UNIVERSITY OF COCHIN

B. Tech. Course

IN

Rubber Processing and Technology

PROJECT REPORT

ON

A Small Scale Unit to manufacture Oil Seals for Automobiles

DISSERTATION

Submitted by

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In partial fulfilment of

B.Tech. degree.

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FOREWORD

This Project Report is prepared and submitted in the form of a dissertation, unlike projects to procure loans to start new industries. The Primary mission is the partial fulfilment of my technical degree. This, I believe, justifies the inclusion of information on technical aspects.

However, I do not claim this report to be exhaustive and complete in all aspects. However, I hope that this will serve as a guideline for action to be followed.

I take this opportunity to express my thanks to all persons who helped in my endeavour and in particular to Mr. C.M. George, Project Officer; Mr. E.V. Thomas, Deputy Director, Mr. M. K. Balagopalan Nair, Chemical Engineer; and Mr. P. U. George, Cost Accounts Officer of Rubber Board and Rubber Research Institute of India.

KOTTAYAM. 9
15th March 1977.

P. A. THOMAS.

O B J E C T O F THE P R O J E C T

This project is intented for the manufacture of 3,60,000 Nos of oil seals per annum for use in Automobiles.

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SECTION- A

INTRODUCTION

Oil seals are used for protect shafts and bearings from ingress of dirt and foreign matters and agress of oil or grease. They find use in static and dynamic applications.

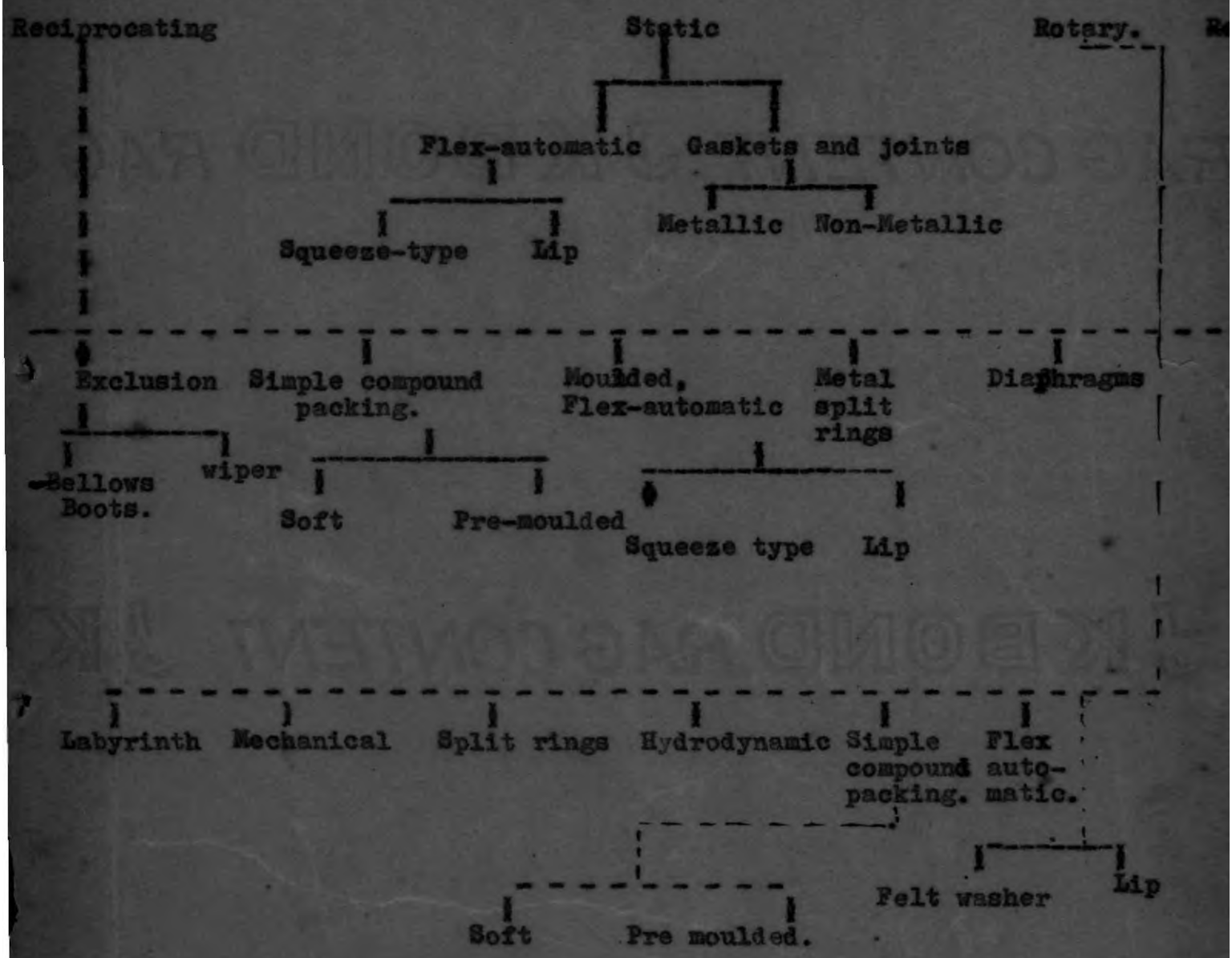
A.1. History of the Product.

There are evidences to show that rubber was used in the middle of last century as a sealing material. It is evident, seals made of Natural Rubber were first used in considerable quantities in the 1920's for the hydraulic brake systems of Automobiles; the actuation fluid was a vegetable oil. Upto introduction of oil Resistant Rubbers (Prior to world war II), materials like cork, leather, felt, cord and fabrics were popular as sealing material. But great demand for seals at high pressures, temperatures and speeds led to the predominance of oil Resistant elastmers over above materials, which are incapable of withstanding severe service conditions. For the last 12 years, significant changes have come in sealing Technology. Oil resistant special purpose synthetic rubbers like poly choloroprene rubber, Nitrle rubber, Fluoro carbons etc. are used principally for mineral based oils such as lubricants and Hydraulic fluids; Butyl and Ethylene propylene rubbers for vegetable oils and phosphate ester hydraulic fluids, and Silicone rubbers for high performance applications.

(Contd.....P/3)

A 2. Classification for Oil Seals.

A general classification on seals is given below:-



Seals can be squeeze type and lip type. Former operate by distortion under radial or axial compressive strain and for latter, sealing is achieved by distortion

(Contd.....P/4)

of the lip assisted by pressure in the system.

A.2.1. Classification with respect to operating Mechanisms:

	Point of application.	Various Types.
a. Static Seals	used at static points; operate by uniaxial compressive strain. Squeeze type.	Toroidal or O-ring. Rectangular, X-type, D-type, T-type and Delta type.
b. Reciprocating Seals	All Elastomer seals. Used at Reciprocating shafts.	Cup seal, U-seal and V-seal.
c. Rotary shaft Seals.	Lip seals, sealing on a rotating member.	Rubber-cased - Type A Metal-cased -Type B. Built up seals - Type C.
c.		

C.1. Description of Rotary shaft seal.

It comprises an interference knife edge lip, sealing against shaft and supported by an elastomer diaphragm which is bonded to a metal support ring. A garter spring, if provided, maintains tension on the Sealing lip.

(Contd.....P/5)

C.2. Types of Rotary seals with respect to its construction.

C.2.1 Built-up seal.	Construction details. Consists of an outer metal shell, an inner metal shelf and distance piece, holding the sealing member in position.
C2.2. Metal-cased Seal.	Bonded Type. Metal outside. Used upto 0.35 MN/m^2 pressurs.
C.2-3. Rubber-cased Seal.	Modification of Bonded type. Metal shell inside rubber. Irregulatirtes of housing are taken up by flexible rubber. Used upto 0.1 MN/m^2 pressurs only.

- -

C.2.4. Others

i) Seals with thicker sealing member.

ii) Seals with steel reinforcement.

iii) Double lip seals where two dissimilar liquids are to be kept apart.

iv) Seals rotating along with the shaft.

A.2.2. Classification with respect to reinforcing materials.

1)All-rubber seals (Squeeze type usually)

ii) Fabric containing seals(Higher modulus and stiffness)

iii) Metal containing seals.

(Contd.....P/6)

A.2-3 Some specific types.

i) Mechanical seals (used at high speeds, temperatures and pressures)

ii) High vacuum seals (in the region of 10^{-9} mm of Hg pressure)

iii) Hydraulic packing seals.

(all rubber & reciprocating type; At pressurs of 500 PSI)

A.3. Applications for oil seals.

An oil seal is essential where sealing is needed for a shaft against oil.

Points of application are:-

i) Air craft components

ii) Refrigeration equipments.

iii) Transmission equipments (eg. gear boxes)

iv) Rotating members eg: Bearing seals for pumps, electric motors, axles etc.

v) Hydraulic systems.

vi) Internal combustion engines.

vii) Automobile components.

A.4. Use of oil seals in Automobiles.

It is seen that in an automobile, use of over 600 rubber parts and components is made weighing nearly 70 kgs. of rubber, excluding tyres. Various types of oils seals are employed at various points of a vehicle. Few automobile components fitted with seals are given below:-

i) Rear axle.

ii)Front axle

iii)Gear Box.

iv)Differential pinion

v) Steering

vi)Water pump

vii)Timing case

viii) Crank shaft

ix) Brake system

x) Speedometer

etc.

The size and type of design of an oil seal at a particular point in a vehicle will vary according to different vehicles. For example, the seal for Front wheel of Ambassador car will not be same as that of Premier President, Fiat in size and type. This brings out the variability between items and hence, the resultant complication in the process.

Usually Automobile manufacturers evolve specification for oil seals, used at various points. ISI has drawn stringent specification for oil seals. ISI designation for a type B (Metal cased) seal with shaft diameter = 25 mm, bore diameter of housing = 40 mm and and width = 7 mm, is B 25 x 40 x 7

IS : 5129 - 1969.

(Contd.....P/8)

A.5. Product Diversification.

The project proposed facilitates for manufacturing all types of oil seals, O-rings and gaskets. It does not require further investment on machinery. If any unfavourable condition necessitates reduction in oil seal production, the resultant excess capacity can be utilized for manufacturing any other moulded items. This will enable the firm to run smoothly.

This firm is proposed to produce following types of seals used in Automobiles.

1. Tata Mercedes Benz Rear axle oil seal.
2. " Front axle.
3. Layland comet Rear wheel inner.
4. Layland Rear wheel outer.
5. " Front wheel.
6. Ambassador Front wheel
7. " Rear wheel.
8. Premier President, Fiat Front wheel.
9. " Rear inner.
10. " Front wheel. Rear outer.
11. Vespas scooter Crank Shaft.
12. Willys Jeep Front wheel.

The reason for selecting these specific types is that wheel oil seals require frequent replacement since they are operating on fast moving shafts and hence greater demand.

S E C T I O N - B

M A R K E T R E P O R T .

Oil seals play a vital role in Engineering field. The importance of its function and increased spread of its applications highlights its demand potential.

B.1. Prospects and Targets.

Nitrile Rubber, due to its unique property of oil Resistance, finds its major use in oil seal industry, which occupies 12% of total Nitrile rubber consumption in India. Yearwise consumption figures of Nitrile rubber are given below:-

Year	Consumption of NBR (Metric Tonnes)
1967-68	254
1968-69	325
1969-70	435
1970-71	530
1971-72	499
1972-73	586
1973-74	597

Ref:- Indian Rubber Statistics Vol. 14.1975.

Motor vehicles require oil seals in large amounts since Automobile industry is progressing steadily in our country, oil seals have got a bright feature.

The fact that the value of Automobile Industry's products and services is in the region of Rs. 24,000 Millions, which constitute 8% of total industrial production of India indicates sign of rapid growth of Automobile Industry in India.

The prospect of seals used for the Mechinary components of Automobiles is directly correlated with production of Motor vehicles.

Following data shows the present demand for Automobile Components.

Yearwise Production.

Year	Cars	Jeeps	Commercial Vehicles.	Scooters
1956	13339	3988	14494	3068
1964	23227	9777	37408	20971
1968	37308	7298	34940	35942
1969	35183	7838	35242	49740
1970	39205	9334	41136	58442
1971	38316	11053	41854	67211
1972	38827	12510	38734	64731
1973	39937	13071	44909	78007

Ref. oil statistics 1976 Jan. Feb.

Around 4,00,000 Trucks and Buses, over Half a million Passenger Cars, Jeeps and light duty vehicles and scooters are running today on Indian Roads.

Also oil seals are used in various components of Motor cycles, Tractors, Three wheelers, Mopeds, Tempo etc.

If vehicle life is taken to be 20 years, requirement of oil seals will be very large. Following figures give an idea of usage of seals in vehicles.

Vehicle.	Nos. of various types.
Tata Mercedes Benz.	20
Layland Comet.	15
Bedford	9
Premier President, Fiat	16
Ambassador	8
Willys Jeep	14
Eicher Tractor	18

Another aspect of oil seals is that they will change in size and type for a new model of a particular vehicle. All these facts indicate that our Automobile industry needs millions of oil seals - an essential auto part which has got only short span of life.

Consumption of oil in India has got an indirect relation with seal industry. It is reported in "commerce and trade, " that the oil industry has made an ' all time record ' in production and consumption during previous years.

Trends in production of Crude oil in India.

1948	1950	1965	1970	1975	1976	
225	259	347	3022	6809	8283	(in Thousand, Tonne

Looking to above statistical figures, one can assure that oil seals for Automobiles have very good demand and future prospects.

Automobile industry plays an important role in the progress of a Nation. A developing country like India is alwyys aiming at Industrial growth. Vehicle Movement is an essential factor to achieve this Industrial prosperity. Also necessity for automobiles is always on the increase with the standard of living, which always relates to the development of a nation. These aspects are clear indications of a bright future for autoparts, especially oil seals.

B.2. Users And Customers Analysis.

A survey conducted in various Automobile workshops brings out followinge aspects of oil seals.

1. When considering a vehicle running at reasonable distance and speed, life of a shaft seal is found to be 5 to 6 months.
2. Seals fitted to axles have to be replaced frequently (Maximum 5,000 kms life)

3. Short life of wheel oil seals is attributed to faster movement of wheels.
4. Metal cased and spring loaded type seals work longer.
5. Leather seals (leather instead of elastomer) are found to be less effective in their function.

The following informations were also obtained from Markey survey.

1. Seals constitute about 5 - 10% of total sales of Autoparts.
2. Wheel oil seals are having considerable demand in market.
3. Seals of following vehicles are having more sales.
    1. Tata Mercedes Benz.
    2. Ashok Layland
    3. Ambassador cars.
    4. Premier President, Fiat.
    5. Willys Jeep.
    6. Vespa Scooter.
4. Market prices of seals show vide variations, depending upon source of supply. Truck wheel seals are available at prices ranging from Rs. 10-18 , Car seals from Rs.3-4 etc.
5. Customers are quality conscious, in the case of seals and they are giving minimum importance to price. The reason is that [illegible]s giving longer service will reduce workshop exp[illegible] Automobiles.

B.3. Geographical extent of Market.

Market for oil seals is spread all over the country. Consumption of seals is larger in highly populated and civilized cities, where vehicle movement is more. That is why oil seal factories are concentrated mainly at the following centres.

Bombay, Madras, Delhi, Poona, Calcutta.

At present the firm proposes to limit the market in Kerala itself. Gradually the market can be extended to neighbouring states.

B,4. Product prices.

Market prices differ much according to manufacturing concerns. Present prices are shown below:-

	Price. (Sales tax extra)
Wheel oil seals of Benz and Leyland. :	10 Rs - 18 Rs.
Wheel seals of Ambassador and Fiat. :	3.25 Rs. - 4 Rs.
Vespa Crank shaft seal :	1.50 Rs.
Willys Jeep Front wheel seal. :	4.50 Rs.

During past years, Manufacturers were fixing prices at their own will, Since number of units involved in seal industry was limited. But now position is changing, firms are ready to sell at a lower price, even at the sacrifice of quality.

B.5. Competitive situation.

Elastometic oil seals have no prominent competitive product in the field. Applications of leather seals are now decreasing gradually owing to following reasons.

1. Failure in functioning at higher pressures, temperatures and speeds.

2. Reduced life.

Since oil seal is a precision product, inspite of higher demand, competition in this field is not much. Major units producing oil seals for Automobile are :-

1. Swastik Rubber products Ltd., Poona.
2. Super seals
3. Fenner Cockill Ltd., Madurai.
4. Automotive Products Co., Agra.
5. Perfect oil seals, Poona.
6. Automobile Rubber products Pvt. Ltd., Madras.
7. Gujarath Associated Rubber Industries Ltd.
8. Tamilnadu Sundharam Industries.
9. Maharashtra Purohit Rubber Works.
10. West Bengal Bhar Rubber Mfg.

Merely 100 units have entered in oil seal world. Still they are not satisfying present demand, due to huge consumption of seals. No unit in Kerala is producing oil seals in mass scale. Kerala being first in population intensity and being a developing state, possess a large number of vehicles. Hence an entrepreneur can be well confident to find market locally.

SECTION - C.

PROCESS

OF

MANUFACTURING.

C.1. Seal design and Material Selection.

Compounding ingredients should be selected to achieve an acceptable balance between :-

a. Vulcanisate properties required.

b. Price.

c. Processability.

The selection of rubber mixed for seals is dictated usually by three factors.

1. Fluid with which the seal will be in contact.

2. Temperature range of the environment in which it will operate.

3. Mechanical environment including such factors as pressure, stressing and Abrasion.

Service Requirements of oils seals, in general, are:-

1. Improved Resistance to swelling by fuels and oils.
2. Specific hardness and its retention when in contact with the liquid.
3. Abrasion Resistance.
4. Low temperature properties.
5. Ozone Resistance.
6. Compression set properties.

Important in sealing applications is the elastic properties of rubber vulcanisate. The distorted rubber exerts a pressure on the contacting surface to

Maintain the seal. Because of the stress relaxation of rubber, the exerted stress relaxes with time and ceases to function as a seal. This process is accelerated by swelling. So compression set measurement is of important value.

C.1.1. Elastomer Selection.

Nitrile Rubber. mixes are the work houses of the seal industry since it is the only polymer whose solibility parameter is far away from that of mineral and Ester based lubricants and to hydraulic liquids. With a knowledge of the 'seal compatibility index ' (defined as % volume swell, to the nearest whole no. of a standard rubber in the oil), of various fluids, the correct grade of NBR can be selected for a specific oil. Increase in Acrylonitrile content results in greater Resistance to oils and fuels, accompanied by reduced low temperature flexibility. Hence High ACN content Nitrile rubber can be used as the elastomer for oil seals.

Other Elastomers.

Depending upon the working conditions and mechanical environment, various other rubbers can be used for seals.

Natural rubber, if suitably compounded, can be used if operating temperatures do not exceed 70-100° C. and if Resistance to mineral oils is not a must.

Cloropene Rubber (Grade Neoprene Q) excels in contact with hypoid gear lubricants, refrigeration oils and non-inflammable hydraulic fluids. Dutyl Rubber is resistant to water, ethylene glycol coolants and detergants. Poly acrylic esters can withstand high temperatures upto 150°C. Polymeric Silicones(for transmission oil seals) are flexible and serviceable between - 100° F and 500° F. Poly sulphides are excellent in static sealing. NBR/PVC. mixes retain high oil resistance of NBR with enhanced passivity to Ozone, weather and flame. Poly tetrafluro ethylene is used in fluid sealing (face-seals) Flurocarbons and Ethylene propylene rubbers are suitable for certain other types of fluids. Certain formulations are given in Appendix V.

C.1.2. Compounding ingrediants.

Rotary sealing compounds are always of 85 to 95 BS. hardness. Reinforcing blacks will increase hardness and tensile properties to an optimum level. Graphite can be included in the formulation for low friction and improved heat resistance. Heat resistence can be improved further by using a high accelerator / low sulpher curing system. Although plasticiser will aid in precessing and enhance low temperature properties, it should be kept minimum for maximum heat resistance. Efficient Anti oxidant should be employed. Many plasticisers are leached out in hot oil. One methed of counter balancing the leaching of plasticiser in hot oil is

to incorporate NR or SBR. This will swell in oil and counteract the shrinkage caused by loss of plasticiser.

C.1.3.CHEMICAL BOUNDING AGENTS:

Most important types are:-

1. Cyclised rubbers generelly containing chlorine
2. Isocyanates.
3. Chlorinated Rubber.
4. Phenol - formaldehyde Resins.

Isocyanate type Bounding agents are generally used in oil seal industry.

Suggested Formulation

		Parts/Hundred rubber
Chemaprene 3811 - x	:	100
Diocdylphthalate	:	5
Zinc oxide	:	5
Stearic Acid	:	1.5
PBN	:	1
HAF	:	40
Graphite	:	60
MBTS		1.5
TMT	:	0-25
Sulpher	:	0.75
Cure at 158°C Curetine	:	9 Minutes
Hardness	:	85 Shore A2
Modulus 100%	:	131 Kgs.

TS	:	2860 PSI
E.B.	:	250%
Compresion set (70 hrs at 121°C)	:	38%

C.2.Production operations.

Six Manufacturing processess to be considered are :-

1. Metal Shell preparation
2. Mixing of Rubber compound
3. Blank preparation.
4. Moulding.
5. Finishing.

Flow diagrem is given in Appendix - 1.

C.2.1.Metal shell preparation.

The Metal Shell is punched from mild steel sheet on a power press. The sides of the dise are raised and the centre punched out. These stages can be achieved in a single operation by using a special die. The rough inner edge of the metal shell is then made smooth, if needed, and the top out edge of the shell chamfered on a lathe. Chamfering is not done in the case of Rubber cased seals (Ambassador wheel seals, layland rear inner) Chamfer on the shell not only permits easy assembly of the seal into its housing, but also eases fitting the shell into the mould.

The shell is degreased, if necessary, in hot frichlore ethylene and sand blasted and again cleaned. Banding agent is then applied to the inside of the shell by hand painting. After drying, a protective coating of inner compound in methyl ethyl ketone is also given. Now Metal shell is ready for loading with the unvulcanised rubber blank.

C.2.2.Mixing.

Mixing of polyner with its associated ingredients in its right quantity is done on a two roll mill. Batch weight should not exceed 8 kg. Sulphur should be added at initial stage of mixing for effective dispersion. Following mixing cycle can be used.

Minutes		
0.	—	Add Rubber
3	—	Add S, St.Acid, ZnO and 1/4C black
7	—	Add 1/2 C black and 1/2 graphite
12	—	Add DOP and 1/4 C black and 1/2 graphite
15	—	Add Anti oxidants and Accelerators
16	—	Blend
19	—	Sheet out

Since this is a hard mix, heat may develop; hence it is advisable to cool the stock in water to avoid premature vulcanisation. Maturing will enhance final properties of the product.

3.

C.2.Blank Preparation.

The compound is sheeted out in required thickness on two-roll mill. The sheets are punched out to profuce a 'blank' or 'preform' suitable for moulding to particular shape (Ring form).

C.2.4.Moulding:

Of various moulding techniques - compression, Injection and Transfer, the simplest and widely used is compression moulding, where heated platens transfer heat to the rubber in the cavities to complete the vulcanisation reaction.

The moulds may have there parts; Base plate, a fixed central core mating with the top plate of the mould and a centre ring which holds the metal shell. Moulds are of mild steel construction and can be single or multicavity type. For truck seals, single cavity moulds are used here. For car, scooter and Jeeps, 4 or 6 cavity moulds are used.

Rubber 'Preform' is properly bonded to metal shell and cured by using hand presses. Temperature should be constant. At a temperature of 158°C, the suggested compour will have a cure cycle of 9 - 10 minutes.

C.2.5.Finishing:

A. Flash Removal.

After moulding, seals are rough trimmed by cutting a the flash at the top of the seal where the chamfered edge occurs on the shell. The f[illegible] the sealing edge is

removed next. To obtain the sharp sealing edge, it is better to mould the product with a longer - than - required lip to which flash is attached. The excess is removed by knife cutting. Buffing with felt pads will give a fine sealing edge.

B. Grinding.

The final process of manufacture is the grinding of the metal case to the required tolerance. This can be done in a grinder.

C. Spring insertion

The last step is assembly of helical spring and inserting it into position behind the sealing lip. Spring loops are bought for each size of seal. It springs are getting at length, tapered and of spring should be twisted into the other opened end.

D. Grease application and Packing

To protect steel case against rusting, they may be dipped in a both of molten grease, and wrapped in grease proof polythene bags and finally packed in paper packets and sent to stores.

c.3. Process Loss

The extent of material loss depends on the product and the process. Maximum care should be exercised to avoid losses, since it will affect the working of the project.

In oil seal production, losses generally are compatively low. The losses in the case of oil seals are Blassified as follows:

1. Handling losses:- This includes fly losses during transportation, handling, weighing and compounding.

2. Losses during vulcanisation

These involve flashes mainly.

3. Losses during Metal Cutting

M.S. Sheets are available usually in 8'x4' sizes when cutting metal discs, usually metal losses will be occuring. The whole sheet cannot be utilised to cut out discs. This loss is taken to be 6%.

Overall process losses are taken as 5%.

C.4. Quality Control

Due to the Critical performance of a seal in service, quality control plays an important part in all aspects of seal Manufacture. Quality control operation should start from Raw Material purchase itself. Statistical quality control methods can be adopted.

a. Acceptance Tests

Acceptance tests on all raw materials are done in order to ensure quality. An outline of the tests proposed to be carried out on each material is given below.

1. Polymer

Random samples are selected and tested for moisture content, Acetone extracts and dirt content. Acrylonitrile content is also

measured.

II. Fillers

Fillers are tested for grit content and purity.

III. Antioxidants, Accelerators and Stearic Acid

Random samples are drawn from each lot and tested for melting point, solubility in suitable solvents, etc.

b. In process Quality testings

The following tests are proposed.

1. Specific gravity:- Specific gravity of each batch is tested after press-curing small strip samples. If it conforms to the compound specific gravity the compound can be passed.

II. Hardness:- The hardness of the above strip is measured using shore A durometer. It should come within the range of 85-95.

III. Tensile Properties

1. Tensile Strength : At intervals, samples are drawn and cured in the form of tensile dumbbell pieces of specified dimensions. The test is done in a tensile testor and the force required to break the sample is measured.

2. Modulus at 200% It is the force required to attain 200% elongation.

3. Elongation at Break :

These tests are done to check whether compound is conforming to certain standard performances.

IV. Compression Set

This is an important property which is measured using a compression device. Samples of specific dimensions are cured and tested. Thickness of samples are measured before and after

keeping them at specified compression level for 70 hrs at 121°C. Percentage set is expressed on initial thickness.

e. Product testing

(1) Seal leak test (is: 5125 - 1969)

This test is done on random samples of seals. Test equipment consists of a chamber containing the testing oil, housing for shaft seal and shaft kept at correct position. Provisions have made to drive the shaft at required speed. The temperature of oil can be adjusted to required level. Speed and temperature shall be agreed between the purchaser and the vendor depending upon the actual application of the seal.

(2) Bond Strength

Occassional testing of Rubber-to-Metal Bonding is done in any service laboratory (Common facility centres etc.)

(3) Hardness is again checked.

C.6. Waste disposal

In the case of oil seals, flash losses will not be much. Metal waste during cutting of discs are sold to foumries.

SECTION D.

PRODUCTION REQUIREMENTS

Location, Layout, Selection of Building and of Machinery and equipments are very important because of their long term nature and commitment of capital. All depend on production capacity.

ESTIMATED PRODUCTION (ANNUAL)

1.	TATA Mercedes Benz (New Model) Rear Axle	:	33,000 Nos.
2.	" Front Axle	:	33,000 "
3.	Leyland Comet Rear Wheel inner	:	33,000 "
4.	" Rear wheel outer	:	33,000 "
5.	" Front Wheel	:	33,000 "
6.	Ambassador Front Wheel	:	27,000 "
7.	" Rear Wheel	:	27,000 "
8.	Premier President, Fiat Front wheel	:	27,000 "
9.	" Rear wheel inner	:	27,000 "
10.	" Rear wheel outer	:	27,000 "
11.	Vespa Scooter Crank shaft	:	30,000 "
12.	Willys Jeep Front Wheel	:	30,000 "
	Total	:	3,60,000 Nos.

D.1. Location

Design of location is very important in any industrial undertaking. Because

1. A factory is relatively immobile and once it is established, it is permanent.

2. A change in location involves a large amount of finance and seriously affect the financial condition of the firm.

The factors affecting selection of site of a factory are given below:

Primary Considerations:

1. Proximity to sources of Raw Material.
2. Nearness to markets
3. Transport facilities
4. Availability of power, Water and fuel.

Secondary Considerations:

1. Availability of labour
2. Government restrictions and taxes.
3. Availability and cost of alnd or rentable space.

As oil seal market is wide spread and faw material is avilable everwhere, the factory can be located in kerala where availability position of power, water and skilled labour are good.

Since no factory in Kerala is making seals in mass scale, a unit in Kerala can supply items here itself at a lower cost owing to lesser transportation and distribution costs.

The advantages of site selection in Industrial Estates are the following:-

1. Lower Capital investment - land and buildings are availabe at very reasonable rent.
2. Electricity, water and transport facilities are avilable without xx dely at reasonable rates.
3. Reduce overhead costs to Minimum.
4. Availability of labour in the grade and quantity require.

5. Industrial Estate Provides accommodation for banks, post and telegraphs office, canteen, shops, dispensaries, Recreation facilities, Reading rooms etc.

6. Availability of testing facilities.

7. Collective purchase of Raw Materials.

The proposed project can therefore be advantageously located in an Industrial Estate in Kerala.

D.2. Plant Layout

Plant layout is the physical arrangement of machines and Processing facilities in the manufacturing departments and fixation of manufacturing as well as all service departments in relation to each other in a Preselected location and site.

The Prime points to be remembered in fixing a layout are

1. Effective utilisation of space
2. Minimum Materials handling
3. Reducing Accumulation of in-process inventory.
4. Provision for Expansion
5. Easy supervision.

The layout for the proposed unit is given Appendix II.

D.3. Building Selection

Industrial Estates provide following types of Buildings, at reasonable rent.

Type		Floor Area
A	..	340 Sq.m.
B	..	218
C	..	102
Special	..	770

For finalising the requirement of builp up area for the factory, the following considereations are taken into account.

i) Minimum build up area for the factory

ii) The layout plan to be adopted

iii) Expansion Programmes

iv) Space to be provided for keeping maximum amount of in process inventories, characteristic of process layout.

Considering above points, total building area required is estimated to 3375 Sq.ft. for this firm. Hence A-type building can be conveniently selected for the purpose. The following Areas are adopted for specific departments.

Raw material storage	..	300 Sq.ft.
Metal shell preparation	..	600 "
Compounding	..	150 "
Mixing and Blank preparation	..	300 "
Moulding	..	675 Sq.ft.
Deflashing	..	100 "
Grinding	..	150 "
Spring Insertion & Inspection	..	150 "
Greasing and packing	..	100 "
Laboratory	..	200 "
Finished goods stores	..	150 "
Office	..	200 "

D.4. Requirements of Main Raw Materials

Since Raw Materials are available locally one months storage is sufficient. Quantity required is estimated on the basis of

material content of each product and compounding formulation. A process loss of 5% is given. As a specific case, Ambassador Front wheel seal consists of 15 gms. of metal and 10 gms. of Rubber compound.

D.4.1. Requirement of Compounding Ingrients

		Kg/Annum
Nitrile Rubber	..	2800
Dioctyl Phthalate	..	140
Zinc Oxide	..	140
Stearic acid	..	44
PBN	..	30
HAF	..	1115
Graphite	..	1670
MBTS	..	44
TMT	..	8
Bonding Agent	..	310

D.4.2. Requirements of Metallic Parts

20 SWG MS Sheet is employed for Car seats, scooter and Jeep seats. For Truck, 18 SWG Sheet can be used. Sheets are available locally from hardware retailers or from Iron and Steel factories in bulk.

18 SWG MS Sheets	..	24 Tons/Annum
20 SWG	..	4.3 Tons/Annum

Metal springs for insertion to sealing lips, can be locally made. Sub-contracts are given to people manufacturing springs. All sizes of springs (according to specifications) can be obtained from Metal spring producers outside Kerala. This will incur

transporting expenses. But the item can be got in bulk quantity.

Addresses of suppliers of Raw materials are given in Appendix III.

Terms of Purchase

Raw Material purchase is done through Banks. The purchased materials will be kept in the Bank's godown and materials in small quantities are withdrawn whenever required, on payment of cash. On a margin of 30%, the bank will spend 70% for the purchase of Raw materials. The amount has to be paid in 70 days with interest.

D.5. Machinery - Selection and Utilisation

Machinery selection is the most important since maximum utilisation of machinery gives better return for the money spent. However Maximum utilisation is not always possible when the machine size is fixed by the nature of the product.

The proposed unit plans to work in three shifts. But one shift will be for the production of metal shells only.

The selection depends on mainly two factors - Technical and Economical . First factory considers whether equipment will work in the best way with the required degree of accuracy and whether its capacity is per requirement; Second whether it will be economically justified by the cost savings, time savings and quality of work achieved and other savings of material, labour, operating methods and production control. The kind, capacity, type or make, size, drive etc. factors also need attention. Following aspects also will be necessary.

1. The targeted Capacity.
2. The accepted standard dimensions of the product.
3. The type of production
4. Its effect on the utilisation of all other machinery.

Conserding all these aspects, the following machinery as selected for a production of 3,60,000 nos. of various sizes.

D.5.1. Mixing Mill

Mixing Mill is the most costly machine in oil seal production. Its selection depends on the amount of compound to be mixed and warmed. For production of 1200 seals in two shifts, compound requirements is only about 30 Kgs. In this case, a small size mixing mill will do the purpose. But considering expansion programme and divisification of products, selection of 10"x24" mill of batch weight 8 Kgs. is justifiable. Warming and sheeting out of the compoound can be done using the same mill with a view to utilise it maximum.

D. 5.2. Vulacanising Presses:

For a small scale unit of oil seals, selection of Hydraulic presses will not be economical since pressure required during moulding seals is not high, Hand presses with electric ~~xx~~ heating are enough for the process. Four presses of single daylight are selected. The utilisation of each of these is made to maximin level. (1) 80 curing cycles are possible in two shifts. (2) In a 30x30 press, 4 truck seals can be moulded at a time.

(3) In a 18x18 press, 4 or 6 cavity mould (for car and jeep seals) can be placed for curing. Considering above points, following press are selected.

Platen size	No. of heaters per platen	Wattage per Heater
18x18	3	750
18x18	3	750
30x30	5	1200
30x30	5	1200

D.5.3. Machinery for Metal Shell Preparation:

Power Press: Metal shell preparation is aquick process if machiners employed are power operated. When using a power press, punching discs from the metal sheets and shaping them into shells will take only 1½ minutes (Maximum) . Since truck maim seals have metal shell of Lower gauge, a 10 ton power press with I HP Motor is selected. For cutting higher gauge sheet for other types of seals, hand operated fly press is sufficient. Metal punching is done at a strech and about 20 pieces can be cut within 1 minute using a power press. Hence iflpower press and 1 Fly press are working in three shifts, 1200 metal shells can be prepard easily.

Lathe:

A 3" Lathe is to be employed for chamfuring the outer edge of metal shell for easy assumbly of the seal into the housing.

Although Chamfering will take only very little time, fitting of seal for lathe work needs 40 - 50 Seconds. Altogether, For 1200 seals, a 3' lathe is sufficient.

D.5.4. Other Machinery

1. Sand blasting equipment with a compressor of 14 cft/Min. with 3 HP Motor.
2. Bench grinders (2 Nos)
3. Hand shearing Machine for cutting MS Sheets at a minimum width of 1250 mm.
4. Testing Equipments.
    a. Compression set apparatus
    b. Tensile tester
    c. Seal Leak tester
    d. Ageing oven. etc.

Terms of Purchase of Machinery

1. Quotations are called for and satisfactory quotations are confirmed.
2. Price quoted are exclusive of packing, transportation costs, Sales tax, excise duty.
3. 30% of the price should be paid in advance and the remaining at the time of purchase.
4. Purchaser has the right for inspecting machinery.
5. Supplier possess the right for cancellation, changing delivery time and price due to unforeseen reasons.
6. Warrantky against manufacturing defects is assured.
7. Liabilities passes onto customer immediately after despatch and shortages should be notified within one week.

D.6. Man Power Requirements

The total manpower requirements are classified under the following heads.

i) Administrative Staff

ii) Technical Staff

iii) Labourers.

D.6.1. Administrative Staff

The head of the Administrative Staff is the Manager who handles the overall management of the factory. He should be a technologist as well so that the additional salary incurred on a separate technologist can be eliminated.

D.6.2. Technical Personnel

The head of this department is the Works Engineer who looks after the production. An experienced Mechanical Engineer should be selected. The Production Supervisors are answerable to the Works Engineer.

D.6.3. Labour Requirement

They involve in the actual Production operation. According to the skill and experience required, they can be classified into three classes - skilled, semi skilled and unskilled.

A. Staff Requirement

Job Description	Total Staff per Shift.	No. of Shifts	Total Staff per day
1. Manager cum Technologist	1	1	1
2. Sales Officer	1	1	1
3. Typist/Accountant	1	1	1
4. Works Engineer	1	1	1
5. Production Supervisors	1	3	3
6. Mechanic	1	1	1

B. **Labour Requirement**

	Category	Working Shift.	Requirement/day		
			Unskilled	Semi Skilled	Skilled
1.	Weighing and Material handling	3	3	-	-
2.	Mill Operators	2	-	-	2
3.	Blank Preparation and Application of Bonding Agents	2	4	-	-
4.	Press Operators	2	-	-	4
5.	Flash Removal	2	-	2	-
6.	Inspecting and Grinding	2	-	-	4
7.	Power Press & Fly Press Operators	3	-	-	6
8.	Lathe Work	3	-	-	3
9.	Sand blashing	3	-	3	-
10.	Packing	1	-	1	-
11.	Watchman	3	3	-	-
	Total		10	6	19

Training Programme

Fresh workers should be given adequate training in institutions like common facility centre or other sources. A certain number of experienced hand will be helpful in a new concern. Adequate time should be given for the workers for factory and process familiarisation.

D.7. Infrastructurs and Other facilities

D.7.1. Roads

Roads are important from the point of view of easy accessibility to Raw Materials source, market etc. Since the proposed project is in an Industrial Estate, these problems do not arise.

D.7.2. Water

Water is required for mixing mills and also for workers aminities. Industrial Estate provides water at very nominal charges. If a separate pump is maintained for water pumping, the firm will be exempted from these charges.

D.7.3. Power

Power is easily available in Kerala. Industrial Estates ensure power without expenditure on transformer and other electrica accessories.

Average Power consumption per day will be 500 Kwh.

Industrial concerns will be getting Electricity at concession charges.

SECTION. K

SELLING AND DISTRIBUTION

The most commonly adopted methods of sales are

1. Direct sales by opening sales depots.
2. Through agents on commission basis.

Opening sales depots in important cities and towns is more practicable for large scale manufactures. For small scale concerns, this will involve more overheads. Therefore for the proposed concern the second method of sales through agents on commission basis is preferred.

Retail dealers are provided with 20% commission on sales. They can contact the firm either directly or through distribution agencies (Provided with 5% commission) A local sales depot can be opened which can cater effectively local demand.

Distribution can be on F.O.R. basis. It can also be done through Parcel agencies.

<u>Pricing Policy</u>

Product price is fixed based on

1. Current market price
2. Cost of Production
3. Production capacity
4. Sales Commission and Taxes.

The proposed unit can sell oil seals at a lower rate than present market prices. Since product has been designed with a view of better quality, it will conform to required specifications. Quality products at lower price can ∴ capture existing market easily. Selling prices of this unit are given in Annexure V.

SECTION F.

CAPITAL REQUIREMENTS

The financial aspect of the firm can be given in the following heads:

I. Fixed Capital Requirement

II. Working Capital Requirement.

III. Gross Capital Requirement.

IV. Total Cost of Production

V. Sales and Sales Administration Expenses.

I. Fixed Capital Requirement

It is the sum of the expenses incurred for Plant, Machinery and Pre-Operative expenses. Pre-Operative expenses are accounted for the costs incurred during the idle-time of Plant and Machinery before regular production starts. The estimated fixed capital requirement are as follows:

		₹
1.	Plant and Machinery	2,08,800
2.	Preliminary and Pre-Operative Expenses	17,025
3.	Other fixed expenses	32,000
		₹,57,825
₹.	Total (Rounded off)	2,58,000

Details of fixed capitalare shown in Annexure I.

II. Working Capital Requirement

The working capital requirement depends on

a) The duration for which raw material inventory has to be kept so as to ensure uninterrupted production.

b) The duration involved in manufacturing, marketing and selling

c) The duration for which finished goods should be stocked to ensure uninterrupted supply to the market.

d) The duration between the selling of the goods and the payment to be received.

The costs involved during this interval is called working capital. Since all materials are available indeginiously, one months raw material inventory is enough. Working Capital is taken as the total variable expenditure involved during a definite period (in this case three months) and are classified as follows:

		₹
1.	Raw Materials, cost of Purchase, transportation etc.	1,54,000
2.	Manufacturing cost	
	a. Cost of Utilities	5,700
	b. Salaries and wages.	62,400
3.	Other Overheads.	10,900
	Working Capital	2,33,000

Details of Working Capital components are given in Annexure II.

III. Gross Capital Required

It is the sum of the fixed Capital requirement and working Capital requirement and is the total investment on the scheme. Details are given in Annexure III.

IV. Total cost of production

It includes all the direct and indirect costs involved im the manufacturing operation. Annual cost of production is classified as follows:

1. Raw Material cost
2. Personnel cost - Salaries and Wages.
3. Utilities - It involves cost involved on power.
4. Overhead expenses - Overheads incurred on maintenance of machinery, administrative expenses etc.

5. Other fixed costs and interest on working Capital - Consists of

(a) Factory depreciation

(b) Interest on term loan

(c) Interest on Working Capital.

The annual costs involved in these heads are as follows:-

			Rs
1.	Raw Materials cost	..	6,16,000
2.	Personnel cost	..	2,49,600
3.	Utilities	..	22,800
4.	overhead expenses	..	43,600
5.	Other fixed costs and interest on Working Capital	..	86,640
			10,18,640
	Total cost of Production		10,18,700 (rounded off)

Details are shown in Annexure IV

V. Sales and Sales administration expenses

These are broken down into

i. Sales Commission

II. Marketing, distribution and freight expenses.

III. Sales administration expenses.

Details are shown in Annexure VI

SECTION 9.

FINANCIAL PLAN

Since the finance requirements of any industry are very high, an entrepreneur is unable to meet by himself all the expenses. The Government has launched several financing schemes for helping small scale entrepreneurs. A brief discription of the aids offered by the financial institutions are as follows:

1. State Financial Corporations

Loans of upto 10 lakhs for a period of 12 years, can be obtained for a single concern from this institution. They provide 100% of Machinery cost, 75% of Building cost and 40% of working capital at 7 to 10% interest.

2. Kerala Employment Promotion Corporation

They provide 95% of the cost involved in the purchasing servicing, taxes, insurance and transportation of all Machinery and equipments as a loan on an interest of 7%.

3. Kerala State Small Industries Corporation

Machinery worth upto Rs. 10 lakhs can be obtained on a hire purchase scheme on a marginal money deposit of 20% (10% for technically qualified personnel). Repayment starts after two years and should be complete within 7 years. Interest is 7.5%.

4. Nationalised Banks

Nationalised banks provide entire working capital at 16% interest and loans for Machinery on 25% margin money and 12% interest.

Other institutions are Industrial Development Bank of India.

National Small Industries Corporation , The Unit trust of India etc.

Financing of the Project

The entire machinery costs are proposed to be taken as loan from Kerala Financial Corporation. The entire Working Capital is to be taken from Nationalised Banks.

Borrowings		Amount Rs.
KFC Loan @ 7.5%	..	1,74,000
Nationalised Banks loan @ 16%	..	2,33,000
Own Fund	..	84,000
		4,91,000

SECTION. H
PROFITABILITY

I. Rate of Return on Own Capital

		₹
Own Capital	..	84,000
Net Profit	..	1,02,500
∴ Rate of Return on Own Capital	..	121.7%

II. Rate of Return on Capital Employed

Fixed Capital	..	2,58,000
Working Capital	..	2,33,000
Total Capital Employed	..	4,91,000
Annual Net Profit	..	1,02,500
∴ Rate of Return on Capital employed	..	20.8%

III. Percentage Profit on Sales Turnover

Annual Sales Turnover	..	17,98,000
Annual Net Profit	..	1,02,500
Percentage Profit on sales turnover	..	5.7%

IV. Brake-even analysis

$$BE = \frac{F}{P-V}$$

F = Annual Fixed Costs
P = Price per Unit
V = Variable cost per unit.

Annual fixed costs	..	1,86,700
Average Price per unit	..	5.06
Average variable cost per unit	..	3.35
Braken even production	..	1,69,000 Units
Percentage	..	47%

Details are given in Annexure VIII.

SECTION I
ECONOMIC VIABILITY

I. Interest Commitments		₹
7.5% interest on term loan	..	13,080
16% interest on working Capital	..	37,300
~~Capital~~	..	
Total interest commitments	..	50,380

II. Ability to Payback Borrowed funds

The firm is intended to use 75% of its surplus to payback term loan and the rest is retained. Since part of the term loan is paid back, the ability to pay back loans will be high in subsequent years.

Payback Period

a. Annual Net Profit	..	1,02,500
b. Depreciation	..	36,260
Available Surplus (a + b)	..	1,38,760
Less Drawings	..	38,760
Amount used for repayment	..	1,00,000
Term loan to be paid back	..	1,74,000
Paybadk period	..	2 Years

SECTION J
SOCIAL BENEFITS

I. To the entrepreneur

It gives

a) Profit

b) Opportunity to use his ideas

II. To the Nation

It gives

a) Larger employment with less investment

b) Facilitates an effective mobilisation of local resources and skills.

c) Increase in revenue earnings of the Nation.

d) more equitable distribution of the National income.

C O N C L U S I O N

The present scheme is a Small Scale one as per the definition. There is ample scope for expansion in the same lines of Production or with multiple products with small capital investment. The Project as such is sound, safe and prospectful.

THE PROJECT IN A NUTSHELL

Fixed Capital	:	2,58,000
Working Capital	:	2,33,000
Total Capital	:	4,91,000
Plant and Machinery	:	2,08,800
Location	:	Industrial Estate in Kerala
Building area	:	3375 Sq.ft.
Labour force	:	85
Staff	:	8
Annual Production	:	3,60,000 Oil Seals.

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SECTION K

ANNEXURES.

ANNEXURE-I

FIXED CAPITAL REQUIREMENT

A. Land and Building : Rented

B. Machinery Required

I.	Hand Shearing Machine (Shearing capacity for M.S. Sheets Min. 1250 mm width, 16 SWG thickness)	..	₹ 2,000
2.	Power Press (Capacity: 10 tonnes) with 1 HP Motor	..	10,000
3.	Sand blasting Equipment	..	3,000
4.	Single body Fly Press	..	900
5.	Compressor 14.1 Cft/Min. 3 HP Motor	..	15,000
6.	Lathe (3'), bed length = 927 mm ½ HP Motor	..	10,000
7.	Mixing Mill (10"x24") with reduction gear and Accessories.	..	40,000
8.	Hand screw Presses (Single daylight)		
	Two 18"x18" Presses	..	10,000
	Two 30"x30" Presses	..	20,000
9.	Bench grinders (6" ½ HP Motors)	..	3,000
10.	Buffing Machine fitted with Wheels made from Felt pads and Wire brushes	..	500
11.	Moulds and Tools for shaping and cutting M.S. Shell	..	10,000
12.	Moulds for seals	..	6,000
13.	Sand Sievers	..	200
14.	Testing Equipments:		
	i) Compression set equipment	..	1,000
	ii) Tensile tester	..	10,000
	iii) Ageing Oven (Thermostatically Controlled)	..	6,000
	iv) Shore A durometer	..	1,000
	v) Seal leak tester	..	5,000
	vi) Miscellaneous laboratory equipments	..	15,000

		Rs
15. Weighing Balances	..	
(I) Platform balance	..	1,500
(ii) 15 kg dial Balance	..	3,000
(iii) Pan type Balance	..	900
Total Capital employed for Machinery and Equipments.	..	1,74,000
	..	1,74,000
5% Provision for Price Escallation	..	8,700
Sale Tax @ 7.5%	..	13,050
Transportation charges @ 5%	..	4,350
Erection and installation @ 5%	..	8,700
Total	..	2,08,800
C. Other Fixed Assets		
i) Tank construction with water pump	..	10,000
ii) Seissors, Cutting knives, punching dies, jigs and fixtures and other accessories.	..	5,000
iii) Office Equipments	..	5,000
iv) Furnitures.	..	5,000
v) Tables, racks and Material handling equipments.	..	5,000
vi) Fire Fighting	..	2,000
Total	..	32,000
D. Preliminary and pre-operative Expenses		
Interest on loan (1,74,000 @ 7.5% for 6 months)	..	6,525
Rent and establishment	..	2,000

		Rs
Travelling Expenses	..	3,000
Postage, telegram Telephone etc.	..	1,500
Legal charges	..	500
Advertisement, interview	..	1,000
Printing and Typing	..	500
Miscellaneous	..	2,000
Total	..	17,025

E. Total Fixed Capital Requirement

Plant and Machinery	..	2,08,800
Other Fixed Expenses	..	32,000
Preliminary and Pre-operative Expenses.	..	17,025
Total	..	2,57,825
Rounded off	..	2,58,000

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ANNEXURE. II

WORKING CAPITAL REQUIREMENTS

A. RAW MATERIALS (For 3 months)

	Price/Kg	Quantity required Kg	Total cost Rs
Nitrile Rubber	23	700	16,100
Dioctylphthalate	16	35	560
Zinc Oxide	16	35	560
Stearic Acid	10	11	110
PBN	40	7.5	300
HAF	5.58	278	1570
Graphite	7.50	417	3127
MBTS	28.4	11	312.40
TMT	26.85	2	52.70
Triethylene glycol (Commercial)	30	100	3,000
Methyl Ethyl Ketone (Commercial)	50	100	5,000
Desmodur R	77	65	5,000
Mild Steel Sheet			
18 SWG	3.50	6,000	21,000
20 SWG	4.00	1,075	4,300
Metal spring loops	-	90,000 Nos.	70,000
	Total Cost		1,30,992.10
	Rounded off		1,31,000

Others:	Rs.
Cost of sand required	300
Cost at grease	2,500
Allowance for Raw materials	3,000
Cost of purchasing, transportation, warehousing etc.	10,000
Polythene ships, paper packets etc. for packing	7,000
Total	1,53,800
Rounded off	1,54,000

B. Details of Working Expenses on Man power Requirements:

Administrative and Technical staff.

Category	No. of persons/day	Rate of pay p.m.	Total p.m.
Manager cum Technologist	1	950	950
Works Engineer	1	800	800
Sales Officer	1	650	650
Typist /Accountant	1	350	350
Production Supervisors	3	475	1425
Laboratory Assistants	2	300	600
Mechanic	1	325	325
Wages of Workers:			
Weighing & Material handling etc.	3	200	600
Mill Operators	2	350	700
Blank Preparation	2	250	500

Category	No. of persons/day	Rate of pay p.m.	Total p.m.
Application of Bonding Agents	2	200	400
Press Operators	4	350	1400
Flash Removal	2	250	500
Inspection and Grinding	4	400	1600
Power press and Fly Press Operators	6	350	2100
Lathe work	3	400	1200
Sand Sieving and sand Balshing	3	300	900
Peon/Watch man	3	200	600
Packing and despatch	1	400	400
			16000

For 3 months, 48,000 Rs.

Terminal welfare @ 30% 14,400

Total salaries and wages 62,400

C. Details of Working Expenses on Utilities:

Power	Kw per hour
1 HP Motor for pumping water	0.75
1 HP Power press	0.75
3 HP Compressor	2.2
½ HP Motor for Lathe	0.4
15 HP Motor for Mixing Mill	11.2
Hand Press	16.5
Two ½ HP grinders	0.8
Buffing	0.4
Lighting, Fan etc.	2.0
Total	35.00

Load factor	0.8
Actual Power consumption per hour	28 Kwh
Average power consumption per day	500 "
Cost of electrity	0.15 Rs/Kwh.
Total cost of power for 3 months	5625 Rs.
Rounded off	5,700

D. Other Overheads (For 3 months)

	Rs.
1. Reparis and Maintanance Machinery @ 5%	2,610
2. Travelling Expenses	1,500
3. Advertisement	1,000
4. Printing, Stationery and supplier	1,000
5. Postage and telephone	1,000
6. Rent	1,500
7. Audit fee and legal Charges	500
8. Miscellaneans	500
9. Insurance @ 2% of fixed Capital	1,290
Total	10,900

E. Total Working Capital Requirement(For 3 months)

1. Raw Mateials	1,54,000
2. Salaries & Wages	62,400
3. Utilities	5,700
4. Other overheads	10,900
Total	2,33,000

ANNEXURE.III

GROSS CAPITAL REQUIREMENT.

	Rs.
Fixed Capital Requirement	2,58,000
Working Capital Required	2,33,000
Gross Capital	4,91,000

ANNEXURE .IV

ANNUAL COST OF PRODUCTION

1.	Raw Mateial	6,16,000
2.	Salaries and wages	2,49,600
3.	Utilities	22,800
4.	Other overheads	43,600
5.	Depreciation on Machinery @15%	31,360
6.	Depreciation on other fixed expenses @ 10%	4,900
7.	Interest on term loan for machinery @ 7.5%	13,080
8.	Interest on working Capital @ 16%	37,200
	Total	10,18,540
	Rounded off	10,18,700

ANNEXURE IV.1.

DEPRECIATION AND INTEREST (FOR 3 MONTHS)

Factory Depreciation	Rs.
1. Depreciation on Machinery @ 15%	7,840
2. Depreciation on other fixed assets @ 10%	1,225
Total	9,065

Interests	
3. Interest on term loan for Machinery @ 7.5%	3,270
4. Interest Working Capital @ 16%	9,320
Total	12,590

ECONOMICS OF THE PROJECTS

Cost of production for 3 months	
1. Working Expenses	2,33,000
2. Depreciation	9,065
3. Interest	12,590
Total	2,54,655
Rounded off	2,54,700

ANNEXURE V.

ANNUAL RECEIPTS.

Percentage Defective is taken as 1%

	Item	Selling/ price/ Unit	Quantity in 1 year Nos.	Sales Turnover Rs
1.	Benz Front axle Seal	9.00	32670	2,94,030
2.	Benz Rear Axle	8.00	32670	2,61,360
3.	Leyland Comet Rear Wheel inner	8.00	32670	2,61,360
4.	" Rear Wheel Outer	9.00	32670	2,94,030
5.	" Front Wheel	8.00	32670	2,61,360
6.	Ambassador Front Wheel	2.00	26730	53,460
7.	" Rear Wheel	2.00	26730	53,460
8.	Fiat Front Wheel	2.50	26730	66,825
9.	Fiat Rear Wheel inner	2.50	26730	66,825
10.	Rear Wheel outer	2.50	26730	66,825
11.	Vespa crank shaft 1x99	1.00	29100	29,700
12.	Willys Jeep Front Wheel	3.00	29700	89,100
	Total			17,98,335

Total Sales Turnover = 17,98,000

ANNEXURE VI

SALES AND ADMINISTRATION EXPENSES	Rs
1. Sales Commission @ 25%	4,49,000
2. Annual freight, distribution and handling charges of products.	75,000
3. Sales representatives and Administration expenses.	50,000
Total	5,74,000

ANNEXURE VII

ANNUAL SALES INCOME AND PROFIT

Total Sales Turnover	17,98,000
Less Sales and Sales Administration Expenses	5,74,000
Annual Sales Income	12,24,000
Less Cost of Production	10,18,700
Gross Profit.	2,05,300
Less tax incidents @ 50%	1,02,650
Net Profit.	1,02,500

ANNEXURE VIII

PROFITABILITY ANALYSIS

1. **Rate of Return on own Capital**

Own Capital	: 84,000
Net Profit	1,02,500
Rate of return on own capital	121.7%

2. **Rate of return on Capital Employed**

Fixed Capital	2,58,000
Working Capital	2,33,000
Total Capital	4,91,000
Annual Net Profit	1,02,500
Rate of return on Capital employed.	20.8%

3. **Percentage Profit on Sales Turnover**

Annual Sales Turnover	17,98,000
Annual Net Profit	1,02,500
Percentage Profit on Sales Turnover.	5.7%

IV. **Brake Even Analysis**

Break-even quantity is that quantity, if produced and sold will give neither a profit nor a loss. Break-even point is calculate using the following formula:

$$BE = \frac{F}{P-V}$$

Where F = Annual Fixed Costs (Not varying in proportion to volume of Production)

P = Average Price per unit.

V = Average variable cost per unit (Most varying, directly with volume of Production)

Variable Costs

1.	Raw materials	Rs. 6,16,000
2.	Utilities	22,800
3.	Direct Labour	1,93,440
4.	Sales and distribution costs	5,74,000
	Total	14,06,240

Average variable cost per Unit. 3.96 Rs.

Price per Unit

Annual Sales turnover 17,98,000

Average price per unit 5.06

Annual Fixed Costs

(Total cost + Sales and distribution costs) - Variable cost

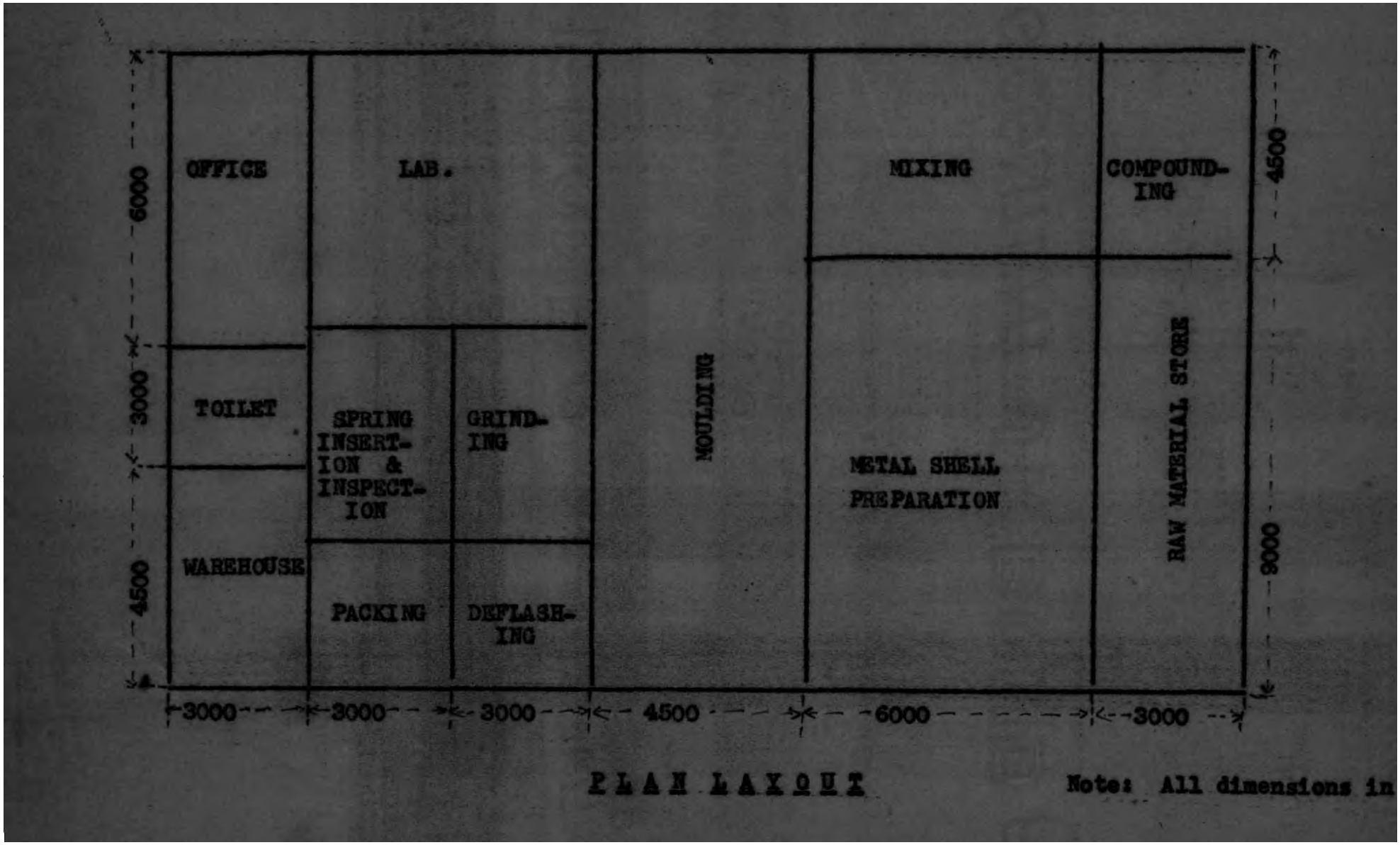
= Rs. 1,86,700

Brake Even Production $= \frac{F}{P - V}$ = 1,69,000 Units

Percentage 47%

SECTION L.

APPENDICES



PLAN LAYOUT

Note: All dimensions in

APPENDIX. III

LIST OF RAW MATERIAL SUPPLIERS

I. Nitrile Rubber

Synthetics and Chemicals Limited,
New Great Insurance Building,
7, Jamshedji Tata Road,
BOMBAY. 1.
(Sales Office: Kottayam, Kerala)

II. Carbon black

A) Philips Carbon black Ltd.,
31, Netaji Subhas Road, Calcutta. 1.

b) United Carbon India Ltd.,
N.K.M. International House,
5th floor, 178, Backbay Reclamation
Bombay. 20

III. Zinc Oxide

a) Anand Chemicals,
8 Horniman Circle, Fort, Bombay. 1.

b) Ashoka Chemical Products,
P-16, Kalakar Street,
Calcutta. 7.

IV. Other Chemicals

a) Alkali and Chemical Corporation of India Ltd.,
Calcutta.

b) Bayer (India) Ltd.,
82, Vir Nariman Road,
Bombay. 1.

c) Mindia Chemicals Ltd.,
Wakefield House, 11 Sprott Road,
Ballard Estate, Bombay. 1.

d) Para Chemicals, C/o. Kerala Paints Pvt. Ltd.,
Mahatma Gandhi Road, Ernakulam, Cochin. 11.

V. Sulphur

Asiatic Chemical Co.
71, Canning Street, Calcutta. 1.

VI. Graphite

a) Graphite India Ltd., 14, Netaji Road,
Calcutta, West Bengal.

b) Graphita Mine of Indian Plumbago Co.
Nagavaramutta, Palavaram Taluk,
West Godavari (Dist.) Andhrapradesh.

VII. Stearic Acid

Goderej Soaps Pvt. Ltd.,
Vikhroli, Bombay. 400 079.

VIII. Solvents

Esso Standard Eastern Inc.
17 J Tata Road,
Bombay. 400 001.

IX. Mild Steel Sheets

i) Tata Iron and Steel Company, Jamshedpur.
ii) Hindustan Steels Ltd., Ramchi, Bihar.

APPENDIX IV

MACHINERY SUPPLIERS

1.	Richardson and Crudas Ltd., Byculla Iron Works, Bombay. 400 008.	Mixing Mills, Moulding Presses.
2.	Ekomech Engineers, 69, Govt. Industrial Estate, Kandivli (West) Bombay. 67	Mixing Mills, Hand Screw Presses.
3.	Sohal Engineering Works, Tulsi Pipe Road, Off Hainee Road, Mahalexmi, Bombay. 400 013.	"
4.	Kelachandra Foundry, Chingavanam. P.O. Kottayam.	"
5.	Batliboi and Co. Pvt. Ltd., Forbes Street, Fort, Bombay. 400 001.	Air Compressors.

6.	Batliboi and Co. Pvt. Ltd., Machinery Division, P.B. No. 1917, M. G. Road, Cochin. 682 016.	Shearing Machine Power Presses, Fly Presses, Lathe etc.
7.	Jayems Engineering Co. M. G. Road, Cochin. 682 016.	"
8.	India Machine Tools Ltd., M. G. Road, Ernakulam.	"
	Testing Equipments	
9.	M/s. Kamal Metal Industries, Arun Park, Bhaipura, Ahmmadabad. 8.	
10.	Indian Engineering Company, Worli & Naka, P.B. No. 16551, Bombay. 18.	

APPENDIX. H

CERTAIN FORMULATIONS FOR ROTARY SEALS

Polychloroprene Compound		Phr.
Neoprene WR-T	..	100
Light Calcined Magnesia	..	4
PBN	..	2
Tri-tolyl Phosphate	..	10
Paraffin Wax	..	2
P_{33} Black	..	100
MPC	..	35
Zinc Oxide	..	5
Stearic Acid	..	1
Ethylene thiourea	..	0.5

Cure, 20 min. at 50 Psi steam.

Nitrile/SBR Blend Compound		
Polysar Krynac 800	..	80
Polysar Krylene NS	..	20
Dibutyl Phthalate	..	10
PBN	..	1
Zinc Oxide	..	5
Stearic Acid	..	1
P_{33} Black	..	100
MPC	..	30
MBTS	..	1.5
TMT	..	0.15
Sulphur	..	1.75
Paraffin Wax	..	2

Cure 20 min. at 297.5°F.