work content has been made and indicated in appendix IV.

For purposes of identifying the types and number of equipments for the phased programme, it is assumed that the plant will work in two shifts in the first year and in three shifts in subsequent years.

Plant Layout

In the experience of the authors, it is felt that the annual market demand for these products will not be uniform and consistent. There will be fluctuations in demand. It would be essential to take up for development, experimental production and commercial exploitation of more and more sophisticated instruments appliances and equipment. It is therefore proposed that the plant layout of the proposed unit should be functional and not in a flow-line pattern. The requirement of floor area for the full complement of equipments for each of the shop has been worked out and given in table below:

		Building Area in Sq. Meters.
1.	Machine shop	1,536
2.	Press shop	1,536
3.	Fabrication shop	1,536
4.	Assembly shop	2,458
5.	Electroplating	768
6.	Painting	1,536
7.	Stores-Raw Materials	460
8,	Stores - Finished products	800
9.	Packing	800
10.	Administrative Building	200
11.	Miscellaneous	500
	Total	12,130 sq.mts.

While working out the requirement of workshop space, provision has been made to include auxiliary space requirement like shop stores, tool stores, inspection space, maintenance locations, space for secretarial assistance on the shop floor and finished products stores, with the requirement of tooling for other projects and a separate profile is enclosed for a tool room. As such, for purposes of this profile, tooling costs have been evaluated and assumed in the feasibility analysis. As a corollary, no provision for tool room is included in this profile.

The various types of raw-materials and other standard items required for the phased five years programme for the different products have been calculated and evaluated. Accordingly, a list of equipment required with general specifications is given in appendix V.

The requirement of land for this project is expected to be 1.0 lakh (100,000) sq. mts. providing for possible expansion to three times the present capacity rating.

The details of tooling that would be required for this programme have also been assessed but this will be taken up in a separate profile for Tool Room.

Services

Taking a total view of the plant and equipment in multiple shift working, the requirement of electrical power has been worked out and indicated below.

a) Maximum demand - 700 KVA

b) Power consumption per annum 9,81,800 units.

For purposes of operating the unit in the multiple shifts as indicated in the production programme, the direct labour requirement has been assessed and indicated in appendix VI.

Based on the normal engineering practice, the requirement of indirect labour including managerial, supervisory and auxiliary services like inspection and quality control, maintenance, store keeping and works accounts, general and personnel administration, has been made and listed in appendix VI.

Feasibility Analysis

Certain assumptions have been made for working out the feasibility analysis. They are listed below:

1) Auxiliary material	2% on sales value
2) Repair & maintenance	1% on cost of plant & equipment.
3) Depreciation:	
a) Building	5%
b) Plant & Equipment	10%
4) Training	66.6% of the Training expense has been amortised in the first year of operation and the remaining 33.4% has been amortised in the 2nd year of operation

5) Consultancy fees	2% on investment.
6) Misc. expenses	1% on sales value.
7) Interest on working capital	15% for six months requirement.
8) Marketing.	12.5% on sale value.
9) Royalty	This provision has been made for two items namely (a) Operation Theatre table-hydraulic - major and (b) Dental Chair at 8% of sale value.

Based on the above assumptions and the data reflected in the earlier paragraphs, a comprehensive feasibility analysis has been made and given in appendix IX. It will be seen that the plant will breakeven in the second year of its operation and reach a return of 14% in the second year of operation. However, it may be noted that the analysis does not take into account the cost of land. It is understood that the cost of land varies from place to place even within the same country, and that special concessional rates are made available by the Government in certain industrial areas. This will suffice to say at this stage that the plant proposed will result in a breakeven in the second year and satisfactory return on investment in the third year.

Special recommendations

1. While bulk of the products in the list would be developed, pooled up and manufactured with the staff pattern provided for in the profile, it would be advisable to take up the following items under licence in collaboration with established manufacturers in the west:
   i) Operation Theatre table, hydraulic - Major
   ii) Dental Chair.

2. This recommendation has been made in order to expose the technical staff and workers to the design features of the latest designs of hospital equipment and also to meet the ready acceptance of the medical profession.

3. As already indicated, the production of blood pressure apparatus and stethoscope could be separated out from this unit at a suitable time when the market so warrants.

Taking an overall view of the infrastructure available in the Arab countries, it would appear that the choice to locate this unit would either be in Egypt or Iraq. This decision is to be taken by ACDIMA.

Conclusion

While the plant proposed is a general purpose and versatile unit, in order to take up wide range of product-mix, it would also be necessary to develop ancillary supports in the region so that the parent body concentrates on more critical aspects of manufacturing for new developments and products and utilise the ancillaries for the common requirements.

B. Surgical instruments

Surgical instruments have been included as a separate project but within the light engineering complex proposed for the ACDIMA project.

The main consideration in introducing these items is the satisfactory skills and experiences available in concerned Arab Countries.

However, the profile is only for the limited production of 300,000 numbers including Haemostic forceps, scissors, dissection forceps, needle holders, instruments for gynocology and tooth extraction forceps as indicated in appendix X.

The plant and equipment proposed in appendix XI does not include facilities for a forge and toolroom. Forging could be obtained either from the existing forge-shops in Cairo or in Baghdad. If necessary they could be obtained from India also. Provision of a separate forge shop for surgical instruments production at the level of 300,000 /annum will not be economical unless the production is expanded to at least 1.5 million numbers/annum.

As and when the production for surgical instruments increases the manual operation also will have to be spread out into small-scale units. The integrated plant for such a massive production will also not be economical. Product mix proposed for this profile has been so selected that the unit will break even in the first and second year depending upon the rapid development of skills and productivity. The feasibility analysis is indicated in appendix XII.

Requirements of the investment, manpower, raw material and services are indicated in appendix XIII.

The profile does not also indicate the details of raw materials as it has been presumed that the forgings will be obtained from elsewhere.

The surgical instruments production should be treated as an integral part of the light engineering complex proposed and its importance assessed in terms of providing the surgeon requisite instruments along with the other items of medical appliances and equipment included in the report.

Appendix I

MAJOR ITEMS OF MEDICAL EQUIPMENT

1. BINAURAL COMBINATION - STETHOSCOPE

   With integrally moulded 'Y' shaped tubing — IS: 3391-1965

2. SPHYGMOMANOMETER: — IS: 3390-1965

   Mercury type — BS: 2744-1956

3. WEIGHING MACHINE, INFANT — IS: 2489-1963

   Spring Balance, self-indicating type — BS: 1887-1966

   The pan for the baby will be an open ended trough of approximate dimentions:

   550 x W300 X D 125 mm
   Capacity - 15 Kg. - Graduation 50 gm.

4. ELECTRIC SUCTION APPARATUS: — IS: 7080-1973

   Twin-bottle suction apparatus, housed in a cabinet and provided with castors for mobility. Each receptacle capacity: 2.3 litres approx. Single-stage rotary vacuum pump to obtain 635 mm Hg.

5. FOOT-OPERATED SUCTION PUMP:

   Mounted on wooden base fitted with 2 Nos. of 500 cc Bottles. Ultimate vacuumof pump 660 mm Hg.

6. CENTRIFUGE, HAND-OPERATED

   to hold two test tubes.

7. CENTRIFUGE, ELECTRICALLY-OPERATED

   with dial rheostat control motor for variable speed upto 4830 RPM on AC mains - Cast Aluminium housing with rubber shock - mounts - Six place angle head for 15 ml. tubes.

8. HOSPITAL STERILIZERS - TABLEMODEL: — IS: 5022-1973

   (Boiling Water type) — BS: 2904-1957

Size	Length	Width	Depth	Wattage
Small	300	150	125	1000
Medium	430	200	150	2000
Large	510	200	150	2500

Features:

- Heat Control with automatic ejection device.
- Special recessed lid to prevent water dripping outside the sterilizer.
- Lifting device for perforated trey.
- All components other than drain cock and heater are made of stainless steel.

9. BOWL AND UTENSIL STERILIZERS — IS: 5035-1969

(Pedal Type) (Sterilizer Dressedera)

Electrically-heated, with foot pedal lifting and silent pump closing action.

Size: L760 x W500 x D480 mm.

Load: 12 KW - 3 phase, 440V Ac mains.

10. PORTABLE PRESSURE STERILIZER

Electrically-operated, cast aluminium construction - self-contained immersion type heating element and automatic thermostatic control, pressure release valve and pilot lamp. Fitted with tilted pressure gauge.

Capacity	-	15 litres
Load	-	1000 watts.

11. VERTICAL STEAM STERILIZER - PRESSURE TYPE :

To operate at 20 p.s.i. Sterilizing temperature 260°F (127°C)

Size: Dia. 400 mm x 600 mm deep

Heating capacity - 8 KW.

Fitted with Thermostatically controlled immersion - heater, pilot lamp, water level indicator, pressure gauge (Jacket), Compound gauge (Chamber) with safety and blow-off valve.

12. HORIZONTAL - CYLINDRICAL AND RECTANGULAR STEAM STERILIZER - PRESSURE TYPE — IS: 4510-1968; BS: 3220-1960; BS: 3219-1960

Electrically heated to operate at a working pressure of 2.25 KG/Cm^2 (136°C) with necessary controls and safety devices.

Sizes:

Cylindrical - 500 mm dia x 900 mm length
heating- 15 KW - 440 Volts

Rectangular: W 600 x L 1500 x H 900 mm.
heating - 20 KW - 440 Volts

13. WATER STILLS FOR PYROGEN - FREE DISTILLED WATER - (electrical) IS: 3830 - 1970

Capacity - 2 litres/hr

Wattage - 3,000

Electrically heated, round shaped stainless steel still for easy cleaning - Wall mounting type.

14. WATER STILLS FOR PYROGEN-FREE DISTILLED (Fuel-Heated) WATER CAPACITY - 2 lit/hour
round shaped stainless steel still for easy cleaning - wall mounting type.

15. ELECTRIC BACTERIOLOGICAL INCUBATORS IS: 3118-1965
Inside Chamber sizes (in mm)

Size	Width	Depth	Height	Wattage
Size I	350	350	350	1000
Size II	450	450	600	1500
Size III	600	600	600	2000

Double walled inside made of thick anodized aluminium with enamelled steel exterior. The door has "double viewing" glass window to permit observation without disturbing thermal conditions.

The adjustable temperature control is by bi-metal thermostat from room temperature to 70°C. Provided with perforated shelves adjustable at any level, to work on 240 volts AC mains. Motor with air circulating fan is provided for size III.

16. DENTAL CHAIR: IS: 6116 - 1971

Power operated.

Heavy non-tip base, raises, lowers, locks and completely revolving. Full automatic foot-rest. Seat and back rest sprung with foam rubber.

Seat height - 550 mm with a travel of 200 mm. Outside width 635 mm. Seat of the chair to carry 300 kg.

17. OPERATION THEATRE TABLE, HYDRAULIC - MAJOR. IS: 5291-1969

Length	-	1800 mm
Width	-	500 mm
Height	-	750 mm minimum ⎫ ± 50 mm 1150 mm maximum ⎭

- Hydraulic lift controlled by foot pedal
- Trendelenburg and reverse Trendelenburg positions $45^{0} \pm 3^{0}$
- Lateral Tilt 20^{0}
- Three-Section stainless-steel table top with large perineal cut-out for drainage tray.
- Full width adjustable head rest
- Foot extension
- Shoulder support
- Anaesthetic screen
- Short and long lateral supports on kidney elevator
- Leather wristles
- Knee crutches
- Shoulder Bridge
- Permeable Table top for Radiography with Cassette trays.
- Mounted on heavy duty castors with non-skid compensating floor locks actuated bya pedal.

18. TABLE, OPERATION, GENERAL PURPOSE (NON-HYDRAULIC) IS: 6328-1971

Dimensions : Length - 1800 mm
Width - 500 mm
Height - 865 mm.

- Frame work of continuous lengths of mild steel tubes, securely welded to give desired shape. The floor ends of the tubular frame work is fitted with metal shoes with rounded edges.
- Table top in three section with shoulder rest and lithotomy rods.
- Trandelenburg 30^{o}
- Reverse Trandelenburg 20^{o}
- Head section capable of being raised to 60^{o} from the trunk position, and leg section capable of being lowered to about 90^{o}.

19. TABLE - EXAMINATION : IS: 4787-1968

Consisting of firm steel frame work and metal top with adjustable Head plate and legs fitted with rubber Shoes:

Length	-	1830 mm
Width	-	510 mm
Height	-	750 mm

20. INVALID WHEEL CHAIR : IS: 6571-1972 BS: 3124-1959 (Type A)

Non-folding type - self-propelled or pushed by attendant, made of tubular steel welded frame with cane/cushioned seat and back. Hand-operated positive-locking safety brake.

Overall size:	Length	:	1050 mm
	Width	:	680 mm
	Height	:	950 mm

21. MAYO'S INSTRUMENT STAND : IS: 6905-1973

with height adjustment, steel tubular frame and stainless steel tray - Oven Baked finish mounted on antistatic rubber castors:

Tray size: 560 x 415 mm adjustable in height from 830 to 1270 mm

22. STRETCHER TROLLEYS: IS: 4035 - 1967
(Without Top) BS: 2563 - 1967

Consisting of welded tubular steel frame work on antistatic rubber castors, for indoor use in hospitals.

Overall sizes: Length - 1220 mm
Width - 610 mm
Height - 785 mm

23. STRETCHER : IS: 4037 - 1967 BS: 896

With hard wood poles and handles with plain canvas cover, metal transverse bars, quick release pattern. Mounted on steel hoop feet.

Overall. Length - 2290 mm
Width - 585 mm
Height - 150 mm

24. Hand operated - continuous knapsack Sprayer - Piston type : 16 litre cap. IS: 3906 - 1974

25. Hand operated Compression Knapsack Sprayer non-pressure retaining type

Capacity: 9 litres.

Appendix II

ESTIMATED PRODUCTION AND CONSUMPTION OF MEDICAL APPLICANCES
(For the first five years of operation)

Sl. No.	Product	Expected Quantity in use by 5th year	Estimated annual production I	II	III	IV	V
1.	2.	3.	4.	5.	6.	7.	8.
1.	Binoural combination stethoscope	98,000	12600	18900	18900	18900	18900
2.	SP hygno manometer (Mercury type)	82,000	6900	10400	10400	10400	10400
3.	Weighing Machine, Infant	13,475	1800	2700	2700	2700	2700
4.	Electric Suction apparatus	4,970	700	1050	1050	1050	1050
5.	Foot operated suction pump.	4,970	700	1050	1050	1050	1050
6.	Centrifuge hand operated.	6,195	800	1200	1200	1200	1200
7.	Centrifuge Electrically operated	4,595	600	900	900	900	900
8.	Hospital sterilizer (Table Model) Boiling water type.	24,150	3200	4800	4800	4800	4800
9.	Bowl & utensil sterilizer (Pedal type)	6,020	800	1200	1200	1200	1200
10.	Portable Pressure sterilizer	6,720	900	1350	1350	1350	1350
11.	Vertical steam sterilizer (Pressure type)	2,310	300	450	450	450	450
12.	Horizonal - cylindrical & rectangular steam sterilizer	5,670	750	1125	1125	1125	1125
13.	Water stills for Pyrogen free distilled water (Electrical)	3,535	450	675	675	675	675
14.	Water stills for pyrogen free distilled water (fuel heated)	12,726	1700	2550	2550	2550	2550
15.	Electric Bacteriological Incubators	1,960	260	390	390	390	390
16.	Dental Chair	4,970	665	1000	1000	1000	1000
17.	Operation theatre table, hydraulic Major.	1,785	240	360	360	360	360
18.	Table operation, general purpose (non-hydraulic)	4,970	665	1000	1000	1000	1000
19.	Table examination	15,050	2000	3000	3000	3000	3000
20.	Invalid wheel chair	17,150	2300	3450	3450	3450	3450
21.	Mayo's Instrument stand	24,150	3200	4800	4800	4800	4800
22.	Strectcher Trolleys (without top)	4,410	580	870	870	870	870
23.	Strectcher	21,350	2800	4200	4200	4200	4200
24.	Hand operated continuous knapsack sprayer (Piston type)	31,500	4200	6300	6300	6300	6300
25.	Hand operated compression knap sack sprayer (Non-pressure type)	35,000	4650	6975	6975	6975	6975

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Appendix III

RAW MATERIAL REQUIREMENTS FOR
1 [illegible] MEDICAL APPLIANCES UNITS

No. Material	1.	2.	8.	4.	5.	6.	7.	8.	9.	10.	11.	12. (cylindrical)	12. (rectangular)	13[illegible].	14[illegible].	15 size (a)	[illegible]
I FERROUS:																-	
castings (Kg)	-	-	400	-	10	380	-	-	-	-	-	-	-	-	-	720	1[illegible]
sections (Kg)	-	20	185	770	195	45	-	-	500	100	500	2500	3800	30[illegible]	600	286	
Tubes (M)	2	-	-	2000	30	-	-	-	300	-	250	600	800	-	-	-	
Sheets (kg)	1	5	240	1150	58	-	10	-	-	-	3200	1000	2000	-	-		
II. NON-FEROUS																100	10
a. Aluminium																-	-
Casting (Kg)		--	-	-	-	·15		.	800		-	300	800	-	-	390	76
Sections (kg)	19,0	30	-	-	-	-	170	-	-	-	-	-	-	-	-	-	-
Sheets (kg)	-	5	-	-	-	-	-	-	-	10	-	-	-	-	-	-	-
Tubes (kg)	50 M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
b. Brass																-	-
casting (Kg)	-	-	-	-	50	-	-	-	-	-	2500	2500	700	-	-	-	-
Sections (kg)	-	30	10	30	~~56~~	10	-	-	-	15	500	1700	2200	-	-		
Sheets (kg)	-	-	-	-	5	-	-	-	-	-	-	-	-	10	10		
Tubes (M)	-	-	-	-	-	60	-	-	-	-	67	700	1200	200	200	-	-
c. Phosphor Bronze/ Gun metal																-	-
castings (Kg)	-	-	-	50	-	-	-	-	-	-	2500	2500	4000	-	-	-	-
																160	20
d. Stainless steel																-	-
Castings (kg)	-	-	-	-	-	-	-	-	-	-	[illegible]	1500	2000	-	-		
Sections (kg)	-	-	-	-	-	-	-	32	300	-	-	500	700	-	-		
Sheets (kg)	-	-	-	-	-	-	-	340	2712	-	800	8500	2200	400	400	470.6	47
Tubes (m)	-	-	-	-	-	-	-	-	100	-	-	-	-	200	200	-	
																447	44
III. PLASTICS & BAKELITE, PERSPEX ETC ($)	55.85	305.8	11.76	541.2	47	235.3	58.82	117.6	-	294.1	823.5	541	658.8	352.9	352.9	-	
IV. GLASS (tubes plate receptacles thermometer) ($)	-	88.23	-	[illegible].5	117.6	—	-	-	-	-	176.5	176.5	176.5	-	-	2152.9	22[illegible]
																-	
V. Electric Motors & ACCESSORIES [illegible]	-	-	-	13294	-	-	5647	1235.3	10117.6	1106.9	705.88	12941	14117.6	941	-	235.3	235
																-	-
VI. RUBBER CASTORS & WHEEL.	-	-	-	941.2	-	-	-	-	-	-	-	-	-	-	-	-	-
VII. Hard Ware ($)	37.64	37.64	35.29	-	117.6	5.88	70.58	-	176.6	5.88	705.88	1764.7	2[illegible]88.2	-	-	-	-
VIII. FABRICS ($)	-	64.7	-	153.0	-	-	-	-	-	-	-	-	-	-	-	-	-
IX. PRESSURE GAUGES	-	-	-	705.9	-	-	-	-	-	588.2	1882.3	1764.7	2355	-	-	423.5	623
X. & VACUUM CORD	-	-	-	-	117.6	-	-	-	-	-	-	-	-	-	-	-	-
XI. Upholstery, Cushion	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
XII. Insulating [illegible] ($)	-	-	-	-	-	-	-	-	-	-	-	688.2	882.3	-	-	-	
XIII. MERCURY ($)	-	176.5	-	-	-	-	-	-	-	-	-	-	-	-	-		
XIV. MISCELLANEOUS ($) Filters, valves, pumps		-	-	1294.1	-	-	-	58.82	1882.3	176.47	705.80	3529.4	4117.6	294.1	294.1		

Notes- Serial numbers indicated above the vertical columns refers to the discription of the Medical appliances indicated in appendix II.

SECTION 1

Appendix III

RAW MATERIAL REQUIREMENTS FOR
MEDICAL APPLIANCES UNITS

	12 ..lar)	13	14	15 size (a)	15 size(b)	15 size(c)	16	17	18	19	20	21	22	23	24	25
si..				-	-	-	20,000	22500	2000	-	-	-	-	-	-	-
-		-	-	720	1100	1600	700	15400	3250	500	300	390	393	290	50	30
11		30..	600	286	450	600	-	700	800	1500	800	365	940	-	-	-
		-	-	-	-	-	-	-	4500	1488	120	-	-	-	-	-
-		-	-													
				100	100	100	500	230	-	-	50	-	-	-	-	-
				-	-	-	500	100	-	-	-	-	-	-	-	-
1C		-	-	390	760	1150	500	-	-	-	-	-	-	-	-	-
76		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-		-	-	-	-	-										
-		-	-	-	-	-	1000	1600	-	-	-	-	-	-	50	50
-				-	-	-	500	2000	-	-	-	-	-	-	800	50
-				-	-	-	-	-	-	-	-	-	-	-	300	200
-		-	-	-	-	-	-	-	-	-	-	-	-	-	400	100
-		-	-													
		10	10													
		200	200	-	-	-	500	1800	-	-	-	-	-	-	-	-
-																
				-	-	-	-	-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	3300	-	-	-	-	-	-	-	-
-				160	200	390	-	1000	900	-	-	260	-	-	-	-
20				-	-	-	-	-	-	-	-	-	-	-	-	-
-		-	-													
		-	-													
		400	400	470.6	470.6	470.6	-	633.5	294.1	47	-	-	117.6	-	-	-
47		200	200	-												
				447	447	564.7	-	-	-	-	-	-	-	-	-	-
44		352.9	352.9	-												
				-	-	3529.4	-	-	-	-	-	-	-	-	-	-
				2152.9	2270.5	3033.3	-	-	-	-	-	-	-	-	-	-
27		-	-	-	-	-	-	[illegible]	-	-	2747	470.6	1411.7	-	-	-
-				235.[illegible]	235.3	235.3	1176.4	3294	94.1	-	58.3	105.8	-	70.58	117.6	117.6
35.		941	-	-	-	-	-	-	-	-	-	-	-	470.58	117.6	50.82
-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-				-	-	-	-	-	-	-	70.8	-	-	345.9	2.94	5.88
-		-	-	-	-	-	4705.9	[illegible]7.6	-	-	-	-	-	-	-	-
-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
				423.5	623.5	823.5	-	-	-	-	-	-	-	-	-	-
-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23.		-	-	-	-	-	7050.8 (Bearings)	2717.6 (Bearings)	-	-	-	-	-	-	235.3	235.3
-		-	-	-												
-		-	-													
		294.1	294.1													

SECTION 2

Appendix IV

PRODUCTION EQUIPMENT FOR 100 MEDICAL AP

Sl.No.	Equipment	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.
1.	Centre Lathe	-	-	506	-	-	277	-	-	1995	890	613	2107	-	=
2.	Capstain I	2215	572	298	1340	335	277	-	-	-	297	230	1673	-	-
3.	Milling m/c 2nd operation	298	-	-	-	-	-	-	-	-	-	-	-	-	-
4.	Milling m/c No.s	-	-	450	838	-	-	-	-	399	297	153	2031	-	-
5.	Horizontal Borer	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6.	Slotting m/c	-	-	60	-	-	-	-	-	-	-	-	-	-	-
7.	Cylindrical grinder	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8.	Surface Grindar	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9.	Honing m/c	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10.	Gear Hobbing/shaping	-	-	120	-	-	-	-	-	-	-	-	-	-	-
11.	Abrasive cut off m/c	185	-	-	-	-	-	-	-	-	-	-	-	-	-
12.	Spl.Threading m/c	845	-	-	-	-	-	-	-	-	-	-	-	-	-
13.	Radial Drill/pillar dril	-	-	1680	-	-	-	-	-	-	148	153	930	-	-
14.	Bench Drill	527	57	149	1229	335	830	821	268	798	297	77	372	-	-
15.	Automat	-	3018	-	-	-	-	-	-	-	-	-	-	-	-
16.	Tapping m/c	105	-	179	665	56	-	149	-	-	-	-	-	-	-
17.	Power Hack Saw	-	-	-	-	-	-	-	-	399	-	-	-	-	-
18.	Guillotine shear	-	-	30	112	7	-	-	268	399	-	51	248	-	-
19.	Press Brake	-	-	-	223	-	-	-	260	798	-	-	248	-	139
20.	Plate Rolling m/c	-	-	-	-	-	-	-	-	-	-	230	578	38	-
21.	Nibbling m/c	-	-	-	-	-	-	-	-	798	-	77	434	-	139
22.	Pipe bending	-	-	-	335	112	-	-	-	-	-	-	-	231	-
23.	Seaming/Grooving m/c	-	-	149	-	-	-	-	1606	-	-	-	310	-	838
24.	Circular Sheet table cutting	-	-	-	-	-	-	-	-	-	-	-	-	38	139
25.	Welding m/c	-	572	-	2234	280	-	-	1606	1995	-	960	6136	231	1257
26.	Spl. Tube Bending M/c	212	-	-	-	-	-	-	-	-	-	-	-	-	-
27.	Energy Belt grinder	-	-	-	665	-	-	-	-	-	-	-	-	-	-
28.	Fly Press	-	-	-	-	112	-	-	710	-	-	77	744	-	-
29.	Crank Press 5 T	42	-	-	-	-	-	-	-	-	-	-	-	-	-
30.	-do- 10 T	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31.	Crank Press 25 T	-	-	-	112	-	-	-	535	-	-	-	-	-	-
32.	-do- 100 T	-	-	-	-	-	-	-	268	-	-	-	-	-	-
33.	Hydraulic Press 10 T	105	438	-	-	-	-	-	-	-	-	-	-	-	-
34.	Deep Drawing Press 150T	-	-	149	-	-	-	-	-	-	-	-	-	46	-
35.	Off hand grinding M/c	2742	-	149	-	-	-	-	2410	-	-	-	-	463	151 167
36.	Injection Moulding m/c	974	-	-	-	-	-	-	-	-	-	-	-	-	1870
37.	Photo Printing m/c	-	572	-	-	-	-	-	-	-	-	-	-	-	-
38.	Anodising	-	-	-	-	-	-	-	-	-	-	-	-	-	-
39	Electroplating	633	572	149	335	56	-	-	-	399	223	153	496	116	-
40.	Painting	-	2309	1340	1676	503	415	835	-	399	-	306	806	-	419
41.	Assy. & fitting	6328	2309	638	1006	670	415	569	1607	3990	742	1532	15246	694	1676
42.	Enamelling	-	-	447	-	-	-	-	-	-	-	-	-	-	-
43.	Portable Bet grinder	-	-	-	-	-	-	-	-	-	-	-	6694	-	-

a/ The serial numbers correspond to those given in appendix II.

SECTION 1

Appendix IV

... EQUIPMENT FOR 100 MEDICAL APPLIANCES UNITS

12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26
107	-	=	-	13300	9576	16644	-	1144	-	-	940	-	-	32022
1673	-	-	-	2660	4778	545	-	-	805	-	-	1047	620	17702
-	-	-	-	-	-	-	-	-	-	-	705	-	-	1003
31	-	-	-	7980	1436	327	-	-	-	-	-	-	-	14111
-	-	-	-	-	1077	-	-	-	-	-	-	-	-	1077
-	-	-	-	-	862	-	-	-	-	-	-	-	-	922
-	-	-	-	1995	1317	-	-	-	-	-	-	-	-	3312
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	479	-	-	-	-	-	-	-	-	479
-	-	=	-	332	120	-	-	-	-	-	-	-	-	452
-	-	=	-	-	2394	-	-	-	-	-	-	-	-	2514
-	-	-	-	2660	598	-	-	-	-	-	-	-	-	3363
10	-	-	-	-	-	-	-	-	-	-	-	-	-	845
2	-	-	-	2660	7182	-	-	-	-	-	-	-	-	12753
-	-	-	-	2660	5746	231	665	381	134	-	564	-	-	16[illegible]1
-	-	-	-	-	-	-	-	-	-	-	-	-	-	3013
-	-	-	-	332	-	-	-	-	134	-	-	-	-	1520
13	-	-	-	-	-	327	332	763	161	48	-	-	-	2030
[illegible]	-	139	52	166	480	222	66	-	53	2	23	210	687	3154
2	38	-	161	1995	240	327	399	191	-	-	-	-	-	8850
34	-	139	-	-	-	-	-	-	-	-	-	349	389	1703
-	231	-	65	-	-	327	398	191	-	-	-	-	-	2209
0	-	838	-	-	-	555	399	1144	1073	48	-	349	233	5367
-	38	-	-	-	-	-	-	-	-	-	-	1047	389	3501
		139	-	-	-	-	-	-	-	-	-	-	-	177
136	231													
-	-	1257	720	-	4070	1331	1995	1526	1073	585	-	3142	2330	32043
-	-	-	-	-	-	-	-	-	-	-	-	-	-	212
744	-	-	-	-	-	-	-	-	-	-	-	-	-	665
-	-	-	-	-	-	221	-	-	-	29	468	349	233	2943
-	-	-	-	-	-	-	-	-	-	-	-	-	-	42
-	-	-	-	-	-	-	-	-	-	-	47	-	-	47
-	-	-	44	-	-	-	-	-	-	-	-	-	155	846
-	-	-	-	-	-	-	-	-	-	-	-	-	-	268
-	46	-	-	-	-	-	-	-	-	-	-	-	-	543
-	463	[illegible] 167	-	-	-	-	-	-	161	-	-	-	-	523
-	-	1670	-	7182	-	-	-	-	1073	-	-	-	-	15689
-	-	-	-	-	-	-	-	-	-	-	-	-	-	974
-	-	-	-	-	-	-	-	-	-	-	1880(carpentry)		-	572
6	116	-	196	-	-	-	-	-	-	-	-	-	-	196
6	-	419	-	3325	2394	221	-	-	-	-	-	-1047	776	11314
46	694	-	262	1330	2394	1331	2992	2208	1073 [illegible]	585	470	-	-	20514
-	-	1676	1570	1330	17555	3993	2992	9155	1073	390	245	4189	4685	84959
4	-	-	-	-	-	-	-	-	-	-	-	-	-	447
		-	-	-	-	665	-	-	-	-	-	-	-	73

SECTION 2

Appendix V

COST OF PLANT AND EQUIPMENT REQUIRED FOR
MEDICAL APPLIANCES PRODUCTION

S.No.	Description of equipment	Quantity	Value ($)
1.	Centre Lathes	8	58,360
2.	Capstan Lathe	4	95,300
3.	Automatic Lathe	1	3,760
4.	Horizontal Boring machine.	1	50,000
5.	Special purpose threading machine	1	18,560
6.	Pipe threading machine	1	600
7.	Milling machines	4	35,350
8.	Gear hobbing machine	1	23,520
9.	Slotting machine	1	5,000
10.	Cylindrical Grinding machine	1	11,870
11.	Surface Grinding machine	1	6,000
12.	Tool and cutter grinding machine	1	4,700
13.	Carbide Tip Tool Grinder	1	700
14.	Honing machine	1	2,250
15.	Injection moulding machine	1	11,760
16.	Abrasive cut off machine	1	3,760
17.	Powder Hacksaw	1	1,530
18.	Gillofine shear	2	7,060
19.	Nibbling machine	1	7,290
20.	Circular sheet metal cutting machine	1	240
21.	Gankpress deep drawing 100 ton.	1	11,760
22.	Crank press 16 ton	1	3,530
23.	Fly press	1	240
24.	Press brake	1	17,640
25.	Plate Bending rolls.	2	5,880
26.	Special tube banding machine	1	240
27.	Grooving machine	1	590
28.	Radial drilling machine	2	7,060
29.	Pillar drilling machine	2	4,700
30.	Bench drilling machine	4	2,100
31.	Tapping machine	1	700

S.No.	Description of equipment	Quantity	Value ($)
32.	Polishing machine	4	3,760
33.	Pedestal Grinding machine	3	2,120
34.	Beuch Grinder	3	290
35.	Emery belt Grinder	1	350
36.	Photo printing machine and Anodising set up	1	16,820
37.	Set up for Electro plating		37,060
38.	Shot blasting machine	1	11,760
39.	Welding equipment:		
	a) Argon arc welding		
	b) Arc welding		
	c) Spot welding		11 760
	d) Seam welding		
	e) Gas welding		
40.	Auxiliary equipment for assembly		3,530
41.	Set up for painting		26,760
42.	Equipment for repair & Maintenance		11,760
43.	Wood turning lathe	1	600
44.	Wood sawing machine	1	600
45.	Wood planning machine	1	700
46.	Accesories for the above machines		34,200
47.	Measuring instruments accessories		17,000
48.	Air Compressors	3	9,400
49.	Material Handling equipments		87,060
	Total:		677,580
50.	Miscellaneous:		
	a) Vehicles		23,530
	b) Furnitures		23,530
	c) Office equipments.		26,000
51.	Cost of installation/erection of Electrical mechanical equipments.		27,585
	Grand Total		102,645

Appendix VI

ESTIMATED PERSONNEL REQUIREMENTS

MAN POWER REQUIREMENT (DIRECT)

Cadre	Requirement for 2nd shift operation	Requirement for 3rd shift.
Machinist	80	36
Fitters	42	21
Welders	12	6
Finishing	16	5
Carpentry & Packing	6	8
Total	156	68

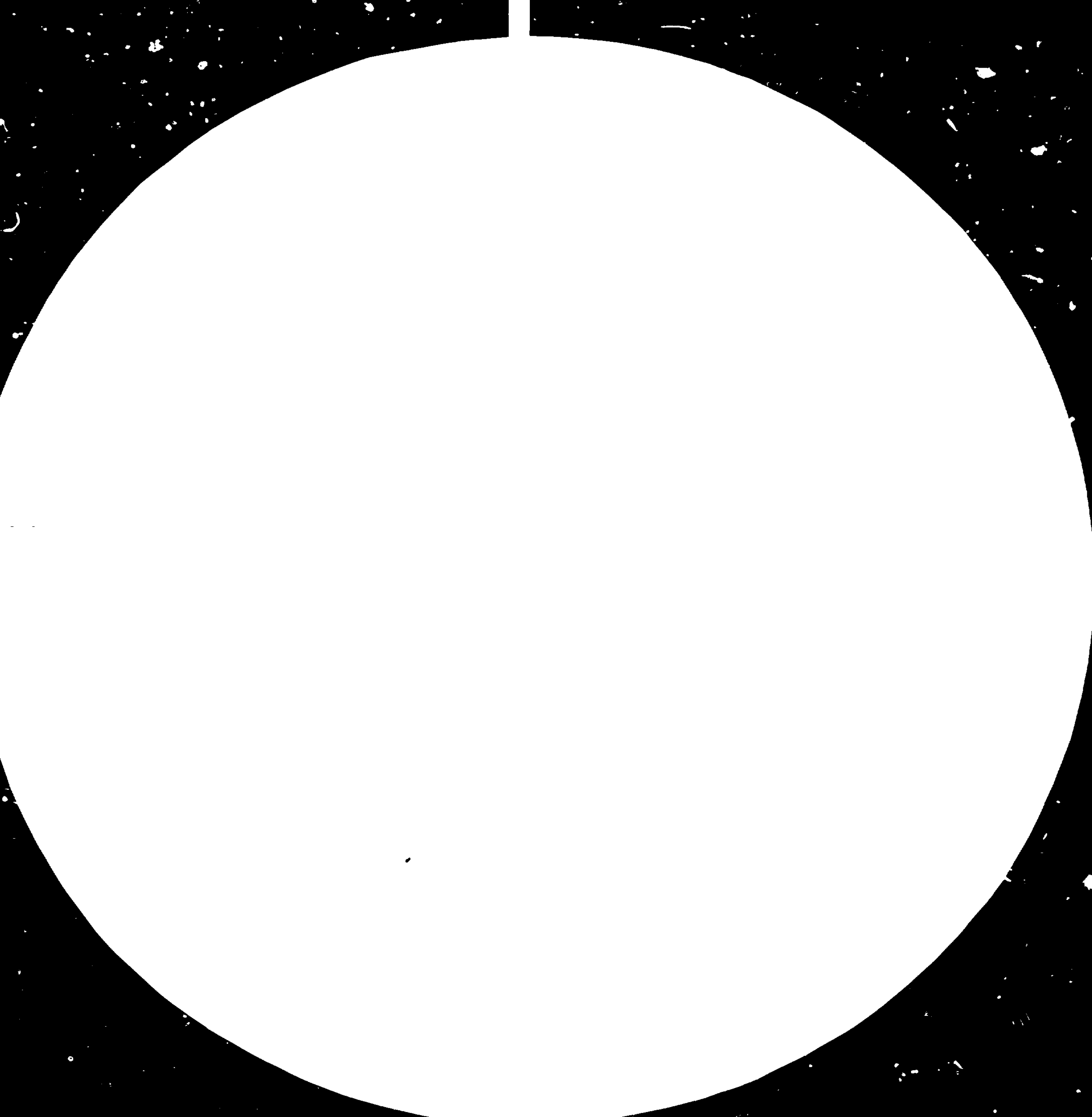
WAGES & SALARIES FOR DIRECT MAN POWER

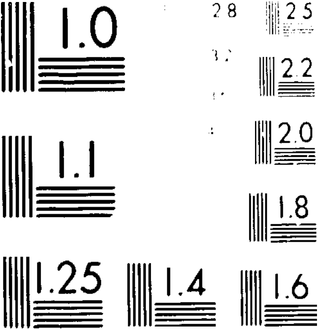
I. For two shift operation

80 persons @ £ E25/month	$ 61,538 per Annum.
76 persons @ £ E50/month	$ 1,16,923 " "
Total	$ 1,78,461 " "

II. For 3rd shift operation

34 persons @ £ E25/month	$ 26,154 per annum.
34 persons @ £ E50/month	$ 52,307 " "
	$ 78,461 " "




1.0
2.8
2.5
2.2
2.0
1.1
1.8
1.25
1.4
1.6

MAN POWER REQUIREMENT (INDIRECT)

		Value in $
Managerial	5	20,000
Technical Supervision	15	32,307
Non-Technical Supervision	5	10,769
Quality Control	2 + 4	10,460
Auxiliary Staff	31	39,230
Security	1 + 5	6,000
	68	1,18,766

ADDITIONAL MAN POWER FOR 50% INCREASE IN PRODUCTION

Technical Supervision	3	6,461
Quality Control	1+2	5,230
Auxiliary staff	5	5,385
Security	3	2,307
		19,383

Appendix VII

ESTIMATED COST OF LAND, BUILDING AND UTILITIES

a) LAND

Required land area - free of cost	50,000 sq. mt.

b) BUILDING

Required area -	12,130 sq. mt.
Cost of Building: @	£ F50/Sq.mt.
	$.15,55,128/-.

c) UTILITIES

i) POWER

Maximum demand	700 KVA
Consumption/Annum	9,81,800 KWH
Cost of power	$ 70,907

ii) WATER

Consumption/Annum	90,000 cu. m.
Cost of water	$ 7000.

Appendix VIII

SALES VALUE OF MEDICAL APPLIANCES

S.No.	Product	Annual Qty.	Unit Price	Total Price for Ist year
1.	Binaural combination stethoscope	12,600	6.28	79,128
2.	SP hygno manometer(Mercury type)	6,900	17,05	117,645
3.	Weighing Machine, Infant	1,800	15,30	27,540
4.	Electric Suction apparatus	700	279.6	195,720
5.	Foot-operated suction pump	700	25.9	18.130
6.	Centrifuge, hand operated	800	14.71	11.768
7.	Centrifuge, Electrically operated	600	91.18	54,708
8.	Hospital sterilizer (Table Model) Boiling water type	3,200	58.82	188,235
9.	Bowl & utensil sterilizer(Pedal type)	800	470.58	376,464
10.	Portable Pressure Sterilizer	900	91.20	82,080
11.	Vertical steam sterilizer (Pressure type)	300	452.90	135,870
12.	Horizonal -Cylindrical & rectangular steam sterilizer.	750	2118.00	1,588,500
13.	Water stills for Pyrogen free distilled water (Electrical)	450	83.52	37,584
14.	Water stills for pyrogen free Distilled water(fuel heated)	1700	74.70	126,990
15.	Electric Bacteriological Incubators	260	186.70	48,542
16.	Dental Chair	665	167.60	111,454
17.	Operation theatre table, hydraulic Major	240	2,176.50	522,360
18.	Table operation, general purpose (non-hydraulic)	665	167.60	111,454
19.	Table, examination	2,000	42.35	84,700
20.	Invalid wheel chair	2,300	76.47	175,881
21.	Mayo's Instrument stand	3,200	40.60	129,920
22.	Strectcher Trollyes(without top)	580	38.80	22,504
23.	Strectcher	2,800	17.76	49,728
24.	Hand operated continuous knapsack sprayer (Piston type)	4,200	42.35	177,870
25.	Hand operated compression knap sack sprayer(Non-pressure type)	4,650	29.40	136,710
				4,611, 517

Appendix IX

PROFIT-AND-LOSS STATEMENT

Figures in $ lakhs.
(100,000)

I. Investment

1.	Plant & Equipment	7.814
2.	Building	15.551
		23.365

II. Expenses	I year of Operation	II Year of Operation	III year of Operation.
3. Raw materials	30.852	46.278	46.278
4. Wages: Direct	1.785	2.569	2.569
Indirect	1.118	1.381	1.381
5. Power	0.709	0.922	0.922
6. Water	0.070	0.070	0.070
7. Special Tooling	0.109	0.164	0.164
8. Aux. Material	0.998	1.497	1.497
9. Repair & Maintenance	0.078	0.078	0.078
10. Depreciation: Building	0.778	0.778	0.778
11. Plant & Machinery & Equipment.	0.781	0.781	0.781
11 Training	3.206	1.602	-
12. Consultancy	0.469	-	-
13. Miscellaneous	0.499	0.748	0.748
14. Interest on Working Capital	2.991	4.148	4.028
15. Marketing	6.249	9.354	9.354
16. Royalty	0.760	1.140	1.140
	51.452	71.510	69.788
Sale value	49.890	74.836	74.836
Profit/Loss	- 1.562	+ 3.326	+ 5.048
Ratio of Profit or loss on investment	- 6.63%	+14.23%	+2[illegible] 5%

Appendix X

RECOMMENDED PRODUCTION PROGRAMME FOR SURGICAL INSTRUMENTS

Group No.	Description	Quantity	Unit (Value in $)	Total (Value in $)
1.	Dissecting forceps of different types and sizes. - S.S.	45,000	1.0	45,000
2.	Knives of different sizes. Carbonsteel - plated.	15,000	1.5	22,500
3.	Chisels, orthopaedic - S.S.	15,000	3.0	45,000
4.	Curettes - Sharp & blunt different sizes - carbon steel - plated	25,000	1.8	45,000
5.	Artery forceps - Box joint - straight - curved of different designs and sizes.	100,000	1.8	180,000
6.	Needle Holders - S.S.	10,000	2.1	21,000
7.	Scissors - straight & curved - S.S.	50,000	1.6	80,000
8.	Vaginal speculums and gynocological instruments.	30,000	3.0	90,000
9.	Dental forceps and dental instruments - S.S.	10,000	4.25	42,500
	Total	300,000		571,000

Appendix XI

RECOMMENDED EQUIPMENT FOR THE MANUFACTURE OF SURGICAL INSTRUMENTS

I. Machine Shop

S.No.	Description	Quantity
1.	Ring Boring	1
2.	Crank Press 16T	1
3.	Horizontal Milling m/c No.1	1
4.	Vertical - do - No.1	1
5.	Bench type Milling m/c	5
6.	Double spindle milling m/c.	1
7.	Centre Lathe	1
8.	Auto Lathe	1
9.	Bench Drill	1
10.	Bench Grinder	1
11.	Tool and Cutter Grinder	1

II. Heat Treatment shop

S.No.	Description	Quantity
1.	Chamber electric furnace-1000°C	1
2.	- do - - 1200°C	1
3.	Tempering furnace	2
4.	Lead Bath furnace	1
5.	Oil quenching tank	2
6.	Water quenching tank	1
7.	Hardness tester	1
8.	Pickling & Electro-polishing set up	1

III. Grinding and Assembly shop

S.No.	Description	Quantity
1.	Off-hand grinding Machine	26
2.	Ring Grinding/Polishing	3

...

3.	Scissor Blade Grinding	1
4.	Spot welding	1
5.	Tapping machine	1
6.	Drilling Machine	1
7.	Emery Belt Grinder	1
8.	Wheel preparation set up	1

IV. Electro-plating shop

1.	Rectifier - 7 V	2
2.	- do - 12 V	1
3.	- do - 20 V	1
4.	Tanks (Plating)	10
5.	Tanks (Polishing)	8
6.	Electric heater	10.

Appendix XII

FEASIBILITY ANALYSIS OF THE MANUFACTURE OF SURGICAL INSTRUMENTS

Investment	Dollars
Plant & Equipment	155,000
Building	260,300
	415,300

Expenses:	
1) Raw material (forging)	190,000
2) Salaries & wages	
a) Direct	70,100
b) Indirect	30,800
3) Power	38,500
4) water	700
5) Special tools	4,900
6) Auxiliary Material	24,000
7) Repair & Maintenance	15,500
8) Miscellaneous	5,500
9) Market	75,000
10) Interest on working capital	28,500
11) Depreciation:	
a) Plant & Equipment	15,500
b) Building	13,000
	512,000
Sale value	571,000
Profit:	59,000

Appendix XIII

BREAKDOWN OF COSTS FOR THE MANUFACTURE OF SURGICAL INSTRUMENTS

Manpower

Department	Direct labour	Indirect labour
Machine shop	26	4
Heat treatment	5	2
Grinding and assembly shop	107	5
Electroplating	5	3
Miscellaneous		10
Repair and maintenance		10
Inspection/quality control		7
Managers		3
Supervisors/engineers		9
Designs		3
Production control		4
Auxiliary staff		5
Security		5
Total	143	70

Salaries and wages

	Dollars
Direct	70,100
Indirect	
Managerial	21,960
Auxiliary	9,010
Total, salaries and wages	101,070

Plant and equipment

	Dollars
Machine shop	45,175
Heat-treatment shop	27,295
Grinding and assembly shop	42,000
Electroplating shop	22,350
Erection and ventilation	18,085
Total, plant and equipment	154,905

Building

	Area (m^2)	Dollars
Machine shop	400	
Heat-treatment shop	150	
Grinding and assembly shop	600	
Electroplating shop	320	
Raw material stores	100	
Shop stores	60	
Offices and other areas	400	
Total, building	2,030	260,256

		Dollars
Raw materials		
Stainless-steel and carbon-steel forgings have to be procurred either locally or be imported.		
Total, forgings		168,300
Power		
Maximum demand	450 kW	
Yearly consumption for two shifts	400,000 kWh	
Total, power		30,768
Water		
Yearly consumption	9,000 m^3	
Total, water		700
Special tools		
Jigs and fixtures		2,550
Press tools		1,045
Form tools		755
Miscellaneous		600
Total, special tools		4,950

XX. INDUSTRIAL PROFILE ON MICROSCOPES

Based on the demand potential and existing level of development of industry in this field in the concerned Arab Countries, it is felt that there is a fairly big demand for microscopes in the existing hospitals, medical colleges, amongst doctors for various investigational studies in Biological, Pathological and Bateriological fields. As the teaching of Biological Sciences has become compulsory in most of the schools and colleges, the demand for student microscopes up to 600 magnification has also gone up.

It is estimated that there is a demand of about ten thousand microscopes of various types per year which is currently met by these countries through imports. In the following industrial profile, the manufacture of microscopes breaks even at hundred per cent capacity by fifth year and is likely to show a return of ten to fifteen per cent in the third year. It is also proposed to include in the product mix, other commercial consumer products of similar technology such as over-head projectors which will involve some changes in the raw material component and no addition to facilities or man power. This will become a second line of production to fill in the possible gaps in the demand to maintain steady profitability. Since the writing on the blackboard during lectures is becoming out of date, the overhead projector has become an essential visual aid in the schools, colleges and auditoriums.

TECHNOLOGY

Although recent technical developments have led to considerable variations in the shape of microscopes, the appearance of the conventional microscope is familiar enough. Usually, it consists of a metal stand supporting a group of lenses, and is, therefore, traditionally divided into "brass" and "glass" by microscopists. The glass parts i.e. lenses, mirrors, prisms, filters etc. are the essential components which enable the specimen to be examined and the brass parts are the necessary mechanical auxillaries which enable the glass parts to be adjusted. The basis of the design as a whole is most easily following in an historical sequence explaining the transformation of the reading glass into a compound microscope. New manufacturing processes and experience of precision engineering have now enabled designer to break away from the conventional microscope, and design a rest without the limitations previously controlling what could actually be produced in practice.

In the normal course, the microscopes can be divided into the following categories :

A. Student Microscopes with magnification upto 600 x for the biological studies in the Schools and Colleges.

B. Biological Medical Microscopes with magnifications upto 1500X mainly recommended for Biologists, Pathologists, Bacteriologists and Medical practitioners

C. Binocular Research Microscopes with magnification up to 1500 x mainly recommended for advanced studies and research purposes.

D. Fluorescence Microscopes which have acquired great importance in recent years in the field of exfoliative Cytology. A very appropriate application is in early detection of Cancer in smears, exudates and tissue sections. Fluorescence techniques are used to advantage in other fields of medical and biological research also.

SPECIFICATIONS

Specifications for student, biological and binocular research microscopes are given in appendix I.

PRODUCTION PROGRAMME

It is proposed to manufacture about 4000 units of microscopes as follows :

Student Microscopes	2500 Units
Biological Microscopes	1000 Units
Binocular Microscopes	500 Units

in the first year where 60% of the metallic mechanical parts like Nose piece, Rack & Pinion, Micrometer Fine adjustment, graduated Mechanical stage Iris diaphragm are to be imported. All optical components like objectives, Eye pieces, condensers, Reflectors are to be imported. These microscopes shall be assembled and tested here by skilled technicians.

In the second year the import of the mechanical components shall be reduced to 25% while the optical components shall all be imported.

In the third year the proposed unit may become self-reliant both for mechanical and the optical components as by that time it is assumed that the required infra-structure for the optical glass might be available for this industry.

SOURCE OF TECHNOLOGY

With a steep rise in the demand of various types of microscopes in various fields like Educational Institutions, Hospitals, Industries and other fields the production methods for the manufacture of these microscopes have been updated to the extent that in the advanced European countries, Japan, U.K. and U.S.A., the stage has been reached to take the industry to automation. Developing countries like India have also set up production facilities during the course of time and reached a stage when they can transfer the technology to other developing countries.

PLANT & MACHINERY

Table 1 gives the machinery requirements for the manufacture of microscopes.

Table 1. Plant and machinery required for microscope production

Item	Quantity	Cost per unit (Rupees)	Total (Rupees)
1. LATHE:			
Bed length 4 ft.	6	30,000/-	180,000/-
Bed length 6 ft.	4	50,000/-	200,000/-
2. Capstan Lathe :			
0-30 mm capacity	4	85,000/-	340,000/-
3. Shaper Stroke length 24" width 12"	2	30,000/-	60,000/-
4. Surface Grinder Chuck size 24" x 6"	1	50,000/-	50,000/-
5. Universal Cylindrical grinder	1	60,000/-	60,000/-
6. Bench Drilling Machine			
0-6 mm	2	3,000/-	6,000/-
0-15 mm	2	4,000/-	8,000/-
7. Piller Drilling Machine			
0-25 mm	2	8,000/-	16,000/-
8. Universal Milling Machine	1	60,000/-	60,000/-
9. Vertical Milling Machine	1	60,000/-	60,000/-
10. Slotting Machine	2	15,000/-	30,000/-
11. Engraving Pentograph with all attachment	1	80,000/-	80,000/-
12. Measuring & fitting tools			100,000/-
13. Sheet Metal working Machines			
Shearing			
Press Brake			
Hand Press			
Bending Machine			85,000/-

14.	Testing Instruments :	
	Profile Projector	35,000/-
	Tool Makers' Microscope	37,000/-
15.	Electroplating Shop Equipment 20 Kg. capacity	100 ,000/-
16.	Painting Shop Equipment	50,000/-
17.	Carpentry Shop	25,000/-
18.	Moulding Shop for Ferrous and & Non-ferrous castings	100 ,000/-
	ca.	Rs. 1,700 ,000/-
	= US $	200,000

PLANT LAYOUT

The plant may be located on the site which should be comparatively free from dust and humidity as these are precision Optical instruments. About 10,000 square meters land are required with factory and facilities to cover floor area of about 3500 sq.meters for following workshops :

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A.	Machine Shop	1,500 Sq.Meters	
B.	Filter Shop	500 Sq.Meters	
C.	Painting Shop	100 Sq.Meters	
D.	Electroplating Shop	100 Sq.Meters	
E.	Carpentry Shop	100 Sq.Meters	
F.	Servicing Shop	100 Sq.Meters	
G.	Testing & Caliberation Shop	150 Sq.Meters	A.C.C.
H.	Administration Office	250 Sq.Meters	A.C.C.
I.	Stores	500 Sq.Meters	

Total : say, 3,300 sq. Meters

Total Cost : 410,000 L.E.

Rs. 9,020,000

US $ 1,025,000

LIST OF COMPONENTS (See appendix II).

7

MAN POWER, TRAINING

		WAGES P.M.	TOTAL PER ANNUM
Manager	2	125/150 L.E. PM	3,600 L.E.
Foreman/Supervisory Middle level	10	80 L.E.	9600 L.E.
Skilled Worker	50	50 L.E.	30,000 L.E.
New Worker	30	25 L.E.	9000 L.E.
Administrative Staff	4	80 L.E.	3840 L.E.
Stores	4	80 L.E.	3840 L.E.
			59,880 L.E.

= Rs. 1,317,360/-

US $ 149,000

Training at a factory in India for one month which shall cost approximately:

$US 75 per day for managers rank and
$US 40 per day for foremen/supervisors

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ACDIMA will pay the following in addition to the travel charges.

1. Top Man	200 $ per day plus five star accomodation for short duration.
2. Senior Managers	150 $ per day plus 3 star accomodation for stay upto 3 months.
3. Foremen/Supervisors	800 $ per month plus furnished accomodation
4. Skilled Workers	500 $ per month plus furnished accomodation.

CAPACITY RATING

	Ist Year	2nd year	3rd year	5th year
A. Student Microscope	2500	3000	3500	4500
B. Biological Microscope	1000	1500	2000	3000
C. Binocular Microscope	500	750	1000	2000

COST OF PRODUCTION

(See table 2.)

TURNOVER & SALES

It is assumed that due to heavy demand of these microscopes already existing and if the quality is maintained the whole production could be consumed and sold. It is also presumed that the sale price shall be either made steady for three years or increased. The downward trend on the sale price is not taken into consideration at least for five years. (See table 3.)

GROSS PROFITS

	Ist Year	2nd Year	3rd Year	5th Year
Sales	455000	633750	812500	1317500
Cost	417500	549000	657500	975000
G.P. US $	37500	84750	155000	342500

Table 2. Cost of production, in years one, two, three and five of operation

SPECIFICATIONS OF MICROSCOPES	1ST YEAR			2ND YEAR			3RD YEAR			5TH YEAR		
	QUANTITY	RATE	TOTAL	QUANTITY	RATE	TOTAL	QUANTITY	RATE	TOTAL	QUANTITY	RATE	TOTAL
		US $			US $			US $			US $	
Student Microscope with Nose piece, Disc diaphragm two objectives 10x & 45x, two Eye-pieces 10x & 15x, Reflecting Mirror and wooden cabinet.	2500	60	150000	3000	58	174000	3500	55	192500	4500	50	225000
Biological Microscope with Nose piece, 1.25 N.A. Abbe Condenser and Iris diaphragm, Three (3) objectives 10x, 45x & 100x oil, two Eye-pieces 10x & 15x, Reflecting Mirror, graduated mechanical stage and wooden Cabinet.	1000	130	130000	1500	120	180000	2000	110	220000	3000	100	300000
Binocular Research Microscope with Binocular Head, Quadruple nose piece, 1.25 N.A. Able Condenser with Iris diaphragm, Four (4) objectives 5x, 10x, 45x & 100x oil, two pairs Eye-pieces 10x & 15x, Base with built in illumination working on variable transformer, graduated mechanical stage, and wooden cabinet.	500	275	137500	750	260	195000	1000	245	245000	2000	225	450000
Total US $	4000	465	417500	5250	438	549000	6500	410	657500	9500	375	975000

Table 3. Sales price in years one, two, three and five of operation

SPECIFICATIONS	1ST YEAR			2ND YEAR			3RD YEAR			5TH YEAR		
	QUANTITY	RATE	TOTAL	QUANTITY	RATE	TOTAL	QUANTITY	RATE	TOTAL	QUANTITY	RATE	TOTAL
		US $			US $			US $			US $	
Student Microscope with Nose piece, Disc diaphragm two objectives 10x & 45x, two Eye-pieces 10x & 15x, Reflecting Mirror and wooden cabinet.	2500	65	162500	3000	65	195000	3500	65	227500	4500	65	292500
Biological Microscope with Nose piece, 1.25 N.A. Abbe Condenser and Iris diaphragm, Three (3) Objectives 10x, 45x & 100x Oil, two Eye-pieces 10x & 15x, Reflecting Mirror, graduated mechanical stage and wooden cabinet.	1000	145	145000	1500	145	217500	2000	145	290000	3000	145	435000
Binocular Research Microscope with Binocular Head, Quadruple nose piece, 1.25 N.A. Abbe Condenser with Iris diaphragm, Four (4) Objectives 5x, 10x, 45x & 100x Oil, two pairs Eye-pieces 10x & 15x, Base with builtin illumination working on variable transformer, graduated mechanical stages and wooden cabinet.	500	295	147500	750	295	221250	1000	295	295000	2000	295	590000
TOTAL US $	4000	505	455000	5250	505	633750	6500	505	812500	9500	505	1317500

SPECIAL RECOMMENDATIONS

It is strongly recommended to include in the product-mix other commercial consumer products of identical technology such as overhead Projectors which can be produced with the same plant and equipment except for some change in the raw materials which can be procured from India from similar sources. This shall become a second line of production to fill up the possible gaps in demand to reach steady profitability.

Overhead Projector is an essential Visual Aid for teaching of Arts and Science at all levels starting from elementry school to post graduate education. The supplementing of a lecture or demonstration with projected diagrams and the like is a well-established means of assisting student comprehension which in turn stimulates interest in what otherwise will be a difficult or tedious subject. An advantage of these Overhead Projectors is that these benefits are now made available to large audiences without disruption of normal class or lecture room set-up.

SPECIFICATIONS OF OVERHEAD PROJECTORS

25 x 25 cm writing aperture. (Fresnel Lens)
600 Watts 230 Volts Quartz Iodine bulb.
Powerful cooling system with forced-circulation blower.
3.25 x 3.25 meters Magnification at 3.5 meters distance.
Minimum Projection distance 1 metre.

Sharp Image free from colour aberration.

Image focussing done by a special Rack and Pinion focussing movable by knob.

28 degree Travel of Projection Elevating device.

Interchangeable Rollifilm attachment.

COMPONENTS FOR OVERHEAD PROJECTORS

Sheet metal Housing (Body) Mild Steel	One
Lamp Housing Mild Steel	One
Lamp Holders	Two
Reflector for lamp	One
Heat Filter	One
Halogen Lamp 600 watts 240 V	One
Exhaust fan	One
Fresnel lens	One
Glass plate 25 x 25 cm	One
Rack & Pinion System Gun metal & Steel	One Set
Projection lens Housing M.S.	One
Surface coated Mirror	One
Interchangeable Rollifilm attachment	One
Rollifilm	15 ft long one
Writing Pencils	Six
Erasing Cloth	One
Dust cover	One

Total cost 1 Set = US $ 95

PRODUCTION PROGRAMME

It is proposed to manufacture 1000 units per year.

COST OF PRODUCTION

Overhead Projectors 1000 @ 125 US $ = 125000 US $

PROFITABILITY

This project shall offer a profit of 15% in the first year if they are assembled in Egypt after importing the finished parts and components from India.

These Overhead Projectors can be marketed easily at the rate of US $ 145 each in the local market and it has a tremendous export potential in the near future as writing on the black-board is almost becoming obsolete. It is assumed that the rate of production for these Overhead Projectors shall be maintained at 1000 numbers per year for three years as we are taking this as an extra load on the proposed set of machinery and manpower. After three years the production may be doubled with addition of some machinery and man-power.

SALES	1000 Nos	@ US $ 145	145000
COST OF PRODUCTION	1000 Nos	@ US $ 125	125000
GROSS PROFIT		US $	20000

GROSS PROFIT ON MICROSCOPES & OVERHEAD PROJECTORS:

	1st Year	2nd Year	3rd Year
Microscopes	US $ 37500	84750	155000
Overhead Projectors	US $ 20000	20000	20000
	US $ 57500	104750	175000

SUMMARY STATEMENT INDICATING COST OF FIXED ASSETS AND WORKING CAPITAL :

A. FIXED CAPITAL :

Cost of the Building with working Area 3500 sq.meters including Air-conditioning 400 sq.meters	$ 1,025,000
Plant & Machinery	$ 200,000
	$ 1,225,000

B. WORKING CAPITAL :

1. Raw material cost in 5th year (100% production) six months	$	330,000
2. Three months wages	$	37,425
3. Semi manufactured and finished stock for six months	$	330,000
	$	697,425

C. TOTAL COST OF THE PLANT :

Fixed Capital	$	1,255,000
Working Capital	$	697,425
	$	1,922,425

D. Depreciation @ 10% on Fixed Capital Assets	$	122,500
E. Interest @ 15% on working Capital	$	104,613

MICROSCOPE SPECIFICATIONS

		STUDENT MICROSCOPES	BIOLOGICAL MICROSCOPES	BINOCULAR RESEARCH MICROSCOPE
1.	BASE	Small stand with three point support painted black.	Large stand with three point support ensuring stability painted in black paint.	Large base with builtin lo w voltage high intensity lamp working with variable transformer.
2.	STAGE	Fixed Square Stage 110x110 mm with Disc diaphagm having five holes.	Square stage 120x120 mm fitted with graduated mechanical stage adjustable by rack & pinion with slide bracket to hold slide upto 50x75 mm.	Square stage 120x120 mm fitted with graduated mechanical stage adjustable by rack & pinion with slide bracket to hold slide upto 50x75 mm.
3.	SUBSTAGE EQUIPMENTS	Plano Concave Mirror 50 mm dia. in jerk quick on bracket for illumination.	Rack & pinion substage 1.25 N.A. Abbe-condenser with Iris diaphragm and cobalt filter. Plano-concave mirrors in jerk quick on bracket 55 mm in diameter.	Rack & pinion substage 1.25 N.A. Abbe Condenser with Iris diaphragm and Cobalt filter. Plano-concave mirrors in jerk quick on bracket 55 mm in diameter.
4.	MICROSCOPE TUBE	Mechanical Tube length 160 mm.	Mechanical Tube length 160 mm (Standard) with straight or tilting inclined arrangement at the junction of the body and base.	Inclined Binocular body tube provided with adjustment of interpapillary distance and two eye-piece tubes.
5.	COARSE ADJUSTMENT	Coarse focusing by Rack & Pinion with [illegible]ng device.	Coarse focusing by rack & pinion with locking device.	Course focussing by rack & pinion with locking device.
6.	FINE ADJUSTMENT	Fine adjustment with micrometer slow motion.	Fine adjustment by fine threaded screw with double lever provided complete parafocallised focusing.	Fine adjustment by fine threaded screw with double lever provided complete parafocallised focussing.
7.	NOSE PIECE	Double nose piece with international threads	Triple nose-piece with positive clik stop with standard international threads.	Quadruple nose-piece pre-centered for parafocallised objectives with international threads.
8.	OPTICAL COMBINATIONS	Two (2) Achromatic objectives 10x x 45x (dry) Two(2) Huygenian eye-piece 10x x 15x Total: Magnification 100x - 675x	Three (3) Achromatic Objectives 10x dry, 45x dry, 100 x oil Two (2) Huygenian eyepiece. 10x x 15x Total Magnifications 100x - 1500X	Four (4) Achromatic Objectives 5x (dry) 10x (dry) 45(dry) x100x (oil) Two (2) Paired Huygenian Eye-piece. 10x x 15x Total Magnification 100x - 1500x
10.	WOODEN CABINET	Polished wooden cabinet with lock and key. Price: each 60 US $	Polished wooden cabinet with lock & key. Price each 130 US $	Polished Wooden Cabinets with lock & key. Price each 275 US $

1.	C.I.	One	Built in low voltage, high intensity light with Blue filter working through transformer.
2.	Al.	One	Arm
3.	Brass	One	Slow motion worm housing
4.	Brass	One	Slow motion washer
5.	Brass	Two	Slow motion knob
6.	M.S.	One	Slow motion worm
7.	Al.	One	Stage TEE
8.	Al.	One	Base shoe
9.	M.S.	One	Base shoe pin
10.	Brass	Two	Base nuts
11.	Brass	One	Slide coarse motion
12.	Brass	One	Coarse motion guide
13.	Al.	One	Tube
14.	Brass	One	Eye piece tube with Binocular head equipped with interpapillary adjustment graduated scale.
15.	Brass	One	Slide Dovetail tube
16.	Al.	One	Stage Plate
17.	Al. O	One	Stopper upper tube
18.	Brass	One	Objective Turret Nut
19.	Brass	One	Tube locking plate
20.	Al.	One	Stage Diaphragm (Disc)
21.	Brass	One	Turret revolving part
22.	Brass	One	Turret fix part
23.	M.S.	One	Objective turret screw
24.	Brass	One set	Tube Locking screw & Nut
25.	Brass	One	Reflector clamp (Arc)
26.	Brass	One	Reflector clamp Pin
27.	Brass	One	Objective turret washer
28.	Brass	One	Stage plate screw
29.	Brass	One	Reflector clamp pin socket
30.	Brass	Two	Coarse motion knob
31.	Brass	Two sets	Pinion plugs & sockets
32.	Brass	One	Rack
33.	M.S.	One	Pinion
34.	Brass	One	Slow motion lever
35.	Brass	One	Slow motion lever screw
36.	Steel	One	Slow motion spring
37.	Brass	One	Slow motion spring stopper
38.	Brass	One	Graduated built in Mechanical stage with vernier scale
39.			Paired eye piece Huygenian 10x
40.			Paired eye piece Huygenian 15x
41.			Achromatic objective 10x
42.			Achromatic objective 45x
43.			Achromatic objective 100x
44.			Wooden box with lock & key
45.			Plastic cover for microscope
46.			Linen Cloth

Appendix II

LIST OF COMPONENTS

Base	Same
Same	Same
Same	Same
Same	Same
Same	Same
Same	Same
Same	Same
Same	Same
Same	Same
Same	Same
Same	Same
Same	Same
Same	Same
Eye piece tube	Eye piece tube
Same	Same
Same	Same
Same	Same
Same	Same
Same	Same
Same	Same
Same	Same
Same	Same
Same	Same
Same	Same
Same	Same
Same	Same
Same	Same
Same	Same
Same	Same
Same	Same
Same	Same
Same	Same
Same	Same
Same	Same
Same	Same
Same	Same
Same	Same
Stage clip & pin	Stage Graduated Mechanical with vernier scale
Same	Same
Same	Same
Same	Same
Same	Same
Wooden box with lock & key	Achromatic objective 100x
Plastic cover for Microscope	Wooden Box with lock & key
Linen Cloth	Plastic cover for microscope
-	Same

XXI. INDUSTRIAL PROFILE ON AN ELECTRONIC COMPLEX

A. Electrocardiograph (ECG) production

1. Market Demand Potential

As indicated earlier, the total demand of the ECG machines in the concerned Arab Countries is presently being met by imports from Japan and the Netherlands. On the basis of the survey, the estimated annual demand at present for all Arab Countries stands at 3350 ECG machines per year. With the improvement in health services and with the establishment of new hospitals, the minimum projected demand for ECG machines after a decade would be 8,600 machines. This indicates a growth rate of 10% every year thereby yielding a growth of 2.6 times of the present demand. It is also estimated that at the end of the tenth year of production there would be some export potential.

The demand pattern of the ECG machines is such that it would be possible to produce them economically in the Arab countries. It is proposed to take up the manufacture of a general purpose machine which would meet almost all routine clinical requirements.

2. Outline of technology and specifications

ELECTROCARDIOGRAPH

The Electrocardiograph is an instrument which records the electrical activity of the heart. This record provides valuable information about a wide range of cardiac diorders such as the presence of an inactive part (infarction) or an enlargement (cardiac Hypertrophy) of the heart muscle. Electrocardiographs are used in the catheterisation laboratory, coronary care units and for diagnostic applications in cardiology.

The abbreviation ECG is commonly used to represent Electrocardiograph, electrocardiogram (waveform representing the electrical activity of the heart) and Electrocardiography (the technique of recording and interpreting the electrocardiogram). The term EKG is also sometimes used in place of ECG.

Origin of ECG Waveform

It is precisely known that rhythmic beating of the heart is due to the triggering pulse that originates in an area of specialised tissue known as sinoatrial node, situated in the upper right region of the heart. The SA node is self-triggering and normally fires about 60-80 times per minutes. The impulse from the S-A node then spreads across the muscle tissues of the heart.

The progress of excitation impulse and the resulting electrical phenomenon accompanying the activity of the heart is known as electrocardiogram when recorded on a graph paper by means of electrodes placed even at the extremities of the human body.

THE ECG MACHINE

The potentials picked up by metallic electrodes from the surface of the body are taken to the lead selector switch. In the lead selector, the electrodes are selected two by two according to the lead program. By means of capacitive coupling, the signal is connected symmetrically to the differential input preamplifier. The preamplifier is usually a three or four stage differential amplifier having a sufficiently large negative current feedback from the end stage to the first stage which gives a stabilising effect. The amplified output signal is picked up single ended and is given to the power amplifier. The power amplifier is generally of the push-pull differential type. The base of one input transistor of this amplifier is driven by the preamplified unsymmetrical signal whereas the base of the other is driven by the feedback signal resulting from the pen position and connected via frequency selective network. The output of the power amplifier is single-ended and is fed to the pen motor which deflects the writing arm on the paper. Direct writing recorder is usually adequate since the ECG signal of interest has a bandwidth from 0.2 to 100HZ. Frequency selective network is an R-C network which provides necessary damping of the pen motor and is preset by the manufacturers. The auxiliary circuits provide 1 mV calibration signal and automatic blocking of the amplifier during a change in the position of the lead switch. It may include speed control circuit for the chart drive motor.

Technology

i) Considerable thinking and concern has been expressed over the safety aspects of electro-medical equipment, the world over. Various associations and institutes connected with standardisation of medical equipment have been seized of the problem of laying down general and safety standards for electro-medical equipment. The most stringent requirement of safety parameters relate to ECG machines as they are directly connected on the surface of the body of the patient and even sometimes inside the heart through catheters and electrodes. General and safety standards on electrocardiographs have been worked out by American Heart Association in USA, British Standards Institute in their Hospital Technical Memorandum No.8 in U.K., International Electro—technical Commission, Geneva and recently by Indian Standards Institution, New Delhi (India). These standards specify the amount of leakage current which should not be exceeded under abnormal and fault conditions of equipment operation. This is to ensure safety of the patient, the operator and other staff.

To achieve low-level leakage currents, there has been considerable development in the patient isolated circuits which provide isolation of a patient from the supply mains. Two types of isolated circuits have since been introduced; one using a high frequency modulating system with a transformer and the other making use of optical isolators. The latter is preferred due to complete isolation provided by it.

ii) During the last decade, tremendous progress has been achieved in the introduction of integrated circuit technology in the electronics field. This has made possible the design of sophisticated ECG machines in portable and miniature form.

This has also resulted in more reliable equipment, which is one of the most significant requirements of any medical equipment. Isolated amplifiers in the integrated form are now available. The power amplifiers are also available in the integrated form.

iii) A high common mode rejection ration (CMRR) ECG machine is a desirable factor. This provides recording of hum-free signals. Modern practice of improving the CMRR of differential amplifiers consists in minimising the common mode signal present on the patient's body due to a.c. pick up from the power line or other sources. This is done by using a circuit called the 'right leg drive'. In this case, the common mode signal picked up by the electrodes is amplified and inverted. This inverted signal is fed back to the right leg electrodes, thereby, partially cancelling the common voltage present on the patient. This reduction helps to minimise the problem of common-made signals.

iv) In order to be able to minimise the effects of changes occuring in the electrode impedance, it is necessary to employ a pre-amplifier having a high input impedance. A minimum impedance of 5 M Ohm from each lead to ground is recommended if the machine is used with limb electrodes. Much higher values of input impedance would be required in case self-adhesive chest electrodes are to be used.

v) ECG machines are occasionally subjected to high input voltages like defibrillating voltage from a dc defibrillator or high-frequency high-voltage signals from surgical diathermy machines when used on a patient. ECG machines are therefore provided with protective arrangement that usually limits the degree of circuit overloading to a safe value. Back-to-back diodes or neons are placed in the input circuit to by-pass excessive voltages.

vi) Input circuits of the ECG machines are usually provided with circuit arrangement to reduce the effects of high-frequency signals from entering the machine when it is used in the vicinity of surgical or shortwave Diathermy machine. A lowpass filter is provided to overcome this difficulty.

vii) The recording machinism is usually of the galvanometeric type. However, a powerful magnet would be required to achieve high-frequency response necessary for a faithful reproduction of the ECG waveform. 'Alnico' magnets are now available which provide sufficient magnetic intensity in a reasonable size. Machines are also available in inkjet type of recording systems. However, production of a direct writing machine is recommended due to its basic ruggedness and smudge-free record.

viii) The writing pen should preferably be of the heated stylus type. This avoids handling of ink while recording and gives a smudgefree dry record immediately.

ix) To make the equipment portable, rechargeable cells are now used as a source of power. The cells can be charged when the equipment is not in use. When powered on the rechargeable cells, the instruments can be taken in the ambulances, to the patient's home and also can be conveniently operated when transporting the patient within the hospital. ECG machines working on rechargeable cells are generally preferred over mains/battery operated models.

Specifications of the Proposed ECG Machine

Input signal amplitude:	10 mV peak topeak.
Sensitivity:	Continuously variable upto 20 mm mV.
Linearity of trace:	Deviation from linearity not more than 5% of the stylus deflections between 5 and 50 mm.
Frequency Response:	Flat within 0.14 to 50 Hz 3 db points 0.05 to 100 Hz.
Calibration Signals:	1 millivolt ± 2%
Input Impedance:	Minimum 5 Meg. Ohm.
Common Mode	Preferably 10,000 : 1
rejection ratio: i) at 50 Hz ii) with an unbalance of 5 K-Ohms in one of the leads.	Adequate 1,000 : 1
Time constant:	Between 3 and 4 sec.
Paper speed:	25 mm/Sec. 50 mm/Sec.

Paper-Speed Accuracy:	± 3 percent.
Damping:	Maximum Overshoot upto 10% for a square waveform of 1mV amplitude.
Limiting value of dc current:	not exceeding 0.1uA.
Chart width power	Minimum 40 mm, ruled in mm. Supply mains and/or battery.

ENVIRONMENTAL CHARACTERISTICS

Operating Temp. Range:	10°C to 40°C.
Opeating Relative Huridities:	Upto 95%
Altitudes:	Sea level to 2000 meters above sea level.

SPECIAL FACILITIES

1. Automatic unblocking after defibrillation.
2. Insensitive to interference caused by radio frequency sources such as therapeutic and surgical diethermy machines.
3. All patient circuits effectively isolated from the mains supply.

3. Know-how arrangement

Possible Sources of Know-how

ECG Machine proposed to be taken up for manufacture is a fairly standard item. Quite a large number of industries are producing these machines in various countries under different brand names and models. Therefore, it will not be a problem to locate suitable sources of know-how. Possibly, there could be one constraint in selecting the know-how from the established manufacturing units in Europe and United States and that is whether or not their machine meets the environmental conditions prevalent in the Arab countries. Some of the companies do market tropicalised instruments. But the low sale volume of medical equipment sometimes does not justify the tropicalisation. Therefore, only a few companies would be in a position to offer know-how suiting to the conditions in the Arab countries. The following companies are presently marketing ECG machines. Only the leading firms have been listed:

1. M/s. Hewlett Packard, Walthaim, Boston, USA
2. M/s. Roche Medical Electronics, Cranbury, NJ, USA
3. M/s. B.D. Electrodyne, Sharon, Boston, USA
4. M/s. Philips Gloeilampenfabrieken, Eindhoven, Netherlands
5. Burdic Corporation, USA
6. M/s. Cambridge Instruments Co., U.K.
7. M/s. Siemens Erlangen, Federal Republic of Germany
8. M/s. Galileo, Italy.
9. M/s. Medicor, Budapest, Hungary
10. M/s. Devices Instruments, UK.
11. M/s. Nihon Kohden & Co., Japan

Know-how for ECG machine is also available in India. The following firms are manufacturing ECG machines in India:

1. M/s Electronics Corporation of India Ltd., Hyderabad.
2. M/s Encardiorite, Lucknow
3. M/s Electromedical, Indore
4. M/s SAECOR, New Delhi
5. M/s British Physical Laboratories, Palghat
6. M/s Cambridge Instruments CO.Poona.

The actual model number corresponding to the specifications which have been laid out in this report can be selected at the time of decision making in this regard.

Cost of Technology

It is estimated that the know-how of ECG machine would be available at US $ 12,000 plus a recurring royalty at 5% on the sale price. This amount reflects the opinion of this consultant and the actual amount would have to be negotiated between the firm selling the know-how and the Arab company.

Mode of Transfer of Technology

Different arrangements exist with different companies/organisations for transfer of technology. The amount charged for giving the know-how may include providing complete information about the process of manufacture, design, drawing and engineering details, raw material, test equipment requirements and their source of availability. It may also involve inplant training of senior level engineers at the company's premises.

The general practice has been to invite engineers from the firms purchasing the know-how and assisting them in fabrication of one complete unit of the instrument for which the know-how is to be released. All help in matters of components, mechanical parts, assembly and testing is provided by the design team. It has been our experience that this method has been found to be highly acceptable by the industry and proves as the most quick and effective method for transfer of technology from the laboratory to the industrial house.

The know-how agreement must provide for the following assistance:

1. A complete know-how document containing information on the product specifications, cost and sources of raw materials, cost and source of test equipment, assembling and testing procedure, schematic diagrams, printed circuit layout and complete mechanical and assembly drawings.

2. Assistance for building up at least one prototype of the instrument at the premises of the industry from whom the know-how is purchased (travel and stay expenses of the engineers deputed for training to be met by the Company purchasing the know-how).

3. It is quite probable that much more help may be required by the Arab company for actually getting into production. For that purpose, the services of an expert would be required. The expert proposed for the job should at least be

Graduate in Electrical/Electronic Engineering with at least 10 years experience in the field of design, development and maintenance of electro-medical equipment. Such an expert would be available at US $ 150 per day. The services can be made available for total 6 months, spread into two assignments of 3 months duration each time. They would also assist in the training of staff for various jobs like R&D Application, production, document preparation and servicing of instruments.

Recommended Sources of Know-how

Although many firms are manufacturing ECG machines in the world, it is suggested that know-how may be obtained from any one of the following firms as the quality of their products is good in the opinion of this consultant:

1. M/s Hewlett Packard, Walthaim, Boston, USA
2. M/s Philips Gloeilampenfabrieken, Eindhoven, Netherlands
3. M/s Cambridge Instruments Co.,UK
4. M/s Galileo, Italy
5. M/s Nihon Kohden & Co., Japan.

4. Equipment and machinery

The list of equipment and machinery required for production, testing, R & D and after-sales service is given in the following paragraph and in table 1.

The machinery and test equipment may be procured from any leading manufacture in the world. It is quite probably that bulk of the workshop machinery might be available in the Arab countries. The test equipment for the electronics laboratory can be purchased from the leading manufacturers of the world, some of which are given below:

1. M/s Tektronix Inc. Beverton, Oregon, USA

2. M/s. Hewlet Packard,
Palo Alto, Calif, USA

3. M/s. Philips Gloeilampenfabrieken,
Eindhoven, Netherlands

4. M/s.Fluke, U.S.A.

5. M/s. Philips India Ltd.,
Bombay, India.

6. M/s. Aplab,
Thana, India.

7. M/s.Systronics, Ahmedabad, India

8. Electronics Corp. of India Ltd.,
Hyderabad, India.

9. Yamuna Digital Electronics,
Hyderabad, India.

The list of equipment and machinery also includes equipment for setting up printed circuit board facility. This facility is necessary in order to keep secrecy of the designs.

The company should have its own tool room facility so that it does not depend upon others for dies and punches.

10% of the total cost of equipment and machinery has been added as custom duty over and above the total cost.

Table 1. Electronic equipment required for production of ECGs

For R & D, Quality Control, Production, Service

S.No.	Item	Quantity	Total price, US $
1.	Differential Input 10 MHz Oscilloscope	1	2352.94
2.	Differential output Function Generator	1	1764.70
3.	Storage Oscilloscope Dual Trace, 10 MHz	1	3529.41
4.	Oscilloscope, 200 MHz	1	1176.47
5.	R.F.Generator 10-500 MHz	1	583.24
6.	Universal Bridge, Accuracy $\mp$ 0.01%	1	1764.70
7.	ECG Simulators	2	235.00
8.	Oscilloscope Single beam DC - 15 MHz	3	3529.23
9.	Oscilloscope, Double beam 15 MHz	2	4705.88
10.	Pulse Generator	2	1411.76
11.	Power supply 0-5V) 0-30V)	0-1 Amp 10	1764.70
		Subtotal	22 823.03

S.No.	Item	Quantity	Total Price US $
12.	Multimeter Model AVO 8	10	1411.80
13.	Digital Multimeter	1	2470.58
14.	LCR Bridge 1%		705.88
15.	Line Regulator 3 KW	5	2352.95
16.	Auto Transformer 4 Amps.	2	94.12
17.	Attenuator Probes for CRO 10:1	2	188.24
18.	Attenuator Probe for CRO 1:1	5	88.12
19.	Curve Tracer Plug in Module	1	705.88
20.	Scientific Calculator	1	176.47
21.	General purpose calculator	1	117.65
		Subtotal	8311.69

Transformer Section

1.	Coil winding machine	1	470
2.	Vaccum Impregnation plant	1	3500
3.	Baking Furance (2KW)	1	400
4.	Drying Oven	1	300
5.	Insulation Tester	1	200
6.	Auto Transformers of different current ratings.	2	100
7.	M.S.Trays	2	10
8.	Multimeters	2	350
		Subtotal	5330

Tools

S.No.	Item	Quantity	Total Price US $
1.	Tool kit (Philips)	20	800
2.	Low voltage Soldering Iron 6V, 15W	5	100
3.	Suction Soldering Iron 60 Watt.	10	100
		Subtotal	1,000

Machinery for Workshop

1.	Capstan Lathe for Production	1	2352.00
2.	Precision Lathe (PTC)	3	8823.00
3.	Heavy duty precision lathe	1	4000.00
4.	Tool and cutter grinder	1	2941.00
5.	Surface grinder	1	1000.00
6.	Pedestal Grinder	1	588.00
7.	Universal Milling Machine	2	11764.00
8.	Horizontal Milling Machine	1	4117.00
9.	Engraving Machine	2	2350.00
10.	Shaper	1	1768.00
11.	Double action power press 40 tonnes.	1	3000.00
12.	Powerpress 10 tonnes	1	500.00
13.	Fly press	1	400.00
14.	Shearing machine	1	1500.00
15.	Nibiling machine	1	2000.00
16.	Punching machine	1	4000.00
17.	Sheet metal folding m/c	1	500.00
18.	Power Hacksaw	1	500.00
19.	Work Benches	5	400.00
20.	Drilling machines of various types	2	400.00
21.	Bench Vices	5	100.00

22.	Gas Welding set	1	800.00
23.	Buffing machines	2	175.00
24.	Electroplating Plant	1	7000.00
25.	Air compressor	2	500.00
26.	Painting gun	2	200.00
27.	Spray painting chamber and drier cabinets.	1	500.00
		Subtotal	62,178.00

Design and Drawing Office

1.	Drafting machine	2	700.00
2.	Blue Printing M/s.	1	800.00
3.	Tracing Table	1	175.00
4.	Paper Trimmer	2	50.00
5.	Drawing instrument boxes & stencils, scales etc.		100.00
		Subtotal	1,825.00

Environmental Tests Facility.

1.	Vibration test equipment	1	2352.94
2.	Hot and Humidity chamber 3' x 3' x 3' (Ambient temperature to 60°C)	1	1764.71
3.	Cold chamber (3'x3'x3') -25 to + 50°C	1	3529.41
4.	Salt spray chamber 3' x 3' x 3'	1	2352.94
5.	Dropt Test apparatus	1	2352.94
			12,352.94

Printed Circuit Board Section

Unit Price (US $)

1.	Process Camera(12"x15") with following accessories	1	6250.00
	i) 300 mm focal length lens		
	ii) Operating arc lamp		
	iii) Vacuum contact positive printing cabinet size 20" x 24"		
	iv) Vacuum printing down frame		
	v) Printing down ArcLamp		
	vi) Vacuum flat bed screen printing machine size 15"x20"		
	vii) Vertical etching machine size 20" x 24"		
	The above items are 'Grafix' make		
2.	Metal cutting machine 24"	1	200.00
3.	Rotary print dryer	1	500.00
4.	Enlarger	1	1000.00
5.	Trays	10	50.00
6.	Automatic Printed Circuit Soldering Machine	1	8000.00
		Subtotal	16,000.00

Furniture requirement

1.	Work tables for assembly & testing (6' x 3')	25	2500.00
2.	Work stools for assembly & testing.	25	200.00
3.	Writing desks	20	3520.00
4.	Chairs	30	600.00
5.	Cupboards/store wells	10	1000.00
6.	Components stacking store wells	10	1000.00
		Subtotal	40,500.00

Total cost of the equipment & machinery =

US $ 138,640.66

Custom duty at 10% = 13,864.07

Total cost of equipment & machinery = 152,504.73

say US $ 150,000

5. Production phasing

The installed capacity is assumed to be the present annual estimated demand of ECG machines.

i) The capacity utilisation would be 20% in the first year, 40% in the second year, 60% in the third year and 80% in the fifth year. It has been estimated that the breakeven point would be reached at 36% of the capacity utilisation. The project is expected to yield a profit of 20% at the end of the fifth year at a utilisation of 80% of the estimated capacity.

ii) The company shall have built-in infrastructure such that it shall be possible to achieve a growth rate of 10% per year after achieving the estimated demand target. After ten years, the capacity would be raised to 2.6 times the installed or estimated capacity.

SCHEDULE OF IMPLEMENTATION OF THE PROJECT

After acquiring the land, the construction of the building should take around 6 months. Till then, the company can function in some rented premises and set up an office for starting purchase of test equipment, machinery and raw-materials.

The delivery period for most of the test equipment and machinery is quoted normally as 3 - 4 months by the suppliers from the date of placing of the order and opening the letter of credit in their favour. It is therefore expected that the delivery of the equipment will take around 6 months. The trial production can start reasonably well after six months of floating of the company.

MANUFACTURING PROCESS

Medical electronic equipment is basically electronic in nature. Therefore, the manufacturing process would involve wiring, assembly and testing of various components, sub-assemblies and fully assembled units. The testing could be divided as follows:

a) Testing of components for ensuring repeatability and quality production.

b) Testing of printed circuit cards individually. This could be done by having test jigs specially designed for the job.

c) Testing of sub-assemblies.

d) Testing of fully assembled units for performance check.

e) Final check for calibration and quality control.

The chassis and other mechanical parts would be manufactured in the workshop. A strict quality control would be necessary in their production. A senior level supervisor would finally inspect the mechanical parts before the same are fitted in the final instrument.

The printed circuit boards would be made as per requirements preferably on the epoxy substrate.

Even though it is proposed to purchase the know-how of the proposed items from some reputed concern manufacturing this type of equipment, it would be essential to have an R & D unit. The unit would assist in the technology transfer and for carrying out modifications or improvements in the designs suiting to local requirements. Highly qualified and experienced engineers would be required for this purposes.

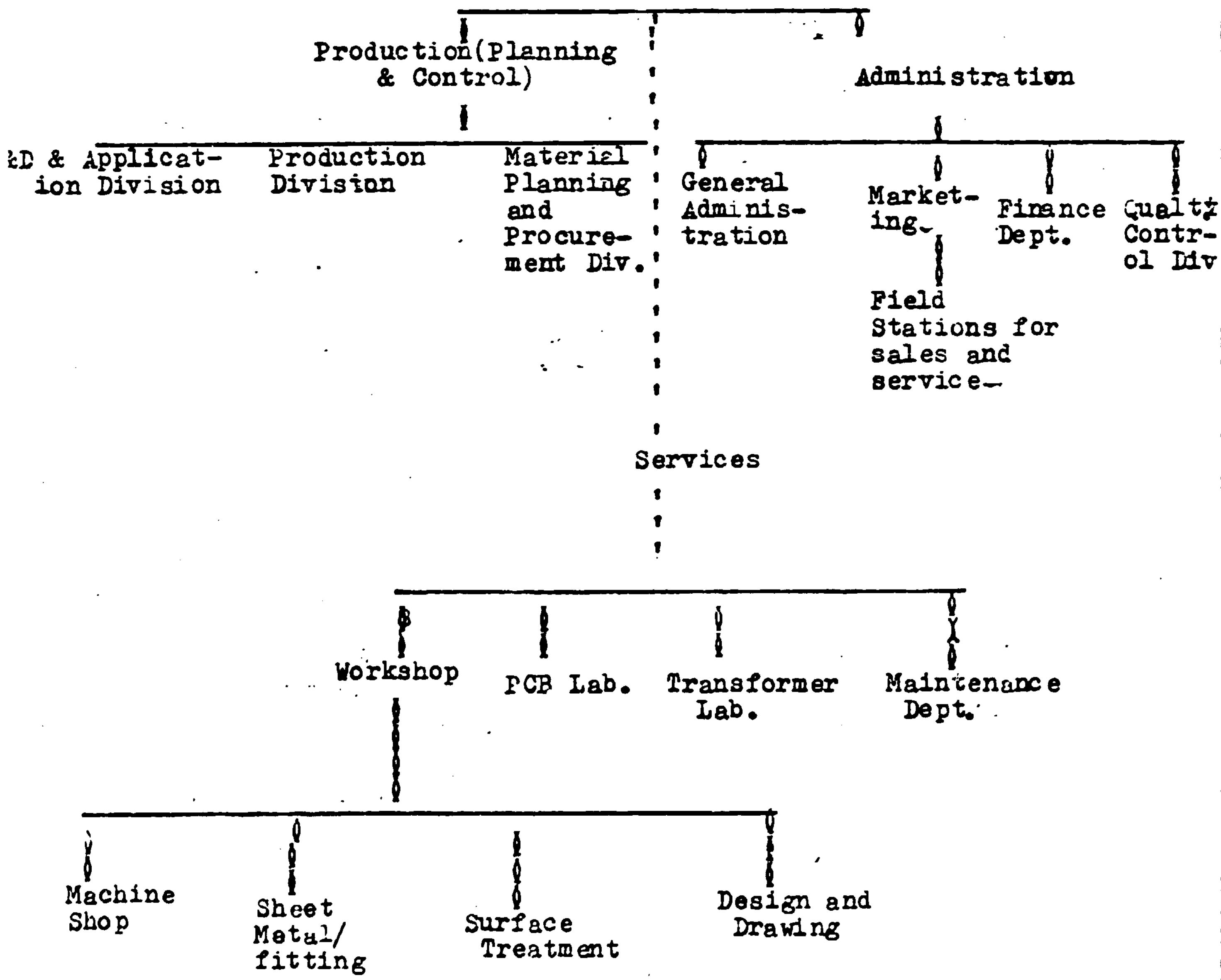
6. Organization and management

The manufacturing unit would have three main departments:

1. Production (Planning & Control)
2. Services, including Workshop
3. Administration

Various divisions under each department are given in the organisational set-up.

ORGANISATIONAL SET UP



Administration and management

The person in charge of the unit would be the Managing Director. He would be assisted, in the initial stages, in planning and execution of production programme by an expert in the field of medical instrumentation. The financial matters would be looked after by the company's secretary-cum-financial controller. The Marketing Manager shall look after sales and after-sale service. The Personnel Manager would attend to matters pertaining to personnel problems, welfare activities and labour relations. The production, Planning and Control Department would be headed by a senior-level electronic engineer whose responsibility would include looking after production, R & D and transformer lab. The head of the workshop would look after various activities in the mechanical shop. He would be assisted by supervisors in various sections. Design and drawing Office would work under the workshop head. Detailed duties of each sections are given in the chapter on manpower requirements.

7. Plant and raw material costs

LAND, BUILDING AND SERVICES

1. Selection of site

i) The site to be selected for the proposed unit should be located in a comparatively dust-free area. Also, the relative humidity levels should not be too high, otherwise it would cause problems for storing electronic components. The area should preferably have moderate temperature throughout the year.

ii) If industries of similar nature already exist in any industrial focal point, it would be advantageous to locate this unit in the nearby area. This is because it would be easier to get trained manpower and develop the infrastructure and ancillary industries quickly.

iii) The unit should be located near a good hospital or medical institute so that the products manufactured could be clinically tried quickly and effectively for feed-back.

iv) The place should be well connected by road and rail so that transportation of raw-materials and finished goods is easy.

v) The proximity of a training institute near the unit would be beneficial from the point of view of meeting the manpower requirements.

LAND

The estimated land requirement for electronics assembly, testing unit, quality control, workshop and other services is about 4000 sq. metres. The total covered area has been estimated as 1000 sq. meters which would leave sufficient open space for lawns and parking. The land has been assumed to be available free of cost. The design of the building would be entrusted to some architectural firm. The cost of construction has been worked out at a rate of £ E 200/- per sq. metre.

The installation of the machinery would be carried out under the supervision of technical staff of the company.

BUILDINGS

The details of the construction proposed and its cost are given below:

		m^2	
1.	Administration	75	
2.	R&D & Application	75	$ 235,290 @ 235.29 per sq.mt.
3.	Assembly & Testing	125	
4.	Design & Drafting	50	
5.	Quality Control	50	
6.	Stores	75	
7.	Main workshop	400	
8.	PCB Transformer	75	
9.	Canteen	75	
10.	Architects fee		$ 5088

Total building cost. $240,378

The administrative, quality control, electronic assembly, testing and stores shall be constructed with burnt brick in cement and RCC roofing. The R&D and Application Department can be either constructed on the first floor of the electronics block or adjoining the same.

The main workshop should be housed separately from the electronics block. This is necessary because sensitive electronic test equipment should be kept away from the vibrations and noise of the shop machinery.

The printed circuit board and transformer shops can be located adjoining the workshop. The workshop building should have good quality construction of bricks in cement. The roof could have corrugated trusses with slanting glass panes on the top to provide sufficient natural light. Some parts of the quality control department are proposed to be air-conditioned.

The total cost of construction including internal roads is estimated at US $ 275,672.

SERVICES

Power

The power requirements at 60% utilisation are estimated at 70 KW. A provision for providing power upto 120 KVA would have to be made. The unit should preferably have it own transformer. If power shortage is not expected at the unit site, company's own diesel generating set is not recommended.

Water

Water requirements of the company are not much as this would be required only in electroplating and printed circuit board sections. The provision can be made by having overhead tank using a lifting pump.

Disposal of Affluent

Affluent containing chemicals would have to be disposed of. This would come from nickel plating, electroplating and anodising plant. As the quantities are not going to be large, normal underground drainage system would suffice.

Table 2. Raw materials and consumable items required for ECG production

RAW MATERIAL REQUIREMENTS

S.No.	Electronic Components	No.
1.	Integrated circuits (linear)	10
2.	General-purpose Transistors	10
3.	Power Transistors	8
4.	Diodes and Rectifiers	30
5.	Capacitors (electrolytic)	6
6.	Capacitors (Polyester, styroflex)	12
7.	Capacitors (tantalum)	8
8.	Resistors (Metal film, carbon film)	50
9.	Present potentiometers	8
10.	High stablity band switch 5-pole, 11-way	1
11.	Relay	1
12.	Multipin connector	1
13.	Connectors for printed circuit boards	2
14.	Potentiometers for front panel	2
15.	Three-way key switch	1
16.	Toggle switch	1
17.	Fuses & fuse holders	2 each
18.	High-quality Teflon wires, PVC wires & cables	
19.	Knobs	3
20.	Pen motor & paper drive	1 set
	Subtotal	$ 221.41

(Item 20 would be fabricated in the second year in the plant itself)

RAW MATERIAL REQUIREMENTS FOR FABRICATED PARTS FOR ECG

1.	Aluminium sheet for cover, shields and brackets etc.	4' x 1' x 1/16"
2.	Aluminium Angle	1½"x1½"x1/8"x2' ½" x½" x 1/8"x2'

3. Aluminium T-Section $1/2" \times 1/2" \times 1/8" \times 2'$

4. Stainless-steel for sodeplates, mounting brackets etc.(22 Swg). 350 gms.

5. Spring wire (30 Swg)

6. Teflon rod 100 gm

7. Brass rod

8. Perspex for cover and Transformer

9. Copper wire for transformer

10. PCB guides and other plastic brackets

11. PCB (Epoxy)

12. Ferrite core

13. Stainless steel/silver/bronze etc. for electrodes

14. Hardware

15. Stainless steel/silver for electrodes

Subtotal $ 36.47

Total = US $ 257.88
Cost per instrument

REQUIREMENTS OF GENERAL CONSUMABLE ITEMS

1. PCB Processing chemicals
   1. Ferric chloride
   2. Commercial thinner
   3. PCB Lacquer
   4. Resist (Photo sensitised)
   5. Resist (Developex)
   6. Resist (Dye)

7. Hydrochloric acid
8. Screen printing ink
9. Ink reducers
10. Hydrogen peroxide
11. Frames and cloth for screen printing
12. Stencil and five star film
13. Cleaning powder etc.

2. Electroplating and anodizing chemicals

1.	Nisol 1206	10 litres
2.	Nisol 1207	10 "
3.	Nisol 1239	10 "
4.	Nisol 1240	10 "
5.	Nisol 75 V	50 "
6.	Nisol 75 B	50 "
7.	Metal clean 105	30 "
8.	Metal clean KW	30 "
9.	Chrosal	50 "
10.	Anodizing chemicals	

<u>Oils & Grease</u>

1.	Silicon lubricating oil	3 litres
2.	Mobil oil	25 "
3.	Soluble oil	50 "
4.	Kerosene oil	50 "
5.	Cutting oil	20 "
6.	Switch-cleaning oil	3 "

7.	Degreasing fluid	3 litres
8.	Grease	10 kg
9.	Soap	50 kg.
10.	Cotton waste	50 kg

Soldering material

1.	Soldering material (Silver lead, tin lead)	40 kg
2.	Spare soldering iron elements	100 kg
3.	Spare bits for soldering iron	75 kg
4.	Soldering wax	5 kg

Painting shop

1.	Paint	80 litres
2.	Varnish	50 "
3.	Thinner	50 "
4.	Putty	10 kg

General Hardware

1.	Tool steels for dies & punches	20 kg
2.	Hardware	
3.	M.S.Plates, rods etc.	
4.	Miscellaneous materials like bushes, spring wire, phosphor bronze etc. sand paper	60 kg.

Packing Material

1.	Card Board	20 rolls
2.	Thermocole	8,00, cubic inches

3. Polythene paper for packing — 200 sq. metres

4. Wooden board for packing

5. Iron strips and hardware

Total cost per year US $ 5,000

Possible sources of components and raw materials

A. Linear Integrated Circuits

1. National Semiconductors, USA
2. Fairchild Corp., USA
3. R C A , USA
4. Analog Devices, Ma, USA
5. Bharat Electronics Ltd., Bangalore, India
6. Motorola, USA
7. Optron Inc., Texas, USA
8. Litronics Inc., USA
9. Precision Monolithics Inchs. Bourns, A.G., Federal Republic of Germany
10. Signatics Corp., Sunnyvale, Calif, USA
11. Plessey Semiconductors, Wilshire, U.K.
12. Hindustan Semiconductors Ltd., Bombay, India

B. Digital Integrated Circuits & Displays

1. Texas Instruments, USA
2. Hewlett Packard, Palo Alto, Calif. USA
3. Raytheon Semiconductor Division, Calif, USA
4. Motorola, AYZ. USA
5. Intel Corporation, Calif. USA

6. Signatics Corp., Sunnyvale, Calif, USA
7. Sprague Elec. Co. Ma. USA
8. Semiconductor Ltd., Poona, India
9. Continental Devices (I) Ltd., Faridabad, India
10. Bharat Electronics Ltd., Bangalore, India
11. GEC Semiconductors,
    East Lane Wembley Middlesex, U.K.
12. Koyo International Inc.
    7-11-15, Ginza, Cohu-ku, Tokyo, Japan

C. <u>Semiconductors</u>

Transistors (General purpose, Power transistors), Diodes, Zener Biodes, SCR, & Rectifiers etc.

1. Lambada Electronics N.Y. USA
2. Allied Electronics, USA.
3. Motorola Semiconductor Products, Arizona, USA.
4. National Semiconductors, USA.
5. General Electric, N.Y. USA
6. Kertron Inc., Riveria Beach, Fla . USA.
7. Plessey Semiconductors, Wilshire, UK
8. R.C.A., USA
9. Fairchild Corporation, USA
10. ISHIZUKA Electronics Corpn.,
    3 - 16 - 7, Higashi-Kowa Edogawa-Ku,
    Tokyo 133, Japan.
11. M/s. Njarat Electronics Ltd.
    Bangalore, India.
12. M/s. Semiconductors (India) Ltd., Poona, India
13. Continental Devices Ltd.
    Faridabad, India.

D. Resistors

1. Calude Lyons Controls Ltd.,
Ware Road, Hoddesdon, Herts, U.K.

2. ALMA Components Ltd., Park Road,
Diss Norfolk, U.K.

3. ABRIFA S 161 11, Bromma, Sweden

4. Erg Components, Luton Road,
Dunstable, Bedfordshire, UK

5. M/s. Asian Electronics Ltd., Nasik, India

6. M/s. Electronics Corpn. of India Ltd.,
Hyderabad, India.

7. M/s. Philips (India) Ltd., Inbelec Division,
Bombay, India.

8. Steatite Insulations Ltd.,
Hagley House, Hagley Road, Birmingham, UK.

E. Capacitors (All types, Tantalum, Mylar, Polyester, Electrolyte etc.)

1. M/s. Transistor, Vermont, USA
2. M/s. Sprague Elec. Co., Ma., USA.
3. Procond, Longarone, Italy.
4. Elogs, Moscow, USSR.
5. Matsuo Electric Co. Ltd., Osaka, Japan
6. Custom Electronics Inc. N.Y. USA.
7. Centralab, Calif, USA.
8. Malloy & Co., Indianapolis, USA.
9. Waycom Ltd.,
Workingam Road, Bracknell, Berks, UK.
10. Sprague Electric (UK) Ltd., 159, High Street,
Yiewsley, West Drayton, Middlesex, UK.
11. Nichicon Capacitor Ltd.,
Mehara Building, Okedori,
Karsumahighashi-iru,
Nakgyo-ku, Kyoto, Japan

12. SANSHIN DENSHI CO. LTD.
27-6, Sapura 3-Chrome,
Setagaya-ku, Tokyo, Japan

13. M/s. Mahindra & Mahindra, Bombay, India

14. M/s. Asian Electronics, Nasik, India

15. M/s. Nippon Electronics, Bangalore, India.

16. M/s. Electronics Corpn. of India,
Hyderabad, India.

F. Potentiometers & Trim Pots.

1. Allen - Bradley
Milwaukee, Wisconsin, USA

2. New England Instruments Co. Ma, USA

3. Spectrol Reliance Group
Swindon, Wilshire, UK

4. Kenure Developments Ltd.,
Plackwater Station Estate,
Blackwater, Camberley Surrey, UK

5. TAMA Electric Co. Ltd.,
2-15-12, Nakane, Meguro-ku,
Tokyo, Japan

6. M/s. Koreay Noble Electronics Co.Ltd.,
Guro, P.O. Box No.91, Seoul, Republic of Korea

7. M/s. Philips (India) Ltd.,
Inbelec Division, Bombay, India

8. M/s. Kiber Ltd., Mahakali Road,
Marol, Bombay, India

G. Switches (Push type, micro, lever)

1. FEME, S.P.A. Milan, Italy

2. Cutler, Hammer, Milwaukee, Wisconsin, USA

3. Alco Electronic Products Inc. Ma, USA

4. C & K Components Inc. Ma, USA

6. Thron Electrical Components Ltd.,
Great Cambridge Road, Enfield, Middlesex, UK

7. M/s. O E N (India) Ltd., Cochin, India

H. Relays

1.. Potter and Brumfield
Princeton, Indiana, USA

2. Magnetic Devices Ltd., Exhing Road,
New Market, Suffolk, UK.

3. Omron Tateisi Electronics Co.,
Control Components SQ.,
Shiba-Daimon, Minato-tu,
Tokyo, Japan

4. O E N India Ltd., Cochin, India

I. Rechargeable Cells

1. Gates Energy Products Inc. Denver, .. -USA

J. Connectors

1. Bendix Corpn., Sydney, N.Y. USA.
2. Amp. Incorpn. Harrisburg, PA, USA.
3. Amphenol, Oak Brook, Illinois, USA.
4. Metway Electrical Industries Ltd.,
Canning Street, Brighton, UK.
5. SOURIAU (UK) Ltd., Shirley Avenue, Windsor,
Birkshire, UK

6. F.W.O. Banch Ltd.,
49, Theobald St.Boreham Wood,
Hertfordshire, UK

7. Amphenol (India) Ltd., Poona, India.

K. Raw materials for fabricated parts.

These materials are available in India

and also would be available mostly in any advanced country. A large number of firms are manufacturing these items. It is not felt necessary to list them all in this document.

Cost Details of Components & Raw Materials

			Ist year		2nd year		3rd year		5th year	
	Cost per Unit (	Estimated Demand	Qty 20%	Cost	Qty 40%	Cost	Qty 60%	Cost	Qty 80%	Cost
G	257.88	3,000	600	154,728	1200	309,956	1800	464,184	2400	618912

Requirements of Components and
Raw Materials at full capacity = $ 7,73,640.

8. Manpower and training requirements

Type of Manpower Requirements

ECG machine is basically electronic in nature and therefore its production would be labour intensive. The personnel requirement range from wiring operation to senior test and quality control engineers. Also, the requirement would exist for design engineers who would work in the R & D and application laboratory of the manufacturing unit. Four categories of staff have been proposed in the unit:-

1. Wiring operators/Machine Operators
2. Supervisors
3. Test Engineers
4. Quality control/R&D/Application Engineers

Training Requirements

1) Wiring Operators/Machine Operators

For this category of staff facilities exist in some of the Arab countries for training technicians in the electronics/radio mechanic trade. No extra training would be required for them and they can be directly employed in the unit. Certificate holders having a trade certificate of about 1 1/2 years duration after matriculation or equivalent would be adequate.

2) Supervisors

The supervisory level would consist of personnel who are diploma holders (three years diploma in electronics/

radio mechanic trade after matriculation). They would form the middle-level technologist core of the unit. Their job requirement would include guiding the wiring operators and themselves undertaking the testing of printed circuit cards and sub-assemblies. This category of personnel is also understood to be available in the Arab world.

3) Test Engineers

Test engineers would be responsible for thoroughly checking the performance of the assembled instruments. They would also be responsible for developing dedicated test equipment for carrying out various test procedures on the assembled instruments. It will be essential to thoroughly check each and every instrument before it is passed on to the quality control department for final check and calibratinn. This category of staff would require special training specific to the instrument which they would be required to test and calibrate. A good knowledge about the electronic specifications, testing procedures and application aspects of the instrument would be essential. This class of engineers would have to be trained.

4) R&D/Quality Control/Application Engineers

Similar would be the situation in case of quality control, R&D and application engineers. Even if the know-how is purchased from an established manufacturer it is quite often necessary to carry out modifications suiting to local availability of components and raw-materials. This can only be done by senior level R & D Engineers. Also, strict control on the quality would have to be maintained in keeping with the general and safety requirements of medical equipment. This class of engineers would also have to be specially trained for the job which would be entrusted to them.

ARRANGEMENT FOR TRAINING

The training of the last two categories of personnel can be held at the manufacturing units from where the know-how would be obtained for manufacturing the machine. Since, it would not be possible to train all the personnel in the manufacturing units, it would be preferable if a senior level bio-medical engineer having expertise and professional competence in the ECG technology is appointed in the manufacting unit for the first two years of its establishment. The expert would arrange for necessary training of the senior-level engineers in the unit itself. The expert would also help in the transfer of technology from the know-how selling organisations to the Arab countries. The qualitative requirements of the proposed expert are given in section C, "Know-how Arrangement".

Table 3. Personnel required during the initial five years of ECG production

	Immediate (at the start of the company)	Year			
		1st year	2nd Year	3rd year	4th year
1. Managerial	4	4	4	4	4
2. Administrative	7	7	7	7	7
3. Engineers	3	4	5	4	5
4. Supervisors/ Inspectors	-	4	4	4	6
5. Skilled	-	18	27	40	56
6. Semi-skilled	3	4	5	12	12
Total	17	41	52	71	90

<u>Qualitative requirements of the staff</u>

1. Managing Director	Degree in Electronic Engineering with 15 years experience in design/development/production of electronic instruments preferably medical electronic instrumentation. At least 5 years experience in a senior management level desirable.
2. Marketing Manager	Degree in electrical/electronics engg. with at least 15 years experience in sales and service of electronic equipment, preferably medical electronic equipment. At least 5 years experience in a supervisory position desirable.
3. Company Secretary-cum-Financial Controller	Degree in Commerce/Cost Accountancy Chartered Accountancy with 10 years experience in a responsible position. Degree in Company Law preferable.
4. Chief Production Engineer/Works Manager	Degree in electrical/electronics engineering with at least 15 years experience in production of electronic instruments preferably medical electronic instruments.

5.	Engineers for production / R&D/ Quality Control/ Design Office/ Material Planning	Degree in Electrical/Electronics/ Mechanical/production Engineering, with at least 10 years experience in the appropriate line.
6.	Supervisors for production/quality control/Transformers shop/packing/PCB lab/ Tool Room/Sheet Metal/ Turning Milling etc./ Surface Treatment/ Printing Section/ Electronic Testing lab.	Diploma in appropriate trade with 7 years experience out of which at least 2 years should be in a supervisory position.
7.	Inspectors for quality control/ production/electronic testing lab and draftsman	Diploma in appropriate trade with at least 5 years experience in the line.
8.	Machine operators/ wiring operators/ tracers/PCB lab Transformer Winders	Certificate in appropriate trade with 2 years experience in the line.

9. Inspection and quality control

Quality control forms an integral part of any manufacturing organisation producing medical equipment. It ensures control and standardisation of the product and thus helps in building up customer satisfaction. It is proposed to have an independent quality control laboratory within the Unit. ECG machines must work within the specified temperature ranges up to a certain humidity level and at specified altitudes within the specifications. In case the environmental conditions change to some other specified limits, the instrument is expected to work, although not necessarily according to the specifications. There would be some other conditions which the machine must be in a position to tolerate for storing purpose. These checks can only be made by having hot and humid chambers and cold chambers. The engineering aspects of the instruments are checked by subjecting it to a vibration and bump test. Even the packaged instruments have to be tested to check the effectiveness of packaging to withstand bumpy road conditions.

The ECG machine would have to be checked for long-term drift and, therefore, it has to be subjected to life test by keeping it on over long periods. Safe operation of the equipment is ensured by measuring various types of leakage currents under normal and fault conditions.

To facilitate quality control on the production, a specimen of "Testing Procedure" is given on the following pages.

INSPECTION PROCEDURES FOR TESTING & QUALITY CONTROL

(Inspection Form)

E.C.G.

Model No. **Serial No.**

1. Condition of control and indicators — O.K. — Action needed — Action taken

   (knobs alright, movement smooth)

2. Quality of Trace

   i) Base line drift
   ii) Base line movement over chart width
   iii) Stylus heat
   iv) 50 Hz interference

3. Attachements

   i) Attachment mains plug
   ii) Line cord
   iii) Patient Cable
   iv) Patient Cable connector
   v) Fuse
   vi) Electrodes
   vii) Electrode straps

4. Patient Cable Resistance

   i) Reference Lead(RL) - ohm
   ii) Highest lead resistance -ohm
   iii) RL to ground pin -ohm

5. Line cord resistance:

   i) Ground wire -ohm
   ii) Hot Ground -M ohm
   iii) Neutral to ground -M ohm

6. Leakage Current to ground (Microamperes)

   i) Between individual leads & ground (Lead I position)

	O.K.	Action needed	Action taken
ii) Between instrument chassis & ground			

	Power	RA	LA	C	RL	LL	Chasis
Properly Grounded	OFF						
	ON						
Ungrounded Correct Polarity	OFF						
	ON						
Ungrounded Reversed Polarity	OFF						
	ON						

7. Inter-lead leakage (Micrcamperes)
(Select lead 1)

	RA/RL	RA/LA	LA/RL
Properly Grounded			
Ungrounded Proper Polarity			
Ungrounded Incorrect Polarity			

8. Calibration Signal

i) Shape of the Calibration pulse

Square Rounded Spiked

ii) Sag: - mm to half amplitude

9. Gain & calibration

i) Recorded pulse height

a) External - mm
b) Internal - mm

ii) Recorded Heights

a) at 2.5 mm/mV - mm
b) at 5 mm/mV - mm
c) at 10 mm/mV - mm
d) at 20 mm/mV - mm

	O.K.	Action needed	Action taken

10. Linearity

Base line Position

	Bottom	Middle	Top
Input amplitude 1 mV	mm	mm	mm
Input amplitude 2 mV	mm	mm	mm
Input amplitude 3 mV	mm	mm	mm

11. Frequency Response (3 db points)

Lower - Hz

Upper - Hz

12. Common Mode Rejection Ratio (at 50 Hz)

RL grounded -

RL Isolated -

Balanced -

Unbalanced (5 k ohm in one lead)-

13. Paper speed

Chart length for 1 Hz at 25 mm/sec - mm

at 50 mm/sec - mm

14. Overload capacity -

15. Distortion if any -

16. Comments and Description of Deficiencies

Inspected by ______________

Date:

Chief Engineer ______________
Quality Control

10. Sales and service

Selling of medical equipment requires special sales arrangements as the users are not engineers and technologists but they are doctors, nurses and other paramedical staff. In most of the cases, they expect demonstration of the equipment which is possible only if qualified sales engineers are appointed by the manufacturing unit. Appointment of distributors is therefore not recommended. The company must have its own sales organisation.

It is suggested that the sales may be handled from the headquarters only. The field stations which would be responsible for after-sales service could be informed for a follow-up action.

It is proposed to sell the ECG at $US 450, e.g., below the cost of imported machines which is from $US 475 to $US 850.

After-Sales Service

After-sales service of equipment forms a vital part of any industrial unit manufacturing medical equipment. It is a common experience that expensive biomedical equipment remain lying unused because of the poor after-sales service offered by the manufacturing units. This has been perhaps due to the fact that only a few companies supply medical equipment throughout the world and the after-sales service is expected to be rendered by their local representatives. It is a known fact that once the equipment is sold, the representatives are often not in a position to carry out repairs and servicing effectively even during the warranty period. It is therefore imperative that an effective after-sales service is planned and organised. This is no doubt a very difficult task but a properly planned service organisation can easily tackle this problem.

After sales-servicing can be organised as follows:

1. Senior servicing staff can be located at focal points in the Arab countries taking into consideration the density of machines in the area.

2. These service engineers can visit the hospital from where the call comes. They would attend to minor repair jobs including replacement at printed circuit card level.

3. If the nature of the fault does not permit completion of the job at site, the instrument could be brought to the regional centre where it would be repaired with the help of test instruments.

11. Standards for medical electronic instruments in different countries

International Electro-technical Commission, Geneva

Draft recommendation 62 (Secretariat) 10 March, 1974 for general safety requirements for electrical equipment used in medical practice was developed by sub - committee 62-A for International Electrotechnical Commission, Geneva, and submitted to the National Commissions. The recommendation applies to Medical Electrical Equipment designed for use in human or veterinary medicine, under the jurisdiction of a qualified person, and installed, applied, used or kept in locations intended for medical practice. Though the recommendation is primarily concerned with safety, it contains some requirements regarding reliability where such reliability is necessary to achieve safe operation. It is an exhaustive document covering 266 full scape printed pages.

Briefly, the document discusses the following:

i) Protection against electric shock hazards

ii) Protection against mechanical hazards

iii) Protection against unwanted or excessive radiation

iv) Protection against the hazards of explosions in medically used rooms.

v) Protection against excessive temperature, fire and other hazards.

The document can be had either from Standards Institutions at National levels or from the office of the International Electrotechnical Commission, Geneva, Switzerland.

It is expected that the ECG Machine proposed to be produced would meet the broad specifications laid out by the International Electro-technical Commission.

American Heart Association

Recommendations for standardisation of leads and of specifications for instruments in Electrocardiography and Vector-cardiography have been worked out by the American Heart Association. The major portion of these recommendations on instruments deal with direct-writing electrocardiographs. It was felt by the recommending committee that the usually available electrographs possess significant limitations in fidelity of data reproduction, particularly in the frequency range. Recommended specifications hence represent minimum requirements. The recommendations also suggest standardisation of controls, cables, legends and recording format. Besides this the recommendations describe high-frequency response, linearity, and input impedance and common mode rejection of direct writing electrocardiographs.

The recommendations appeared in Circulation, March 1967. They were also published in IEEE Transactions on Bio-medical Engineering.

British Standards

Hospital Technical Memorandum No. 8 issued by Departmant of Health and Society Security, UK, describes Safety Code for electro-medical apparatus. This is a general code and is appliable to electrical apparatus used for diagnostic, therapeutic and other medical purposes. This standard does not specifically bring out recommendations on the ECG machine and associated instruments, but is intended to cover the requirements, in general, which must be met by the electromedical equipment with the aim of ensuring the following:

i) Safety from electric shock to patients and to operators

ii) Safety from overheating and risk of fire in both the apparatus and its surroundings

iii) The provision of adequate and clearly-marked controls

iv) That apparatus is conveniently accessible for servicing purposes

The HTM 8 is available from 49, High Holborn, London WC IV 6HB, UK

Indian Standards Institute

Indian Standards Institute adopted IS 8048 - 1976 on March 22, 1976 on standard specifications for electrocardiograph. This draft covers the requirements and test methods for direct-writing single channel and multichannel electrocardiographs. The standard, however, does not cover methods for using electrocardiographs. The main object of preparing this standard was to lay down safety and performance requirements of these machines and for recording chart used with these machines. The standard, however, does not cover the electrocardiograph for direct-writing from heart muscles. The legend for marking of controls is also given.

The Indian Standard IS 1885 (part III)-1977 was adopted to cover definition of terms relating to electrical equipment used in medical practice. This standard is useful in interpretting IS 8048 - 1976.

12. Feasibility analysis

Basic Factors for feasibility analysis

1. The capacity ratings have been based on the estimated demand of ECG Machines in Arab countries. This demand has been established on the basis of the survey conducted

2. The build-up of the capacity is estimated at 20%, 40% and 60% in the first, second and third year. The production at the end of the fifth year is assumed to be 80%. Subsequently, a growth rate of 10% is estimated. The infrastructure is such that it would meet the production requirement upto 10 years when the production figures are likely to be 2.6 times the present estimated demand.

3. The cost estimated for various raw materials and electronic components is based on their present actual cost as they are prevailing in Indian market. For imported components, catalogues and price lists of manufacturers have been consulted. Any rise in their cost can be adequately met from the provisions made for margin money.

4. Sales and servicing costs have been estimated at 12-1/2% of the total sale value. This is

based on the assumption that the sales and services would be handled by the field staff of the company itself.

5. Depreciation on the plant and machinery has been calculated at 10% per annum.

6. Depreciation on buildings has been worked out at 5% per annum on the total cost.

7. The interest on the working capital is assumed to be 15%.

8. The cost of land has been assumed to be nil for working out the cost of project.

9. The cost of direct labour has been computed in direct proportion to the capacity utilisation. It implies that the technical staff strength increases as the capacity is built up.

10. Most of the indirect labour comprising of administrative staff, marketing staff and accounts section ais assumed to be recruited in the first year itself. The annual increase in their wages and salaries has been taken at 5%.

<u>Phased Production Programme</u>

	Installed capacity	1st year 20%	2nd year 40%	3rd year 60%	4th year 70%	5th yr 80%
E.C.G. Machine	3000	600	1200	1800	2100	2400

Statement showing yearly turnover (US $)

	Price per Unit. US $	1st year	2nd year	3rd year	5th year
E.C.G. Machine	450	270,000	540,000	810,000	1,080,000

Estimated cost of the project	$US
a) Cost of land	Free
b) Building	240,378
c) Machinery	150,000
d) Electrical fitting, Installation etc. at 2.5% on building and machinery	10,632
e) Cost of air conditioning 100 sq. metre at $ 352.94 per sq. meter	35,294
f) Contingencies (10% on the cost of building and machinery)	39,037
g) Other assets (transport, typewriters, filing cabinets etc.)	12,000
h) Marginal money for working capital (about 25% of the working capital for the first year)	21,922
9) Royalty lumpsum	12,000
Total	521,263

The total cost of the project has been worked out as US $ 521,263. The financial requirements are proposed to be met by raising aquity shares of appropriate value. The value of each share can be decided by the prevalent practice in Arab countries.

The requirements of working capital are proposed to be met by loans secured from commercial banks. A 15% rate of interest has been estimated on the working capital.

The requirements of working capital have been worked out as approximately US $ 87,686 , 171,100 and 259,189 in the first, second and third year respectively of the company's operation. This corresponds to utilisation of 20%, 40% and 60% estimated demand. The margin money requirements are estimated at 25% of the working capital for the first year. The liability due to rents and insurance has been calculated keeping in view the build-up of current assets and depreciation expected to take place.

Sufficient provision requires to be made for purchase of items like typewriters, filing cabinets, motor cars, station wagon and truck etc. A sum of US $ 12,000 has been made for the purpose.

Table 4. Working capital for ECG production

($US)

		1st year 20% capacity	2nd year 40% capacity	3rd year 60% Capacity
1. Raw Material	4 months	51,576	103,152	154,728
2. Miscellaneous consumable materials	4 months	400	660	1,000
3. Direct Labour	1 month	930	5,445	6,020
4. Indirect Labour (Administration)	1 month	2,653	2,793	2,940
5. Power and Fuel	1 month	725	1,450	2,175
6. Repair & Maintenance	1 month	375	750	1,125
7. Goods in fabrication (at cost)	1 month	25,788	51,576	77,364
8. Finished goods				
9. Misc. Admin. expenses	1 month	142	284	426
10. Sales and service at 12-1/2% on sale	1 month	2,812	5,625	8,437.5
11. Taxes, rent & insurance	1 month	1,500	2,000	2,500
12. Royalties	1 month	2,250	3,375	
		89,151	177,110	256,714

Working capital at 100% capacity = 432,000

Table 5. Break-even calculation for ECG production
($US)

Total sales at 100% capacity	1,350,000
Raw material at 100% capacity	773,640
Stores, spares and other consumables	5,000
Wages and salary (Directo)	10,033
Selling expenses at 12-1/2% of the sales	168,750
Power End Fuel	43,500
Total	1,000,923
Surplus at 100% capacity	349,077
Administration salaries	24,480
Other Adm. Expenses	2,100
Repair and maintenance	1,765
Depreciation of machinery at 10% per year	15,000
Depreciation of building at 5%	14,705
Interest	64,800
Rent and Taxes, & Insurance	4,000
Total	126,850

Break-even point $\frac{126,850}{349077}$ = 36% of the installed capacity

The break-even point has been calculated at 100% of the present estimated demand (full capacity rating of the unit) for the third year of the company's operation. Calculations indicate that the company will be breaking even at 36% of its installed capacity . The break-even point at 36% utilisation compares very favourably with the norms generally available in the medical electronics industry. This is highly satisfactory position.

Profitability analysis

The profits have been calculated in table 6.

Table 6. Profitability statement for ECG production ($US)

	1st year	2nd year	3rd year	5th year
Raw material	154,728	309,456	464,184	618,912
Power & Fuel	7,050	14,100	9,000	12,000
Direct labour	11,160	11,160	72,240	96,320
indirect labour	22,000	23,300	24,480	26,000
Other consumables	1,200	1,980	3,000	4,000
Repair & Maintenance	300	900	1,060	1,414
Rent, taxes & insurance	200	200	250	333
Interest	12,960	25,920	40,513	51,840
Depreciation of building @ 5%	14,705	13,970	13,271	12,607
Depreciation of machinery @ 10%	15,000	14,250	13,537	12,860
Other Admn. expenses	750	100	1,250	1,680
Sales & Service	33,750	67,500	101,250	135,000
Total	273,803	482,836	744,035	992,966

Percentage profit at 80% capacity = $\frac{106841}{521263}$ = 20.5%

It is seen that percentage profit at 80% capacity is 20.5%. This is satisfactory condition as the profit is comparable to other electronic industry. The feasibility of the project is highly satisfactory.

B. ECG and associated instrument (cardiac monitor, pacemaker, defibrillator and foetal monitor) production

Industrial profile prepared for ECG machine indicates that due to a good demand of ECG machines in the Arab world, it is feasible to undertake its manufacture by setting up an industrial unit in one of the Arab countries. This would help meeting the immediate needs of this vital hospital equipment. The proposed industrial unit would also act as a strong base to build up medical electronics industry in the Arab countries.

It would be advisable to undertake the production of items of similar technology and applications simultaneously. Therefore, it is suggested that instead of taking up the manufacture of ECG machine alone, a full range of cardiac equipment may be covered in the production plan. This would include Cardiac Monitor, external ON-demand Pacemaker and DC Defibrillator. These items cover almost all the needs of the cardiac care unit. Any of this equipment can be used individually or as a system. The latter is called Cardiac Care Unit or Coronary Care unit.

It has been estimated that about 60-80% of the deaths occurring in the hospitals are due to cardiac diseases. The cardiac patients are normally emergency patients and require special attention and equipment for their care and treatment. Therefore, the equipment has to be such that it is portable and reliable.

This project report also includes the manufacture of

Foetal Monitor which has acquired immense popularity in the obstetrics departments due to their usefulness and reliable prediction of foetal distress, progress of pregnancy, localisation of placenta and detection of twins etc. Though it does not form a part of the cardiac equipment, it has been included with a view to introduce this instrument in the Arab countries as quickly as possible.

This project profile also includes ECG machine. This has been done to facilitate decision making for setting up an industrial unit for ECG machine alone or when ECG machine would be produced along with other items of important clinical applications that are similar in technology. An estimate of annual production of ECGs and associated instruments is given below.

S. No.	Item	Estimated Demand	1st year 20%	2nd year 40%	3rd year 60%	5th year 80%	10th year
1.	ECG Machine (General Purpose)	3000	600	1200	1800	2400	7800
	(Sophisticated)	350	70	140	210	280	910
2.	Cardiac Monitor	2000	400	800	1200	1600	5200
3.	Pacemaker (External on-demand)	1500	300	600	900	1200	3900
4.	Defibrillator	1000	200	400	600	800	2600
5.	Foetal Monitor	3000	600	1200	1800	2400	7800

OUTLINE OF TECHNOLOGY

CARDIAC MONITOR

Cardiac monitors with a memory are becoming very popular as the ECG trace can be made to roll across the Cathode Ray tube screen at a desired rate, can be viewed on the full length of the screen and can be frozen, if necessary, for diagnostic purposes. It is convenient to view the ECG on the CRT screen rather than having a long paper record and studying it at a later stage. The above-mentioned provisions have become possible with the availability of cheap and reliable digital integrated circuits.

A Cardiac Monitor is basically similar to the conventional oscilloscope used for display of wave forms in the electronics laboratory. It has the usual circuit blocks like vertical and horizontal amplifiers, the time base and the EHT for the cathode ray tube. However, it differs from the conventional instrument in two aspects; it has a slow speed and a long persistance screen. The cardiac monitor also includes a heart-rate meter which may display average or instantaneous heart-rate of the patient. This is computed from the ECG signal. The pre-amplifier of a cardiac monitor is similar to the one used in the ECG machine. However, lead selecting arrangement is not generally provided with the cardiac monitor though it is advantageous to have the same. The cathode ray tube used may be flat-faced having a diagonal of 180 mm and is usually of the electromagnetic deflection type. This type of tubes is generally of small length but has a large viewing area. The EHT is generated in the same manner as is done in the commercial televisions. For providing memory to the cardiac monitor, the input signal is sampled at a rate of about 250 samples per second and the samples are digitized in an A/D convertor. The digital signal thus obtained is made to circulate rapidly through shift registers which in turn drive the display.

D.C. DEFIBRILLATOR

Ventricular fibrillation is a serious cardiac emergency resulting from asynchronous or uncoordinated contraction of the heart muscles. This irregular contraction of muscles results in considerable reduction of pumping action of the heart as the muscles simply quiver. This may result in a steep fall of cardiac output and can prove fatal if adequate steps are not promptly taken. Fibrillation can be converted to a more efficient rhythm by applying high-voltage shock to the heart. This instant shock across the heart causes all muscle fibres to contract simultaneously. Possibly, the fibres may then respond to normal physiological pacemaking pulses. If the heart does not recover spontaneously, a pacemaker is employed to restart the rhythmic contraction of the mycardium. The instrument for administering the shock is called the "Defibrillator". Most commonly used defibrillating technique consists in delivering a high energy shock by discharging a capacitor either through the chest of the patient or directly through the exposed heart. The instrument basically comprises of high value high voltage capacitor and associated arrangement for charging it to a maximum energy level of 400 watt/seconds. Present day defibrillators are accompanied with a monitoring facility. This is done by incorporating a small 70 mm cathode ray tube. The electrodes used for picking up the ECG signal from the patient are generally the defibrillating pads. This is essential because in fibrillating patients there is no time to attach the conventional electrodes. Also, the signal pick up is from two electrodes instead of three and this requires lot of technological refinements to get a humfree ECG trace on the monitor.

The construction of the electrodes is such that the discharge does not take place if the operation is not desired. The electrodes must be so designed that they would have to be pressed with some force and the spring action would then enable the contact to be made with the instrument output. The safety requirements regarding leakage, currents etc. also play an important part in the design of a DC Defibrillator.

The matter regarding incorporation of a synchroniser with DC Defibrillator has been quite well discussed and it has been conclusively proved that if the shock is delivered on the T wave of the ECG cycle, it proves fatal. This requires that the electronic circuit should adequately provide for avoiding the delivery of the shock during vulnerable zone of the ECG cycle. Therefore, DC Defibrillators often incorporate a synchronising unit along with the basic instrument. However, this project report does not include the manufacture of a DC Defibrillator with synchroniser. This is because another section of users believe that this instrument is used only in emergency cases and there is hardly any time to have a proper synchronisation of the ECG cycle with the defibrillating shock. The instrument proposed for production would have just one control on the panel which would select monitor, charging and discharging functions. This is necessary to avoid confusion in moments of anxiety when quick action is desirable to save the life of the patient.

PACEMAKER

It is precisely known that rhythmic action of the heart is due to the triggering pulses that originate in an area of specialised tissue in the right atrium of the heart known as Sino-atrial node. In the abnormal situation if this natural pacemaker ceases to function, or becomes unreliable or the triggering pulses do not reach the heart muslce because of blocking by the damaged tissues, the natural and normal synchronisation of heart action gets disturbed. This abnormality manifests itself by decrease in heart rate and changes in the ECG pattern. By giving external electronic stimulation impulses to heart muscle, it is possible to regulate the heart rate. These impulses are given from an instrument known as pacemaker.

External pacemakers are used in emergency cases whereas the internal pacemakers are used for long-term implantation. The technology of manufacturing internal implantable pacemakers is highly sophisticated and therefore for the

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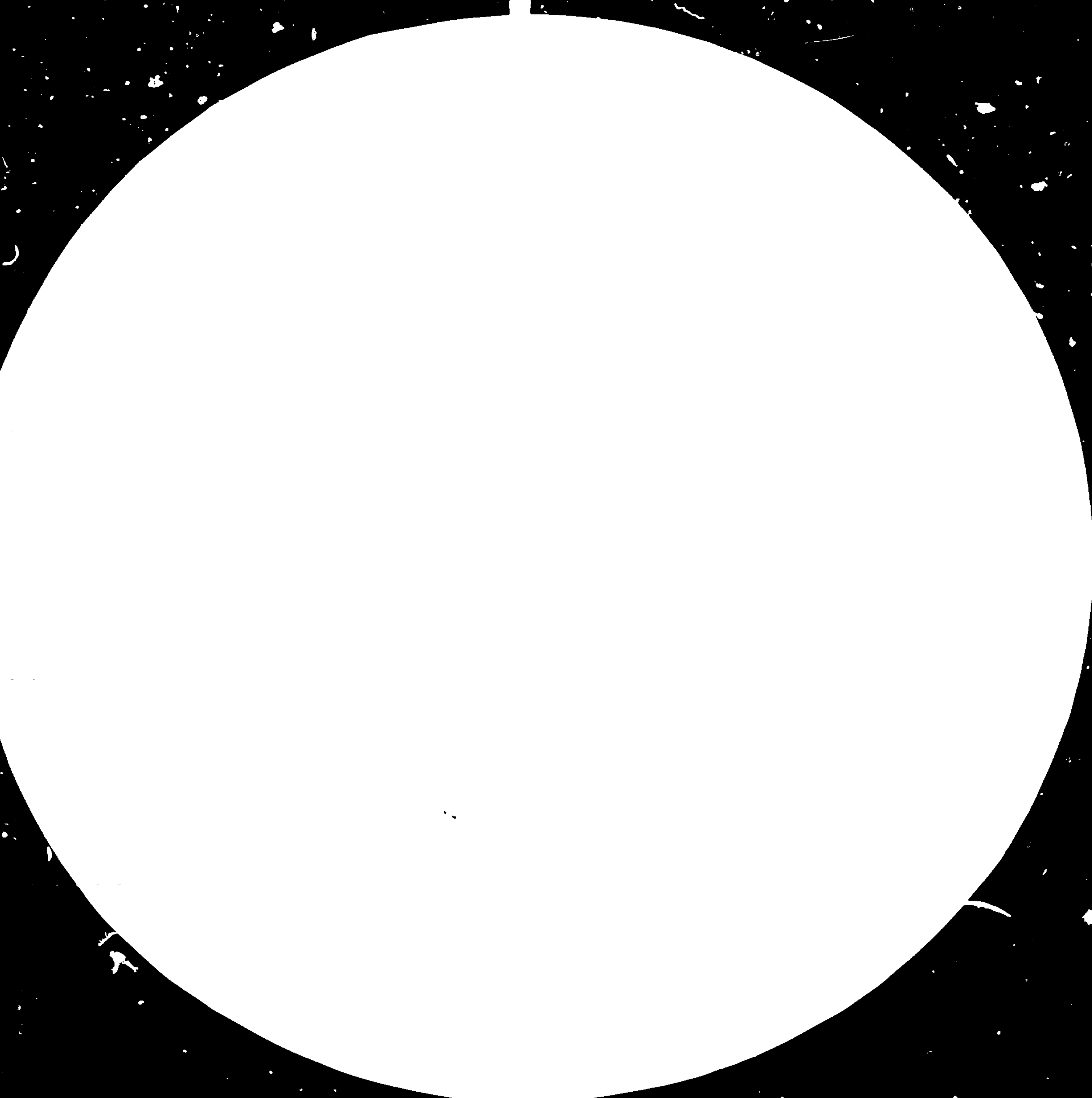

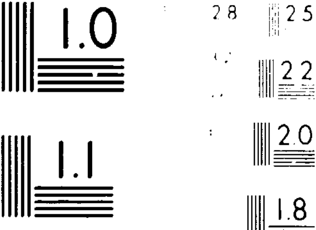
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present the manufacture of only the external pacemakers is recommended. The proposed instrument would be battery-operated and portable. The patient wearing the pacemaker would be in a position to move around in the ward and, if permitted, even in the house. These pacemakers are normally used as stop-gap arrangement before the implantation of the internal unit actually takes place. Modern practice of designing pacemakers is to have a continuous as well as on-demand operation. In the continuous operation the instrument's output is independent of the electrical activity of the heart. In the on-demand mode, the pacemaker remains inoperative normally but gets into activity when the average rate falls below the present value. This is done by an examination of the time interval between two heart beats continuously. When this interval exceeds the pre-set value, the pacemaker gets into operation. This thus avoids the competition between the heart's own pacemaker and external pacemaker pulses.

The design of a pacemaker circuit requires high skill because current drain on the battery has to be restricted to a few micro-amperes to ensure a long life of the battery. This has become particularly possible due to the advent of cosmos technology. It is intended that catheter electrodes will not be manufactured in the proposed unit as they require an entirely different technology. They can be easily obtained from standard firms. One of the important safety features in the pacemaker is the facility to lock the on-off switch once the instrument is put into operation. This is to avoid the inadvertent switching off of the instrument and thereby putting the life of the patient at risk. The instrument can be tied with a belt around the waist or may be strapped on the fore-arm.

FOETAL BLOOD-FLOW DETECTOR

This is an ultrasonic based instrument and uses Doppler's shift principle for detection of flood flow in the foetal heart. A 2MHz PZT crystal is excited from an oscillator of the same frequency. The crystal generates ultrasonic energy which is beamed from the transducer into the body of the subject. The reflected ultrasonic waves are amplified in an RF amplifier, the low frequency doppler shift signals are detected, amplified and given to a speaker for audio indication. The quality and character of the sounds provide vital information on the condition of the foetus. The instruments based on Doppler shift are capable of detecting foetal life conveniently after tenth week of pregnancy.

Foetus monitors are now miniaturised and the audio information can be obtained through ear-phones using conventional stethoscope extension leads, using rechargeable pocket-size cells. It is proposed that the manufacture of the foetus monitors and foetus stethoscopes may be taken up simultaneously.

SPECIFICATIONS

Cardiac Monitor with Memory

ECG Amplifier	Isolated
Common-Mode input Impedance	20 Megohms
Differential input impedance	Minimum 2 X 5 Megohms
Common Mode Rejection	Greater than 1,000,000 to 1 (120 db)
—	Greater than 150,000 to 1 (104 dB) with 25 K Ohms unbalance
Isolation Voltage	5,000 volts peak to peak
Defibrillator Protection	Protected for standard low pulse to 400 watt/sec, terminated to patient.
Noise	10 volts peak to peak referred to input
ECG Frequency Response	.05 HZ to 100 HZ
Power Isolation to Chassis	2500 volts RMS any power lead or leads. Leakage current from chassis to ground 50 A.
Operating Temperature	10°- 50°C maximum
Operating humidity	Up to 95%

DEFIBRILLATOR/MONITOR

ECG	Isolated ECG amplifier
Frequency Response	0.5 Hz to 40 Hz (-3dB max.)
Gain	Variable from 0.3 to 3 for nominal deflection of 1 cm on scope
Input impedance	Greater than 1 megohm differential
Input offset telerance	Greater than 1 volt
Common-mode input Impedance	Greater than 10 megohms from patient, leads to chassis ground.
Re-set Recovery	Automatic return of waveform within 0.5 second after defibrillator, electrosurgical or other overload
Calibration Signal	1 mV ± 2.5% referred to input
Scope Screen Display Sweep Speed	25 mm/sec ± 5%
Defibrillator Output Waveform	Monophasic pulse (Lown waveform)
Energy Range	0 to 400 joules delivered into 50—ohm load
Delivered Energy	Less than 10% or 4 joules error, whichever is greater, delivered into a 50-ohm load
Charge Time	10 seconds maximum to 320 joules
Power Supply	Rechargeable cells
Input requirements	240 V, 50 Hz

Battery pack life	5 hours minimum ECG Monitoring, or 50 320-joules defibrillator discharges minimum
Low-battery indicator	Illumination signifies enough battery life remaining for 1/2 hour minimum monitoring time or two 320 joule defbrillator discharges.
Battery pack charge time	Less than 14 hours
Risk Current	Less than 1[illegible] A @ 220V, 50Hz, without patient cable Less than 20 A with 220 V applied to electrode end of ECG patient cable

ENVIRONMENTAL CHARACTERISTICS

Operating Temperature	$10^{o}C$ to $55^{o}C$
Storage Temperature	$-25^{o}C$ to $+ 55^{o}C$
Operating humidity	5% to 95%
Storage humidity	5% to 80%
Altitude	Sea level to 2000 meters.

EXTERNAL ON-DEMAND CARDIAC PACEMAKER

Modes	Continuous & demand
Pulse Rate	Adjustable from 50 to 150 pulses/ minute Accuracy ± 10%
Pulse Amplitude	Adjustible from 0.1 to 20 milliampere. Constant current type on loads up to 500 ohms Accuracy ± 10%
Pulse Duration	2 milli-second ± 10%
Sensitivity to detected R-wave	1.2 - 1.5 mV minimum signal
Meter Indications	Right deflecting pulses - pulses from pacemaker to the heart. Left deflecting pulses - Detection of R-waves from the heart.
Catheter Electrode used	Biploar - Endocardial (Intravenous)

FOETUS MONITOR

Operating frequency	2 MHz
Electrical output voltage across the transmitter crystal	5-7 Volts peak to peak
Electrical input power to the crystal	25 mw/cm^2
Ultrasonic output from the transducer	Less than 10 mW/cm^2
Operating voltage	9 volts (dry batteries or chargeable cells)
Pit/it	Audio output through a speaker
Crystal size	25 mm diameter

SPECIFICATIONS FOR FOETUS STETHOSCOPE

Operating frequency	2 MHz
External output Voltage across the Transmitter crystal.	5-7 volts peak to peak
Electrical input power to to the crystal	25 mW/cm^2
Ultrasonic output from the transmitter	Less than 10 mW/cm^2
Output:	Audio output through an earphone connected at the end of stetho-scopic rubber extensions.
Operating voltage:	9 volts (rechargeable cells)

SOURCES OF TECHNOLOGY

The cardiac equipment proposed for manufacture is a fairly standard equipment. Quite a large number of industries are producing these machines in various countries under different brand names and models. Some of the leading industries in this field have been listed in the profile on ECG machine.

The know-how of cardiac Monitor with memory, defibrillator pacemaker and foetus monitor can be made available from Central Scientific Instruments Organisation, Chandigarh, a National Laboratory of the Council of Scientific and Industrial Research of India. The transfer of technology in the last case can be conveniently affected through the National Research and Development Corporation of India.

Cost of Technology

The cost of technology would be as follows:

Estimated cost of know-how

		US $
1. ECG Machine	(i) General-purpose model	12,000
	(ii) Sophisticated model	12,000
2. Cardiac Monitor with memory		18,000
3. Defibrillator		12,000
4. Pace Maker		10,000
5. Foetus Monitor		6,000
	Total:	70,000

In addition to this, royalty at 5% on the sale price is estimated.

Table 7. Building requirements for ECG associated instrument production

Activity	Area (sq.meters)	Rate/sq.meter US $	Amount US $
1. Administration	500		Free
2. R&D application	500		
3. Assembly & testing	750		
4. Design & Drafting	200		
5. Quality Control	300		
6. Stores	400		
7. Main. Workshop	1500	235.29 per sq. meter	1,129,392
8. PCB, photography & transformer shop	300		
9. Canteen	200		
10. Car park	4,800		
11. Internal Roads & pavements			23,535/-
12. Architect's fee			23,535/-
Total			1.176.470

Table 8. Estimated cost of ECG and associated instrument production

Item	$US
Cost of land	Free
Buildings	1,176,447.00
Machinery	529,411.50
Electrical fittings, installation etc. at 2.5% on building and machinery	44,117.63
Cost of air-conditioning 100 sq.meters area at $ 352.94 per sq. metre (352.94)	35,294.10
Contingencies (10% on the cost of buildings, machinery)	170,588.15
Other assets (Transport, typewriters, filing cabinets etc.)	35,294.10
Marginal Money for working Capital (about 25% of the working capital for the first year)	117,647.00
Royalty lumpsum	70,600.00
	$ 2,179,422.48

Say : US $ 2.18 million

Table 9. Personnel required during the initial five years of ECG and associated instrument production

	Immediate (At the start of the company)	Year 1	2	3	5
1. Manageri-l	9	9	10	11	11
2. Administrative	9	9	10	11	12
3. Engineers	5	6	12	17	23
4. Supervisors	-	11	22	33	44
5. Skilled		75	149	223	298
6. Semiskilled/Unskilled	5	8	16	24	32
Total	28	118	219	319	420

Table 10. Estimated sales prices of ECGs and associated instruments
(In million US dollars)

	Estimated sales price per unit	1st yr 20%	2nd year 40%	3rd yr 60%	5th yr 80%	10th year
1. ECG Machine (General Purpose)	470.59	.282	.565	0.847	.129	3.671
2. ECG Machine (Sophisticated)	941.18	.066	.132	0.198	0.264	0.856
3. Cardiac Unit Monitor	882.35	.353	.706	1.059	.412	4.588
4. Pacemaker	235.29	.071	.141	0.212	0.282	0.918
5. Defibrillator	1176.47	.235	.471	0.706	0.941	3.059
6. Foetus Monitor	235.29	.141	.282	0.424	0.565	1.835
		1.148	2.296	3.445	4.593	14.927

PROPOSED ORGANISATIONAL CHART

- Managing Director
  - Administration
    - Personnel Manager
    - Marketing Manager
    - Financial Controller
    - Public Relations Officer
    - Quality Control Engineer
  - Production Planning & Control Chief Engineer
    - Material Planning Engr.
    - Production Engineer
    - R&D Engineer
    - Supervisor PCB Lab.
    - Supervisor Transformer Lab.
    - Supervisor Packing & Forwarding
    - Design & Drawing Engr.
  - Workshop (Shop Incharge
    - Supervisor Tool Room
    - Supervisor Milling, Turning Shaping & Fitting
    - Supervisor Surface Treatment
    - Senior Maintenance Engr. (Mechanical)
    - Senior Maint. Engr. (Electrical)

Table 11. Break-even calculation for ECG and associated instrument production

		US $ (X 100,000)
Total sales at 100% of the capacity		57.412
Less	Raw material	28.965
	Stores, spares and other consumables	1.571
	Wages and salary (Direct)	5.294
	Selling expenses	7.176
	Power and fuels	1.412
	Total	44.418
Surplus at 100% capacity		12.994
Fixed expenses		
	Administrative salaries	1.322
	Administrative expenses	0.612
	Repairs and maintenance	0.706
	Depreciation of machines @ 10%	0.529
	Depreciation on building @ 5%	0.588
	Interest on US $ 2.3529 million at 15% working capital	3.529
	Total	7.287
	Breakeven point	$\frac{7.287}{12.994}$ = 56%

Table 12. Profitability statement for ECG and associated instrument production

(US $ X 100,000)

Cost of production	1st year	2nd year	3rd year	5th year
1. Raw material	5.794	11.588	17.382	23.176
2. Power and fuel	0.282	0.565	0.847	1.129
3. Direct Labour	1.059	2.118	3.176	4.235
4. Indirect labour	0.882	0.929	0.976	1.059
5. Other consumable items etc.	0.031	0.062	0.094	0.126
6. Repair and maintenance	0.141	0.282	0.424	0.565
7. Rent, taxes, insurance	0.028	0.035	0.042	0.053
8. Interest	0.706	1.418	4.235	2.824
9. Depreciation on buildings 5%	0.588	0.559	0.531	0.475
10. Depreciation on machinery 10%	0.529	0.476	0.428	0.347
11. Other Administrative expenses	0.122	0.245	0.367	0.489
12. Sales and service 12-1/2%	1.436	2.871	4.306	5.741
Total cost of production	11.600	21.259	32.147	40.220
Total sales	11 482	22.965	34.447	45.929
Profit in US $	- 11,800	1,70,600	2,30,000	5,70,900
% profit on the investment	- 0.54%	+ 7.8%	+ 10.7%	+26.2%

C. Future diversification plans for an electronic company project

The preceding pages have detailed a project report on the manufacture of ECG Machine. A plan has also been suggested to undertake the manufacture of basic cardiac equipment along with foetus monitoring instrumentation. The project report presents a fairly satisfactory position regarding the break-even point and profitability. However, there are other medical instruments which are also important and require thorough consideration for production in the Arab countries. They are designed specially for use in different departments in the medical institutions and hospitals. In fact there are lot many instruments which find applications in the hospitals and which are equally and even more important than cardiac-care equipment. Some of most important instruments which would be needed in the hospitals in the Arab countries are as follows:

1. Surgical Diathermy machine
2. Short-wave diathermy machine
3. Microwave diathermy machine
4. Ultrasonic therapy unit
5. Stimulators for application in physiology and physio-therapy
6. Electroencephalograph
7. Electromyograph
8. Patient-monitoring system

It is certain that these instruments are being imported at present for use in the hospitals in the Arab countries. Items 6,7,8 are very sophisticated in nature and their manufacturing would require highly-skilled personnel and complex know-how. It would also be essential to conduct a proper market survey before any decision is taken for taking up their manufacture.

Items 1, 2 and 5 are standard hospital equipment and it is essential that some steps are taken to undertake their manufacturing also. The limitation of time does not permit working out exhaustive industrial profiles for the manufacture of these items. However, broad details are given below for consideration. If required a complete industrial profile in the form of a project report can be worked out.

Surgical Diathermy Machine

With the tremendous developments in the field of devices technology, solid state devices have almost completely replaced the vacuum tubes. However, their introduction had been rather slow in the construction of high-power, high-frequency equipment. This had put a severe constraint on the size reduction of one of the important machines used in the hospitals, namely, the surgical diathermy machine and the short-wave diathermy machine. Modern day operation theatres are cluttered up with large numbers of instruments which continuously monitor the condition of the patient undergoing operation, provide extra-corporeal paths to the blood during open heart surgery, keeping a proper check on the anaesthetic conditions and diathermy machines for cutting and coagulation purposes. Reduction of size in the case of operation theatre equipment is of paramount importance. With the availability of high-power transistors and with the ingenuity of the circuit designer, it is now possible to get surgical diathermy machines in a size of 15" x 9" x 9". In case it is decided to take up the manufacture of surgical diathermy machines, it is recommended that only the manufacture of solid state version of surgical diathermy machine should be taken up. Several firms are known who are marketing this type of machine and it will not be difficult to negotiate with them for the know-how.

Short Wave Diathermy Machine

Short-wave diathermy machines continue to be valve-based. This is perhaps due to limitations of drawing current in the continuous mode for which the present-day solid-state devices are not capable. Well-known firms like Siemens, Federal Republic of Germany; Philips, Netherlands and Birtcher Corporation, USA, are marketing this equipment in the world.

Electroencephalographs

Electroencephalographs are galvanometric type ink writing recorders mostly in the 8 and 16 channel versions. They incorporate highly stable, high input impedance, high gain preamplifiers for amplification of low-level EEG signals. The writing mechanism usually consists of galvanometric type movement, though more sophisticated versions make use of ink jet mechanism. The galvanometers for different channels normally have a common magnet and there is always an additional channel provided for replacement in case one of the channels gets defective during operation. The estimated cost of an 8-channel electro-encephalograph is around $ 12,000. These instruments are required in the neurology and neuro-surgery departments in the hospitals. There have not been any significant innovations in the electroencephalograph instruments except that they are now available in portable form. However, even portable instruments are not really portable as they do not work on the batteries due to heavy current drain required for the recording unit, and therefore, work on the supply mains.

The manufacture of ECG may only be taken up after proper market survey has been conducted.

Electromyograph

Electromyographs are used for recording muscle potentials to study several aspects of neuro-muscular conditions, extent of nerve lesion, reflex response etc. They are used for diagnosis and research applications. The diagnostic capabilities of this instrument are based on detection of abnormal wave forms and co-relating them to specific abnormalities of the muscles. Electromyographic signals are high-frequency signals and would require a different type of recording mechanism for display and recording of these waveforms. High-frequency signals cannot be recorded on conventional type of recorders. They are displayed on the CRT screen having a fibre optics face plate in front of which a light sensitive paper is made to move. When exposed to light the paper produces a visible trace of the recorded phenomenon. The pre-amplifiers used in the EMG machines are of the parametric type with a wide bandwidth, very high input impedance, very high common mode rejection ratio and a very high gain. In order to protect the amplifiers from degradation of common mode rejection ratio they are mounted in a small box and placed near the signal pick up points. The amplifier signals are given to the processing part of the machine for further display. EMG machines are expensive machines and are mostly known to be used in established medical institutes and research departments. They would again be of low volume, high cost type of instruments. It is possible to have EMG machines of different specifications. Perhaps it would be possible to take up manufacture of simpler type of EMG machines at the initial stages. The simpler machine consists of an amplifier and oscilloscope display with an audio display. Most of the EMG machines also incorporate diagnostic type of electronic stimulators.

Patient Monitoring System

Patient monitoring systems were introduced in several advanced countries for monitoring critically ill patients continuously and automatically. The intensive care units were set up in which instruments were installed for automatic collection of data on the patients conditions in terms of heartrate, pulse rate, temperature, blood pressure and respiration rate. The concept of patient monitoring system originated as a spin-off of the space research where physiological conditions of the astronauts were required to be monitored during the period of the flight. The instruments comprising the system have been found to be useful even as individual instruments in wards other than intensive care wards. Although the patient monitoring system was introduced with a big bang hoping for extensive market possibilities, they have more or less come to a stage where their introduction in their conceptual form is not considered appropriate. More often, the monitoring has been restricted to measurement and recording of data connected with heart and therefore the patient monitoring systems have virtually been brought down to the cardiac care equipment level. Immediate manufacturing programme of the whole system is not feasible although manufacture of individual items for specific applications is recommended.

Stimulators

Stimulators are used in the physiology and biophysics laboratories for experimentation and research purposes. With different specifications, they are used for the diagnosis and therapeutic purposes for neuromuscular diseases. For experiments in students' laboratories in medical colleges, a simple type of stimulator having frequency and amplitude control of the output is required in large numbers. Depending upon the number of medical colleges and their intake per year, production plan for their manufacture can be worked out. Undoubtedly, they would be required in very large numbers. The research model stimulators are required in the physiology departments of the medical institutions and hospitals. The requirement may not be very high but they form an essential part of the physiological laboratory equipment. Simple type of neuro-stimulators are easy to design. They have limited frequency and output ranges. Any qualified engineer would be in a position to design the same. Number of physiotherapy wards would have to be determined to take up their development and manufacture at a reasonable production level.

Ultrasonic and Microwave diathermy Machines

Ultrasonic therapy and microwave therapy instruments are special purpose therapeutic instruments. They are used when treatment with shortwave diathermy machine does not prove useful. The level of introduction of instrumentation in the physiotherapy wards in the Arab hospitals could be determined before their introduction and subsequent manufacture is taken up.

Table 13. Suggested production programme for diversification

	1st year	2nd year	3rd year	5th year
Surgical Diathermy Machine	100	250	400	600
Shortwave Diathermy Machine	100	250	400	600
EEG Machine	12	30	50	70
EMG Machine	12	30	50	70
Stimulators for Physiology				
i) Stimulator, student model	100	500	2000	3000
ii) Stimulator, Research Model	12	30	50	70
Stimulator for Physiotherapy	50	100	175	250

The estimated sales of these instruments at the end of the third year is expected to be US $ 2.4 million.

D. Conclusions and Recommendations

1. The techno-economic analyses prepared for production of ECG machines in the Arab world indicate that the proposal is financially sound and can be implemented.

2. As it always takes time for the buildings and other services to get ready, it is suggested that the work of the company may be started from a rented building. Proposals for equipment and machinery procurement can be processed to cut short the initial production delay.

3. The recommended capacity utilisation is 20%, 40% and 60% of the estimated annual demand in the first, second and third year of company's operation.

4. It is not necessary to set up facilities like printed circuit boards (PCB) shop immediately. In the first one or two years, the PCB boards can be obtained from outside parties if facilities exist nearby.

5. In the first year of production, complete import of electronic components and even sub-assemblies is recommended. The instruments should only be assembled with the aim of meeting the production targets.

6. It would be advisable to take up the manufacture of other equipment for cardiac care simultaneously. The three instruments suggested are Cardiac Monitor, External On-demand Pacemaker and Defibrillator.

7. To increase company's profits and to introduce a very useful locally produced item in the Arab countries, it is recommended that Foetus Monitor may also be taken for production.

8. After 2-3 years of company's operation, when the infrastructure gets ready, some more items from the recommended list of instruments may be taken up for production.

9. Services of a senior level expert on medical instrumentation would be essential for planning the project in detail, training of staff, helping in the transfer of technology etc. The expert would have to be associated right from the initial stages of setting up of the unit.

10. The manufacturing unit would require a very efficient and organised sales set up. However, sales may be done through the established distributors in the initial stages till the sales and after-sales service network grows to meet the requisite demand.

XXII. INDUSTRIAL PROFILE ON HEARING AIDS

Based on the assessment of demand, the annual requirement of hearing aids in the concerned Arab Countries has been estimated to be 6,000 pieces. So far all types of hearing aids have been imported from different countries including Austria, Denmark, Federal Republic of Germany, Netherlands and United Kingdom.

With the improvement in health services and with the establishment of new hospitals, the projected demand for hearing aids after a decade is expected to be 16,000 pieces. This indicates a growth rate of 10% every year, thereby yielding a growth of 2.6 times of the present demand. It is also estimated that at the end of the tenth year of production, there would be some export potential.

A. Basic features of hearing aids

Technology

Hearing Aid is a device used by the persons having loss of hearing. This is to over-come the deficiencies of different types of hearing losses which may differ from person to person.

A hearing aid primarily consists of the following:

A) Ear piece
B) Amplifier
C) Microphone
D) Power supply
E) Casing

Earpiece essentially consists of an earphone which is a device by which the sound pressure is conducted into the ear. It acts as a converter for electrical energy to mechanical energy giving hearing sensation. It is used in conjunction with the ear moulds which fit in the auricular canal.

The Amplifier amplifies the signals received from a Microphone, the amplification being in the range of 60 to 80 dB above the human hearing threshold. The output power is of the order of 0.5 mW to 2 MW and the frequency response in the range of 200 Hz-5.5 KHz.

Microphone is a device which converts the sound energy into electrical energy for further amplification and correction.

Source of supply is usually a single mercury cell of 1.3 V. Alternatively, rechargeable Nickel cadmium batteries can also be used.

Casing houses the PCB of the amplifier, microphone and the cell.

Types of hearing aids

In general, Hearing aids can be categorised as:

1. Body Aids
2. Spectacle Aids
3. Behind-the-ear Aids
4. In-the-ear Aids

The body type aids have an advantage that they create less trouble due to the feedback or interaction between earpiece and microphone as they are arranged apart. Their disadvantages are larger dimensions, tell-tale cord and greater sensitivity to rubbing noises.

The hearing aids incorporated in spectacle frames, being binaural, offer considerable advantages over other types. Their amplifiers offer directional hearing being incorporated in the two shanks — the disadvantages of this type being the absence of tone correction and the earpiece being not directly fitted in the ear.

Behind-the-ear aids can be concealed by the hair and are therefore extremely popular with people who don't like to get exposed. They also eliminate noises due to cloth rubbing.

However, these have shortcomings like the need of frequent battery replacement, due to the small capacity for the batteries; non-selection of proper frequency response by earpiece, being an integral part of the appliance; and increased singing on higher volumes.

Being minature in size their cleaning is easy but repairs are complicated.

In the ear-aids, the whole unit is placed inside the ear and it is practically invisible. They are decidedly preferred over other types. However, they are extremely expensive and these are out of the reach of a common person.

Since the various types cannot substitute one another, to satisfy the requirement, producers generally manufacture the complete assortment.

Functional Considerations

1. In seventy to eighty percent of cases the hearing aids are handled by technically inexperienced and mostly elderly people. It may be, many times, that the hearing aid is the first they have ever used.

When designing hearing aids, the aforesaid consideration should be borne in mind so that the complications due to manipulation, maintenance and cleaning do not arise during usage. In a battery fed unit an easy approach for battery change is desirable. Similarly, the switches should provide safe and faultless contact and the volume control smooth tracking. The earmould coupled to the earphone should fit accurately into the external ear as only then can it give maximum utilisation. In case of an improper fitting at a certain position of volume control, earpiece and microphone will interact across the air, causing acoustic problems like self oscillations and singing. Hence only a fraction of the available gain would be utilized in practice. For maximum utilisation, the best possible solution is to have individual earmoulds which would fit in the auricular canal.

2. Along with the useful signal, other noises are also equally amplified by the hearing aids. Among these noises are those caused by the rubbing of the appliance with the cloth. It can be minimised by giving mirror smooth surface finish to the appliance case or by fixing the case to the clothes.

3. The high sensitivity microphone can detect even exceedingly small forces of the order of approximately $2x10^{-8}$ Newton (a "drop" causing a force of approx. 2.0 Newton would impose a catastrophic load on the microphone and no microphone can withstand such a high shock). While even with the utmost care the user may have chances of dropping the hearing aid.

4. To withstand mechanical stresses the rigid suspension of the microphone would be preferable while on the other hand to reduce rubbing noises, a softer suspension is desirable. Usually, a compromise between the two is worked out.

<u>Design and Production Consideration</u>

1. With the latest achievements in the field of Electronics Engineering technology, the hearing aid amplifier capable of transmitting full frequency range (200 Hz to 6KHz) without distortion enables the clear perception of normal speech from a distance of several metres.

2. The degree of amplification in different frequency ranges should be different, because different afflictions (diseases) of the auditory nerves may require different amplification of frequencies.

3. The general requirement of the acoustic gain

ranges between 50 to 60 dB, but in severe cases of hearing loss the gain may rise to 70 to 80 dB.

4. In general diseases of the hearing loss, 0.5 mw to 2.0 mw out-put power provides sufficient sound pressure with air conducted hearing aids.

5. There is a critical disease of hearing with the name "narrowed-down range of hearing" which is nothing but the higher hearing thresshold (the minimum vibration that causes a sense of hearing). Under such conditions the over-control of the aid would cause pains to the patient which can be prevented by incorporating an Automatic Volume Control (AVC). The automatic volume control reduces the overall gain through feedback above a certain prede-fined level. Making the appropriate adjustment of an AVC switch, the doctor or the seller of the hearing aid may set the output level best suited to the patient.

6. The stability against variations in the temperature and in supply voltage are other two problems. To achieve stability against temperature variations, some more components and space are required whereas for best utilization the space should be minimum. To solve the aforesaid problem a compromise is a must.

7. The introduction of Ic's in the hearing aids is becoming popular. Philips has already introduced an integrated monolithic audio-frequency amplifier for use in hearing aids. The use of Ic's would sinplify assembly, testing and repairs of hearing aids.

SALIENT FEATURES EXPECTED OF A GOOD HEARING AID

* Compactness
* Useful Power gain
* Satisfactory performance over a useful range of ambient temperature
* Low Power Consumption
* Suitable Frequency Response
* Reliability of operation
* Freedom from internal noises, self oscillations and cloth rub noises.
* High Sensitivity

SPECIFICATIONS	MODELS Standard	High power	Wide range	Extended range
1. Max. acoustic gain 1 KHz in dB	67	72	65	55
2. Max. sound pressure level, in dB	132	134	127	116
3. Frequency range in Hz	300-4000	320-4500	280-4200	300-5500

4. Current Drain ——— Less than 5 mA ———
5. Circuit ——— RC coupled using 4 transistor/ Integrated Circuit.
6. Battery ——— 1.3V ———
7. Tone Correctionm ——— Creates improvement in the response ———
8. Size and Weight ——— Minimum possible ———

All these models though seemingly look different. The construction and production techniques are the same; with minor adjustments, any one of these models can be produced.

B. Standards and sources of technology

International Standards on Hearing Aids

Following standards have been worked out by the International Electrotechnical Commission and International Organisation for standardisation.

Standards International Electrotechnical

1. IEC 188 Recommended methods for measurement of the electro-acoustical characteristics of hearing aids.

2. IEC 123 Recommendations for sound level meter

3. IEC 126 reference coupler for measurement of hearing aids using earphones coupled to the ear by means of ear inserts.

4. IEC 177-Pure tone audiometers for general diagnostic purposes.

5. IEC 178 Pure tone screening audiometes.
6. IEC 179 Precision sound level meters.

7. IEC 303 IEC Provisional reference coupler for the calibration of earphones used in audiometry.

8. IEC 318 An IEC artificial ear of the wide band type, for the calibration of ear phones used in audiometry.

9. IEC 373 An IEC mechanical coupler for the calibration of bone vibrators having a specified contact area and being applied with a specified static force.

STANDARDS FROM INTERNATIONAL ORGANISATION FOR STANDARDISATION

1. ISO R 226-1961 Normal equal loudness contours for pure tones and normal threshold of hearing under free field listening conditions.

2. ISO R 226-1962 Standard reference zero for the calibration of pure tone audiometers.

3. ISO R 389-1964 Standard reference zero for the calibration of pure tone audiometers.

4. ISO R 389/Add. 1-1971 Standard reference zero for the calibration of pure tone audiometers.

Sources of technology

Hearing aids are manufactured by a large number of firms in the world. They are marketed in different types. It is felt that it will not be a problem to acquire knowhow for the manufacture of hearing aids in the Arab Countries.

Some of the leading manufacturers are listed below:

A. DENKYOSHA & Co. Ltd.,
3-1, Niponbashi-Higashi 4 Choma,
Naniwa-KU, Osaka,
Japan

B. MATSUSHITA ELECTRIC INDUSTRIAL CO. Ltd.,
1006, Kadoma, Osaka,
Japan

C. SANYO ELECTRIC CO LTD.,
18, Keihau Handori, 2 Chome,
Meriguchi City, Osaka,
Japan

D. RIO CO. LTD.
20-41, Higashi Motomachi 3 Chome,
Kokubunji-City Tokyo,
Japan

E. DANAVOX A/S
Lerso Parkalle 112,
Copenhagen-O
DENMARK

F. OTICON A/S
9, Klædemaalet,
2100 Copenhagen-O
DENMARK

G. TRANSISTOR -AB
Svarvargaten,11, Stockolm-K,
SWEDEN

H. BOMMER A.G.
Langgritstr, 112, Zurich,
9/47, SWITZERLAND

1. MICRO-ELECTRIC AG.,
Scharenmoostr,
117, Zurich 11 /52,
SWITZERLAND

J. Aparatos" REIVOX
RDa. Universidad 12,
Barcelona 7,
SPAIN

K. BONOCHORD HEARING AIDS LIMITED
Tubs Hill Ho.
London Road,
Sevenoaks, Kent,
UK

L. BELCLERE CO LTD.(The)
385, Wowley Road,
Oxford Ox 4 2 Bn
UK

M. BOSCH ROBERT ELEKTRONIK GMBH
1, Berlin (West) 31
Federal Republic of Germany

O. VIENNATONE - LNG
H. Kohser & Lng. H.May
Franz-Josefs-Kai 3-5
Vienna 1,
AUSTRIA

P. SIEMENS AG
Bereicr Medizinsche Technik,
Henkestr, 127,
852, Erlangen,
Federal Republic of Germany

Q. ADSON (ETARLTS)
32, Rue de Mogador,
Paris Ie,
FRANCE

R. CENTRE AUDIOMETRIQUE PHILLIPS
41, Rue du Bac,
Paris 6 e,
FRANCE

S. Zenith RADIO CORP.,
1900 N. Austrin Avenne,
Chicago III,
U.S.A.

T. SONOTONE CORP.
Saw Mill River Road,
Elmsford, New York,
U.S.A.

U. Hearing Aid Centre,
D-2, Hermes House,
Near Roxy Cinema,
Bombay - 400004
India

However, the recommended sources of know-how in order of preference are given below:

1. DANAVOX A/S
Lerso Parkalle 112,
Copenhagen-O,
DENMARK

2. OTICON A/S,
9, Klaedemaalst,
2100, Copenhagen -O,
DENMARK

3. BONOCHORD HEARING AIDSLIMITED
Tubs Hill Ho.,
London Road,
Sevenoaks, Kent,
UK

4. RION CO. LTD,
20-41, Higashi Motomachi 3 Chome,
Kokubunji-City, Tokyo,
JAPAN

Cost of Technology

The estimated cost of technology would be US$ 2,500.

C. Production requirements

The yearwise production figures are given below:

It is proposed to reach 80% of the full rated capacity in the third year of production. For the first year of manufacturing, it is suggested that the hearing aids in C.K.D. condition (KIT) may be obtained and the final assembly and testing be done at the factory. In the second year, it is proposed to expand local facilities so that fabrication of printed circuit boards, fabrication of casing and basic electronic assembly can be carried out at the proposed manufacturing unit.

The production of special types of hearing aids may be taken up only in 4th year.

	Installed capacity	Year 1	2	3	4	5
Geneal purpose Type	5000	2500	4000	5000	5000	5000
Special type	1000	-	-	*	500	1000

* Preparation and ground work for production of special type of hearing aids will be initiated in the third year of production.

1. Man-power Requirements

The production of hearing aids involves basically assembly and testing of electronic circuits. Therefore, requirements would exist for the following types of personnel.

i) Working Operators & Technicians

ii) Supervisors

iii) Quality Control Engineers

2. Training Requirements

1. The first category of staff would be easily available. No training would be required for this type of staff.

2. Supervisors and quality control engineers would require training and calibration of hearing aids. At least one supervisor and one quality control engineer would have to be trained in the company from where the know-how would be obtained.

The training programme in testing and quality control for other staff members would be conducted by a senior level expert in the field of electronic testing and calibration. It would be possible to obtain the services of such an expert for a total period of three months/spread over visits of six weeks each in two years. The approximate cost would be US $ 150 per day, Research & Development Group

The Research & Development Group would be mostly engaged in the transfer of technology, adaptation of technology and for making modifications and improvements in the design. Once the production starts, this group would engage itself in developing types of hearing aids. It would also undertake mechanical design and drafting work for the unit.

Sale & Service

Sale of hearing aids may be handled by distributors in the initial stages. However, to render effective service for repair and maintenance, service engineers would have to be appointed, as per details attached.

Administration:

Administration would look after routine administrative matters including stores, purchase, packaging and forwarding.

The details of staff requirement are given in organizational diagram.

Staff Requirements and their placement

Project Engineer (Hearing Aids) = 1   Total Staff = 38

R & D

Staff

1. Engg.-in-Charge = 1
2. Engg. Electronic = 1
3. Engg. Mech. =1
4. Draftsman =1.
5. Lab. Attendants = 2

Production & Quality Control

Staff

1. Engg.in-charge =1
2. Engg.Fabrication = 1.
3. Engg. Test & Quality Control =1.
4. Technicians = 4
5. Lab.Attendants = 1.

Sales & Service

Staff

1. Manager = 1
2. Engg.(Sales)=1
3. Engg. Service =1
4. Asstt. Engg (Sales) = 1.
5. Asstt. Engg. (Services) = 1.

Administration Executive = 1

Management group

Staff

1. Sr.Executives =1.
2. Accounts Executives = 1
3. Admn. Supervisor = 1
4. Accounts Supervisor =1
5. Assistants = 2
6. Unskilled worker = 1
7. Sweepers = 1

Stores & Purchase

Staff

1. Executives Stores & Purchase =1
2. Stores Supervisor =1.
3. Purchase Supervisor = 1
4. Asstt.Stores/Purchase = 2
5. -

Packaging & forwarding

Staff

1. Packing & forwarding supervisor =1.
2. Assistants = 2.
3. Loader =1
4. -
5. -

Qualitative requirements of important categories of Staff are listed below:

S.No.	Name of the post	Requirements
1.	Project Engineer	Degree in electrical/electronics engineering with 5 years experience in design, development & production of electronics appliances.
2.	Engineer-in-Charge	Degree in engineering with 3 years experience in design development and production of Electronic instruments.
3.	Manager(Sales&Service)	Bachelor degree in engg./management or M.Sc. in Physics with 3 years experience in sales and marketing of electronics.
4.	Executive(Admn)	Master's Degree in Science/Arts with 5 years experience in various field of administration such as establishment, purchase audit and accounts etc.
5.	Engineers	Bachelor degree in Electronic Engg. with 3 years experience in electronic/mechanical shop.
6.	Asstt. Engineers	Bachelor Degree in Electronic Engg./Diploma in Electronic with 2 years, experience in electronic mechanical shop.
7.	Technicians	Certificate in electronics/machine shop practice.

Table 1. Salaries and wages

S.No.	Designation	No. of Employees	Proposed Salaries per annum	Total Salaries (US $)
1.	Project Engineer	1	3600	3600
2.	Engineers-in-charge	2	2500	5,000
3.	Manager(Sales &Service)	1	2500	2,500
4.	Executive (Admn.)	1	2500	2,500
5.	Engineers	6	1800	10,800
6.	Draftsman	1	1500	1,500
7.	Executive (Stores & Purchase)	1	2000	2,000
8.	Executive (Section)	1	2000	2000
9.	Accounts Executive	1	2000	2000
10	Assist. Engineers	2	2000	4000
11.	Technicians	4	1,250	5000
12.	Assistants	6	1,000	6000
13.	Supervisors	5	1500	7500
14.	Unskilled workers/ Loaders Sweepers/ Laboratory Attendant	6	750	4,500
			TOTAL	58,900

3. Equipment and machinery

The equipment required for production and testing of hearing aids consists of general electronic laboratory test equipment. It would be available from leading manufacturers of electronic test equipment. Some of them are detailed below:

1. Philips India Ltd.,
   Dr. A.B. Road Worli,
   Bombay-400018,
   India

2. Digital Instruments Corpn.,
   1680, Amir Chand Marg,
   Nai Sarak,
   Delhi-110006.
   India

3. Electronics Corpn. of India Ltd.,
   Charlapallai,
   Hyderabad,
   India

4. Systronics,
   Ahmedabad,
   India

5. Applied Electronics,
   Bombay,
   India

Special calibration equipment would be required for inspection, quality control of hearing aids. It would be very necessary to have a complete test and calibration set up in the unit itself. The manufacturers who supply testing and calibration equipment are given below:

1. VEB RFT MESSELEKTRONIC "OTTO SCHOEN" DRESDEN
   8012 DRESDEN
   LINGNERALLEC 3
   GERMAN DEMOCRATIC REPUBLIC

2. BRUEL & Kjaer
   DK-2850 NAERUM
   DENMARK

3. LABORATOIRE ELECTRO AGOUSTIQUE
   5, Rule Jules Parent
   92-Rueil-Malmaison,
   FRANCE

4. AMESA
   Ateliers Macaniqueset
   Electro Techniques 5-A
   97, Avenue de Chatelaine,
   Geneve,
   SWITZERLAND

Table 2. Estimates cost of machinery and equipment

Electronic Test Instruments

S.No.	Instruments	Qty.	App. Cost US $
1.	Oscilloscopes with plug-in curve tracers	2	1200
2.	Multimeters	4	480
3.	Power Supplies 0-30V/3Amp	2	100
4.	A.C. Stabilizers 15 KVA	2	500
5.	Variac & Amp, 0-270V	2	100
6.	Insulation Tester	1	100
7.	Temperature-Controlled Oven	1	400
8.	RLC Bridge (Accuracy 1%)	1	400
9.	Electrolytic Condenser Tester	1	600

Calibration Equipment

S.No.	Instruments	Qty	Cost US $
	Hearing Aid Test system Comprising of		
1.	Hearing Aid test Box	2	6400
2.	Artifician Voice	1	1300
3.	Artifician Ear	1	500
4.	Artificial Ear	1	1100
5.	Artifician Mastoid	1	1500
6.	Precision Sound Level Meter	1	2000
7.	Pistaphone |for acoustic Calibrator	1	1300
8.	Sound level Calibrator	1	600
9.	Tracking filter	1	4000
	Workshop		
1.	Plastic Moulding Machine	1	600
2.	Hand Tools & Drill Machines	-	2000
	Miscellaneous Requirements:		
1.	Serviee Kits (which contains necessary tools & Test equipment)	2	400
2.	Office Equipment		2000
3.	Furniture		4000
4.	Staff Vehicle		3000
	Sub-Total		34,580
	Custom duty 10%		$ 3458
	Total		$ 38038

Details of suggested testing & calibration equipment

Hearing Aid Test Box

Hearing aid test Box allows quick and accurate tests on all types of hearing aids. It consists of an anechoic enclosure which serves to provide a reproducible sound field, and a very good approximation to free field conditions, along with built-in loudspeaker, Oscillator and amplifier.

The Frequency range from 200 HZ to 5 KHZ is covered by means of 15 fixed frequencies spaced according to the internationally standardised third octaves. Further, provision is made for the connection of an external generator.

Artificial Voice

This instrument is used in development and quality control of small microphones. Artificial Voice produces a sound field which closely resembles the sound field from the human mouth. Its frequency bandwidth is between 50 HZ to 10 KHZ.

Artificial Ear with 2 cm^3, 6 cm^3, couplers

Artifical Ears are used for measurements in the audiometric and related fields. They enable electroacoustical measurements on either insert earphones or headphones to be carried out under well-defined acoustical conditions, which is of great importance for the comparability of different designs in accordance with IEC recommendations. (IEC R 126-1961, IEC R-303)

Artificial Mastoid

It is made for objective calibration of bone vibrators as used in hearing aids and audiometers. It consists of an inertia mass of 3.5 Kg with a curved top plate of stainless steel, upon which are arounted the impedance determining elements.

Precision Sound level Meter

The sound level meter performs sound and vibration measurements of almost any kind with a high degree of accuracy. It should preferably be battery operated.

Pistaphone for Acoustic calibration

It is a small battery operated, high level precision sound source, which provides quick and accurate direct calibration of sound measuring equipment, tape recorded sound etc. The error is less than + 0.2dB when measurements are made with this instrument.

Sound level calibrator

This calibrator enables easy calibration of sound measuring equipment in the field.

4. Land, building and services

The covered area requirement for this project is estimated to be 200 sqmtrs. Therefore, an independent building for this project will not be an economical proposition. It is suggested that the requirements may be clubbed with any other manufacturing unit.

The electricity requirement for this unit is estimated to be 15 KVA which includes the air-conditioning requirements as well.

Cost estimates for the buildings

a)	Cost of building area 200 sqm. @ 225 sqm	$45000
b)	Cost of Air-conditioning of 20 sqm @ 350 per sqm.	$7000
c)	Cost of electrification and Architect @ 5% of (a)	$2250
d)	Cost of Water pipes & sewerage fillings @ 25% of (c)	$500
e)	Cost of Anechoie Chamber. App.	$5000
		$ 59750
	Contingencies 10%	$ 5975
	Total	$ 65725

Note: The cost of land has hot been included in the estimate.

Plant Layout

The production of hearing aids involves the following:

1. Assembly of Electronic Unit
2. Fabrication of Mechanical Components
3. On- Line production testing
4. Complete assembly
5. Testing & Quality Control of Production

The special requirement in the field of hearing aids is to provide an acoustically controlled Air-conditioned room. This room will be used for final testing and quality control. All together one big room for assembly and four small rooms for above mentioned sections.

Layout

1. One of the rooms would be used as a small workshop for doing drilling and minor mechanica jobs.
2. In another room finally assembled hearing aids can be tested which would be ready for calibrating.
3. The assembly can be done in the big hall proposed in the unit.
4. One room can be acoustically controlled for final calibrations.
5. The other rooms could be used for administration, stores and other assisting services.

5. Components and raw materials

Hearing aids comprise of general electronic components which would be available from the leading manufacturers of components in the world. The details of components and raw materials along with their cost are given below:

	Item	Cost US $
1.	Transistors or integrated Circuit	3.00
2.	Condenser (miniature)	1.50
3.	Resistor (miniature)	0.75
4.	Earpiece & Microphone	7.00
5.	Hardwares including plastic	4.00
6.	Chassis	2.00
7.	Anodised Aluminium sheet	0.50
8.	Printed Circuit Boards	0.50
9.	Battery	0.50
		19.50
	Customs duty 2%	0.50
	Total for one unit.	20.00

Sources of Components & Raw Materials

1. Microphones & Earpieces

A. Shure Bros. Inc.
22, Hastrey Avenue,
Evanston, Ill.
U.S.A.

B. Knowles Electronics Inc.
10545 Anderson PI
Franklin Park, Ill., U.S.A.

C. Walchris Ved Ingerior W.Christensen,
Skodsborgeej 315, Naerum,
DENMARK

D. Bouyer P & GIE
Route De Ro Pasis,
Montarban (T&G),
FRANCE

E. Audio Ltd.,
26, Wendell Road W 12 9 R T,
UK

F. Vitavox Ltd.,
Westmoraland Road,
London NW 9,
UK

G. Beyer Engen Elektrotechnische Fabrik,
Theresienstre 8,
71, Heil brown,
Federal Republic of Germany

2. Transistors & Integrated Circuits.

A. Bharat Electronics Ltd.,
P.O. Jalahalli,
Bangalore, India

B. Continental Devices India Ltd.,
C.120, Naraina Industrial Area,
New Delhi-110018

C. Fair Child Semiconductor Corpn.,
313, Fairchild Drive,
Mountain View,
California 94040
U.S.A.

D. Hitachi Ltd.,
Semiconductor & IC Division,
1450 Joshihonimachi,
Kodalra City,
Tokyo,
Japan

E. Massushita Electronics Corpn.,
Kotri Yakemachi,
Nagaokakyo City,
Kyoto,
Japan

F. Mullard Ltd.,
Mullard House Torringtone Place,
London WC IE 7 HDm
UK

G. Phillips Gloilampenfabriken,
Eindhoven,
Netherlands

3. <u>Resistore Capacitors, Volume controller etc.</u>

A. Asian Electronics Ltd.,
Bombay,
India

B. Electronic Corpon. of India Ltd.,
Charlapali,
Hyderabad.
India

C. Phillips India Ltd.,
Dr. A.B. Road,
Worli,
Bombay
India

D. Rescon Manufacturing Co. Pvt. Ltd.,
S.V. Road Maray House, Bandra,
Bombay-400050.
India

E. Bharat Electronic Ltd.,
Jalahalli,
Bangalore-560013.
India

F. Driver Harris SA,
Chemin De Bucheiay,
Mentes-La. Jolie (S&Q)
France.

<u>Raw Materials</u>

Raw materials requirements are of very general nature for the hearing aids. Most probably, they would be available in the Arab countries. It is not felt necessary to give the lists of suppliers of raw materials.

Cost of the Project

		US $
1.	Plant and Machinery	38,038
2.	Building & Services	65,725
3.	Know-how	2,500
		106,263

Recurring Expenses

1.	Staff salaries	57,400
2.	Electricity charges for 15 KVA (considering 9 hours a day and 270 day/year	1,530
3.	Water & other misc Charges	2,000
		60,930

Working Capital

Cost of components and material of 4 months and 10% of recurring expenditure is enough as working capital.

= $ 33,333 + $ 6,093

= $ 39,426

D. Financial estimates

Price Indication

The cost of hearing aids imported in Arab country on the average, comes out to be US $ 55 to US $ 88.

It is estimated in this profile that when they are produced in Arab countries, the selling price would be US $ 46. This would be a highly acceptable price for the body type of hearing aids.

Feasibility

The sale price for hearing aid suggested is $ 46. The cost of the hearing aid is cheaper to the ones so far imported by Egypt. In addition the hearing aids proposed to be produced will be of latest type. The profit in first year, second year and third year is 8.73%, 11.4% and 30.24%. Therefore, by setting up the factory the hearing aids will be locally available and will create technical base, enhance employment opportunities for technical personnels.

Therefore, the project is economically and technically feasible.

COST ana ysis

Basic factors for COST Analysis

1. The capacity rating has been taken as estimated demand of hearing aids in the Arab countries. This demand has been established on the basis of the survey conducted by two Indian experts.

2. The build up capacity of the plant is estimated at 50%, 66% and 80% in the Ist, 2nd and 3rd years. Subsequently, a growth rate of 10% is estimated.

3. The cost estimates for materials and electronic components are based on their present actual cost as they are prevailing in Indian market.

4. Sales and servicing cost have been estimated at 12.5% of the sales value. The cost of the land has been assumed to be nil.

5. The cost of direct labour has been computed in direct proportion to the capacity utilisation.

6. Depreciation on the plant and machinery has been calculated at 10% per annum.

7. Depreciation on building has been worked out at 5% per annum.

PROPOSED

PRICE INDICATION

A. Capital Investment:

(Cost of Equipment plus land and Building)	\$ 38,038+\$65,725= = \$ 1,03,763
know-how fee	\$ 2,500
Total	1,06,263

B.	i)	Recurring Expenses:-(staff salaries)	$ 57,400
	ii)	Electricity charges of 15 KVA (considering 9 hour a day and 270 days/year)	$ 1,530
	iii)	Water & other Misc. charges	$ 2,000
	iv)	Building Depreciation @ 5%	$ 3,185
	v)	Plant & Machinery Depreciation @ 10%	$ 3,800
	vi)	Interest on working capital @ 15% of $ 1,00,000/3	$ 5,000
			$ 72,915

Cost Estimation

1.	Recurring Expenses	$ 72,915
2.	Profit on capital investment @ 25% ($ 1,06,263)	$ 26,563
		$ 99,478

R.E./pc. $\frac{\$\ 99{,}478}{5.000}$ = $ 19.9

Cost of hearing Aid excluding marketing (cost of raw material + depreciations) $ 20+$19.9 = $ 39.90

Let us assume the marketing expenses are 12.5% on sale price $ 5.84

Selling price $ 45.74

Say $ 46

COST ANALYSIS			IST YEAR
a)	Turnover	2500x46	$ 115,000
b)	Marketing Cost	2500x4.99 =	$ 12,475
c)	Net Returns	a-b	$ 102,525

EXPENDITURE:

a)	Components and Materials	2500x20 =	$ 50,000
b)	Other Expenditure		
	Considering in the Ist year recuritment, procurement of plant & machinery will take time therefore utility factor can be taken 0.6... Therefore recurring expenditure & depreciation		$ 40,750
c)	Interest on working capital		$ 2,500
	Total a+b+c		$ 93,250
	Profit $ 1.02,525 - $ 93,250		$ 9,275

Percentage Profit $\frac{9275}{106,263}$ X 100 = 8.75%

COST ANALYSIS			2ND YEAR
a) Turnover	4000 x 46	=	$ 184,000
b) Marketing Cost	4000x4.99	=	$ 19,960
c) Net Returns (a-b)		=	$ 164,000

EXPENDITURES

a) Components & materials		
	4000x20 =	$ 80,000
b) Other expenditure (Utility Factor = 1		$ 67,915
c) Interest on working Capital		$ 4,000
Total a+b+c		$ 151,915
Profit	$ 164,040-$ 151,915	$ 12,125

Percentage Profit $\frac{12,125}{106,263} \times 100 = 11.41\%$

COST ANALYSIS — 3RD YEAR

a)	Turnover	5000x46	=	$ 230,000
b)	Marketing Cost	5000x4.99	=	$ 24,950
c)	Net Returns (a-b)		=	$ 205,050

EXPENDITURE

a)	Components & Materials	5000x20	=	$ 100,000
b)	Other Expenditure (Utility Factor = 1.0)		=	$ 67,915
c)	Interest on working Capital		=	$ 5,000
	Total a+b+c		=	$ 172,915
	Profit	$ 205,050-$ 172,915	=	$ 32,135

Percentage profit $\frac{32,135}{106,263} \times 100 = 30.24\%$

Cost benefit Analysis at Glance

% Profit 1st year	= 8.73%
% Profit 2nd year	= 11.41%
% Profit 3rd year	= 30.24%

E. Recommendations

1. The feasibility analysis given in the project profile indicates that production of hearing aids in the Arab countries would be technically and economically feasible and can be implemented.

2. The recommended capacity utilisation is 50%, 66% and 80% of the estimated annual demand in the Ist, 2nd and 3rd year of Company's operation.

3. The building requirements for the project are very meagre and therefore, it is suggested that the work of the company may be started from a rented building, to cut short the initial delay. It is also recommended that it will not be worthwhile to have separate building and services for this unit. Preferably, building of the Hearing Aid Plant may be integrated with the other plant on Medical Appliances.

4. The fabrication of printed Circuit Boards, the casing and other fabricated parts may be got done from outside in the first year of company's operation.

5. In the first year of production complete import of CKD kits is recommended. The hearing aids would only be assembled and tested in the proposed manufacturing unit.

6. After 2 to 3 years of company's operation, the production of Audiometers of the automatic type may be considered. This would be necessary to fill up the demand gap and to stabilised profitability.

7. The sales of the hearing aid would preferably be handled through the established distributors of this type of appliances in the Arab World. However, the repair and servicing should only be handled by the company's engineers.

XXIII. INDUSTRIAL PROFILE ON PH METERS

According to a survey, the present annual demand for pH meters in the Arab countries amounts to 2,300 pieces. These are mainly of three types - General purpose, precision and sophisticated type. So far, all types of pH meters in Egypt have been imported from France, Japan, Switzerland, U.K. etc. With the improvement in health services and with the establishment of new hospitals, the minimum projected demand after a decade is expected to be 5,700 pH meters. This figure may go up to 7,800 pieces in case the demand for non-medical sector is also taken into consideration.

A. General

OUTLINE OF TECHNOLOGY

pH Meter is a direct reading instrument for precise and accurate measurement of pH and millivolts. With different types of electrodes it could be used for the measurement of blood pH, biological measurements, specific ions, oxidation-reduction potentials, chemical analysis, Karl - Fischer titrations etc. The pH Meter should have input circuit offering very high input impedance and be drift free and highly stable so as to perform chemical analysis with outstanding accuracy. It is essentially a voltage measuring device with some added features.

pH MEASUREMENT

pH can be described as a measure of the acidity/alkalinity of a solution. For instance, lemon juice is acidic while the lime is alkaline. The pH scale is used to express the degree of Hydrogen ions concentration in a solution. As these activities vary over a wide range, a log scale - the pH scale, is adopted for convenience.

The pH in terms of Hydrogen ion concentration could be expressed as:

$$pH = -\log_{10} C_{H^+}$$

$$\text{or } C_H = 10^{-pH}$$

The pure water is the neutral point at which Hydrogen and Hydroxyl ions exist at the same concentration:

$$\text{so that} \quad C_{H^+} = kw = 10^{-7}$$

This implies that the pH at neutral condition i.e. of pure water is 7. Therefore, the number greater than 7 indicates the degree of alkalinity, and numbers less than 7 indicate the degree of acidity.

Essentially, a pH Meter indicates the Hydrogen ion concentration in a test solution by responding to the potential developed by an electrical cell. The cell consists of two electrodes, a glass electrode and a reference electrode, immersed in a test solution.

The glass electrode is pH sensitive and its potential is proportional to the pH of the solution in which it is immersed while the reference electrode develops a constant electrical potential against which the potential of the glass electrode can be measured.

The potential developed across the glass solution boundary according to the nearest equation:

$$E_o = E^0 + 2.3026 \frac{RT}{F} \text{pHc.}$$

E^0	=	Standard potential
R	=	Gas constant
T	=	Absolute temperature
F	=	Faraday's constant
pHc	=	pH value deviation from 7

Thus the equation implies that a given temperature the measured E.M.F. is a linear function of PHC.

$$6pH = 2.3026 \frac{RT}{F}$$

$$= 58.2 \text{ mV at } 20^{\circ}C$$

$$= 62.2 \text{ mV at } 40^{\circ}C$$

i.e. by $1^{\circ}C$ change, the emf changes by 0.2 mV.

From this, it is concluded that pH measurement is essentially a measurement of millivolt signal by a special technique.

Design Techniques

The advances in semi-conductor technology coupled with digital readout have made it possible to design an accurate, highly reliable and relatively inexpensive pH Meter. Digital readout due to its inherent advantages over the analog type is the obvious choice. Therefore, the design of the instrument should be based - on integrated circuit technology which makes it compact, light weight and reliable. LED Display should be used as it offers advantages of operating over wide temperature ranges, can be multiplexed, drives current requirements down to about 0.5 mA per segment and is available in various colours. Input circuit should make use of new design techniques so as to make input circuit stable and offer high input impedance.

Production Techniques

To check the instrument numerous tests are required to be performed repetitively. If the traditional manual methods are employed, the test time will be more - i.e. more production cost and difficult to ensure consistency of the results. Therefore, in order to take care of the human errors and to reduce test time during production, dedicated tester should be used. The dedicated tester should be developed for each model separately. The essembly should be done through dip soldering method and dedicated tester should be used for testing the components, printed circuit boards and the complete instrument for the specifications. This method will greatly reduce the testing time, while at the same time ensure consistency of the results, better quality control, thereby reducing the cost of production.

Production Phasing

The pH Meter has wide applications not only in hospitals but in Drug Industries, chemical industries, research and educational institutions etc.

The proposed design for the manufacture of PH meter makes use of new design techniques and latest devices, so that the product will be better in specifications, compact in size and less expensive as compared to the equivalent pH meter so far being imported by Egypt. In addition the pH meters will be comparable in price/ performance with the equivalent models available in developed countries. The production figure provided are 2500 for all, the three models. It is envisaged that the plant will reach to full productionin 3rd year.

However, keeping in mind the additional internal requirements in other sectors and likely export possibilities, in the fifth year the production should reach 5000 pieces. This will increase the profit margin. The production of electrode assemblies and printed circuit boards has been suggested only after the plant reaches to its proposed capacity and starts making profit, that is in the 4th year. Till that time, the electrodes assemblies and printed circuit boards can be procured from the outside parties. The proposed phased programme is given below:

	Phase I 1st year	Phase II 2nd year	Phase III 3rd year	Phase IV 4th year	Phase V 5th year
Model I	600	1000	1200	1200	1200
Model II	400	800	1000	1000	1000
Model III	Nil	50	100	100	100
Electrode	Nil	Nil	Nil	General purpose electrodes	General purpose Blood & Ion electrodes
Printed ckt. boards(Double sided thorough holes.)	Nil	Nil	Nil	50% demand should be met.	100% demand should be met.

B. Specifications

Three different types of pH meters - the first one low cost analog type of 0.05 pH accuracy, the second being the digital type of .01 pH accuracy and the third one the R&D type of .001 pH accuracy with digital display, are suggested for production.

Specifications of three models are given as below:

Model No.1

Specifications

Ranges	pH	0.to 14
	Milivolt	0 to 1400
Resolution pH		0.05
	milivolt	5

Accuracy	pH	± 0.05
	Milivolt	± 5
Repeatability		
	pH	± 0.05
	Milivolt	+ 5
Input impedance		5×10^{11} ohms
Temperature Compensation		0 to 100°C (Manual)
Recorder Output		up to 200 mV
Power Requirements		Mains/battery operated
Readout		Indicating Meter

Model No. 2

Specifications

Range	pH	0 to 14
	milivolt	0 to 1400
Resolution	pH	.10
	milivolt	1
Accuracy	pH	± .01
	milivolt	± 1
Repeatability		
	pH :	.01
	Milivolt :	1
Input Impedance	:	10^{13} ohms
Temperature Compensation		0 - 100°C(Automatic or manual
Recorder Output		1 - 100 mv per pH unit
Display		Four digit LED
Outputs		BCD

Zero Control	5 to 9 pH
Test Switch	Electronic test of pH amplifier and digital display
Slope	80 - 105%
Power Requirement	Mains

Model No. 3

Specifications

Range	pH	0 - 14
	Milivolt	0 - 1400
Resolution	pH	.001
	milivolt	.1
Accuracy	pH	± .001
	milivolt	± 0.1
Repeatability		
	pH	± .001
	Milivolt	± .1

Input Impedance	10^{13} ohms.
Temperature Compensation	0-100°C, automatic or manual
Recorder output	1-100 mV per pH unit
Display	Five digits LED
Priner Output	BCD
Zero Control	6 - 8 pH units
Test Switch	Electronic test of amplifier and readout
Slope	80 - 105%
Power requirement	Mains
Polarizing current	10 microamps.

C. Sources of know-how

It is observed that in developing countries first model developed costs, which are analogous, to 'grass root', 'starting from scratch', type of product development, are most uneconomical due to initial enormous set-up costs On the other hand it is significant that for improved models the R&D cost is very much lower. It is more cost effective to buy the foreign know-how in the beginning for the first proposed models and concentrate on local R & D for future improvements thereof. The selection of know-how and transfer should be under the expert advice so that there is no difficulty in the adoption of the know-how and item goes in to the production without delay. It is, therefore, suggested to purchase the know-how on one time transfer basis. One time purchase scheme reduces the drain of foreign exchange in terms of royalty to be paid on a per piece basis. Once the latest and needful technology is brought, future modification could be made through local R & D. This approach eventually creates a technical base, reduces lead time and leads to self reliance.

The know-how of pH meters is available in developed countries like UK and USA etc. and also developing countries like India. The cost of know-how on the basis suggested will cost $ 8000 to $ 12000 if purchased from developed countries and at the same time there will be lot of operational difficulties. On the other hand, if know-how is purchased from developing countries, it will costs 40000 In addition, if the know-how is purchased from developing countries it will be easier to absorb as the conditions are more identical.

For initial training and expert advise, it is suggested that atleast 3 engineers/technicians of Egypt should be trained from where the know-how has been purchased. The duration of training should be from 3 to 6 months. The training should be detailed one, in design and practical aspects converting design, assembly, testing, quality control and specification and source of components and raw materials. It is further suggested that a provision for expert should be made for three months' period at the beginning of the project and again for three months after one year. The remuneration of the expert should be $ 150 per day and free furnished accommodation. In addition if the suggested supervisory staff and technicians are not available locally, they should also be engaged from the appropriate agency for a period of more than 12 months. The monthly salary of these personnel should be $ 800 and $ 500 respectively. A few important sources of know-how are given as below:-

1. M/s. Beckman Instruments Co.,
   2500, Harbor Blvd.
   Fullerton,
   California - 92634
   USA.

2. Corning EEL,
   Halstead, Essex,
   U.K.

3. Central Scientific Instruments Organisation
   Sector 30,
   Chandigarh 160002C, INDIA

The sources of know-how for different types of electrode are:

1. Beckman Instruments Co.,
   2500 Harbor Blvd.,
   Fullerton California - 92634.
   U.S.A.

2. Corning EEL,
   Halstead Essex,
   U.K.

3. Central Glass and Ceramic Research Institute,
   Calcutta- 700032, INDIA

D. Organizational structure and manpower requirements

There are a number of considerations which are very vital for the success of the project. These are - efficient operation, experienced management, appropriate technology and minimum cost of production etc. In addition, the fact remains that the production cost of the item goes down each time the number of units produced is increased.

The electronic industry is to keep pace with the advancements in the electronic technology developing at a fast rate -- technology changes in about 5 - 6 years - to such an extent that there is a clear economic advantage for changing over to the new technology. If the country decides to live with the obsolete technology, it may pay more by way of lower productivity and hence higher costs than if it had opted for the transition. Therefore, the production programmes should be backed up by R&D units so as to bring out new models at appropriate times.

The complete set up has been shown under four groups:

Group I - R & D

R & D, quality control and training should be kept under one head for better liaison and also to ensure optimum utilisation of the equipment.

The main responsibility of the R&D unit should be to develop dedicated testers required at different production stages. Minor modifications required by the customers and above all the section should be well aware of the latest devices and technology so as to bring out suitable models at appropriate times and keep the cost and quality competitive.

The main responsibility of the training section should be to organise short-term courses to train the technicians and engineers and refresher courses for service engineers.

The quality control section should be responsible for the quality of the incoming and outgoing equipment and components. The testing of functional specifications should be the responsibility of this group while environmental and vibration testing facilities should be at a Central place. To create environmental and vibration testing facility independently will not be economical as the use will be limited.

GROUP II - PRODUCTION

Production of pH Meter will involve electronic assembly fabrication of mechanical components, mechanical assembly and final assembly and testing.

The electronic assembly will involve the layout of printed circuit boards and wiring of the complete instruments functional testing of components, insertion of components on printed circuit boards, soldering of each printed circuit board one by one, testing the continuity of printed circuit boards and finally complete wiring of the instrument. Transformer should be checked for insulation before fixing. Mechanical shop will involve the fabrication of chassis terminal connector, electrode stand, engraving of front panel, assembly of mechanical parts and finally anodising and painting. Some mechanical portions such as covers and panels, may be moulded using fibre glass or plastic so that the weight of the instrument and its production cost as a whole is reduced.

After electronic assembly and mechanical assembly is over, the final assembly and functional testing is carried out. The finished instrument then goes to quality control for final approval.

GROUP III- DOCUMENTATION AND AFTER-SALES SERVICE

The after-sales service should be provided efficiently through trained service [illegible] and the complete documentation should be supplied to the customers. This not only requires the provision of a schematic diagram and operation procedures but also a complete components list with standard replacements, where possible, common faults trouble shooting hints, waveforms and voltage date at the schematic diagram, and a complete layout of the printed circuit boards with physical location of all the components. In addition, calibration prodedure should also be incorporated in the operational manual. The sale is suggested through other agencies. The company should act only an advisory body.

In addition different sections of administration such as store, purchase, accounts and audit and security are given in organizational chart.

Organizational chart

Other staffs: 2

1. R&D
2. Quality Control
3. Training

Staff

1. Manager - 1
2. Sr. Engineer - 4
3. Engineer - 1
4. Assistants - 4

Production

Design Drawing & Inspection

Electronics
1. Sub-Assembly
2. Transformer winding
3. Wiring & final Assembly

Mechanical
1. Machine shop
2. Sheet metal
3. Fitting & Assembly
4. Final finish

Final Assembly, Testing & Packing

Staff

1. Production Manager - 1
2. Engineer/Supervisors - 6
3. Assistants - 10
4. Technicians - 12

1. Marketing
2. Documentation
3. After Sale Service

Staff

1. Manager - 1
2. Engineer/Documentation Officer - 3
3. Assistants - 3
4. Technicians - 2

Administration

1. Establishment
2. Purchase & Stores
3. Accounts & Audit
4. Security

Staff

1. Administrative Officer - 1
2. Assistants - 5
3. Security - 3
4. -

NOTE: Marketing will not be the responsibility of the Company.

MANPOWER & QUALIFICATIONS

	Name of the post	No. of the Post	Qualifications	Experience
1.	Managing Director/ General Manager	1	1. B.E(Electronics)/M.Sc Physics with electronics as Specialisation 2. Master Degree in Business Administration.	1. 10 years experience in design, development & Production of electronics instruments. 2. The selected person should have at least 5 years experience of independly handling charge of R&D and production section.
2.	Production Manager	1	1. B.E.(Electronics)/Mechanical	1. Seven year experience in design & fabrication of mechanical hard ware of electronic instruments. 2. Should have worked in a senior position on the production side of electronic instruments
3.	Manager R&D.	1	B.E. Electronic/M.Sc. Physics with electronic.	1. Five years experience in design development of electronic instruments, Candidate should be well versed in the latest techniques and devices used in fabrication of electronic instruments.

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4.	Sales & Marketing Manager	1.	Bachelor degree in engg/ management or Master's degree in physics.	1. Five years experience in sale and marketing of electronics product in a reputed firm.
5.	Administrative Officer	1.	Master's degree in science/ Arts.	1. 10 years experience in various fields of administration such as establishment, purchase audit and accounts etc.
6.	Sr. Engineer R&D	4	Bachelor degree in Electronic/Mechanical/production Engineering.	1. 5 years experience in design development/Quality control of electronic instruments.
7.	Sr. Engineer Quality Control.			
8.	Sr. Engineer Training			
9.	Engineer Quality Control	1	Bachelor degree in Electronic Engineering.	1. 2 years experience in testing and calibration of different type of electronic equipment with special reference to quality control testing.
10.	Production Engg/Supervisor.	6	Diploma in electronic/ mechanical engineering.	5 years experience in electronics/ mechanical shop in wiring of electronic circuit/assembly & fitting of mechanical components.

11.	Documentation Officer	3
12.	Assistants	22
13.	Technicians	12
14.	Security	3

Master's degree in Science/Arts	3 years experience in documentation.
Bachelor degree in arts Science of High School pass. Diploma in Electronics/Mechanical.	2 years experience in handling official matters in case of candidates having bachelor degree & 5 years for those having high school certificates. 2 years experience in assembly & testing of electronics instruments.
Diploma in electronics/I.T.I. Certificate in the trade of Radio/Instrumentation.	No experience for diploma holders and two years experience in the requisite trade for the candidates holding I.T.I. Certificate.
Literate preferably	Preferably retired army personnel with stout physique.

E. Financial analysis

Raw Materials

The list of the components is based on the assumption that the design of the proposed item will be based on integrated circuit technology and will make use of LED display. The details of the components against each model are as follows:

Table 1. Raw materials

Type	Source (For details see appendix I)	Quality	Cost/ unit in $	Total in $
Model No. 1				
FET	USA, UK	1	1.5	1.5
General purpose linear IC's & regulators	USA, UK	4+2	.6	3.6
Transistors including power transistor	UK, India	12		3.6
Diodes & Zener diodes	UK, India	[illegible]		2
Resistances & Capacitors	UK, India	36 (approx)		2.5
Band switch & main switch	UK, India	1 each		1.5
Potentiometers & Trim pots	UK, India	4		2.4
Hardware, including knobs, fuse holder, transformer, main cable, connecting wires etc.	Locally available or to be fabricated in the production shop.			5.0
Printed circuit board	Locally available	1	5	5
Chassis including painting, electro-plating, engraving etc.	To be fabricated in the Shop.			6 (Material cost)
Indicating meter	UK, India	1	10	10

Accessories

Assorted Buffer Kit			
KCL Solution			
Polypropylene Electrode holder			
Electrode Support rod		To be fabricated in the shop	3 (material cost)
Electrode stand			
Terminal connector			
Polarizing Jumper			
Dust Cover			
		Imported	27.1
		Procurement 20%	5.4
		Duty 2%	0.7
		Locally available & Raw material cost.	19.00
		Procurement charges 10%	2.00
			54.2
		Rejection 5%	2.6
Electrode Assembly & buffer solutions	USA, UK, India		20.00 (The cost includes procurement charges & duty)
		Total	76.8

Model No.II

Digital Ics	USA,UK	14	4	8
FET input operational amplifier	USA, UK	1	4	4
General purpose operational amplifier and voltage regulators	UK, India	8	.6	4.8
LEDs	USA	4	1.5	6
Transistors, Zener diodes & thermistors	UK,India	36		9
Posts & trimpots	UK, India	6		6
Capacitors & Resistances	UK,India	60(approx.)		4
Band switch & main switch	UK, India	3		3
Hardware, including fuse holder, transformer, main cable & connecting wire	Locally avaialble or to be fabricated in the shop			9
Printing circuit Board				7 (material cost)

Accessories

Assorted Buffer Kit	To be fabricated in the shop	4 (material cost)
KCL Solution		
Polypropylene Electrode holder		
Electrode Support rod		
Electrode Stand		
Terminal connector		
Polarizing jumper		
Dust cover		

			Imported components	44.8
			Duty	.9
			Procurement charges 20%	9.0
			Locally available & material cost	25.0
			Procurement charges 10%	2.5
				82.2
			Rejection 5%	4.2
Glass electrodes assembly & buffer solution	USA,India	1 pair	24.6	24.6 (The cost includes procurement charges and duty)
			Total	110.8

Model III

Digital Ics	USA,UK	20	1.7	12
FET input operational amplifier	USA,UK	1	8	8
General purpose operational amplifier & regulators	USA,UK	11	.6	6.6
LEDs	USA	5	1.5	7.5
Transistors, diodes, zener & thermistors	India	32		9.0
Pots & trimpots	UK,India	7		12
Capacitors & resistances	UK,India	72		12
Band switch & main switch	UK, India	3		6
Hardware, including fuse holder, transformer, main cable & connecting wires				
Printed circuit board	Locally available or to be fabricated in the shop	3		15
Chassis including painting, electro-plating, engraving etc.		1		10 (material cost
Accessories as detailed in Model II				5

	Imported	78.1
	Procurement charges 20%	15.6
	Duty 2%	1.6
	Locally available and raw material	38.00
	Procurement charges 1%	3.8
		137.1
	Rejection 5%	6.9
Glass Electrode assembly and buffer solution	USA,UK	30.00 (The cost includes procurement charges and duty)
		174.00

Table 2. Plant, machinery and equipment

a) For R&D Unit, Quality control & training

Name of the Instrument	Number required	Source (For details see appendix I)	Approx. unit cost in $	Total cost in $
Oscilloscope, double trace DC - 15 MHz including plug-in unit for transistor curve tracer	2	USA, UK, India	400	800
Digital Multimeter				
5½ digits	1	USA, UK	800	800
4½ digits	1	-do-	400	400
Digital pH meter of .001 pH Resolution	1	USA, UK	800	800
RCL Bridge 1%	2	UK, India	300	600
Transistor Tester	2	UK, India	225	450
IC Tester	2	USA, India	450	900
Regulated power supplies	4	India	100	400
Multimeter/AVO	6	UK, India	120	720
AC Stablizer 1KW	3	UK, India	300	900
Variac 5Amp	2	India	50	100
Sine/Square Oscillator MHz	1	UK, India	175	175
Component comparator	1	UK, India	350	350
Insulation tester	1	India	150	150
Q meter	1	UK	600	600
Pico meter	1	USA	800	800
Power meter	1	USA	150	150
Weighing machine	1	UK, Japan	150	150
X, Y Recorder	1	USA, UK	1500	1500

Function generator	1	USA,UK,India	250	250
Calibrator	1	USA	1800	1800
Simulator	2	to be fabricated in R&D section	200	400 (raw material cost only)
Electrolytic condensor tester	-	UK,India	600	600
Oven temperature controlled 0 - 100°C	1	UK,India	800	600
		Total:	$	14,295
		Procurement Charges 10%		1,430
		Duty 10%		1,430
			$	17,555

b) Production Unit

Multimeter	8	UK,India	120	960
AC Voltage Stablizer 2 KW each	4	UK,India	400	1600
Variacs	4	UK,India	50	200
RCL Bridge 1%	1	UK,India	300	300
Digital Multimeter 3½ digits	1	USA,UK,India	250	250
Logic probe	4	USA,India	80	320
Pulse generator 1 MHz	1	UK,India	250	250
Battery charger	1	-do-	150	150
Insulation tester	1	-do-	100	100
Special tester 2 types	4 each	To be fabricated in R&D unit	200	1600 (material only)

Transformer Winding M/c	2	UK, India	600	1200
Dip soldering system (Small size)	1	USA	8000	8000
Oscilloscope single beam DC - 10 MHz	1	India	200	200
Regulated power supplies 5 volts & 6 volts	8	India	50	400
			Total	15,530
		Procurement charges 10%		1,553
		Duty 10%		1,553
				18,636

c) Service kit for service engineers which involves voltage simulator, multitest kit, tools, electrodes, assembly & buffer solutions etc. — USA, UK — 4 sets — 800 — 3200

Procurement charges 10%		320
Duty 10%		320
Total cost	$	3840

d) Special + general purpose tools	$	2000
Procurement charges 15%		300
Duty 10%		200
Total cost (d)	$	2500

Total cost of electronic equipment i.e. a) + b) + c) + d) — $ 42531

Workshop Machinery

Item	No.reqd.	Source	Total cost in $
Centre lathe with milling and other attachments	1	India, Germany	8000
Shaping machine	1	-do-	2800
Multi-speed bench drill machine 1/4" capacity 1/2" capacity	1+1	-do-	300
Double pillar screw type press	1	- do-	900
Power press	1	-do-	2200
Gellotin shaping M/c	1	-do-	2200
Surface grinding machine	1	-do-	1300
Motirized hacksaw machine	1	-do-	1400
Production and hand tools		-do-	2300
a) Die head	1		
b) Tail stock turret	2		
c) Slice turret	2		
d) Anti-vibration mounts	5		
e) Vertical indexing attachment	1		
f) Pneumatic revetting hammers	1		
g) Pneumatic tapping machine	1		
Surface finishing equipment	1 unit	-do-	2200
Bending machine, rolling machine	1	-do-	1500
Engraving machine	1	-do-	1200
			$ 25000

Packing Shop

All-purpose wood-working machine	1	India/Germany	1500
Hand tools & general equipment		-do-	800
Welding shop			
Gas welding set with accessories (Oxyacetyline flame)		-do-	800
Spot welding machine	1	-do-	900
		Total $	30,000

Office equipment, furniture and miscellaneous

Office equipment	$ 3500/-
Wooden furniture including lab tables, stools, production tables, chairs, sitting tables.	$ 3500/-
Steel furniture e.g. almirah filing cabinets, drawing cabinets, components racks etc. etc.	$ 5000/-
Staff car and station wagon	$ 9500/-
	$ 21500/-

Land, Building & Services

The pH meter will be required in other sectors in addition to the present requirement for hospitals. At the same time the proposed models of pH meters to be produced will be compatible in price/permance etc. with equivalent models available in the developed countries. Therefore there is a possibility to export the pH meters to the developed countries and east European countries. Keeping all these points in view the building requirement has been envisaged for the production of 5000 pieces pH meters.

The space provision has been made for the fabrication of printed circuit boards and electrodes. The financial provisions for the air-conditioning has been provided only for the quality control R&D laboratory etc., so as to keep the overheads minimum in the beginning.

(a) Cost of construction:

	Covered Area	= 153 x 50 x 40 sq.ft. = 5846 + 2000 sq.ft. = 7846 sq.ft. = 700 sq.meters approximately
	Construction rate -	= $225 per sq.meter
	Total cost of construction	= $ 700 x 225 = $1,57,500
(b) i.	Cost of Electrification and Architecture 5%	= $ 7,862
ii.	Cost of water pipe fitting & severage	= $ 2,000
iii.	Air conditioning for quality control and senior Management, 30 sq.mt. @ $350 per sq.mt.	= $ 10,500

	iv. Misc. such as Carpets	=	$ 2,000
	Total cost of furnishing & air-conditioning etc. (Sum of i,ii,iii & iv)	=	$ 22,362
c)	Power consumption for workshop, air-conditioners, electronic shop etc. on the basis of plant & machinery suggested	=	75 KVA
d)	Total cost of construction (Sum of a & b)	=	$1,79,862

The cost of the land is extra.

Cost of the project

A. Fixed Capital Investment

a) Plant & Machinery

(i) Electronic equipment	= $ 42,531
(ii) Workshop machinery	= $ 30,000
ii. Installation & other expenses 10%	= $ 3,000
(iii) Office equipment	= $ 21,500
Total of i), ii) iii)	= $ 97,031
Contingencies 10% on total of (i), (ii) & (iii)	= $ 9,703
Total	= 106,734

b) Building cost	= 179,862
c) Know-how fee and training	= 22,000
Total of (a +b+c)	= 308,596

B. Recurring Expenditure

1) SALARY EXPENDITURE

i)

Status	No.	Salary p.m. in dollars	Total p.m. in dollars.
MD/GM	1	300	300
Managers	3	250	750
Administrative Officer	1	250	150
Senior Engineers	4	200	800
Engineers/ Supervisors	10	160	1600
Assistants	23	120	2760

Technicians/ Security personnels	18	75	1350
	60		7710

Annual Salary $ 92, 520

ii) Electricity Charges = 75x0.6x9x270x0.07
@ 0.07 per unit = $ 7655

iii) Misc. charges = $ 5,000

Total (i)+(ii)+(iii) = $ 105,175

Assuming total capacity required 75 KVA on the basis of proposed set up, utility factor 0.6, working hours 9 and working days in a year, 270.

C. Working capital

Considering that the purchase of raw material and components for four months production at a time and 10% of the recurring expenditure is enough as working capital.

a) Components of material cost

Model No. I = 400x76.8 = 30,520

Model No. II = 110.8x 100/3 = $37,000 (approx.)

Model No.III = 174x100/3 = $ 5,800 =73,320

b) Working Capital for meeting the R.E. say 10% of R.E. (Salary, electricity & water charges etc) = 10,517

Total (a & b) = $ 83837

Financial Estimates at a Glance($)

A.	Fixed Capital Investment	3,08,506
B.	Recurring Expenditure	1,05,175
C.	Working Capital	83,837

Cost Analysis

(Annual Expenditure)

Recurring Expenditure	$105,175
Building Depreciation, 5%	$ 9,893
Plant & Machinery Dept., 10%	$ 10,673
Interest on working capital, 15%	$ 12,575
Total	$1,38,316 .....(i)

Production cost

Keeping in view the sophistication and work involved in assembly, test time and packaging etc., The production cost should be in the ratio 1:1.5:3 If 'a' is the production cost of one unit of Model No. I, then,

$$\text{Total production cost} = 1200a + 1000(1.5a) + 100(3a) = 3000\,a$$

It should be equated to .. (i) above.

$$\text{Therefore 'a'} = \frac{138316}{3000} = \$\ 46.2$$

Therefore, Production cost of

Model No. I	= $ 46.2
Model No.II	= $ 69.3
Model No.III	= $138.6

(i) <u>Estimated Sales Price</u>

<u>Profit</u>

Assuming at full rated capacity, rate of = 25%

Total profit = Fixed capital investment

$$= \frac{308,596}{4}$$

$$= 77,149 \quad \ldots\ldots\ldots (I)$$

Considering the specifications and production the profit ratio should be 1:1.5:2.5 for three models

i.e. if the profit for Model I = b
then " " " " " II = 1.5b
" " " " " III = 2.5b

Total profit = 1200b+1500b+250Cb =

To be equated to (I) i.e. 2950b = 77,149
b = 25.8
Therefore the profit for Model I = 25.8
" " " II = 38.7
" " " III = 64.5

<u>Sales Price</u>

Assuming market expenditure on sales price:

Model	Component & material cost i	Production cost ii	Profit iii	Total i+ii+iii
Model I	76.8	46.2	25.8	148.8
Model II	110.8	69.3	38.7	218.8
Model III	174.0	138.6	64.5	377.1

Marketing Cost	Sale Price	Sales price suggested
21.2	170.0	170.0(21.25)
31.2	250.0	260.0(32.50)
53.9	431.0	440.0(55.00)

The figures in bracket shows final marketing cost at the rate of 12.5% on sale price.

Cost benefit analysis year-wise

I year

i) Turn over

Model I = 600x170 = 102,000
Model II = 260x400 = 104,000

Total = 206,000

ii) Marketing Expenditure =

Model I = 600x21.25
= 12750
Model II = 400x32.5
= 13,000

Total = 25,750

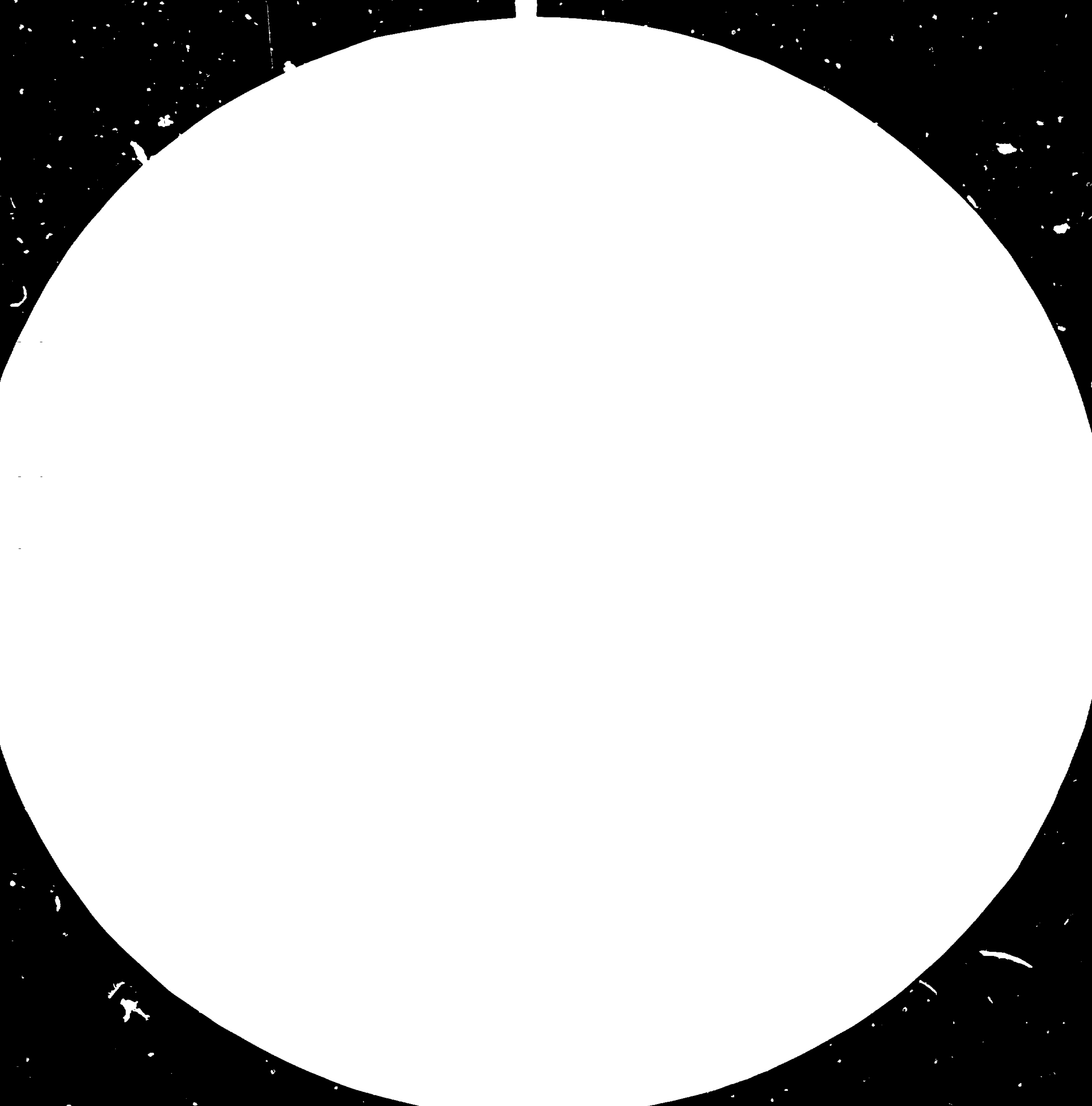
iii) Net returns = 180,250

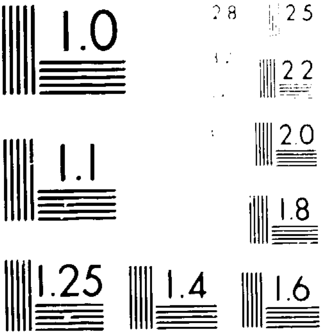
iv) Expenditure

a) Component and raw materials

Model I = 600x76.8
= 46080
Model II = 400x110.8
= 44,320

Total = 90,400 .....(1)




2.8
2.5
2.2
1.0
2.0
1.1
1.8
1.25
1.4
1.6

b) Other expenditures

Considering in the first year, recruitment, procurement of plant and machinery will take time, threfore, utility factor can be taken safely = 0.6

i.e. 0.6 times the total expenditure at full capacity
= 0.6 x 138,316
= 82953.6

Total (a+b) = 173353

Profit = 180,250 - 1,73,354
= 6896

Considering that in the first year the maximum average use of fixed capital investment will be = 0.6

Therefore % Profit

$$= \frac{6896}{308,596 \times 0.6} \times 100$$
$$= 3.8\%$$

IInd Year

i) Turn over

Model I	=	1000x170
	=	170,000
Model II	=	800x260
	=	208,000
Model III	=	50x440 = 22,000
Total		400,000

ii) Marketing cost

Model I	=	1000 x 21.25 = 21,250
Model II	=	800 x 32.5 = 26,000
Model III	=	50x55 = 2,750
Total	=	50,000

iii) Net return = 350,000

iv) Expenditure

a) Components and Raw material

Model I = 1000x76.8 = 76800

Model II = 800x110.8 = 88640

Model III = 50x174 = 8700

Total = 174,140 ....(i)

b) Other Expenditure

Considering full fixed investment has been utilised

(Salary + Total Dep.) + Interest on working capital

= 125,681 + 8700 (15% interest on 1/3 of (ii)

= 134,381

Total (a+b) = 308,521

Profit = 350,000 - 308,521 = 41,479

% Profit = $\frac{41\ 479}{308,586}$ x 100

= 13.6%

III year

Full rated capacity turnover in III year

Model I = 1200x 170 = 204,000

Model II = 1000x 200 = 250,000

Model III = 100 x 440 = 4 4,000

Total = 508,000

Marketing Cost

Model I = 1200x21.25 = 25,500

Model II = 1000x32.5 = 32,500

Model III = 55x100 = 5500

Total = 63,500

Net returns = 444,500

Expenditure

a) Raw material + components =

Model I	=	1200x76.8	=	92,160
Model II	=	1000x110.8	=	110,800
Model III	=	100x174	=	17,400

Total 220,360

b) R.E & interest on working capital

= 138,316

Total a & b 358,676

Profit = 85,884

%Profit = $\frac{85,885}{308,336}$

= 27.6%

Cost Benefit at a Glance

I st year	=	3.8%
IInd Year	=	13.6%
IIIrd year	=	27.6%

F. Feasibility

The proposed sale prices for three different type of pH meters including electrodes are $ 170.00 for analog type of 0.05 pH accuracy and battery/mains operated, $ 260.00 for digital type of 0.01 pH accuracy and $ 440.0 for the R&D type of 0.001 pH accuracy. The cost of these proposed models to be produced is much cheaper than the equivalent models; imported by Egypt. Labour cost in Egypt is cheap compared to the developed countries, import duty on components and equipment is negligible and the proposed technology and production methods are latest. Therefore the sale prices of the three models suggested are cheaper than the equivalent models available in the international market and at the same time would be comparable in performance and technology.

On the basis of demand market potential indicated above, the profit in the first year is 3.8%, in second year 13.6%, while in the third year 27.6%. So even if the demand of the other sectors such as chemical, petrochemical industries, agriculture research and educational institutions and export are not taken in to consideration the project is economically feasible and at the same time would create the technical base to take up the similar instruments.

G. Conclusions and recommendations

pH Meter is a vital analytical instrument having wide application in hospitals, chemical, petrochemical and drug industries, agriculture, research and educational institutions. In any developing country, the growth of these sectors is increasing by rapid rate, therefore, the demand of this item will increase manifold in the days to come.

The set up of production unit for PH meters is strongly recommended. It is economical, feasible, and will earn profit on the existing demand. At the same time, it will create technical base to take up many mor types of digital analytical instruments, trained cadre of engineering/technicians and will lead to self-reliance. It is recommended that printed circuit boards should be purchased locally and if not available they may be imported along with the electrodes in the first three years. In fourth year the production of printed circuit boards and electrode assembly should be taken up. The tool room facility should be provided at central places.

The electronic unit of other analytical instruments, such as digital flame photometer, digital colorimeter and digital spectro-photometer (visible) etc. uses the same technology and electronic assembly and testing requirements are also the same as that of pH meter. The small optical shop and some additional facilities in the mechanical workshop have to be created. With the additional investment of approx. 35%, the production of the suggested digital instruments could be clubbed with the production of pH meter. Therefore, the production of all analytical instruments at one place will increase profit margin and at the same it will be economical to create more facilities independently such as fabrication of printed circuit boards, environmental and vibration testing and adequate provision of technical books and Journals. Sometimes if the demand of a particular item goes down, the production could be diverted to other items which will ensure the full utilization of production set up. Therefore, it is strongly recommended that the production of all laboratory analytical instruments should be at one place.

Appendix I

SOURCES OF EQUIPMENT

Transistors, zeners and diodes

1. Fairchild Ind., Prod. Div.,
1501 Fairchild Dr.,
Winston - Salem,
NC 27105, USA

2. Texas Instruments Inc.
P.O. Box. 280, Rte 1 Indi PK,
Norwood, MA-02062, USA

3. Teledyne Semiconductor,
1300 Terra Bella Avenue,
Mountain View,
California - 94040,
U.S.A.

4. Motorola Semiconductor Divn.
Lit Distrib. Center,
616 W 24th st.,
Temple AZ 82581, USA

5. Plessey Semiconductors,
Cheney Maberm
Swidon,
Wiltshire SN 220 W, UK

6. M/s. Mullard Limited,
Mullard House, Torrington Place,
London WCIE 740, UK

7. Hitachi Ltd.,
New Maruncuchi Bldg.,
5-1, Maruncuchi 1 -chone,
Chiyodaku,
Tokyo, JAPAN

8. M/s. ECIL,
P.B.No. 2020, Hyderabad
INDIA

9. M/s. B.E.L.,
P.O. Jalahalli,
Bangalore, INDIA

10. CDIL,
C-120 Naraina Industrial Estate,
New Delhi - 28, INDIA

11. Semiconductors Ltd.,
Ador House
6, Kaikushru Dubash Marg,
Bombay-400001, INDIA

Resistances and capacitors

1. A.H. Hunt (Capacitors) Ltd.
   Wandsworth,
   London S.W. 18, UK

2. M/s. Erie Resistor Ltd.
   South Denes, Gtyarmouth,
   Norfolk, UK

3. Dubilier Condenser Co.,
   Docon Works, Victoria Rd.,
   North Action; London W.Z., UK

4. Punjab Semiconductors Ltd.
   Mohalli,
   Punjab, INDIA

5. Keltron component complex Ltd.
   P.B.No. 37; Mill Rd.,
   Cannanore - 670001 INDIA

6. M/s. ECIL
   P.B.No.202,
   Hyderabad, INDIA

7. M/s. BEL,
   P.O. Jalahalli,
   Bangalore, INDIA

8. M/s. Asian Electronics,
   Handloom House, 3rd Floor, 221,
   Dr. D.N. Rd., P.B. No. 1863,
   Bombay - 400001.
   INDIA

9. M/s.Nippon Electronics (India) Pvt.Ltd.,
   P.B.No. 5, Bull Temple Rd.,
   Bangalore - 19, INDIA

10. M/s.Rescon Manufacturing Co. Pvt.Ltd.,
    Maray Rd., 2nd Floor,
    Near Bandra, Tallies,
    Bandra,
    Bombay - 400050, INDIA

Linear and digital integrated circuits

1. Motorola Semiconductors Division,
   Lit Distrib Centre,
   616 W 24th St.,
   Temple AZ 82581, USA

2. National Semiconductors Corpn.,
   2900 Semoconductor Divn.,
   Santa Clara,
   CA 95051, USA

3. Analog Devices, Inc.,
   P.O.B. 280, Rte 1 Indi PK,
   Norwood, MA 02062 USA

4. Texas Instruments Inc.,
   Box 5474
   Dallas Tex 75222
   U.S.A

5. Burr-Brown Res. Corpn.,
   Inti Airport Ind., PK,
   Tusson, A Z 85734, USA

6. M/s. Mullard Limited,
   Mullard House,
   Torrington Place,
   London Wc IE 7 HD, UK

7. Plessey Semiconductors,
   Cheney Manor,
   Swidon,
   Wiltshire SN 220 W, UK

8. Fairchild Ind.,
   Prod. Div.,
   1501 Fairchild Dr.,
   Wiston-Salem,
   NC 27105, USA

LEDs

1. Litronics Inc.,
1900 Homestead Road/
Vallco Park/Cupertino,
California - 95014, USA

2. Monsanto,
Electronics Division,
3400 Hillview Avenue - Palo Alto,
California - 94304
U.S.A.

1. John Fluke Mfg. Co. Inc.,
P.O. Box 7428, Seattle,
Washington -98133,
U.S.A.

2. Hewlett Packard,
1501 Page Mill Road,
Palo Alto,
California - 94304, USA

3. Tektronix Inc.,
P.O. Box 500,
Beaverton,
Oregon 97077,
U.S.A.

4. Philips Test & Meas. Instr. Inc.,
400 Crossways Park Dr.,
Woodbugg;
N.Y.11797, USA

5. Marconi Instruments Ltd.,
St. Albans Hertford Shire,
UK

6. Solartron,
Schlumberger,
Farnborough Kents,
UK

7. Yokogawa Electric Works Ltd.,
2-9 Nakacho,
Musashino-shi,
Tokyo 180,
Japan.

8. M/s. ECIL,
P.B.No.2020
Hyderabad, India

9. Aplab,
Aplab House,
A-5, Wagle Estate,
Thana - 400604, India

10. Systronics,
89-92, Industrial Area,
P.O. Naroda,
Distt. Ahmedabad(Gujarat)
India

11. Toshniwal Brothers Pvt.Ltd.,
3-E/8, Jhandewalan Extention,
New Delhi-110055, India

12. Eastern Electronics (Delhi) Pvt.Ltd.
1-2, Industrial Area,
Faridabad, India

Appendix II

ELECTRODE SPECIFICATION

S.No.	Name of the Electrodes	Electrode Length	Lead Length	pH Range	Temperature Range	Other Features
1.	pH (Glass) Electrode	5"	30"	0-14	-5 to 100°C	In this full length of the electrode is electrostatically shielded and the internal element is permanently fused to the electrode body for long life in high temperature applications.
2.	Standard Amber Electrode	5"	30"	0-14	35 to 100°C	It is for continuous high temperature measurements over 0 to 14 pH range. It is used with silver - silver chloride reference electrode.
3.	Calomel Internal with Quartz Junction	5"	30"		-5 to 100°C	Quartz junction is designed to offer resistance to strong oxidizing and reducing agents.
4.	Silver-Silver Chloride Internal with ceramic Junction.	5"	30"		-5 to 100°C	Ceramic junctions is designed for the applications offering extremely low and stable junction potentials.
5.	Full - Range Combination Electrode	5"	30"	0-14	-5 to 100°C	This unit can be used in all solvents, both aqueous and non-aqueous.

6.	J on Electrode	5"	30%	-
7.	Blood pH Electrode Assembly.			

-5 to 100°C

Designed for use in etching and plating processes, ore refining, soil samples, water treatment, foods and beverage

The assembly consists of a sample chamber Glass electrod reference electrode and remot reservoir for salt bridge solution. For this not more than 0.5 millilter of sample is required.

XXIV. INDUSTRIAL PROFILE ON DIGITAL COLORIMETERS, SPECTROPHOTOMETERS AND FLAME PHOTOMETERS

Based on a survey, the annual demand for spectrocolorimeters in the Arab States is put at 9,250 pieces; for spectrophotometers UV type it is 450 pieces while the demand for flame photometers is 625 pieces per annum. Currently all these instruments are being imported from Japan, Switzerland, UK and USA.

With the improvement in health services and the establishment of new hospitals the projected demand for these items after a decade is as follows:

Spectrocolorimeter	5,850
Spectrophotometer UV type	1,170
Flame photometer	1,625

A. Outline of technology

FLAME PHOTOMETER

Principle of Operation

The alkali metals, when raised to a sufficiently high temperature will absorb energy from the source of heat and be raised to an excited state in their atomic form. As these individual atoms cool, they will fall back to their original unexcited state and re-emit their absorbed energy by way of radiation at specific wavelengths, some of which are in the visible region. Therefore, if a mixture of the alkali metals, sodium potassium and lithium in solution are aspirated into a propane-air flame, in an aerosol form they will, after excitation by the flame, emit a number of discrete frequencies which may be isolated by optical filters and individually allowed to fall on suitable photodetectors to be coverted into electrical signals.

The proposed Digital Flamephotometer is a compact, easy to use low temperature instrument of very fast response for use in clinical laboratory. It uses precise international standard measure of measurement for the simultaneous determination of Sodium, Potassium or Lithium from very small physiological samples.

Results are displayed on Digital Panel Meter(DPM), displays. When lithium samples are being determined, the Na display is blanked off and the K DPM displays the lithium results. A moving coil meter-mounted on the front panel gives a constant indication of the level of the internal standard contained in the sample. When the reading is outside, the prescribed limit, the DPM displays are switched off.

SPECTRO-COLORIMETER

The spectro-colorimeter is an important analytical instrument that makes possible a quantitative measurement of the light passing through a clear solution. It is capable of isolating 'monochromatic' radiation. The desired wave length is isolated by using dispersers like prism or grating with optical components like mirrors, slits together form the monochromator of the instrument.

The filter photometer isolates several wavelengths of radiant energy using filters. An instrument equipped with an interferometric filter will isolate a band of 10 to 20 mu. Hence the instrument is equipped with proper radiation source, monochromator or filter for isolating the desired wavelength, a container or cell to keep the solution under examination, and a detector of radiant energy.

Radiation sources:
- Tungsten lamp for visible spectrum (330 mu - 700 mu)
- Hydrogen or deuterium lamp for ultraviolet spectrum (190-mu-330mu)

Photocells or photomultipliers are used to detect the radiant energy emanating out of the cell containing the sample. The electrical output of the photocell is then processed by the d.c. amplifier indicator system which could be of direct deflection type.

Principle of Operation

The white light that is emitted by the tungsten source lamp passes through the entrance slit of the monochromator. This light is focussed by the field lens upon the objective lens. The objective lens in turn focusses the image of the entrance slit on the exit slit. However, since the light has been reflected to the exit slit by means of a diffraction grating, the light appearing at the exist slip will have been dispersed into a spectrum.

The monochromatic light passing through the exit slit continues on through the sample compartment and is ultimately terminated at the photo detector tube.

Depending upon the nature of the sample and cuvette used plus the wavelength of light, some of the incident light will be absorbed by the sample.

The photo detector converts the incident light energy passing through the sample into electrical energy in the form of a photocurrent. The level of photocurrent is governed by the intensity and wavelength of the incidient light and the photo-emissive characteristics of the photo detector. Hence, in the ultraviolet and visible wavelength region an S-1 response phototube is used along with appropriate second order filters. Optical filters can be placed in the optical path to block second order wave lengths in the near infrared region and to reduce the stray light in the near ultraviolet wave length region.

A light control (occluder) mechanism is used to adjust the amount of incident light energy falling on the phototube. When there is no sample in the instrument, a shutter blocks the light so that the meter can be set to zero.

A base wall separates the optical system from the electronic circuits, thus preventing dust and dirt from affecting the efficiency of the optical system. At the same time, the wall shields the phototube to prevent erroneous readings caused by stray light entering through the meter face. Error-free operation is possible in bright light or even variable sunlight.

The photocurrent generated by the phototube is converted into a direct current signal by a detector circuit. The strength of this signal is proportional to the amount of light energy passing through the sample. This electrical signal is amplified and the resulting level is displayed upon the meter and may be read in either percent transmittance or in absorbance units. An external output convertor could be provided for use with related plug-in accessories.

APPLICATIONS

Quantitative and qualitative analysis of mineral acids, organic acids and esters, alcohols, amines, inorganic anions, carbonyl compounds, cations, monocyclic aromatic hydrocarbons, nitrogen compounds, olefins, phenols, pigments like carotene, chlorophyll, etc. Polycyclic hydrocarbons and derivatives, sulphur and sulphur compounds. These are but just a few.

BIO-MEDICAL APPLICATIONS

Spectrophotometric analysis has of late become a very vital method of estimation of bio-medical samples for the analysis and estimation of proteins, nucleic acid, amino acid and peptides, hippuric acid in urine, blood serum proteins, cystine, etc.

APPLICATIONS IN FORENSIC SCIENCE

Analysis of Air Pollution - Ex. Ozone in air, chlorinated solvents. Polynuclear aromatics from air dust.

Identification of Drugs - Toxicology, nicotine in tobacco, local anaesthetics identification in dosage form, morphine etc.

FOODS

Vitamins and amino acids, chicory and caramel detection in coffee extracts, tannins in tea and beer, food product substitutes in butter, fat, olive-oil, animal fats, sugar and uronic acids, detection of decay in potatoes etc.

Spectrophotometer - UV Type

Principle of Operation

Light from the tungsten lamp is focussed by the condensing mirror and directed in a beam to the diagonal slit entrance mirror. The entrance mirror deflects the light through the entrance slit and into the monochromator to the collimating mirror. Light falling on the collimating mirror is rendered parallel and reflected to the quartz prism where it undergoes refraction. The back surface of the prism is aluminized so that light refracted at the first surface is reflected back through the prism, undergoing further refraction as it emerges from the prism. The desired wavelength of light is selected by rotating the Wavelength Selector which adjusts the position of the prism. The spectrum is directed back to the collimating mirror which centres the chosen wavelength on the exit slit and sample. Light passing through the sample strikes the phototube, causing a current gain. The current gain is amplified and registered on the null meter.

The Spectrophotometer - UV type is one of the most widely used instruments. This is equipped with quartz optics and can be used in the ultraviolet (190-350 mu) and visible range of the spectrum. The instrument is provided with interchangeable radiation sources with hydrogen or deuterium discharge tube for the lower wavelength or deuterium discharge tube for the lower wavelength including ultraviolet, the tungsten filament lamp for the visible region. A pair of mirrors direct the beam through an adjustable slit on to the monochromator compartment. After traversing the length of the instrument, the beam is reflected on the slit. The optics are so arranged that the entrance and the exit beam are displaced from one another in the same vertical axis. The exit beam passes above the entrance mirror as it enters the cell compartment.

Four cuvettes of 1 cm rectangular cells can be accommodated within the beam by movement of the carriage in the path of the beam.

The detectors are housed in a phototube compartment. Radiation intensity can be controlled by adjusting the shutter in the path of the beam. Photomultipliers are used for the ultraviolet and visible range 190-625 mu. Red sensitive phototube is for the range beyond 625 mu. The current from the detector due to the incidence of the radiant beam after passing through the sample is passed through a high resistance, and the voltage drop is fed to the d.c. amplifier using electrometer valve. The amplifier circuit is of null type to provide absorbance or transmittance data. The electrometer plate current is indicated by a rugged 1 mA milliammeter.

In order to counterbalance the photo current, three potentiometric circuits are employed. Each of the potentiometer control circuits alters the grid potential of the electrometer tube to bring the needle of the milliammeter to Zero. The first control (dark current control) is employed to offset the small phototube current when no radiation is falling on the detector. The second control (sensitivity control) offsets the photo tube current when radiation from the monochromator reaches the phototube after passage through the solvent. The transmittance control adjusts the position of the contact on a potentiometer slidewire that is calibrated in absorbance and transmittance units. It is used to null the instrument when the sample is in the radiation path.

Proposed Models & Specifications

On the basis of the Expert's Report, three types of instruments are proposed to be covered in this industrial profile. Though their principle of operation and applications have already been discussed above. The specifications for the proposed models are given below:

Flame Photometer: Proposed to introduced in the first year.

Specifications:

Detectable Elements	Sodium & Potassium simultaneously	
Range	Sodium	Serum 0-200 meq/L
		Urine 0-200 meq/L
	Potassium	Serum 0-100 meq/L
		Urine 0-100 meq/L

Accuracy: ± 1%

Transmission:	0-100%
Combustion gas:	Bottled gas
Built in Burner:	Stainless steel
Atomiser:	Stainless steel concentric suction type
Air Compressor:	Diaphragm type working pressure 5 to 15 psi
Detector:	Photocell
Readout:	Digital Display with 3 digits
Power Supply:	230V, 50C/s & 100 watts, an electronic voltage stabilizer for ± 10% mains fluctuation

S pectrocolorimeter:

This is also proposed to be introduced in the first year.

General Features:

- High resolution grating single beam monochrometer.
- Wide wavelegth range selected by cam drive.
- A single tungsten lamp to cover the entire range.
- Highly senstitive phototubes (Blue & Red) as detectors premounted with selector knob.
- Regulated and fully solid state power supply.
- Double cell accommodation for 'reference' and 'sample' together.

Specifications:

Wavelength Range:

350 to 650 nm extendable to 900 nm by placing phototube and inserting a red filter.

Special Slit width:	20 mm
Wavelength Accuracy:	1nm
Wavelength Readability:	1 nm
Photometer Range:	000.0% to 100.0%
Absorption:	0.000 A to 2.000 A
Readout:	Digital with 3 digits LED
Power Supply:	230V, 50C/s. 45 watts.

Spectrophotometer-UV type

This model is proposed to be introduced during the third year.

General Features

- High resolution grating single beam monochromator.

- Highly sensitive photomultiplier as radiation detector.
- Regulated and fully transistorised power supply.
- Sample compartment accommodates four cells.
- Ideal for precise and spectrophotometric analysis.

Specifications:

Wavelength Range: 200-650nm (linear)
Wavelength Accuracy: ± 0.2 nm
Wavelength Resolution: 0.2 nm throughout at 0.1 mm slit width.

Photometric Range: 0-100% in Transmittance; 0-2A in Absorbance

Wavelength selection: Motor & gear drive mechanism with digital readout.

Slit width: Adjustable from 0.01 mm to 1.7 mm

Spectral bandwidth: 1 nm/mm slit width
Light Sources: Tungsten and Deuterium lamps,
Power Supply: 230 ± 20V, 50c/s; 70 watts.

The unit sales prices and the quantities in which these instruments will be manufactured as as under:

Product	Unit sales price	Qty. to be manufactured I	II	III	IV	V
1. Flame Photometer	$ 650	100	200	375	425	500
2. Spectro-colorimeters.	$ 780	300	600	1000	1500	1800
3. Spectro-photometer uv type	$ 1900	-	-	100	150	250
Total		400	800	1475	2075	2550

Sources and cost of technical know-how

In developing countries the development cost of the first prototypes is most uneconomical due to high initial set up costs. It is, therefore, most cost effective to buy the foreign know-how in the beginning for the initially proposed models and concentrate on local R&D units for further improvements. It would also be worthwhile to purchase the know-how on one time transfer basis.

A few important sources of know-how are:

Flame Photometer	i) Bausch & Lomb, USA
Spectro Colorimeter	ii) E.E.L., U.K.
	iii) CSIC, Chandigarh, India ECIL, Hyderabad, India.
Spectrophotometer	i) Beckman Instruments Inc., California. U.S.A.

The know-how of flamephotometer and spectro-colorimeter is available both from developed countries like UK and USA as well as from developing countries like India. This would mean around $ 12,000 in case of know-how from developed countries and $ 6,000 in case of know-how from developing countries. The know-how of spectrophotometer-uv type can be had only from the developed countries like UK and USA and would cost around $ 36,000.

For initial training and expert advice it is recommended that at least 3 engineers/technicians from Egypt be provided 'On-job' training at the site of know-how offering agency. The duration of training could be from 3 to 6 months and should cover all aspects covering design, assembly, testing, quality control and they should also be made to acquire familiarity with specifications and sources of components and raw materials. It is also recommended to make a provision for the services of an expert initially for 3 months in the begining of the project and again for 3 months subsequently in the second year. The remuneration of the expert could be $ 150 per day excluding other perquisites. In case the suggested supervisory staff and technicians are also not available they could also be arranged from an appropriate agency for a period not exceeding 12 months and could be paid at a rate ranging between $ 600 to 800 per month.

A. Outline of technology

In recommending the proposed manpower, the requirement has been given for the first year and only the additional manpower that may be required subsequently in the 2nd, 3rd, 4th and 5th year. The necessary augmentation of staff at various levels has been proposed wherever the production is to be stepped up.

The proposed manpower strength has been recommended assuming that the plant will go into two - shift operating from the 2nd year onwards.

It has also been assumed that necessary skilled labour and other experienced technical and managerial personnel would be available from local I.T.I.s, engineering and technical institutions and the management institutes.

The broad salary and wage rates have been taken from the Expert's report and necessary interpolations have been done so as to keep some differential in order to assume the necessary hierarchical set up and span of control.

The organizational set-up and manpower is given in table 1.

Table 1. Organization and manpower

ADMINISTRATIVE	Annual Salary rate	1st yr.	Additional			
			2nd yr.	3rd yr.	4th yr.	5th yr.
General Manager/ Project Manager	$ 3,600	1	-	-	-	-
Manager (Commercial)	$ [illegible],200	1	-	-	-	-
Personnel Officer	$ 2400	1	-	-	-	-
Purchase Officer	$ 2400	1	-	-	-	-
Accounts Officer	$ 2400	1	-	-	-	-
Security Officer	$ 1800	1	-	-	-	-

Office Assistants and clerical staff for Personnel Purchase and Accounts functions	$ 1,440	7	-	4	-	-
Security staff & Drivers	$ 960	5	4	-	-	-
Total		18	4	4	-	-
Total Annual Salary (in $)		30,480	39,368	46,864	52,552	56,706

MARKETING

	Annual salary rate	1st yr.	Additional 2nd yr.	3rd yr.	4th year	5th year
Marketing/Sales Manager	$ 3,000	-	-	1	-	-
Sales Executives	$ 2,400	1	-	2	-	1
Warehouse/shipping incharge	$ 1,440	1	-	-	-	1
Sales Asstts.	$ 1,440	2	-	2	1	1
Total		4	-	5	1	3
Total Annual Salary (in $)		7,720	7,392	18,812	22,132	29,626

OPTICS ASSEMBLY SECTION

Engineer	$ 2,400	1	-	-	-	1
Jr. Supervisor	$ 1,600	2	-	4	-	2
Total		3	-	4	-	3
Salary in $		5,760	6336	13,688	15,058	24,664

DIRECT LABOUR						
Skilled	$ 960	10	-	5	1	5
Total Annual Salary (in $)		9,600	10,560	16,416	18,053	24,664
ELECTRONICS ASSEMBLY & TESTING						
Manager (Electronics)	$ 3,000	1	-	-	-	-
Test Engineer	$ 2,400	2	3	5	-	3
Supervisor	$ 1,920	3	5	7	-	2
Total		6	8	12	-	5
Total Annual Salary (in $)		13,560	31,716	60,328	66,360	84,036
DIRECT LABOUR						
Skilled	$ 960	3	3	2	-	2
Semi Skilled (Wireman)	$ 600	15	20	20	-	5
Un-Skilled (wireman)	$ 180	2	2	-	2	-
		20	25	22	2	7
Total Annual Salary (in $)		12,644	29,400	46,260	51,606	61,686
WORKSHOPS & STORES						
Works Manager	$3,000	-	-	1	-	-
Deputy Manager (Production)	$ 2,700	1	-	1	-	-
Asstt. Manager (Services)	$ 2,400	-	1	-	1	-
Cost Accountant	$ 2,400	1	-	-	-	-
Sr. Foreman/Supervisor	$ 1,920	3	-	2	2	1
Jr. Foreman/Supervisor	$ 1,630	2	2	2	3	1

Sr. Store Keeper	$ 1,680	-	-	1	-	-
Jr. Store Keeper	$ 1,560	1	1	1	-	-
Store Asstts.	$ 1,440	1	1	2	-	-
Helpers Work-charged staff	$ 360	2	2	2	-	2
		11	8	12	6	4
Total Annual Salary (in $)		17,940	31,134	53,986	70,666	82,052

DIRECT LABOUR

Skilled	$ 960	5	5	4	2	6
Semi Skilled	$ 600	10	8	6	4	15
Un-skilled	$ 360	2	3	5	8	6
Total		17	16	15	14	27
Total Annual Salary (in $)		11,520	23,352	34,928	45,620	67,102

6.6 PCB SECTION

Asstt. Manager	$ 2400	1	-	-	-	-
Engineer	$ 1920	1	-	-	-	-
Jr. Foreman/ Supervisor	$ 1680	1	-	-	-	-
Jr. Supervisor (Layout & Testing)	$ 1680	1	-	1	-	-
Jr. Supervisor (Photoetching)	$ 1680	1	-	1	-	-
Technical Asstt.	$ 1440	1	-	1	-	-
Total		6	-	3	-	-
Total Annual Salary (in $)		10,800	11,880	17,368	19,654	21,6[illegible]

DIRECT LABOUR	Annual Salary rate $	Additional 1st Year	2nd Year	3rd Year	4th Year	5th Year
Skilled (Drilling & Etching)	960	1	-	1	-	-
Semi-skilled (Planning, Job evaluating, Dark room & PCB preparation)	600	2	-	2	-	-
Un-skilled (Lab. work)	360	1	-	1	-	-
Total		4	-	4	-	-
Total Annual Salary (in $)						
ENVIRONMENTAL TEST & ANALYSIS SECTION						
Sr. Engineer	2400	1	-	-	-	-
Jr. Engineer	1920	1	-	-	-	-
Jr. Supervisor	1680	1	-	1	-	1
Technical Asstt.	1440	1	-	1	-	1
Lab. Attendant	360	1	-	1	-	1
Total		5	-	3	-	3
Total Annual Salary (in $)		7,800	8530	12,918	14,210	19,110

Qualitative requirements for managerial and supervisory persons

1.	General Manager/ Project Manager	Degree in Electronic Engineering with 15 years experience in design/development/production of electronic instruments preferably medical electronic in instrumentation. At least 5 years experience in a senior management level desirable.
2.	Marketing Manager	Degree in electrical/electronics engg. with atleast 15 years experience in sales and service of electronic equipment, preferably medical electronic equipment. At least 5 years experience in a supervisory position desirable.
3.	Company Secretary-cum-Accounts Officer.	Degree in Commerce/Cost Accountancy/ Chartered Accountancy with 10 years experience in a responsible position. Degree in Company Law preferable.
4.	Manager(Electronics)	Degree in Electrical/Electronics engg. with atleast 15 years experience in production of electronic instruments preferably medical electronic instrument
5.	Engineers for production/R&D/ Quality Control/ Design office/ Material Planning	Degree in Electric/Electronics/ Mechanical production engineering, with at least 10 years experience in the appropriate line.
6.	Supervisors for production/quality control/Packing/ PCB Lab./Tool Room/ Sheet Metal/Turning, Milling etc./ Surface Treatment/ Printing Section/ Electronic Testing Lab.	Diploma in appropriate trade with 7 years experience out of which at least 2 years should be in a supervisory position.

C. Raw materials and components

In order to ensure obvious price advantages, the procurement value of raw material and components for atleast 100 pieces of instruments has been given. This also serves to take into consideration the minor price fluctuations that are likely to take place from time to time. Though it has been attempted that maximum amount of components are fabricated locally, there are still many critical components which will have to be bought out till separate production facilities are set up to produce them locally.

RAW MATERIAL REQUIRED

Flame Photometer

Raw material	Estimated cost $
Fibre glass	1500.00
Al casting	400.00
Al Sheet	200.00
MS/Br. rod	900.00
Total	$ 3,000.00

SPECTRO-COLORIMETER

Raw material	Estimated cost $
Al/Br.	530
Al &CI Casting/Br.	320
Al casting	350
Al Sheet	80
Al rod & plate	400
Fibre glass	2500
Others	3250
Total	$ 7,730

Spectrophotometer (UV type)

Raw material	Size	Qty.	Estimated cost $
Al Casting	..	840 Kgs.	2010
Alplate	5 mm thick	130 Kgs.	320
Al Sheet	1.2 mm thick	150 Kgs.	360
M.S. Sheet	1.00 mm thick	30 Kgs.	20
M. Steel	18 Gauge	360 Kgs.	140
Fibre Glass	2 mm	-	2800
Br. Plate	10 mm thick	400 Kgs.	1200
Br. Plate	5 mm thick	250 Kgs.	770
Br. Casting	-	150 Kgs.	500
Bakelite sheet	5 mm thick	20 kgs.	60
Misc. components	-	-	1600
		Total	$ 9780

TOTAL RAW MATERIAL REQUIREMENTS (in $)

	I	II	III	IV	V
Flame Photometer	3,000	9,000	11,250	12,750	15,000
Spectro Colorimeter.	23,190	46,380	77,300	115,950	139,140
Spectro photometer (UV type)	-	-	9,780	14,670	24,450
	$ 26,190	$ 55,380	$98,330	$143,370	$168,59[illegible]

COMPONENTS REQUIRED
(Cost Data is provided for 100 pieces)

Flame Photometer

Components	Approx. Cost $	Sources of supply
Optics		
Lens (Doublet)	1,500	
Interference Filter	5,000	
Photocell	1,000	M/s Khandelwal & Co. Bombay, India
Concave Mirror (coated)	600	

Electronics

Linear ICs

		Approx.cost $	Source of supply
i)	Operational Amplifiers	2,200	M/s National Semiconductors, U.S.A.
ii)	Voltage Comparator		
iii)	Voltage Regulator		

Digital ICs

Decade Counters 4-bit latch (Memory) Decoder Driver Flip Flops Quad-2 input NAND - Gate	2,050	M/s National Semiconductors, USA. M/s INTED, USA M/s Texas, USA

Components	Approx. Cost. $	Source of supply
Transistors	600	
Zener diodes & other diodes,	400	M/s Continental Oefices India Ltd., India
Resistances, Capacitances,		
Potentiometers	600	
Others:		
Compresser with motor, Rubber tubing pressure gauge etc.	4000	
Totals	17950	(including wastage allowance)

SPECTRO-COLORIMETER

Components	Approx. Cost $	Source of supply
Optics		
Grating (600 lines/mm)	2940	i) Edmund, USA ii) B&L, USA
Phototubes		
350 mu to 625 mu	1260	RCA, USA
625 mu to 950 mu	1260	RCA, USA
Filter (Second order cut off)	1260	B&L, USA
Objective lens (f/5)	924	-do-
Field lens (f/2.5)	504	-do-
Spectral Lamps (6V, 21 Watt)	210	-do-
Electronics		
Digital ICs: i) Gates ii) Decades iii) Decoders iv) Flip-flops and latches	756	i) National Semiconductors, USA ii) Fair Child, USA
Linear ICs: i) General Purpose ii) Low level-high input iii) Impedance iv) Regulators	504	National Semiconductors, USA
Displays		
Light Emitting diodes (0.3")	504	i) Litronix, USA ii) Monsanto, USA
Transistoes & Diodes	336	
Resistances, capacitances and potentiometers	840	

Electronic Hardware: i) Transistors ii) Terminals iii) Knobs iv) Fuses v) PCBs	1344	Local Suppliers
Fan	1500	ECIL, Hyderabad, India
Others i) Counter ii) Micrometer Spindle iii) Sample Holders iv) Light Control Assembly v) Miscellaneous	6000	
Total:	$ 20142	(including wastage allowance)

SPECTROPHOTOMETER -UV TYPE

Lamp i) Tungsten ii) Deuterium	5000	
Plane Mirror Concave Mirror	2000	
Grating (600-1200 lines/mm)	15000	
Electronics		
FET Operational amplifier	1344	
Photomultiplier Tubes	4200	
Digital ICs	1344	
General purpose Operational Amplifiers and voltage Regulators	604	
HV Transistors, General Purpose Transistors Zener diodes	1512	
Pots, Trimpots	504	
Resistance (high, valuc, highly stable, general purpose), condensers etc.	3360	
Band Switches	1008	
Electronic Hardware i.e. Knobs, convertors etc.	3700	
OTHERS		
Wavelength scale Slit scale, TA scale, Null Meter etc.	8000	
Total	47656	Including wastage allowance

TOTAL COMPONENTS REQUIRED

	1st year	2nd year	3rd year	4th year	5th year
Flame Photometer	17,950	35,900	67,312	76,288	87,750
Spectro-colorimeter	60,426	120,852	201,420	302,130	362,556
Spectrophotometer - UV Type	-	-	47,656	71,484	119,140
Total:	$ 80,376	$ 156,752	$316,388	$ 449,902	$ 569,446

D. Plant and machinery

While recommending plant, machinery and equipment, it has been felt that maximum amount of production takes place locally, so that the dependence on outside resources is minimal.

Though most of the plant, machinery and other equipment proposed has been given in three phases, its utilisation may not be adequate in the 1st year when the production would be comparatively at a lower level. However, the possession of machinery at this level is bound to prove beneficial to the undertaking as the workers and the staff will get acclimatised to its use and this will not, therefore, present any problem from the 3rd year onwards when the production is geared up. Further, the plant and machinery has been proposed assuming that the plant would go into two shift operation from the 2nd year onwards. This would ensure greater utilisation of resources and more economical plant operation.

Table 2. Plant and machinery

3.1 SHOPS Machinery	ADDITIONAL 1st year Qty.	Approx. Value $	Make/ Type	2nd year Qty.	Approx. Value $	Make/ type	3rd year Qty.	Approx. Value $	Make/ Type	4th year Qty.	Approx. Value $	Make/ Type	5th year Qty.	Approx. Value $	Make/ Type
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Lathe M/c	3	11000	PTC-2 HMT H-22-1	1	2500	PTC-1	1	5000	HMT-IB-17	-	-	-	2	8500	HMT-1 Kirloskar -1
Milling M/c	2	22000	Universal-T Milling M/c HMT-1 FN-2(HMT)-1	1	10000	HMT-M-ITR1		12000	HMT	-	-	-	2	20000	M-ITR-HMT-1 FN-2 - 1
Precision Milling M/	1	15000	HMT Type	-	-	-	1	15000	HMT Type	-	-	-	-	-	-
Drilling M/c	2	1400	-	1	700		2	1400		-	-	-	1	700	-
Sheet Metal M/cs		2500			3000			4000		-	-	-		3000	
Electrically operated sheaving M/c	-	-	-	1	5000		-	-	-	1	6000		-	-	-
Surface Finishing equipment	-	3000			5000	-	-	-	-		7000	-	-	-	-
Fibre Glass Moulding Equip.		2500			3500			5000			-				5000
Foundry & Pattern making		3500			-			5000			-				6000
Plastic Moulding Equipment Ind. Die making		3000			-			5000			4000				
Misc. Tools like Drills, Taps, files, Cutters etc.		5000			3000			6000			2000				5000
Welding set (Arc & Gas)		1000			-			2500							
		69900			32700			60900			19000				48200

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ELECTRONICS ASSEMBLY AND TEST EQUIPMENT

Name of equipment	No. of units (Accumulated)
Storage Scope	2
Low level differential input Tektronix scope	1
Digital LCR Bridge (.01% accuracy)	3
Oscilloscope Philips dc to 15 MHz	12
Philips Double Beam	3
Single Channel AC-DC Recorder	5
Set of filters of Wavelengths & Standards	
Function Generator	2
Pulse Generator	5
Digital Multimeter 3½ Digit	6
Oscillator	2
Mains Voltage Stabilizer	18
Attenuator	1
HV Power Supply (0-300)	2
Power Supplies (0-15V,10A)	2
Power Supplies (0-30V,1A)	19
AVO Meters	30
Variac	8
	TOTAL:

Average rate Per unit $	Additional capital requirement in US $ 1 yr.	2 yr.	3 yr.	4yr.	5yr.
6000	6000	-	6000	-	-
3500	3500	-	-	-	-
2500	5000	-	2500	-	-
1200	6000	-	4800	-	3600
2000	2000	-	2000	-	2000
2000	4000	-	4000	-	2000
2000	2000	-	-	-	-
1000	1000	-	1000	-	-
600	1200	-	600	-	1200
500	1000	-	2000	-	-
500	500	-	500	-	-
400	4000	-	1600	-	1600
300	300	-	-	-	-
200	400	-	-	-	-
200	200	-	200	-	-
150	450	-	900	-	1500
125	1250	-	1250	-	1250
25	100	-	50	-	50
	38900	-	27400	-	13200

PCB SECTION

Name of equipment	No. of units	Price per unit $	Requirements* over the 1st year $	Indian source	Foreign source
Drafting Section					
Layout table 36" x 40"	1	450.00	450.00	M/s Monotype Corpn., Asafali Road, New Delhi	M/s Bishop Graphic Inc., 5388, Stirling Centre Driv PO Box 5007, West Lake Vil
Magnifier 5x	2	15.00	30.00	-do-	-do-
-do- 10x	1	15.00	15.00	-d8-	-do-
Mylre Sheets 18 x 24	10	12.75	127.50	-do-	-do-
Grid Sheet 18 x 24	10	12.75	127.50	-	-do-
Accuscales 1mm (.39") 36"x1x	1	21.24	21.24	-	-do-
18"x1x	1	21.24	21.24	-	-do-
Metric 100 0 & 500 mm 36" x 4x	1	25.50	25.50	-	-do-
Electronic Puppets 2x Kit	5	21.50	127.50	-	-do-
Plastic Rolls in different colours & sizes	100		425.00	-	-do-
Co-ordinatograph Universal Plating machine (Aristo type 4438)	1	8500.00	8500.00	-	M/s Dennert & Tape Aristo Werek Hamburg.
Rotcuching Desk	1	600.00	600.00	M/s Monotype Corpn. New Delhi	
CAMERA SECTION					
Process Camera 16" x 20" or 20"x24" Darkroom type with 10" lens	1	7200.00	7200.00	-do-	-
Contact Printing cabinet with single point light source	1	600.00	600.00	-do-	-

Name of equipment	No. of units	Price per unit $
Air Conditioning Plant	2	800.00
Arc Lamp35 Amp	1	650.00
Printing down freme motorised table model	1	1500.00
Whirler	1	450.00
Ultrasonic Cleaner	1	3500.00
Practice high speed drilling Machine 0-45000 RPM with overhead probes and standards	1	2975.00
Plating equipment	1	5000.00
Silk Screne Printing Machine	1	6375.00
Etching Machine Horizontal	2	750.00
	TOTAL	

* nothing is required subsequently.

Requirement over 1st year. $	Indian Source	Foreign Source
1600.00	M/s Voltas Ltd., New Delhi	-
650.00	M/s Monotype Corpn.	-
1500.00	-do-	-
450.00	-do-	-
3500.00	M/s Imeo Bombay	-
2975.00	-	M/s Unit Process Assemblie Inc., 60 OAK, Drives, Syosset, New York - 11791.
5000.00	M/s Graves & Neil (I) Ltd., Sukh Sagar, S.Parkar Marg, Bombay	
6375.00	-	-
1500.00	M/s Monotype Corpn.	
52020.48		

Name of equipment	Brief Specifications	Cost per unit $	Total requirements $ 1 yr.	2 year	3 yr.	4yr.	5yr.	Source
Dry Heat, Cold & Damp Heat Equipment	-70 to $+80^{\circ}C$ 20% to 95% RH, Temp. Constancy $\pm 2^{\circ}C$ Humidity Constancy $\pm$ 3% RH	5000	5000				-	i) Hostex Products Ltd., Bombay ii) Vostch, West Germany iii) Kasinath & Co. iv) Consolidated Elect.Ind,Banga v) Vijay Laxmi Ind., Bangalore
Vibration Test Equipment	Sinewave 5Hz to 3K Hz Capacity 20Kg	5000	5000		-		-	i) Gilmore Ind. Inc., USA ii) Ling Dinamic Systems, UK iii) Environmental Equipments Ltd. England iv) M.B. Electronics,USA
Mould Growth Test Equipments	0 to $+50^{\circ}C$ RH 90% to 98%	500	-		500		-	i) Consolidated Electric Ind., Bangalore ii) Kasi Nath & Co.
Salt Spray Equipment	Ambient to $50^{\circ}C$, 98% to 100% RH, Spray pressure 0-843 to 1.265Kg per cm.	4000	-		4000		-	-do-
Dust Test Equipment	Ambient to $60^{\circ}C$	2000	-		2000		-	i) Kasi Nath & Co. ii) Vijay Laxmi Ind., Bangalore
Thermal Shock Test Equipment		7500	-		7500		-	Tenney Engg. Inc., USA
Bump Test Equipment	Capacity 110Kg	5000	-		5000		-	Consolidated Elec.Ind.,Bangalo
Altitude Measuring Equip.	$-65^{\circ}C$ to $+100^{\circ}C$ Altitude upto 1,50,000ft.	8000	-		-		8000	Vostch, West Germany
Mechanical Shock Test Equipment	Max. Capacity 200 lb. Max. B = 3000, 0.52 to 25 ms. pulse duration	5000	-		-		5000	AVCO Electronics, USA
Solar Radiation Test Equipment		3000	-		-		3000	Standard Cabinet Co., USA
Hermetic Sealing Equipment		3000	-		-		3000	VEECO, USA
	TOTAL	18000		-	19000	-	19000	

E. Land, building and services

The land has been assumed to be gifted and hence no cost towards it has been considered.

In order to cut down on the gestation lag in undertaking production operations, it has been assumed that either some building would be available or some workshop like structure would be erected in a very little time. The building requirement has been asked for in two phases; in the begining of the first year and then some times towards the end of 2nd year or beginning of third year when 45% of the capacity is expected to be reached.

As the building gets completed, the corres-pondening services have immediately been planned so that the building gets operational the earliest.

			Additional		
	Iyr.	IIyr.	IIIyr.	IVyr.	Vyr.
Land Requirements	12000 sq.m. Gifted	-	-	-	-
Building Requirements:					
(Approx. cost of construction @ 200 per sq. meter)					
Administrative block	300 sq.m.	-	100 sq.m.	-	-
Electronics Assembly & test section(inclu-ding Quality Control Section, Stores etc.)	600 "	-	600 "	-	-
Optics Assembby & test Section	200 "	-	200 "	-	-
Workshop Floor Section (includi-ing turning, milling, fitting assembly & sheet metal patern making & foundry, surface finishing & fibre glass moulding Section, tools & die stores, equipment stores etc.)	500 "	-	400 "	-	-
PCB Section	80 "	-	-	-	-

	Ist yr.	II yr.	III yr.	iv yr.	v yr.
Environmental test section	60 sq. m	-	40 sq.m.	-	-
Other building requirements like Corridors, Toilets, canteen resting room etc.	160 "	-	100 "	-	-
Total:	1,900 Sq.m.	-	1,440 sq.m.	-	-
Total cost of construction in $	3,80,000/-	-	2,88,000/-	-	-

<u>Services:</u>

	Ist yr.	II yr.	III yr.	iv yr.	v yr.
Foundations for Machines & Electrical Installations (including transformer circuit breaker, cables etc.)	20000	-	6000	-9	-
Vehicles	20000	-	7500	-	-
Office Equipment	5000	-	1500	-	-
Furniture & Fixtures	5000	-	3750	-	2500
Water Supply Equipments	3000	-	1500	-	-
Intercommunication system	2000	-	750	-	-
Architectural services	20000	-	1025	-	-
Fire Extinguishers	1000	-	750	-	-
Total	76000	-	32,775	-	2500

Manufacturing Phasing

The project is proposed to be phased out into four phases keep8ng in view thevarious activities, availability of machines, procurement of raw materials, training of

Items	Phase I One yr.	Phase II two yr.	Phase III three yr.	Phase IV One yr.
1. Decision of installing the plant	✓			
2. Collaboration agreement is signed and decision on source of technical know-how	✓			
3. Project engineering Report is prepared	✓			
4. Building and Civil Engineering details are worked out and construction begins.	✓			
5. Plant, machinery & Equipment for Phase II, i.e. for first year production is ordered.	✓			
6. Procurement of RM and components for Phase II i.e. First year of production.	✓			
7. Steps initiated to recruit staff and workers for first and second year of production.	✓			
8. Steps undertaken to initiate double shift operation for the 2nd year of phase II.		✓		

Items	Phase I One year	Phase II Two yrs.	Phase III 2 yrs.	Phase Iv one yr.
9. Initiate steps to introduce spectro-photometer UV type in the phase III		✓		
10. Extension of building for phase III begins.		✓		
11. Procurement of Plant, machinery and equipment for phase III		✓		
12. Procurement of RM & components for phase III production, identification of alternate sources etc.		✓		
13. Steps to initiate recruitment of staff and workers of Phase III and their training.		✓		
14. Repeat steps from (11-13) above for raising production capacity to 80% during phase IV.			✓	
15. Attain 80% production capacity.				✓

F. Financial analysis

Total fixed Investment, Working Capital and Sources of Finance

Capital Cost of the Project

First Year:	Physical Aspect	Value $	
1. Land	12000 sq.metres	-	(Gifted)
2. Building	1900 sq.meteres		3,80,000
3. Plant & Machinery			
3.1 Workshops		69,900	
3.2 Electronics Assembly & Test Equipment		38,900	
3.3 PCB Section		52,020	
3.4 Environmental Tests & Analysis section		10,000	170820
4. Other fixed assets (including services)			
4.1 Foundations & Electrical Installations		20,000	
4.2 Vehicles		20,000	
4.3 Cffice Equipment		5,000	
4.4 Furniture & fixtures		5,000	
4.5 Water Supply equipment		3,000	
4.6 Intercommunication services		2,000	
4.7 Architectural services		20,000	
4.8 Fire Extinguishers, etc.		1,000	
			76,000
5. Technical know-how fees			24,000
Grand Total			6,50,000

Additional Capital Required

	Second yr.	Third yr.	Fourth yr.	Fifth yr.
Land	-	-	-	-
Building	-	288000 sq.mt.s	-	-
Plant & Machinery	32700	107300	19000	80400
Other fixed assets (incl.Services)	-	32775		2500
Technical know-how Fees	30000			
Total	32700	458075	19000	82900

Additional capital requirement for 2nd year, 3rd year 4th year and 5th year = $ 592675

Working Capital Requirements

	I	II	III	IV	V
1. Raw materials 3 months	6548	13845	24583	35843	42148
2. Components 3 months	22094	39188	79097	112476	142361
3. Direct labour 1 month	3020	5507	8598	10118	13349
4. Administrative & Marketing Selling overhead one month	7755	11200	18705	21636	26290
5. Advertising & Publicity one month	249	498	1011	1443	1837
6. Power & fuel one month	374	748	1517	2164	2755
7. Repair & maintenance one month	377	382	975	978	998
Total:	40,417	71,368	1 134,486	1 184,658	2 229,758

Sources of Finance

Capital of the company (Owner's Equity)	$ 650820	$ 32700	$ 458075	$19000 $ 82900 = 1243495
Short term loans (working capital)	$ 40417	$ 71368	$ 134485	$184658 $229738

	Ist Year
Gross sales Turnover	
i) Flame photometor	65,000
ii) Spectrocolorimeter	2,34,000
iii) Spectrophotometer -UV type	-
Total:	299000
LESS :	
Cost of goods sold	
i) Raw materials	26190
ii) Components	88376
iii) Direct labour	36240
TOTAL:	150806
EQUALS GROSS MARGIN	148198

2nd year	3rd year	4th year	5th year
130000	243750	276250	325000
468000	780000	1170000	1404000
-	190000	285000	475000
590000	1213750	1731250	2204000
55380	98330	143370	169590
156752	316388	449902	559446
66034	103172	121410	160190
278216	517890	714682	898224
319784	695860	1016568	1305774

	Ist year
LESS : OPERATING EXPENSES	
i) Administrative marketing & other over-heads	93060
ii) Advertising & Publicity*	5980
iii) Packing & Forwarding**	29900
iv) Power & Fuel	6700
v) Repair & Maintenance***	7740
vi) Staff welfare Expenses ****	9306
Total:	152696
EQUALS OPERATING PROFIT Before interest & depreciation	(-)4492
Less	
Interest *****	6603
Depreciation******	
i) Building	10450
ii) Plant & Machinery	17080
Insurances & other local taxes*******	14950
Total:	4983
EQUALS	
NET INCOME (-)	53575

Parkword's retrun on overall (-117.9)x assets (also equal to rate of (.459) return) = $\frac{\text{Net income}}{\text{Sales}}$ x $\frac{\text{Sales}}{\text{Assets}}$ =

2nd year	3rd year	4th year	5th year
134406	224466	259634	315476
11960	24274	34624	44080
59800	121375	163125	220400
13450	27300	38940	49590
8250	20240	20810	23260
13440	22446	25963	31547
241306	440101	553096	684353
73478	255759	463472	521421
10705	20173	27699	34461
10188	17680	17233	16870
18624	27492	26642	32000
29900	60687	66562	110200
69417	126032	158141	193531
$\frac{9061}{(1.5)\times(.875)}$	$\frac{129727}{(10.7)\times(1.065)}$	$\frac{305331}{(17.6)\times(1.491)}$	$\frac{427890}{(19.4)\times1.772)}$
1.3%	= 11.37%	= 26.25%	= 34.30%

NOTES

* Through the Company will have complete monopoly for its products and, therefore, no special advertising or promotional compaigns may be required. However, to build customer awareness, it is suggested that the company spends at least 2% of its sales volume on advetising and publicity.

** Packing and forwarding expenses: Recommended at 10% of the total sales volume.

*** Repair and maintenance: Building: 1% of total buildings value in the first two years and 1.5% subsequently.

Plant & Machinery: 2% of total plant and machinery value in the first two years and 3.0% subsequently.

**** Staff welfare expenses: 10% of Administrative, marketing and other overheads.

***** Interest on working capital: 15%

****** Depreciation: Buildings - 2 1/2% on written down value Plant & Machinery - 10% on written down value

******* Insurance and other local taxes - 5% of the sales volume.

G. Feasibility analysis

i) The capacity ratings have been based on the estimated demand of Spectro-Colorimaters, Flame photometers and UV type in the Arab countries. The demand has been established on the basis of the survey conducted by consulants who worked for the project under UNIDO assignement.

ii) The build-up of the capacity is estimated at around 15%, 25%, 45%, 65% and around 80% in the first second, third, fourth and fifth years respectively. The infrastructure is such that it would meet production requirement for the next decade with slight additions when the figures are likely to be 2.6 times the present estimated demand.

iii) The cost estimates for various raw materials and components have been taken for 100 pieces and are based on their prevailing actual costs. This would not only ensure some price advantages but would also take into account the minor fluctuations in their prices.

iv) The cost of direct labour has been computed in direct proportion to the capacity utilisation. It implies that the technical staff strength increases as the capacity is built up.

v) Most of the indirect staff comprising of administrative, marketing and accounts section staff are assumed to be recruited in the first year itself. However, adequate care has been taken to augment it as and when the capacity increases. The annual increase in their salaries has been taken at 10%

vi) The most interesting feature about the entire proposal is the growth in ratio of net income to sales and sales to assets; both of which lead to the overall return on investment. While the sales to assets ratio, increases from 0.459 to 1.772 thereby implying a regular growth in sales generating capacity of assets, the net income to sales has risen from 17.9% to 19.4% implying regular growth in the profitability of its operations. The overall return works out around 34% in the fifth year and this compares well with similar industries in India.

H. Recommendations

i) The techno-economic analysis conducted for the manufacture of Spectro-Colorimeters. Flame Photometer and Spectro-photometers - UV type is financially sound and can therefore, be implemented.

ii) Since the construction of buildings, and other civil engineering details takes time, it is recommended that the production may be started in some rented building. This would also cut on the gestation lag considerably.

iii) The recommended capacity utilization is approximately 15% in the first year, around 25% in the second year, around 45% in the third year, around 65% in the fourth year, and around 80% in the fifth year of the yearly annual demand.

iv) In order to assure maximum level of production locally it is recommended that the production facilities be created as soon as possible. This will cut down on trial production runs and training time of the workers and staff.

v) In order to assume greater utilization of assets, it is recommended that the plant goes into second shift operation from the 2nd year onwards.

vi) The electronic and optics components have been recommended for procurement outside. These could, however, continue to be bought out till production facilities are set up to produce these components locally.

vii) The manufacturing units would require a very efficient and organised sales set up. The sales could be undertaken initially through established distributors till the company builds up its own sales force to meet the requisite demand.

Viii) It is also recommended that the services of senior level expert on analytical instrumentation and management consultant be requisitioned for planning the project in detail. training of staff and in transfer of technology, at the time of implementation.

I. Conclusions

The Industrial Profile on manufacture of Spectrocolorimeters, Flame Photometers and Spectrophotometers-UV type has met the following objectives broadly.

a) Description of the proposal in details:

b) General assessment whether the proposal is prima facie feasible;

c) Determination of the resources and inputs required in broad terms.

With its established feasibility it is expected that the project wouodld be implcmented soon.

XXV. INDUSTRIAL PROFILE ON BALANCES

A. Market demand potential

According to a survey, the present annual demand for all types of balances in the concerned Arab States is around 11,000 pieces. With the improvement in health services and with the establishment of new hospitals, the minimum projected demand for balances after a decade would be 28,500 balances. This indicates a growth rate of 10% every year thereby yielding a growth of 2.6 times of the present demand.

B. Outline of technology

It is a precision instrument for weighing accuratly different substances in laboratories. In medical applicati the balances are required for weighing adults, restless infants and young children. In addition the table balances and analytical balances are required for weighing small substances even upto 0.1 mgm in the different laboratories.

Body weight change is an extremely important parameter of body composition in clinical studies, particularly those concerned with the estimation of protein and energy utilization and the assessment of human requirement. For metabolic research requirements, the type of balance should be of high performance and should be able to resolve 10 gms in 100 kilograms. Keeping in view the different types of medical requirements, four models have been suggested for production.

Three models of electronic balances using digital display and the fourth one for very high resolution, one pan auto-mechanical type has been suggested for production.

Technology.

With the spectacular advances in semi-conductor technology the cost of digital I.C. has gone down tremendously. It is now feasible to design an electronic balance which is much better in accuracy, resolution and easy to operate as compared to mechanical balances. The cost of electroni balances is also comparable with the mechanical balances. For weighing with mechanical balances one has to place several weights on the pan, proportion to the weight of an object to be measured, until the balance restores to its null position. While in digital balances all operation are automatically performed, and the weight measuring is finished instantaneously with a high precision.

Precision strain gage type transducers are used to sense the total weight. Load cells are electronic transducers that translate changes in weight into change in voltage which produces in the readout instrument, a repeatable indication that is calibrated directly in terms of the load applied to the cell. Hermetically sealed within the load cell are one or more sets of matched straingages bonded to magnoflux - tested high strength steel element, machined to close toleranaces The strain gages are electronically connected to form a balanced wheat-stone bridge with additional compensation resistor in the circuit to maintain the accuracy of the bridge over a wide range of temperature.

The principle of operation depends upon deflection of the strain gage filament, creating a change in its resistance, thereby unbalancing the bridge circuit. As a result, for a given input voltage excitation, the output voltage of the bridge varies proportionally with the load, and this change is indicated on the associated instrument.

The out-put of the transducer is amplified, converted in to digital form and the unknown weight is displayed in digital form with automatic decimal positioning. The design of electronic balances should make use of LSI Technology and LED displaye The mechanical balance should be optically aligned for better sensitivity.

C. Proposed models and production phasing

Four different types of balances have been suggested for production. The first three types are electronic digital type and fourth one is mechanical type.

MODEL 1.

Low cost table type having resolution of 1 gm and 10 gms for general purpose and for weighing infants.

MODEL II

Digital type having measurement capability in 10^4 usefull for weighing adults.

MODEL III

Precision type having resolution 1 Omgm and four & a half digital display.

MODEL IV

Single pan mechanical type having resolution 0.01 mgm.

(i) Specifications

Model I.

Ranges	:-	Two ranges full scale 1 Kg and 10 Kg.
Resolution	:-	1 gm and 10 gms on two different ranges
Display	:-	3 digit L.E.D.
Sensor	:-	Load Cell
Accuracy	:-	2 gms
Supply	:-	Mains
Zero Adjus-ment		Automatic.

MODEL II.

Measuring Ranges	:Full scale 100 kgm.
Resolution	: 10 gms.
Display	: $4\frac{1}{2}$ digits L.E.D.
Sensor	: Load Cell

Accuracy	:-	10 gms.
Supply	:-	Mains
Code	:-	B.C.D.
Zero Adjustment	:-	Automatic

MODEL III.

Measuring Range	:-	Full range 20 gms.
Resolution	:-	1 mgm
Display	:-	4½ digits L.E.D.
Sensor	:-	Special load cell
Accuracy	:-	1 mgm.
Linearity	:-	0.1%
Code	:-	B.C.D.
Zero Adjustment	:-	Automatic
Measurement time	:-	0.5 Sec.
Power	:-	Mains.

MODEL IV.

Resolution	:-	.01 mg.
Display	:-	Mechanical digits for weight upto 100 gms and 100 mgm and optical graduation for weight below 100 mgm.
Accuracy	:-	± .0001 gm.
Max. Measuring Capacity	:-	100 gms.
Zero adjustment	:-	Optical
Readibility by vernier		0.1 mgm.
Built in weights	:-	0.1 - 99.9 gms.
Beam	:-	Special aluminium alloy.
Knife edge & Bearings	:-	Agate
Pan & Weights	:-	Non-magnetic stainless steel.
Projection Lamp	:-	Low voltage.
Supply	:-	Mains.

(ii) PRODUCTION PHASES

The production of four type of balances has been proposed 11,000 pcs. The production facilities required for the mechanical type of balances are very exhaustive. The production of mechanical type requires very good facilities for fabrication of dies, dust proof rooms, highly temp. controlled rooms and precision workshop facilities. To create this type of infrastructure, a lot of time is required. Therefore, it has been suggested that in the first and second year all components of mechanical balance may be imported and only the assembly should be made in the factory. A proposed phased programme is given as below:-

MODELS	Ist year	II year	IIIrd year	IV year	V yea
Model I	1,000	2,000	3,000	4,000	4,000
Model II	500	1,000	1,500	2,000	2,000
Model III	500	1,000	1,500	2,000	2,000
Model IV	100	500	1,500	2,500	3,000
% Rated production	18%	40%	67%	95%	10[illegible]

D. Sources of know-how and foreign assistance

It is suggested that the know how, on one time transfer basis should be purchased. Once the latest and needful technology is brought, future modifications should be made through local R&D. This approach eventually creates a technical base, reduces lead time and leads to self-reliance. The know how of balances is available in Switzerland, Japan, U.S.A., German Democratic Republic and India.

For initial training and expert advice, it is suggested that atleast 6 engineers/technicians of Egypt should be trained from where the know how has to purchased. The duration of training should be from 3 to 6 months. The training should be detailed one in design and practical aspects-covering design, assembly, testing, quality control and specification and source of components and raw materials, type of space requirements, the details of different dies etc. It is further suggested that a provision for two experts should be made, one expert of electronic and the other of fine-mechanism, each for three of electronic and the other of fine-mechanism, each for three months period at the begining of the project and again for three months after one year. The renumeration of the experts should be $ 150 per day and free furnished accomodation. In addition if the suggested supervisory staff and technicians are not available. They should also be engaged from the appropriate agency for a period of more than twelve months. The salary of these personnel should be $ 800 and $ 500 p.m. respectively. A few important sources of know how are given below:-

1. Mettler.
   E.Mettler
   Plikanstrasse, 19
   Zurich
   SWITZERLAND.

2. Shinko Denshi Co. Ltd.,
   9-11, Yushima, 3-Chome,
   Bunkyo-Ku,
   Tokyo,
   JAPAN.

3. Carl Schenck Maschinen fabrik GmbH
D-61, Darmstadt,
Postfach, 4018
German Democratic Republic

4. Adair Dutt & Co. (India) Pvt. Ltd.,
21, Asaf Ali Road,
New Delhi-110001.
INDIA

5. Keroy (Pvt.) Ltd.,
32, Latafat Hussain Lane,
CALCUTTA-10
INDIA

E. Organizational set-up and manpower

The production of balances involves multi dispciplanary facilities. The production shop should have electronic, mechanical and optical assembly units. The mechanical shop requires the high degree of sophistication and precision and should have very good die and moulding section. The optics requirement are only for alighning the scale, to increase the sensitivity. It has been suggeste that optical components may be purchased from other units.

In addition meterology section should be provided to standardise weights and other precision mechanical components

The complete set up could be shown under five groups headed by the M.D.

1. Research and development and training.
2. Production.
3. Quality Control and Metrology.
4. Marketing, Servicing and documentation,
5. Administration.

Total Staff = 145

MANPOWER

R & D Training

G.M. (General Manager)

Electronics.		Mechanical/Industrial Engg.		Training	
S.Engineer	2	Manager	1	S. Engineer	1
Engineers	1	S.Engineers	2	Engineers	1
Tech. Asstt.	2	Engineers	2	Tech. Asstt.	2
Technicians	3	Technicians	4	Technicians	2

PRODUCTION

G.M. (General Manager)

Electronic		Mechanical		Final Assembly & Testing Inspection.	
Manager	1	Manager	1	Manager	1
Engineer.		Deputy/Asstt.	2	Engineers	2
Supervisors	4	Managers Engineers	6	Supervisors	
Tech. Asstts.	2	Supervisors		Tech. Asstts.	4
Technicians	8	Tech. Asstt.	10	Technicians.	5
		Technicians	22		

(10.a)

Quality Control & Metrology

Quality Control

Manager	1
S. Engineer	2
Engineer/Supervisor	2
Tech. Asstt.	4
Technicians	4

Marketing, Service & Documentation.

Manager	1
Deputy/Astt. Manager	1
S.Engineer	2
Engineer/Supervisor	3
Technical Asstt.	4
Technicians	2

Administration

Administrative Officer	1
Stores/Purchase Officer	1
Accounts Officer	1
Assistants.	4
Clerks	8
Security Staff	8

Manpower and qualification requirements

Post	Qualification & Experience
1. Managing Director	B.E. Electronics/Mechanical 15 years experience in design, development & production of Elec[illegible] mechanical instruments. The selected person shoudd have [illegible] least 5 years experience of inde[illegible] dently handling charge of R&D production.
2. General Manager	B.E. Electronics/Mechanical 10 years experience in the line.
3. Manager	B.E. electronics/Mechanical M.Sc. 5 years experience in the line.
4. Deputy/Asstt.Manager/ Sr.Engineers.	B.E. Electronics/Mechanical, M.Sc 2 years experience in the line.
5. Engineer/Supervisor	Diaploma in electronic/mechanical 5 years experience in the line.
6. Technical Asstt.	Diploma in Electronic/Mechanical 2 years experience in the line.
7. Technicians	ITI Certificates in the trade.
8. Administrative Officer.	M.Sc./MA/M.B.A. 10 years administrative experience in a reputed Firm.
9. Purchase/Accounts Officer	B.Sc./B.A. 5 years experience in the line.
10. Asstt.	B.A. with 2 years experience in th line.
11. Clerks.	B.A./High School with 5 years experience in the line.
12. Security Staff	Literate persons preferablly, retired army personnel with stout physique.

F. Raw materials and components

Raw material	Source	Quantity Model I	Quantity Model II	Quantity Model III	App. Total cost in $ Model I	App. Total cost in $ Model II	App. Total cost in $ Model III
1. F.E.T. Operational Amplifier	U.S.A.	1	1	1	1.2	3.5	5.5
2. L.S.I. & Load cells – 3 digits for model I. 4 digits for model II 4½ digits for model III.	U.S.A.	1	1	1	10.00	15.0	20.00
3. T.T.L. ICs.	U.S.A. U.K.	4	8	10	1.6	3.4	4.2
4. Linear I.C's & Regulators	U.S.A. U.K.	3	5	6	1.8	3.0	3.6
5. Transistors Diodes & Zener Diodes	U.K. INDIA	12	28	36	2.4	9.6	12.8
6. L.E.D's	U.S.A.	3	4	5	4.5	6.0	7.5
7. Band Switch	INDIA	2	5	4	1.8	3.2	4.6
8. Posts.	U.K. INDIA UK.	2	4	4	1.4	3.8	3.8
9. Hardware including knobs etc.	Locally available or to be fabricated in production shop.	-	-	-	5.6	6.0	6.0
10. P.C.B.	-do-	1	2	2	4.0	9.0	12.0
11. Chassis including painting & Electro Plating	-do-	-	-	-	6.0	6.0	7.0
12. Container	INDIA	1	1	1	2.0	3.0	3.0
Total cost of raw material imported					24.70	47.5	61.0
Procurement charges on imported raw material 10%					2.47	4.75	6.10
Duty 2%					.50	.95	1.32
Total cost of raw material locally available					15.6	21.0	25.0
Procurement charges of raw material locally available 10%					1.56	2.10	2.5
Grand Total					44.83	76.30	95.92

The list of the components is based on the assumption that the design of electronic balance will be based on LSI technology and will make use of LED display.

Raw Material for Model IV

S.No.	Raw material	Source	Quantity	App. Cost in $
1.	Pan	India, USA, German	1	5.0
2.	Pan Support	German, India, USA	1	3.0
3.	Beam	-do-	1	12.0
4.	Pan break	-do-	1	1.5
5.	Forked Pointer	-do-	1	0.9
6.	Taring Disk	-do-	1	3.0
7.	Height Setting Knobs	-do-	1	6.5
8;	Arrestment lever	-do-	1	4.8
9.	Damping Pot	-do-	1	2.1
10.	Guide	-do-	1	0.8
11.	Mounting Optical Assembly	-do-	1	13.5
12.	Weights	-do-	Complete set	10.3
13.	Cabinet	-do-	1	22.0
24.	Adjusting Zero Point Mechanism	-do-	1	8.3
15.	Graticule	-do-	1	5.5
16.	Focussing lens	-do-	1	4.5
17.	Condensors	-do-	1	3.8
18.	Prism	-do-	1	2.7
19.	Lamp	-do-	1	1.5
20.	Calibrated Scale	-do-	1	3.6

Total cost of the raw material	$ 115.7
Procurement charges 10%	$ 11.57
Duty 2%	$ 2.31
Total:	$ 129.58

Raw material used for mechanical assembly is made from stainless steel or hardened steel where as optical assembly is made from good quality optical glass. The optical components will be purchased from outside sources.

G. Plant and machinery

1. For R and D unit, quality control and training

Name of the Instrument	Number required	Source	Unit cost in $US	Total cost in $US
Oscilloscope double trace DC-15 MHz including plug-in unit for transistor curve tracer.	3	USA, UK, India	400	1200
Digital Multimeter 5½ digit	1	USA, UK	800	800
Digital Balance of 1mg. resolution or better.	1	USA, Germany, Japan	400	400
RCL Bridge 1%	2	UK, India	300	600
Transistor Tester	2	UK, India	225	450
IC Tester	2	USA, India	450	900
Regulated Power supplies	8	UK, India	100	800
Multimeter/AVO	6	UK, India	120	720
AC Stabilizer 1KW	3	UK, India	300	900
Variac 5 Amp.	2	India	50	100
Sine/Square Oscillator 1MHz	1	UK, India	175	175
Component comparator	1	UK, India	350	350
Insulation Tester	1	India	150	150
Q meter	1	UK	600	600
Prico meter	1	USA	800	800
Power meter	1	USA	150	150
Weighing Machine	1	UK, Japan	150	150
X, Y Recorder	1	USA, UK	1500	1500
Universal measuring machine	1	- Switzerland	18000	18000
Function Generator	1	USA, UK, India	250	250
Calibrator	1	USA	3200	3200
Simulator	2	to be fabricated in R&D section	200	400 (raw material cost
Electrolytic condensor tester	1	UK, India	600	600
Oven Temperature controlled 0-100°C	1	UK, India	1200	1200

Analytical Balance resolution 0.01 mg. or better	1	Switzerland	1400	1400
		Total		36,295
		Procurement charges 10%		3,629
		Duty 10%		3,629
				$ 43,553

2. Production Unit

Multimeter	12	UK, India	1440	1440
AC Voltage Stabilizer 2KW	6	UK, India	400	2400
Variacs	8	UK, India	50	400
RCL Bridge 1%	2	UK, India	300	600
Digital Multimeter 4½ digit	1	UK, USA	450	450
Logical probe	4	USA, India	80	320
Pulse Generator 1MHz	2	UK, India	250	500
Battery Charger	1	-do-	150	150
Insulation Tester	1	-do-	100	100
Special tester	4	To be fabricated in R&D Unit	200	800 (Material cost only)
Transformer Winding M/c	2	UK, India	600	1200
Dip Soldering system medium	1	USA	12000	12000
Oscilloscope Single beam DC-10MHz	3	India		1400
Regulated Power supplies packs 5 volts & 6 volts	16	India	50	800
		Total		22,560
		Procurement charges 10%		2,256
		Duty 10%		2,256
				$ 26,772

Service kit for service engineers which involves voltage simulator, multitest kit, tools and precision tools.	6	USA, UK	900	5400
		Procurement charges 10%		540
		Duty 10%		540
				$ 6480
Special general purpose tools				6000
		Procurement charges 15%		900
		Duty 10%		600
				7500
		Total cost of electronic equipment		84305

3. Precision machines

Milling Machine	1	Switzerland	7000
Drilling Machine	2	-do-	2200
Lathe with one meter bed and 40mm swing over the bed.	1	-do-	5200
Power Press 5 tons	1	-do-	17400
Surface Grinder (hydraulic)	1	-do-	8200
Diaform attachment	1	-do-	4900
Electric Discharge Machine for Dia making	1	-do-	48000
		Total	90,900
		Procurement charges 10%	9,090
		Duty 10%	9,090
			109,080

4. workshop machinery

Centre lathe with milling and other attachments	1	India	8000
Shaping machine	1	-do-	2800
Multi-speed bench drill machine 1/4" capacity 1/2" capacity	1+1	-do-	800
Double Pillar screw type press	1	-do-	900
Power Press	1	-do-	2200
Gellotin Shaping Machine	1	-do-	2200
Surface Grinding Machine	1	-do-	1300
Motorised hacksaw machine	1	-do-	1400
Production and hand tools			
a) Die head	1		
b) Slice turret	1		
c) Anti-vibration mounts	5		
d) Tail stock turret	2		
e) Vertical indexing attachment	1		
f) Pneumatic rivetting hammers	1		
g) Pneumatic tapping M/c	1	-do-	2300
Surface finishing equipment	1	-do-	2200
Bending machine, Rollingmachine	1	-do-	1600
Engraving machine	1	-do-	200
			$25,900

Packaging shop

All purpose wood working machine	1	India	1600
Hand tools & general equipment		-do-	1800

Welding shop

Gas welding set with accessories (Oxyacetylene flame)		-do-	1200
Spot welding machine	1	-do-	900
			31,400
		Procurement charges and 2%	6,280
			$37,680

5. Office Equipment, furniture and Miscellaneous

Office equipment	6500
Wooden furniture including lab. tables, stools, production tables, chairs, sitting tables	5800
Steel furniture e.g. almirah filing cabinets, drawing cabinets, components racks etc. etc.	8500
Staff car and station wagon	13500
	34300
Total Plant and Machinery (1-5)	$ 2,65,365

H. Land, building and layout

The production of balances involves fine mechanism in assembly, fabrication of precesion components and quality control of very high degree. Therefore, the highly temp. controlled and dust proof rooms have to be provided. The proposed production quantity of four types of balances is 11, 500. Keeping in view the requirements on the basis of organisation set up suggested the covered area should be approx. 1300 sq.mt. A number of rooms have to be air conditioned for quality control, metrology and precision workshops, etc.

A) Cost of building construction:

Construction area	1300 sq.mt.
Construction rate $ 225/sq,mt	
Total cost of construction	2,92,500

B)	On the basis of plant & Machinery suggested and air-condition requirement, power requirement 250 KVA charge of electrification 5% of A	14,625
C)	Cost of Air-conditioning @350/- per sq.mt. for 60 sq.mt.	21,000
D)	Cost of waterpipes and Sewerage filling 25% of B	3,656.25
E)	Cost of dust proofing & Temp. controlled rooms	12,000.00
	Total (A+B+C+D+E)	343,781.25

Cost of the Project

i) Fixed capital Investment

a) Building and services	$ 343,781
b) Plant and Machinery	$ 265,365
c) Technical know-how fee and training	$ 65,000
Total (a) + (b)+ (c)	$ 674,146

ii) Recurring expenditure per annum

A) Designation-wise salary		Salary/month in US $	Total P.M. in US $
a) M.D.	1	350	350
b) G.M.	2	300	600
c) Managers	6	250	1500
d) A.M./S.E./A.O.	13	200	2600
e) Engineers/Supervisors./store officer/Account officer	23	160	3680
f) Technical assistance/assistance	34	120	4080
g) Technicians and others	66	75	4950
			17,760 x 12
Annual expenditure			213,120

B) Electricity charges @ 0.07 $ per unit (utility factor 0.6) — 25,515

NOTE: Installed capacity 250 KW as alre dy indicated working 9 hours a day and 270 days per year.

C) Misc. Charges like water, petrol charges etc. — 13,500

Total a+b+c	252,135

III C) Working capital on full capacity proposed production

Assuming that the raw material and components cost for 4 months production at time and 10% of the recurring expenditure is enough as working capital.

a) Cost of raw material and components in US $

Model I	= 44.83 x 4000 =	179,320
Model II	= 76.3 x 2000 =	152,600
Model III	= 95.92 x 2000 =	191,840
Model IV	=129.58 x 3500 =	450,530
Total	= $974,290	

b) 10% of the recurring expenditure = $ 25,213

Total a + b = $999,503

Financial estimates at a glance in US $

A. Fixed Capital Investment	= 674,146
B. Recurring expenditure	= 252,135
C. Working capital	= 999,503

I. Cost analysis

Annual expenditure at full production capacity

a) Recurring expenditure	$ 252,135	
b) Building depreciation @ 5%	17,189	
c) Plant and machinery depreciation @ 10%	26,536	
d) Interest on working capital	149,925	
Total a + b + c + d	445,785	.......(1)

A) Production Cost

Keeping in view the sophistication and work involved in assembling fabrication of mechanical components, final assembly time, test time cost of quality control and packing time etc. The production cost should be in the ratio of 1:1.5:2:5

If (a) is the production cost of onunit of Model I then

Total production cost = 4000a + 2000 (1.5a) + 2000 (2a) + 3500(5a)

= 28500 a.

Therefore (a) equating to (1) $= \$ \dfrac{145,785}{28,500}$

= $ 15.7

Therefore the production cost of

Model I	= $ 15.7
Model II	= $ 23.5
Model III	= $ 31.4
Model IV	= $ 78.5

8) Profit

Assuming profit and capital investment on full rated capacity say 25% $= \frac{674,146}{4} = 168,539$ ....(2)

Assuming the profit on the basis of production cost and to keep the sale price compatible to the International market the proposed ratio = 1:2:3:4

If (b) is profit on 1 unit for model I then

total profit = 4000(b) + 2000(2b) + 2000(3b) + 3500 (4b)

= 28000b.

Therefore (b) equating to (2) = 168539/28000 = 6 approximately

Therefore the profit on different models

Model I	= $ 6
Model II	= $ 12
Model III	= $ 18
Model IV	= $ 24

(C) Suggested Sale Prices

Models	Components & Material.	Production cost	Proposed profit	Total 1+2+3	Marketing cost	Estimated sale price	Suggested Sale Price	Mark. cost.	Net Sale price
	1	2	3	4	5	6	7	8	9
I	44.83	15.7	6	66.53	9.5	76.03	75.0	9.4	65.6
II	76.3	23.5	12	121.8	17.4	139.2	140	16.8	123.2
III	95.92	31.4	18	145.32	20.8	166.12	180	22.5	157.5
IV	129.58	78.5	24	232.08	33.2	265.28	320	40	280

(D) Cost benefit analysis of 1st year.

A) Turnover (excluding marketing cost)

Model I	= 65.4 x 1000	= 65,400
Model II	= 123.2 x 500	= 61,600
Model III	= 157.5 x 500	= 78,750
Model IV	= 280 x 100	= 28,000
Total	= 233,750	

B) Expenditure in US $

(a) Component and material

Model I	= 44.83 x 1000	= 44830
Model II	= 76.3 x 500	= 38150
Model III	= 95.92 x 500	= 47960
Model IV	= 200 x 100	= 20000

Note: Assuming that in the first year model IV will be imported in CKD form i.e. importing the kit and assembling in the factory at $ 200 per kit.

b) Other expenditure
considering in the first year recruitment, procurement of plant and machinery will take ~~time~~. In addition the suggest plant and machinery and construction of building will be in phases. The utility factor is = 0.4 = 252,135 x 0.4
= 100,354

c) Interest on working capital i.e. on (a) @ 15% + 10% of (b)
= 22,941

Total ~~a+b+c~~ = 274,735

(A) - (B) = - 40,985 % Loss = 6%

Cost ~~of~~ benefit analysis of 2nd year:

A) Turnover (excluding marketing cost) in US $

Model I	= 2000 x 65.4	= 130,800
Model II	= 1000 x 123.8	= 123,800
Model III	= 1000 x 157.5	= 157,500
Model IV	= 280 x 500	= 140,000

Total = 5,52,100

B) Expenditure in US $

a) Component and material cost

Model I	= 44.83 x 1000	= 44,830
Model II	= 76.30 x 1000	= 76,300
Model III	≐ 95.92 x 1000	= 95,500
Model IV	= 129.58 x 500	= 64,790
Total	= 281,440	

b) Recurring expenditure with utility factor = 0.7

= 252.135 x 0.7 = 1,76,494

c) Interest on working capital i.e. on (a) + 10% of (b) @ 15%

= 44,600

Total of (a+b+c) = 502,534

(A) - (B) = 49,566

% profit $= \frac{49,566}{674,146} \times 100 = 7.3\%$

Cost benefit analysis of III year

A) Turnover (excluding marketing cost) in US $

Model I	= 65.4 x 3000	= 196,200
Model II	= 123.8 x 1500	= 185,700
Model III	= 157.5 x 1500	= 236,250
Model IV	= 280 x 1500	= 420,000
Total	= 1038150	

B) Expenditure in US $

(a) Component and material cost

Model I	= 44.83 x 3000	= 134490
Model II	= 76.3 x 1500	= 114450
Model III	= 95.92 x 1500	= 143880
Model IV	= 129.58 x 1500	= 194370
Total	= 593590	

(b) Recurring expenditure with utility factor = 1

= 252135

(c) Interest on working capital @ 15% (a) + 10% of (b)

= 92,700

Total of (a+b+c) = 938,425

(A) - (B) = 99,725

% profit = 99,725/674,146 x 100 = 14.7%

Cost benefit analysis of V year (Full proposed production)

A) Turnover (excluding marketing cost) in US $

Model I	= 65.4 x 4000	= 261600
Model II	= 123.8 x 2000	= 247600
Model III	= 157.5 x 2000	= 315000
Model IV	= 280 x 3000	= 840000
Total	= 16,64,200	

B) Expenditure in US $

a) Components and material cost

Model I	= 44.83 x 4000	= 179320
Model II	= 76.30 x 2000	= 152600
Model III	= 157.50 x 2000	= 315000
Model IV	= 129.58 x 3000	= 388740
Total	= 1,035,650	

b) Recurring expenditure = 2,52,135

c) Interest on working capital = 163500
@ of 15% on (a)+10%(b)

Total of (a+b+c) = 14,51,295

(A) - (B) = 2,12,905

% profit = 212,905/674,146 x 100 = 31.6%

Cost benefit analysis at a glance

% loss I year	= 6%
% profit 2nd year	= 7.3%
% profit IIIrd year	=14.7%
% Profit Vth year	=31.6%

J. Feasibility

The proposed sale prices of four types of balances are 75$, 140 $, 180 $ and 320 $. In most of the cases, these prices are much cheaper than the prices of equivalent balances imported by Egypt, so far. In fact, the labour in Egypt is cheap and import duty is negligible. The cost of these balances is, thus, much cheaper compared to equivalent models, available in the international market. The proposed design and production technology is latest, as such the balances proposed to be produced would be compatible in performance and technology and much cheaper in cost.

In the 1st year, the loss is 6%, due to high capital investment required to setup the high degree of precision mechanical work- -s for manufacture of mechanical type of balances. However, the profit in IInd year is 7.3%, IIIrd year is 14.7%, and Vth year is 31.6%. Therefore, the project is technically and economically feasible.

K. Recommendations

1. The cost analysis given in the Industrial profile indicates that the production of balances in the Arab countries could be technically and economically feasible.

2. The use of double-sided thorough-hole printed circuit board has been suggested. The capital investment for production of these PCB is of the order of 100,000 dollars, so it is recommended that this facility should be created at a central place.

3. The capital investment requirement for the setting up production and testing facilities for optical components is very high. Therefore, it has been recommended that optical components be purchased from other units and if not possible, be imported.

4. The environmental and vibration test facilities and tool room facility should be set up at a central place.

5. The marketing should be through a central agency or through the established distributors. However, the service facilities should be provided by the company through its own service engineers.

6. In the 1st year of production, complete import of the kit for mechanical type balance is recommended. The mechanical type balance in the 1st year and 2nd year should only be assembled.

XXVI. INDUSTRIAL PROFILE ON X-RAY FILMS

A. Market demand potential

The market demand for x-ray films is expected to be 23.44 million Nos. of assorted sizes or 2.30 million sq.m. at the fifth year. The present demand level is of the order of 13.44 million Nos. or 1.3 million sq.m. However, there will be a gestation period for establishing credibility and capture substantial portion of market which is now fed by imports. In view of this, the target for production for the first year is restricted to one million sq.m. which are equivalent to 10.33 million Nos. approximately. With a marginal addition to staff, this could be raised to 2 million sq.m. In the third year the capacity will be raised to 3 million sq.m. by increase in marginal staff. From the end of the second year the market demand in the Arab States will be reviewed and suitable export market in the neighbouring countries explored.

B. Experience of a developing country

It may not be out of place to trace the history of X ray film industry in India. Among the developing nations India has successfully developed over the last decade a self sufficient industry from raw material to finished products for vital photo sensitive goods. India has joined the ranks of other leading photographic manufacturers in the world such as KODAK, DU-PONT,AGFA, FUJI, ORWO etc. After attaining self sufficiency in a wide range of photo sensitive goods for entertainment, public health and mass communication, the Indian Industry has now entered the export market as well with its products like medical x ray film to GDR and Silver Nitrate to Hungary, among others.
India has successfully built up a confident team of specialists in these photo sensitive materials and India is now poised for sharing this know-how to the developing nations in Asia by setting up Joint ventures in this field.

C. Technology

The manufacture of film making is the most sophisticated and secretive industry. The process of photographic film manufacture consists of four stages viz.

i. Film Base making

ii. Emulsion making

iii. Coating and Drying

iv. Conversion

Let us dwell in brief the various aspects of the process in the above areas of operation.

1. Film Base Making :

In this area, base film required for different products is manufactured. The base film could be manufactured in different thickness depending on the type of film. Now in the case of X-ray film, the specified thickness is 180 $\pm$ 5 microns.

The machine known as the 'Base Casting Machine' is ear-marked for casting the base to the required thickness. These machines are over 120 lm long and has a width of 2.00 Mmetres, These machines run at an effective speed of about 150 lm/hr. for X-ray film.

These machines are housed in dust free condition and the areas of operation are to keep absolutely clean. The workers working in the area are required to change on to factory clothes. As this is the first stage of the process, utmost precaution is to be taken for maintaining high degree of cleanliness standards.

The entire 'Base Casting Machines' area is to be maintained at a temperature of 20 $\pm$ 2^{o}C and a RH of 55 $\pm$ 5%.

Cellulose Triacetate, Methylene Chloride along with other chemicals are mixed in a mixing kettle known as 'Collodion Mixers'. When properly mixed this is formed into a viscous liquid. The viscous liquid is then passed through filters to filter any foreign matter. The filtered liquid is then taken to the Stainless steel band by means of stainless steel pipe lines and then cast on it, to form a film of required thickness. The required thinkness could be adjusted at the time of casting. The stainless steel band is of mirror polish. The cast film is passed through various drying zones.

Periodic visual inspection of the film is carried out, so that the film is free from nay surface defects. The tearing strength of the film is checked and uniform thickness measurements are taken across the film to maintain uniformity in casting. The film thus cast is wound on mandrels of 1.303 M. wide and to a length of 400 lm. These are wrapped in polythene sheets and kept on 'Peg' storage, and these rolls known as 'Jumbos' are kept in dust free atmosphere. The above operations are carried out in natural light conditions.

ii. Emulsion Preparation:

This entire area of operations is in 'Safe light' conditions. The entire area is air conditioned and the temperature conditions are maintained at 22 $\pm$ 2^{o}C and RH of 55% $\pm$ 5% The entire area should be dust free. As this is a vital area no contamination should take place. The workers change over to factory clothes when they work in this area.

Here the main ingredients of photo sensitive chemicals like Silver Nitrate, Potassium Bromide, Gelatine are weighed accurately and blended as per the formulations are then kept in a cold room which is maintaned at - 4^{o}C. These emulsions are stocked in stainless steel jars and categorised batchwise. Each batch is given an Emulsion Number for identification thereon.

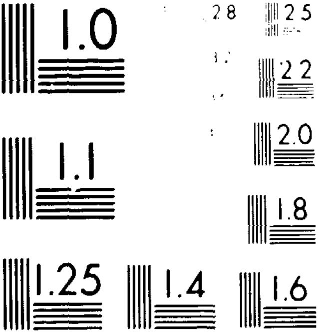
iii. Coating and Drying :

This is yet another area of vital importance in film manufacturing. This entire area is air conditioned and the temperature condition are maintained at 22 ± 2°C and RH of 55 ± 5%. It is needless to say that the entire area shall be dust free. As this also happens to be a vital area no contamination should take place. The workers change on to factory clothes when they work in this area.

1. There are two systems of drying the film. One system of drying is known as Flat Bed Dryer and the other systems is known as Festoon type or Loop type of drying. Normally X-ray films are dried in Festoon type driers.

The smearing of the viscous emulsions on top of the base film is known as coating and there are various types of coating emulsion. The conventional method is the Dip method of coating. The advanced technology of coating is by Air Knife method which is the normal practice for X-ray film coating.
The speed of the coating machine is 16 lm/mt. The coating machine comprises of an UNWIND station, Drier and WINDING station. The Drier portion of the machine alone will be 200 lm long.

The Base film that is to be coated with the required emulsion is brought from the Base Stores by means of trolley and loaded on to the unwinding station.
The film is spliced on to thefilm that is already on the move in the coating machine. When the film comes to the coating head, the emulsion, that was already prepared and kept ready after remelting is coated on the film bymeans of Air knife coating. The emulsion is sensitised and the film passes through various temperature and humidity conidtions, and when the film comes out at the end of the drier it is fully dried and is wound on Fibre mandrels.


1.0
2.8
2.5
2.2
2.0
1.1
1.8
1.25
1.4
1.6

Routine samples are taken as per sampling plan to ascertain the quality of film. Then these rolls are known as 'Jumbos' are kept in 'Peg' storage. Edge aligning systems are introduced to keep the film in the required path of movement.

iv. <u>Conversion</u> :

This area also should be dust free and the conditions to be maintained are:

- Temperature : 21°C ± 1°C,
- Humidity RH : 55% ± 5%

The coated film jumbos are brought to the slitting machine by means of trolley. The 'jumbos' are loaded by means of a hoist on to the machine. There is a splicing table for splicing the film. Edge aligning systems are introduced to keep the film in the required path of movement. The counter knives are of adjustable type and any desired width of roll may be slit. The slitting speed of the machine is 50 lm/min. The slit rolls are then taken from the storage and taken to the chopping machine by means of trolleys.

The slit rolls are loaded on to the unwind station of the chopper manually. There is an edge aligning system tokeep the web in proper alignement. The inspection of the film is done visually with suitable positioning of the transmitted and reflected light. The operator signals by a button, the footage at which a coating defect occurs. It is recoreded by the 'Pin Wheel Memory' drum and the right chop to the rejected is removed before the counter. The speed of the chopper is 30 lm/min. The chopped good sheet moves on a felt conveyor and there is an electronic counter which gives a signal bell to the operator when the quantity is 5 sheet short and is full. There are two trays which receive the counted sheets alternately.

The sheets of 125 or 100 bunch are collected from the trays at the end of the conveyor and are packed between 2 card board sheets to avoid kink marks and then the corners are rounded off. In this machine only one corner is rounded at a time. After rounding all the four corners, the pack of 100 or 125 sheets is inserted into a polythene pouch through a stainless steel gadget. Then the packed film is cartoned and labelled. The entire operation is done on continuous laid out benches.

The boxes with films are then put on a pallet and kept in an intermediate storage area awaiting final clearance. The In-process-control which tests the samples are taken from the box, in case of defects. If no defects are found, clearance is given for the product. A flow diagram of the operations is enclosed.

Sources of technology

As already mentioned as the process of film making is the most secretive industry and as such there are only a few countries in the world who are in the business of manufacturing various types of photographic films. They are USA, UK, France, Federal Republic of Germany, German Democratic Republic, Japan and India. It may be mention that among the develdping nations India has successfully developed over the last decade. It has also successfully developed the other indigenous sources of supply of raw materials which were hitherto imported.

D. Production phasing

As a first step towards making available large quantities of medical x-ray films it is proposed to take up manufacture of this by importing the coated film in semi-finished form and converting it in the country. Such a conversion programme will result in saving of valuable foreign exchange by importing the coated film in semi-finished form in preference to finished film since the conversion and packing costs would be incurred in Arabian currency. This would also provide employment potential both direct and indirect and scope for setting up ancillary industries for supply of required packing materials for the conversion plant. This will form the nucleus of a future integrated photographic complex where further facilities of film base making, emulsion preparation and coating could be established within a year or two after the technical know-how is purchased. It is also the normal practice prevailing with other photographic goods manufacturers to set up similar conversion plant as a prelude to an integrated photographic project.

Further setting up of an integrated photographic plant envisages a regular supply of photographic quality of silver nitrate, Cellulose Triacetate, Gelatine and Potassium Bromide. Besides the above there are about hundred chemicals required for the formulation of various types of emulsions. Therefore it is essential that the regular supply of these materials is ensured before an integrated photographic plant is set up and therefore it would be in order that a conversion plant would be the first step before setting up the other facilities.

The demand for medical x ray film in the Arab States is currently met by imports to the tune of 0.83 million L.E. (2.3 Million US Dollars). The free availability of X ray films is a must for meeting the health needs of the growing population in the country. Hence it is found necessary by the Arab States to manufacture x-ray films for meeting the increasing demand and also save considerable amount of foreign exchange.

X ray is an important source of medical diagonosis and it is still outside the reach of the common man and the mere thought of poviding cheap medical facilities to the majority of Arabs living in the rural areas through rural health centres and mobile medical centres alone would project the vast potential that exists for medical x-ray films and the explosion in demand likely to occur. Therefore it is imperative for the Arab nations to meet the anticipated demand of x-ray films.

E. Plant, equipment and layout

The project proposed for the manufacture of x-ray films involves the installation of a high speed slitter, chopper, Guillotine etc. The major production machinery, quality control equipment and service equipments have to be imported. The sources of the production machinery are from the Federal Republic of Germany, the United Kingdom, USA and Japan. The service equipments are to be imported either from the West or may be obtained from other developing countries like India. The detailed breakdown of the cost for the various equipment, machinery and services required is given in tables 1 and 2.

The new plant will have a separate slitting and chopping machine for x-ray films as per the prevalent practice existing in plants of other leading photographic manufacturers in the world. Besides the chopping machine, will have a built in inspection arrangement with 'Pin Wheel Memory System'. This process adopted with modern equipment will not only increase the out-put but also improve the efficiency of the conversion operation making it more economical.

The layout of the plant is given in figure I. The plant will have an improved lay out for conversion as prevalent with the leading photographic manufacturers, leading to better flow of material and movement of operating personnel.

F. Plant location

The Plant may be located at a place near to a port from the point of view of convenience and economy in transportation of semi-finished material from the port for conversion. Also it would be an easy outlet for the finished materials if the plant were to be located near to a port. In the event of importing large quantities of chemicals, for an integrated photographic complex, the ideal choice for

Table 1. Estimated cost of machinery and equipment

				Million dollars
I.	**PRODUCTION EQUIPMENT :**			
a.	Slitting machine	- 1 No.	:	0.09
b.	Chopping machine with Inspection arrangements	- 1 No	:	0.18
c.	Corner cutting machine	- 2 Nos	:	0.02
d.	Guillotine	- 1 No	:	0.05
e.	Rewinding machine	- 1 No.	:	0.01
f.	Heat Sealing machine, X ray inspection tables etc.	-	:	0.02
II.	**QUALITY CONTROL EQUIPMENT:**			
g.	Processing machine	- 1 No	:	0.01
h.	Densitometer	- 1 No)	:	0.01
i.	Sensitometer	- 1 No.)		
				0.39

Table 2. Estimated cost of service facilities/equipment

			(million dollars)
a.	Air conditioning including insulation	:	0.14
b.	H T. power supply-Transformer and main distribution	:	0.04
c.	Lighting including provision of safe lights	:	0.02
d.	Standby generator set (300 KVA)	:	0.12
e.	Compressed Air	:	0.09
f.	Laundry and industrial canteen equipment	:	0.02
g.	Material handling facilities (Fork lift, Trucks,Trolley, racks, mandrels etc.)	:	0.07
h.	Furniture and office equipment including interior decoration	:	0.02
i.	Installation costs of equipment.	:	0.02
j.	Transport and contingencies	:	0.02
			0.56

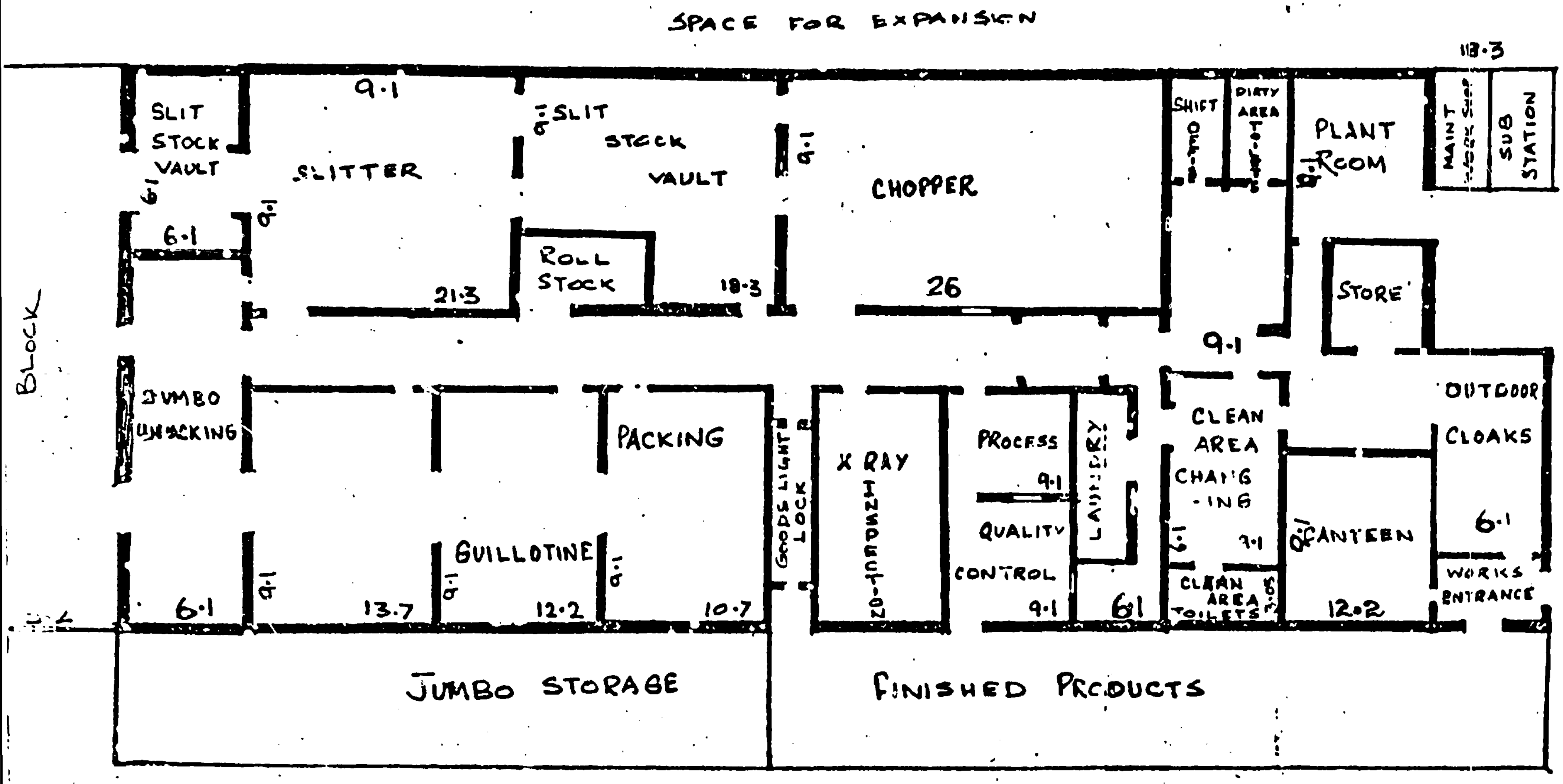


Figure I. Layout of the conversion plant locating the plant would be near to a Port. Although the plant maybe air conditioned it would be preferable that the surrounding areas are dust free. Chemical Plants like Nitric acid plant, Sulphuric acid plant nearby this area are detrimental.

For an integrated plant, large quantities of water would be required and would be of the order of 250,000 gallons per day. The water should be free of sulphur content.

G. Land and building

The required land will be made available by the Arab Government. An area of approximately 10 acres of land will be required. For the first stage a plinth area of approximately 2800 sq. m. is required. This area Comprises of the production shops viz.

i. Slitting Room
ii. Chopper Room
iii. Guillitine Machine Room
iv. Packing Room
v. Vault Room for intermediate storage
vi. Unpacking of Jumbos.

The building pertaining to the production area should be of RCC construction and as these are dark areas with safe light fittings, windows should not be provided.

1.8.2 The other room like

i. Jumbo storage
ii. Finished products
iii. Plant Room
iv. Canteen

may also be of RCC construction.

The Administrative building is contemplated in two Floors made of RCC construction. The production shops and storage for jumbos and finished product storage should be air conditioned.

H. Utilities

The auxiliary services required for the plant from the I year of the operation willbe as under :

Power

The power demand for the project will be 300 KVA. The connected load to the plant will be about 500 HP. A standby Generator of two Nos of 150 KVA each has been included, to maintain the temperature/humidity conditions required for semi-finished coated material and finished products during any power cut period or power failure. The supply should be 3 phase, 440 volts, 50 cycles and 220 volts, 50 cycles. The generators may be of NON AMP type.

Water

It is estimated that the requirement of around 30,000 gallons per day will be required for meeting the factory's needs daily. The demand will go up to 250,000 gallons per day for the integrated photographic plant. The water should be free of Sulphur content.

Air conditioning

A central air conditioning plant of 75 g tonnes capacity as per details given in the lay out will be installed for maintaining the process condition viz. 55% ± 5% RH, 22 ± 2°C. Proper insulation will be done to ensure the above conditions. The following areas will be be air conditioned :

1. Jumbo unpacking area
2. Vault Room
3. Slitting Room
4. Chopper Room
5. Guillotine Room
6. Packing Room
7. Jumbo Storage
8. Finished product Stores.

I. Raw materials

Raw materials for the proposed project consist of only semi - finished material in the form of jumbo rolls for conversion into finished products. The X-ray film is to be of high speed intended for medical radiography with intensifying screens. It is to be supplied on blue safety base. The film is to be of high contrast and fine grain, to produce brilliant picture of high diagnostic quality. The film is to be hardned so that the film can be processed under tropical conditions. The film shall be wound on mandrels having a width of 1,303 mm & ID 150mm and OD 157 - 160 mm.

J. Personnel

The personnel required for operating the plant for (i) One Million Sq. M., (ii) Two Million Sq. M., (iii) Five Million Sq. M. has been worked out in detail and is given in appendix I.

Local labour would be suitably trained for operating the new plant. It is proposed to train 5 persons from the Arab country for a period of three months in the Collaborator's factory. Also it is proposed that a senior worker and a Foreman will be posted in the Collaborator's factory for a period of 6 months. Supervisors and the operating Management will also be given the necessary in-plant training in the operation maintenance of the plant after the contract. They will be exposed to modern methods of Management,

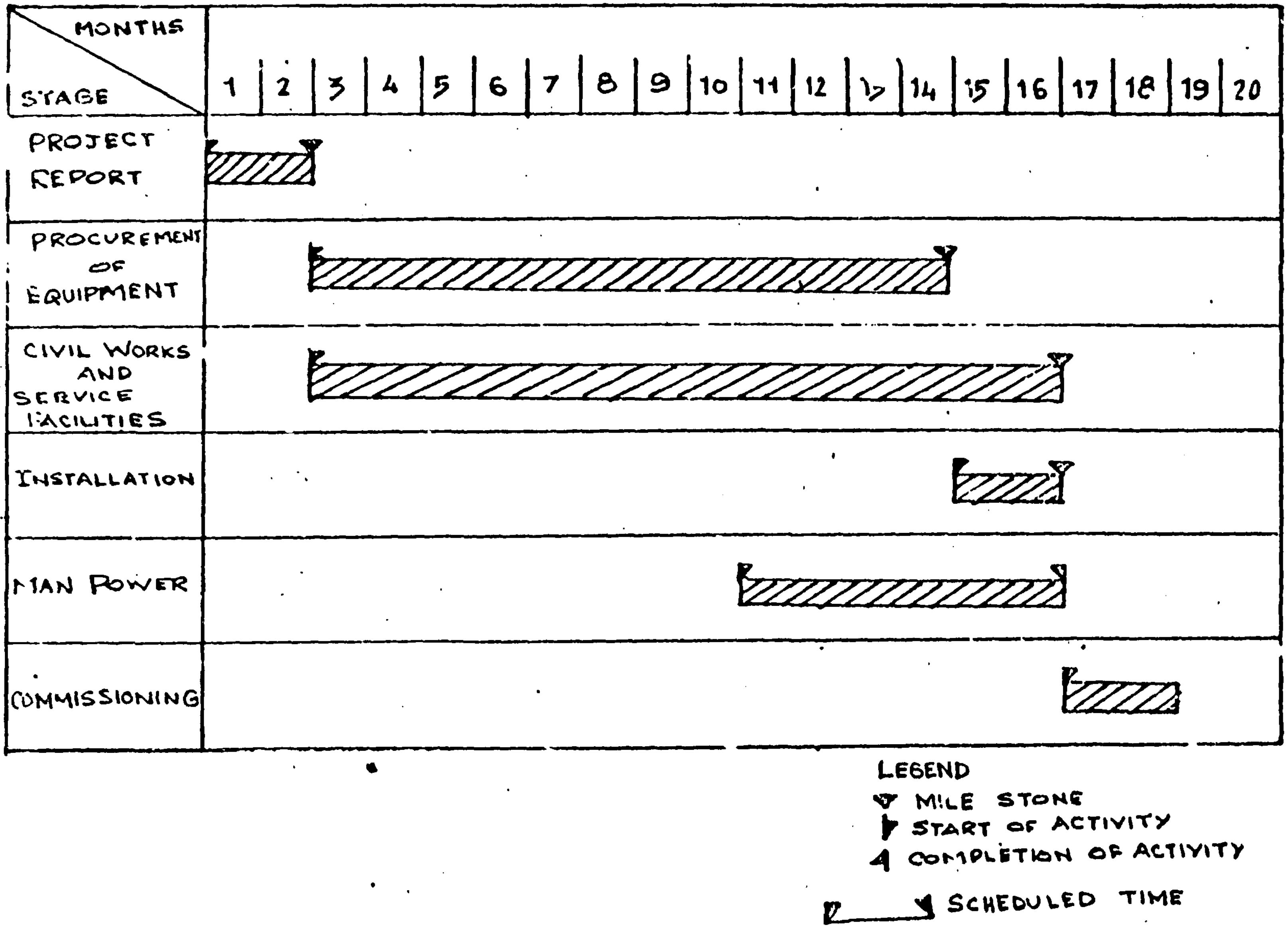
K. Project schedule

It is estimated that the project will take about eighteen months for completion which is inclusive of two months for the preparation of the detailed Project report. The important stages of the project schedule are given below:

Project report	:	2 Months
Procurement of equipment	:	12 Months
Civil works, service facilities	:	14 Months
Instalation of equipment	:	2 Months
Manpower - recruitment, training and placement	:	6 Months
Commissioning	:	2 Months

Figure II is a Bar Chart giving the project schedule.

Figure II. Project schedule



L. Financial analysis

A financial analysis is given in appendix II.

The details pertaining to the working capital is also attached. It will be seen that 15% on the working capital and 10% Depreciation on machinery have been taken into account. Royalty has been taken at 2% on turn-over.

M. Feasibility analysis

The total cost of the project as per details furnished in appendix II. C.is estimated at 1.65 Million dollars. The plant will make a loss in the 1st year and marginal loss in the 2nd year and result in a return of 16.97 % on investment in the third year, after making suitable adjustments for taxes, development resources etc. as applicable in respective countries which should settle down to 12% to 15% on investment. The same plant can also be operated at 5 Million Sq.m with additional man-power and with a return on investment at 36.36%. At this level of out-put the profitability is expected to be 0.600 Million dollars without any additional investment.

The price of X ray film in 25 sheet packing as prevalent in EGYPT for different makes as per the particulars given below:

	MAKE	AVERAGE PRICE PER SQ.M (Dollars)
1.	ORWO	3.18
2.	GEVAERT	4.935
3.	3M	5.55
4.	KODAK	6.22

In order to enter the competitive market the price of film has been fixed at 4.75 dollars per Sq.M which is much less than the other brands from the Western countries but slightly higher than one manufacturer. It should be possible to bring down the price considerably at the capacity of 5 Million Sq.M.

N. Special recommendations

In the event of the Arab Countries wishing to set up an integrated photographic complex, right from the Film Base Casting stage, right from now on they should concentrate in setting up chemical industries for the manufacture of chemicals like Silver Nitrate, Potassium Bromide, Cellulose Triacetate, Gelatine etc.

From now on there should be close liaison with the other manufacturers of X ray films.

A base structure of an R & D set up must be planned from now on.

It is a pre-requisite to set up a full fledged Design, Engineering cell.

With the help of the Design cell it would be possible for Duplication of the facility and thereby the conversion plant itself could be dispersed in the Arab States.

In order to fulfill the above objectives a Consultancy Service is essential, and will go a long way.

Appendix I

ESTIMATES OF REQUIREMENTS OF MANPOWER

A. For an operating level of 1 million sq. m

Plant operation including maintenance and quality control	No. of persons proposed	Total average salary per month per Employee	Total salary per annum	
			LE	US $
		LE		
Highly skilled	7	50	4200	10732.08
Semi skilled	17	35	7140	18244.53
Un skilled	26	25	7800	19931.10
Security	5	30	1800	4599.46
Plant shift supervisor	2	80	1920	4906.01
CLERICAL :				
Store keeper / Chief clerk	3	35	1260	3219.62
Stenographer / Office Assistant	5	30	1800	4599.46
MANAGERIAL :				
Chief Executive	1	150	1800	4599.46
Production Executive	1	100	1200	3066.83
Plant Service, Quality Control, Commercial, Personnel and Accounts Executive	6	80	5760	1471.28
	73		34680	88616.12
				Say 90,000

B. For an operating level of 2 million sq. m

Plant Operation including maintenance and quality control	No. of persons proposed	Total average salary per month per Employee	Total salary per annum L.E.	US Dollars
Highly skilled	14	50	8400	21464
Semi skilled	36	35	15120	38635.40
Un skilled	52	25	15600	39962.00
Security	5	30	1800	4599.46
Plant Shift supervisor	5	80	4800	12265.28
CLERICAL :				
Storekeeper/ Chief Clerk	4	35	1680	4292.83
Stenographer/ Office Assistant	7	30	2520	6439.29
MANAGERIAL :				
Chief Executive	1	150	1800	4599.46
Production Executive	1	100	1200	3066.30
Plant Servicd , Quality Control, Commercial, Personnel and Accounts Executive.	6	80	5760	14719.28
	131		58680	149942.01
			Say	1,50,000

C. For an operating level of 5 million sq. m

Plant Operation including maintenance and quality control	No. of persons proposed	Total average salary per month per Employee (L.E.)	Total salary per annum L.E.	US $
Highly skilled	21	50	12600	32196.20
Semi skilled	55	35	23100	59026.40
Un skilled	76	25	22800	58259.80
Security	7	30	2520	6439.21
Plant Shift Supervisor	6	80	5760	14718.20
CLERICAL :				
Storekeeper/Chief Clerk	5	35	2100	5366.00
Stenographer / Office Assistant	10	30	3600	9198.91
MANAGERIAL :				
Chief Executive	1	150	1800	4599.46
Production Executive	1	100	1200	3066.32
Plant Service, Quality Control, Commercial, Personnel and Accounts Executive	6	80	5760	14718.20
	188		81240	207588.69
			Say	207600.

Appendix II

FINANCIAL ANALYSIS

A. Investment

S.No.	Expenses	I Year One Million Sq.Metres.	II Year Two Million Sq.Metres	III Year Three Million Sq.Metres	IV Year Four Million Sq.M.
		(In million dollars)			
1.	Raw materials	3.730	7.460	11.190	18.750
2.	Wages and Salaries	0.100	0.150	0.180	0.208
3.	Power	0.025	0.050	0.050	0.120
4.	Repairs and Maintenance	0.009	0.009	0.009	0.009
5.	Auxiliary material at 2% production	0.095	0.190	0.285	0.361
6.	Packing material	0.300	0.614	0.900	1.500
7.	Depreciation	0.087	0.087	0.087	0.087
8.	Int. on working capital	0.233	0.466	0.699	1.165
9.	Training and collaboration cost	0.155	0.155	-	-
10.	Royalty at 2%	0.095	0.190	0.285	0.475
11.	Selling and Distribution 2%	0.095	0.190	0.285	0.475
		4.924	9.561	13.970	23.150
	Recovery cost	4.75	9.50	~~[illegible]~~ 14.250	23.75
	PROFIT /LOSS	- 0.174	- .06	+ 0.280	+ 0.600
	RETURN ON INVESTMENT	[illegible]		16.969	36.36 %

Note :The fourth year is kept open. However the return on investment will be the same pattern as that of the III year.

B. Working capital on the basis of an output of 1 million sq. m, 2 million sq. m and 5 million sq. m

	1 M.Sq.M	2 M.Sq.M	5 M.Sq.M
	(in Million Dollars)		
Stock of semi finished material - Two months	0.66	1.32	3.28
Stock of packing material - One month	0.04	0.08	0.18
Stock of finished materials- one month	0.41	0.82	2.05
Accounts receivable at 30 days	0.44	0.88	2.16
Salaries, wages and other overhead expenses	0.02	0.02	0.04
One month's net working Capital	1.57	3.12	7.71

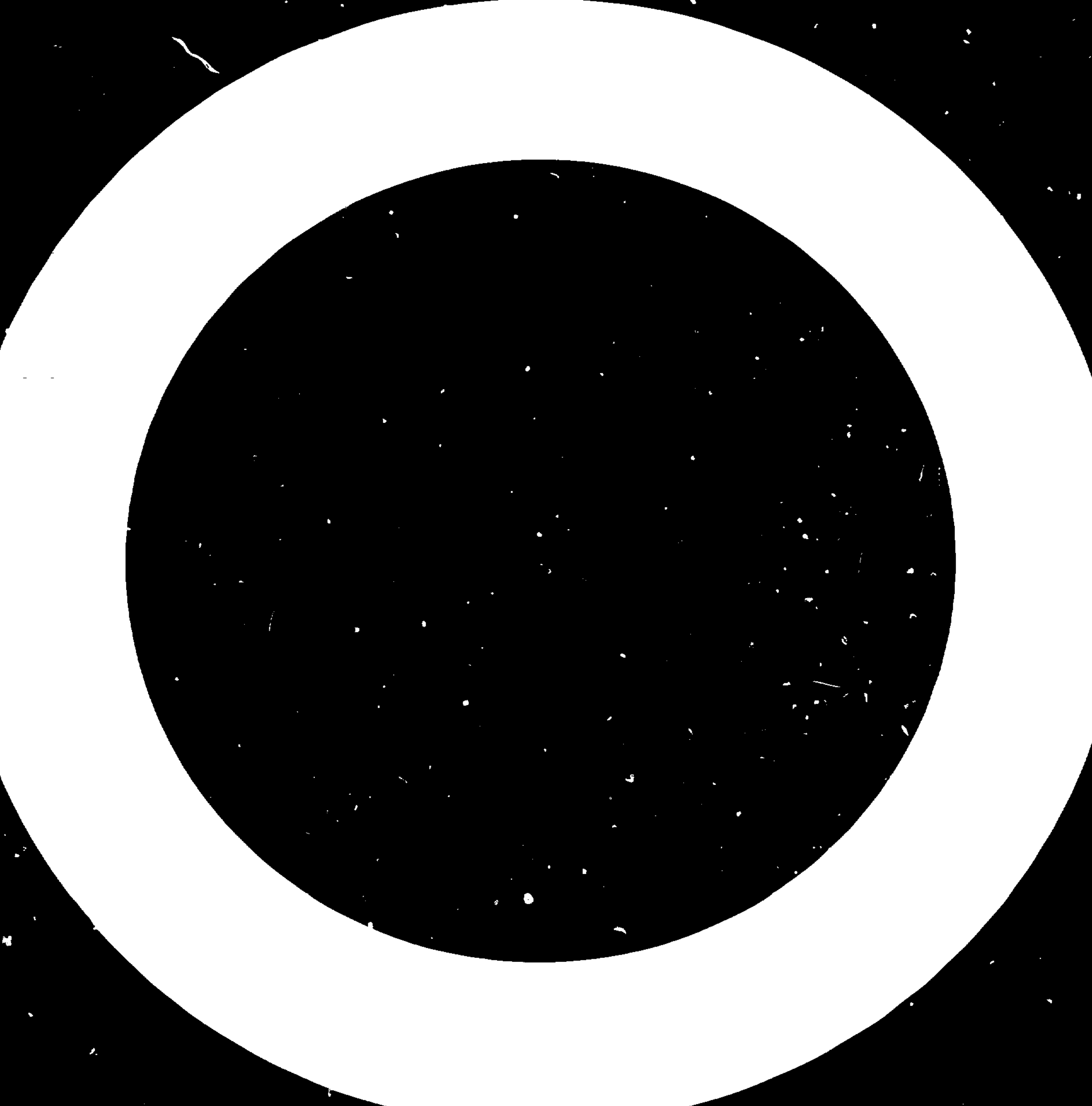
Interest Charges :

Production capacity	Capital required	Interest at 15%	Interest charges per Sq.M.
	(In Million Dollars)		
1.00 M.Sq.m.	1.57	0.233	0.02
2.00 M.Sq.m.	3.12	0.466	0.02
5.00 M.Sq.m.	7.71	1.165	0.02

• There is no interest charges on investment since funds are available.

C. Estimated total investment

		(in Million dollars US)
Buildings including Administrative Block	..	0.35
Machinery and equipment	..	0.39
Services	—	0.47
Spares and tools for two years of operation	..	0.03
Start up and training	..	0.08
Consultancy / Engineering including preparation of Project Report	..	0.23
Contingencies	..	0.10
Total	..	1.65



XXVII. INDUSTRIAL PROFILE ON REPAIR WORKSHOP MEDICAL APPLIANCES

A survey of the hospitals and medical institutions in some Arab countries showed that there was an urgent need to repair and service many medical appliances, instruments and equipment lying unused. Apart from serving the needs of these institutions, this will result in the saving of valuable foreign exchange required for the purchase of new equipment.

In view of this, it is recommended that a repair and maintenance workshop for medical appliances be set up immediately preferably near Cairo, where the requisite infrastructure is available. As ACDIMA enters the Medical Appliance market, this unit will function as the servicing centre. Initially this workshop will repair the medical appliances and instruments currently imported.

It will, also, privide an opportunity for ACDIMA to train the staff for taking up 'after-sales' service of medical appliances to be manufactured at a later stage by different limbs of ACDIMA Medical Appliance Factories.

A. Objectives of the project

The main objective of the proposed Workshop is to provide through first organised effort, a centralised organisation for repair and maintenance of defective Medical Appliances and instruments, lying in large number at various hospitals and medical institutions and thus bring them back into use and promote health facilities.

This Workshop will in fact, also, act as a nucleus for training of Engineers and technicians, from various Arab countries, in servicing of medical appliances.

The trained Engineers and technicians will form the backbone of organisation to be set up for 'after-sales' service to Medical Appliances/Instruments/ Equipment to be manufactured in proposed ACDIMA Projects for Medical Appliances.

B. Programme of work

The proposed Workshop will be developed in three phases :-

Phase I

An electronics test and measuring laboratory to look after simple type of medical appliances will be laid out.

Precision test and measuring equipment will be procured for the laboratories.

Qualified staff with aptitude in the field of servicing and maintenance of instruments will be recruited.

Training of staff

a) The senior staff may be trained in service and maintenance of instruments in developing countries like India (Central Scientific Instruments Organisation, CSIO, A National Laboratory of Council of Scientific & Industrial Research, Govt. of India) or at Instruments manufacturer's organisations in developed countries like the Federal Republic of Germany, the United Kingdom and the United States of America.

b) For training junior staff and to assist in proper layout and set up of laboratory, engineers from developing country like India (CSIO) where expertise is available or from developed countries may be invited.

c) Estimate of expenditure on training

c.i) Egyptian Engineer/Scientist in India (One month each)

		$
i)	Cost of Air travel	900
ii)	Cost of Boarding/lodging	1000
iii)	Cost of travel in India	200
iv)	Training fee	600
v)	Miscellaneous	500
		3200

c.1.1 Sub-total (for three persons) 3200 x 3 = 9600 ($)

c.2 Four Indian Engineers/Scientists in Egypt

c.2.1 Senior consultent top grade Engineer/Scientist
(For short duration up to one month)

		($)
i)	Cost of Air Travel	900
ii)	Lodging in a Ist Class Five Star Hotel (One month)	1800
iii)	Boarding, misc. expenditure for one month @ $ 200 per day	6000
		8700

C.2.2 Senior Manager (up to six months)

i)	Cost of Air Travel	900
ii)	Lodging in a Three star hotel/or suitable furnished accommodation	3000
iii)	Boarding, misc. expenditure for 6 months @ 1200 $ per month	7200
		11100

C.2.3 Foreman/Supervisor (up to one year)

i)	Cost of Air Travel	900
ii)	Lodging in Furnished accommodation	3000

iii) Boarding, misc. expenditure for one year @ 800 $ per month	9600
	3500

C.2.4 <u>Skilled Worker (one year or more)</u>

i)	Cost of Air Travel	900
ii)	Lodging in furnished accommodation	1800
iii)	Boarding, misc. expenditure for one year @ 500 $ per month	6000
		8700

C.2.5 Total $ 42,000

C.3 <u>Total Training Expenditure</u> $ 51,600

Note: The lodging/boarding and air travel should be made free/borne by ACDIMA, in addition to salary so as make the offer attractive to the persons to be made available in Egypt.

<u>Phase II</u>

Servicing and maintenance of sophisticated electronic instruments and mechanical instruments will be undertaken. Mechanical and optical workshops will also be set up.

Contract servicing of medical appliances/instruments will be started and facilities made available to users.

Information and library facilities to provide information on medical appliances and instruments will be added.

Research, design and development facilities for improvement, modification and design of medical appliances to suit the need of medical profession and other users will be started.

Calibration and testing facilities for medical appliances repaired and modified in the Workshop will be added.

Phase III

Mobile Servicing

Mobile van, a laboratory on wheels, for servicing, at-site, of medical appliances, either difficult to transport due to large size or fittings or delicate nature, will be provided. This will help in putting back into use equipment needed in emergency and reduce shutdowns due to instrument failure.

Consultancy Service

For solution of technical problems related to medical appliances, the workshop will render consultancy services.

'On-job' Training

An 'On-Job' training programme under which methods and techniques of servicing of instruments are explained to the trainee, while the instruments are actually being repaired, will be initiated. A large number of Engineers and technicians working in various medical institutions and hospitals will make use of this facility.

C. Scope of services to be provided

Repair and maintenance of Instruments

The Workshop will undertake repair and maintenance of medical appliances and instruments used for diagnostic, therapeutic, monitoring and house-keeping.

In diagnostic group, instruments used for detection and displaying body potentials i.e. electrocardiograph, electro-encephalograph, electromyograph, electromanometers, blood flow meters, oximeters and apparatus for laboratory analysis like Microscope, pH Meter, Colorimeter, Flame Photometer, Spectrophotometer and Balances.

In the therapeutic group, apparatus for applying radiant energy to the body such as Diathermy Apparatus, Microwave Diathermy, Ultrasonic Diathermy and equipment like Respirators, cardiac devices, physical therapy devices and muscle nerve stimulators may be mentioned.

In the monitoring group, instruments for continuous indication of body parameters are included.

House-keeping group includes signal systems, sterilizing apparatus and data handling equipment.

The main disciplines involved in medical appliances and instruments include electronics, electricity, optics, mechanics and chemistry for which separate divisions will be established in due course.

Contract Servicing of Instruments

It is seen that regular inspection and calibration of instruments minimises slow drift and small fluctuations in the instruments.

Arrangement will be made for users of instruments who enter into contract servicing on yearly terms to utilise the services of the Workshop for periodic check up and smooth running of the appliances and instruments.

Under the contract, maintenance and repair of appliances and instruments will be executed on a programmed basis and immediate attention will be paid to the work at any time required by the party, thereby, reducing substantially, shut-downs due to instrument failure.

Information & Library

The Workshop will provide information regarding medical appliances/instruments, availability and the spare-parts needed for repair.

A small library having books on medical appliances and instruments will be made available to the users and to the staff for repair, development and fabrication work.

Research, Design and Development

Due to availability of latest type of instruments the Workshop will be ideally suited for the positive feed back of new ideas and creative thinking for the purpose of designing new medical appliances, instruments, gadgets and devices.

The Workshop will also help medical profession in designing instruments by improving upon and modification of the existing technology of medical appliance and instruments.

Calibration and Testing forms an integral part of service and maintenance of medical instruments, without which repair work is incomplete.

Facilities will be created so that instruments are calibrated in accordance with the degree of accuracy and suitability required.

Mobile Servicing

In medical institutions, hospitals and clinics, there are medical appliances and instruments of large size, or with permanent fittings, and delicacy in nature, which cannot be transported to the Service Centre. Also some instruments are required to be attended immediately on account of their urgent need. To meet the interhospital servicing requirement, mobile servicing facility will be provided by attaching a van to the Workshop.

Mobile van will be a laboratory on wheels for repair and maintenance of appliances and instruments. This can be be made use of by various hospitals, clinics on demand. Whenever any medical appliances, instrument, device and apparatus is defective or out of order, the message can be passed on to the Workshop from where this Mobile Van will visit the site for servicing instruments at the hospitals and other institutions. This will help in putting back into use equipment required in emergency and reduce shut-down due to instrument failure. The van will be fitted up with various types of testing and measuring instruments required to check up and repair defective appliances and instruments and staffed with experienced and qualified technical personnel.

Consultancy Service

Consultancy service with regard to technical problems related to medical appliances and instruments will be provided. Problems will be examined and solutions found. The Workshop will render service for selection of suitable medical appliances and instruments and provide information on availability of spare-parts etc.

'On - Job' Training

Looking to urgent need of hospitals and medical institutions for expert training of maintenance staff, 'On-Job' training programme will be started at the Workshop. Under this training programme, the methods and techniques of repair of medical appliances and instruments will be explined to the trainee while the instruments are actually repaired.

D. Personnel

For preparation of detailed project report and setting up 'ACDIMA MEDICAL APPLIANCES REPAIR WORKSHOP', services of a top grade engineer/scientist will be required as follows:

Period:

i)	Two months in the home country:	Identification of different stages of development of the Workshop and other related information for making detailed project report.
ii)	Eighteen months in	Selection of site, supervision of the establishment of workshop, selection of staff, their training, laying out of laboratory, procurement of equipment.

iii) In addition, provision for travel abroad for identification and procurement of test and measuring equipment, be made.

Since, person required for such a job description has to be a top expert in the field, service conditions have to be very good to attract proper persons in the field.

The workshop will have following staff:

S.No.	Name of the post	No.
1.	Chief Service Engineer/Scientist	1
2.	Asst. Chief Engineer/Scientist	1
3.	Service Engineer/Scientist	5
4.	Technicians Class 1,2&3	20
5.	Store Keeper	1
6.	Workshop Asst.	2
7.	Laboratory Asst.	2
8.	Security Guard	2
9.	Sweeper/cleaner	2
10.	Clerical Asst.	1
11.	Stenographer	1
12.	Driver for Staff Car/Van	2
	Total	40

Approx. Staff Salary for one year $ 75,000/-

E. Equipment

The Workshop will have following test and measuring instruments and equipment:

S.No.	Name of the equipment	No.
1.	Multimeter	4
2.	V.T.V.M	4
3.	Signal Generator	2

S.No.	Name of the equipment	No.
4.	Double Beam Oscilloscope	3
5.	Valve Characteristic Meter	2
6.	Transistor Tester	4
7.	Wave Analyzer	2
8.	Electrostatic Voltmeter	5
9.	Ammeter	10
10.	Wattmeter	2
11.	D.C. Microvoltmeter	4
12.	A.C. Milivoltmeter	4
13.	R.C. Generator	2
14.	L.F. Pulse Generator	2
15.	M.F. Pulse Generator	2
16.	H.F. Pulse Generator	2
17.	R.F. Generator	3
18.	Low Function Generator	2
19.	Portable 10 MHz Oscilloscope	2
20.	Q-Meter	4
21.	D.C. Potentiometer	5
22.	100 Watt Amplifier(0-100kcs) (flat response)	1
23.	Thermogalvanometer(0-100mA) DC.fSD or (0-1mA)	3
24.	Vobulators(15 kc-30Mc/s) (30Mc/s to 100 Mc/s+10 Mc/s, (0-50 KC or more)	1 pair
25.	Multimeter Calibrator	2
26.	Audio Oscillator	2
27.	L.F. Attenuator	3
28.	Decade Attenuator	2
29.	R.F. Attenuator	3
30.	T.V. Oscillosynochroscope	1
31.	Stroboscope	1
32.	S.W.R Indicator	3
33.	D.B. Meter	4
34.	Frequency Meter	2
35.	A.C. Stabilizer	6
36.	D.C. Power Supply (low voltage)	6

37.	Megger	5
38.	R.L.C. Bridge	2
39.	Multiflex Galvanometer	4
40.	Decade Capacitor Box	3
41.	Decade Inductor Box	1
42.	Decade Resistance Box	3
43.	Veriable Transformer & Voltage Regulator	6
44.	Electromagnet Powers Supply	1
45.	Battery Charger	5
46.	Earth Tester	2
47.	Water Still	1
48.	Vacuum Pump	1
49.	Vacuum Oven	1
50.	Kelvin's Bridge	4
51.	Ultrasonic Cleaner	1
52.	Tachometer	4
53.	Bench Lathe	2
54.	Photo Copying Machine	1
55.	Tool Kit	10 Set

Cost of test & Measuring = 100,000/-
Equipment

Cost of components, accessories etc. $ 10,000.00
(Annual Requirement)

F. Space, furniture and services

1. Space

Electronics Section — 5,000 Sq. ft.

Electrical & Electro-Mechanical Section.

Laboratory Room for repair of

a) Motor & transformer winding & repair section — 600 Sq. ft.

b) Ovens, Incubators, Autoclaves etc. Section	1400 Sq. ft.

<u>Optical Section, Laboratory Room</u> for repair of

Microscopes, Projectors etc.	1000 Sq. ft.

<u>Mechanical Section, Laboratory Room</u>

for repair of Balances, Pressure Gauges and Microtone etc.	1000 Sq. ft.

<u>Workshop Facilities</u>

Bench Lathe, Drilling Machine etc.	1000 Sq. ft.

<u>Research, Design & Development Cell Laboratory</u>

for development, design and modification improvement and experimentation medical appliances and instruments

1000 Sq. ft.

<u>Calibration & Testing Facilities Section, Laboratory Room</u>

Having instruments like Multimeter Calibrator, RLC Bridges, Calibrated Oscilloscopes etc.	1000 Sq. ft.
Library Section	600 Sq. ft.
Chief Engineer Office	500 Sq. ft.
Asst. Chief Engineer's Office	400 Sq. ft.
Administration Office	500 Sq. ft.
Stores Room	600 Sq. ft.
Reception Room	500 Sq. ft.
Seminar Room	500 Sq. ft.
Total floor area required	~~15,600 Sq.ft.~~

The cost of building the workshop, at $15 per ft^2, will be $234,000.

2. Furniture

Table for Chief Engineer	Two
Tables for Staff	Two
Laboratory Tables	Twenty
Chairs	Twenty five
Almirah for instruments, tools & Components	Ten
Stools	Fifteen
Waste Paper Baskets	Ten
Book Racks	Ten
Library Book Almirah	Eight
Sofa Set for visitors	Four
Almirahs for office use	Six

3. Service and facilities

The following facilities will be provided at the Workshop:

i) Power connection and fittings
ii) Electricity fittings
iii) Gas Supply
iv) Furniture, lab. fittings, racks etc,
v) Water Supply fittings etc.
vi) Telephone
vii) Staff Car
viii) Water Cooler
ix) Mobile Van Facility
x) Air conditioning (in specified sections of Laboratory)

Approximate expenditure for aforesaid facilities $ 100,000/-

G. Economic viability

A list of medical instruments to be repaired at the Workshop would show that the categories of these instruments run into a few scores. In each category dozens of varieties are manufactured in the world. Every make and model has its special features and basic principles of operation. These require specialised skill, training and experience. In order to fully meet the requirements of servicing, personnel trained meet the requirements of servicing, personnel trained in various technologies, namely electronics, electrical, mechanical, optical and electro-mechanical etc. have to be employed. Then, there is the problem of spares.

Success and utility of the Workshop must be judged not by the revenue earned in the form of service charges for the organisation but by the savings effected to the instrument users in terms of man-hours saved in the medical institutes and hospitals. It may be mentioned, in this connection, that more than 90% of the instruments to be serviced at the Workshop would be of imported variety.

The proposed Workshop would take up the job more as a challenge rather than as an earning proposition. This will often result in spending more time on one particular instrument than is warranted by the service charges billed. Many a time spare-parts will be fabricated and electronic circuit redesigned, making use of available parts only. It needs time and skill.

Thus the proposed Workshop may hot have economic profitability but certainly will provide fiscal and notional benefits. It will provide self sufficiency in the Arab world in the field of medical appliances, in the years to come.

H. Liaison

Liaison with Scientific Instruments Centre (SIC), Cairo

There already exists in Egypt (Cairo) an important Instruments Organisation 'Scientific Instruments Centre' which provides facilities for Research, Development and design of scientific instruments as well as their servicing to some extent.

This Centre (SIC) may be approached for having collaboration in set up of proposed 'ACDIMA, Medical Appliances Repair Workshop'.

Liaison with Institute for Maintenance of Medical Appliances Bahrain

It is learnt that an institute for maintenance of medical appliances and instruments has been started in the current year with the aid of some foreign agencies at Bahrain, nearly 100 miles from Kuwait. It will serve Gulf States (Bahrain, Iraq, Qatar, Saudi Arabia and the United Arab emirates and is supported by Institute of Scientific Research in Seientific Work.

Liaison may be maintained with the above institute for getting cooperation in set up of proposed ACDIMA Medical Appliances Repair Workshop. It will be useful in getting new persons trained in the establishe institute and organise facilities on a similar pattern and locate sources of quality test and measurement equipment required.

Liaison with Iraq Government

The authorities concerned in Iraq may be approached for keeping liaison in set up of proposed workshop in Cairo.

Liaison with Central Instruments Repair Workshop, Khartoum, SUDAN

As a result of UNIDO Expert's visit to Sudan in 1973 for assessement of instrumentation problems and suggestion for set up of a repair organisation, Sudan Government has as per his recommendations established (Central Instruments Repair Workshop) (CIRW) at Khartoum.

Liaison be kept with CIRW for seeking collaboration in set up and functioning of proposed 'ACDIMA WORKSHOP'.

I. Financial estimates (million dollars)

Capital Expenditure

A. Land & Building and services

1) Land & Building

Cost of construction for 15,600 sq. ft. carpet area @ $ 15 per sq. ft 0.234

Cost of land (depends upon the area selected and may be provided free)

ii) Services: 0.100

Power, laboratory fittings, furniture, electricity, water supply, telephone, water coller, staff car and mobile van

B. Machinery, Instruments, Equipment etc. 0.100

Sub-Total	0.434

Recurring Expenditure (Annually) (Million Dollars)

a)	Components, accessories etc.	0.015
b)	Staff salary	0.075
c)	Running incidental recurring expenditure (Misc.)	0.025
	Sub-Total:	0.115

Expenditure on Training 0.052

Total

i)	Capital Expenditure (Land, building, construction, services & machinery) ...	0.434
ii)	Recurring (annual)	0.115
iii)	Expenditure on training	0.052
Grand Total		0.601

Out of the total expenditure of 0.601 million dollars, the major portion i.e. 72.3% is under Capital expenditure, (0.434 million Dollars). The balance is to be spent for training and annual recurring expenditure which account for 8.6% and 19.1% respectively of the total expenditure.

XXVIII. INDUSTRIAL PROFILE ON A CENTRAL TOOL ROOM

A. General

Establishment of a Central Tool Room on a modest Scale is necessary as Engineering Electrical and Electronic industries require variety of toolings for mass production of components. The performance of Tool Room largely depends on its capability to produce precision tools in a reasonable time. Greater the precision, higher the price of the product. Therefore, such a Tool Room will have to have equipments like precision Jig boring, EDM (Spark Erosion), Profile grinders etc. besides other general purpose Engineering equipment. In addition, it should have Heat-treatment facility as number of components for tooling require to be hardened & tempered to various hardness range.

Another important factor in running the tool Room successfully is the calibre of the skilled workers. The machinists for precision equipments and fitters for the work of press tools etc. are to be given sound practical training. The performance of the tool Room will depend on the capacity of men & machine in reaching the degree of precision specified by the customer.

The list of equipment proposed in appendix I will meet the tooling requirements of Light Engineering Industries forging tools for the manufacture of forgings up to 2 kg weight, precision press tools and other Jigs & fixtures for Electronic & Electrical Industries.

Certain equipment like Jig grinding, Centre lapping machines, Thread grinder, lapping Machines have been excluded from the list. As and when the proposed Tool Room Picks up sufficient work load for manufacture and depending upon type of tools jobs received required new equipments could be added. Enough space has been provided for such an eventuality.

To start with, the proposed Tool Room is to function on a single shift basis and minimum of staff has been provided. Increasing the men or adding another shift work has to be decided after running the tool room for a reasonable period of time to gain experience and also volume of trade justifies such a course of action.

The Engineering and supervisory personnel should have tool room Experience or they should be given suitable training.

The Tool Room will require a gestation period of 3-5 years to reach break even level for the following reasons:

a) Workers and Engineers are to gain experience for the production of precision tooling like combination press tools etc.

b) Tool room will take time to establish its credibility with the customers.

c) Booking of orders from industries would require time.

B. Raw material

a) The types of steels that are normally used will be as under:

1. Low Carbon steels
2. Medium Carbon steels
3. High Carbon Steels
4. Spring steels
5. Die Steels (oil hardening and non shrinking)

6. High speed steel
7. Special alloy steels.

b) non-ferrous materials will be required.

Careful material planning will be required to maintain 18 months' inventory for imported items and 6 months inventory for indigenous supply. Normally, certain commonly required sections in rounds flats, sheets and plates are stocked in low and medium carbon steel category and round and flat and square sections in other category of steels.

The tool room can either manufacture tools to customers design or design and manufacture to suit the requirements of customers. In the later case, establishment of tool engineering design cell will be necessary.

Appendix II gives a summary of plant requirements and costs.

Appendix I

LIST OF EQUIPMENT FOR THE TOOL ROOM

				$
I.	**Lathes:**			
	a) Centre Lathe - 700 mm		2 Nos.	12,200
	b) Centre Lathe 1500 mm			
	c) Gap Bed Lathe - heavy duty		1 No.	10,000
	d) Relieving Lathe		1 No.	8,500
II.	**Milling Machine**			
	a) Universal Milling Machine No.2		1 No.	8,000
	b) Vertical Milling Machine No.2		1 No.	7,500
	c) Ram Trivvet Vertical Milling Machine		1 No.	10,000
	d) Multipurpose milling machine (similar to Deckel FP3-model)		1 No.	
III.	3D Pentograph machine		1 No.	4,300
IV.	a) Shaping machine Light duty		1 No.	2,300
	b) Shaping machine heavy duty		1 No.	5,000
	c) Slotting machine		1 No.	4,000.
V.	a) Universal cylindrical Grinding Machine		1 No.	14,000
	b) Internal Grinding Machine		1 No.	8,000
	c) Surface Grinding Machine heavy duty		1 No.	13,800
	d) Surface Grinding Machine precision		1 No.	5,380
	e) Optical profile Grinder		1 No.	25,000
	f) Universal Tool & Cutter Grinder		1 No.	5,900
	g) Pedestal Grinder		2 No.	700
	h) Carbide Tip Tool Grinder		1 No.	1,180
VI.	Jig Boring machine		1 No.	117,600
VII.	Punch shaping machine		1 No.	6,500
VIII.	EDM (Spark erosion) machine		1 No.	52,940
IX.	a) Radial Drilling machine 50 m/m		1 No.	7,000
	b) Bench Drilling machine		2 Nos.	940

			$
	Lathes		
X.	a) Fly press	1 No.	230
	b) Hydraulic press	1 No.	7,060
XI.	Treadle Type Gillotine Sheer	1 No.	1,180
XII.	Power Hacksaw	2 No.	2,950
XIII.	Portable filing machine (similar to Diprofil make)	2 Nos.	4,500
XIV.	Air Compressor	1 No.	2,000
XV.	Pneumatic Hand Tools		500
XVI.	Measuring equipments & instruments		47,000
XVII.	Machine tool accessories		40,000
XVIII.	Welding machine	1 No.	2,000
			$27,060

Equipment for heat-treatment Section attached to the Tool Room.

1.	Salt Bath furnace(High Temp.)	1 No.	4,700
2.	Chamber Electric furnace - 1000°C	1 No.	5,880
3.	-do- - 1200°C	1 No.	3,000
4.	Aircirculating type tempering furnace	1 No.	4,700
5.	Oil quenching tanks	2 Nos.	820
6.	Water quenching tank	1 No.	150
7.	Sand blasting equipment	1 No.	900
8.	Hardness testing machines	2 Nos.	2,300
9.	Bench Grinder	1 No.	100
10.	Control/calibrating instruments		500
	Total	11 Nos.	23,100

Installation and erection of electrical and mechanical equipments.	$ 28,000

Appendix II

SUMMARY OF PLANT REQUIREMENTS AND COSTS

	$ in lakhs.
I. Capital Investment	
Plant & Equipment	5.782
Building	2.971
Air-conditioning, Installation and Erection of Electrical & Mechanical Equipment	0.400
Total	9.152

II. Floor Area allocation

Tool Room	1920 sq. meters.
Heat Treatment	100 " "
Stores	100 " "
Others	200 " "
Total	2320 Sq.meters

III. Power Maximum demand 350 Kw.

Consumption for the shift operation/Annum. 220,000 Units.

Power Cost $.16,923.

IV. Water: Marginal requirement

V	a) Manpower Direct	Machinics	17	
		Fitters	6	
		Welder	1	
			24	$.30,770
	b) Indirect			
		Managerial	1	
		Engineers/Supervisors	3	
		Inspectors	2	
		Administrative/Accounts	3	
		Others	6	
			17	$ 23,615

VI. Requirement of Land : 11600 Sq.Meters.

VII. Types of Toolings for Manufacture

a. Presstools
- Simple - single stage
- Progressive Punching
- High Precision

b. Jigs
- Plate Drill Jigs
- Bin Drill Jigs
- Special purpose Drill Jigs

c. Fixtures
- Turning fixtures
- Milling fixtures
- Boring fixtures

d. Cutters
- Form Relieved Cutters
- Plain cutters

e. Form Tools
- High speed steel
- Carbide Tipped
- Form gauges/templates

i. Injection Moulding Dies
- For Plastics
- For Rubber

g. Forging Tools
- Forging Dies
- Trimming Dies
- Strengthening Dies
- Binding Dies
- Punching Tools

h. Miscellaneous
- Mandrels - Turning / Milling/ Grindings
- Simple post gauges
- Taper Plug gauges

VIII Training

Workers, specially those who are put on spark erosion, jigpens, profile grindings, Docke's Mills etc. and fitters presstool work are to be trained.

Training expenses $ 1,73,600