

**REPORT OF THE WORKING GROUP ON
INTERMEDIATE AND SECONDARY
ENGINEERING PRODUCTS FOR
FOURTH PLAN**

**INDIAN RURAL DEVELOPMENT CORPORATION LIMITED
RURAL CONSULTANCY BUREAU, NEW DELHI 1**

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TECHNOLOGICAL CONSULTANCY BUREAU, NEW DELHI**

CONTENTS

	PAGE
1. Introduction	1
2. Demand Patterns	3
3. Installed Capacities in the Third Plan	6
4. New Facilities in the Fourth Plan period	7
5. Some Problems of the Industry	9
6. Iron Castings	11
7. Malleable Castings	14
8. Steel Castings	15
9. Non-ferrous Castings	18
10. Cast Iron Pipes	19
11. Steel Forgings	20
12. Steel Pipes and Tubes	23
13. Gears	25
14. Forging Dies	26
15. Patterns	27
16. Rolling Contact Bearings	28
17. Rolls	30
Annexure A.2.1—Requirements of semi-products, capacities to be generated and suggestions thereon, and magnitudes of investments during the Fourth Plan period.	32

REPORT OF THE WORKING GROUP ON INTER-MEDIATE AND SECONDARY ENGINEERING PRODUCTS

1. INTRODUCTION

1.1. In pursuance of instructions contained in Ministry of Steel, Mines and Heavy Engineering letter No. M.E. Ind. 9 (16)/63 dated the 3rd October, 1963, the National Industrial Development Corporation was appointed as the Working Group for Intermediate and Secondary Engineering Products. The assignment required that the Working Group should assess—

- (i) targets of production,
- (ii) magnitudes of investments involved, and
- (iii) suggest important Projects/Schemes which would have to be taken up.

during the Fourth Plan period.

1.2. Intermediate and Secondary Engineering Products, which may briefly be referred to as semi-products, cover a wide range including castings, forgings, pipes, tubes, dies, pattern etc.

The Working Group has, in its studies, covered the following semi-products:—

- (i) Iron Castings;
- (ii) Malleable Castings;
- (iii) Steel Castings (including alloy steel castings);
- (iv) Non-ferrous castings;
- (v) Cast Iron Pipes;
- (vi) Steel forgings;
- (vii) Steel Pipes and Tubes;
- (viii) Gears;
- (ix) Forging dies;
- (x) Patterns; and
- (xi) Rolling Contact Bearings.

It was realised by the Working Group that the above list did not completely cover all semi-products, but within the time limit available it has not been possible to cover the entire field although the more important ones have been determined.

Demand surveys relating to other items will require considerable amount of time and could be taken up separately if required.

1.3. It is necessary to emphasize that semi-products are as vital as raw materials for ensuring optimum utilisation of machine building facilities. For a variety of reasons capacity in these fields has not kept pace with requirements, with the result that in many instances machine building facilities are unable to operate at full capacity in spite of existing demands. In other cases, less satisfactory and uneconomic designs have had to be adopted.

It is, therefore, vital that due emphasis be given to the speedy building up of adequate capacities for the production of Intermediate and Secondary Engineering Products during the coming years of the programmes of industrial development and particularly those relating to the machine building industries are not to suffer for available reasons.

2. DEMAND PATTERNS

2.1. A separate Report has been prepared by the Working Group on the demand patterns of Intermediate and Secondary Engineering Products and the same is appended to this Note. The method of data collection and co-relation relating to each of the semi-products has been defined in this Report.

2.2. The Working Group wishes to emphasize that it has not been possible, due to the current National Emergency, to make any assessment of the requirements of Intermediate and Secondary Engineering Products for Classified purposes. Allowances would, therefore, have to be made for such requirements additionally other than the production facilities and programmes controlled by the Ministry of Defence.

2.3. In making the detailed study of demands, an endeavour has been made to develop norms of consumption of the various Intermediate and Secondary Engineering Products so that these could form the basis for assessing the total requirements of such products. A note of caution is, however, necessary regarding the application of such norms to future targets of production. Changes in product-mix, design of product, methods of manufacture and of technology, may result in significant changes in specific norms. In other words, norms developed, such as in the present case, while considered as being well representative of current requirements may need revision after some time to ensure that any changes in product-mix, design or modes of manufacture are duly allowed for. Within relatively shorter periods of time, however, the use of such norms for the purpose in view may be accepted as being quite satisfactory.

2.4. The total requirements of individual Intermediate and Secondary Engineering Products have been estimated on the basis of production programmes envisaged by the Planning Commission in their preliminary estimates for the machine building industry during the Fourth Plan period. While some modifications to the original estimates of the Planning Commission were intimated to the Working Group, it is likely that as a result of studies now in progress by other Planning Groups, some of the initial targets may again have to be revised. Unless the variations in the preliminary targets set by the Planning Commission are very wide, the variations in total requirements of the respective Intermediate and Secondary Engineering Products are not likely to be other than marginal.

2.5. Apart from the detailed investigations of actual end-users' requirements of semi-products in the country and the determination of total demands on that basis, the requirements may also be checked by co-relating them to—

- (i) Finished steel production or
- (ii) Increase proportionate to investments in machine building industries during the Fourth Plan period.

While such comparisons are useful to the extent of being *indicators of the orders of magnitude*, it would not be correct to adopt such comparisons as the basis of computation of actual requirements.

2.6. An approximate idea of requirements can be judged by taking the ratio of the requirements of a particular semi-product to total finished steel production and comparing this with corresponding ratios obtaining in other countries. Thus, for example, the ratio of total iron castings (including pipes and malleable castings) to finished steel production in U.K. ranged from 21.1% to 23.6% over the period 1956-'61. The requirements of all types of iron castings (including pipes and malleables) during 1970-71, as determined by the Working Group, would amount to approximately 24.3% of the finished steel production in that year. Having regard to the fact that the estimated requirements are *exclusive of classified demands*, this percentage compares well with the corresponding figures for U.K. Such comparisons can serve no better purpose. Determination of actual requirements through such comparisons, disregarding data collected from actual end-users is not a satisfactory procedure, particularly when it is remembered that there are bound to be variations in such ratios due to variations in product-mix, exports etc.

2.7. Since total industrial production in 1965-66 is expected to double itself by 1970-71, it can be argued that the requirements of Intermediate and Secondary Engineering Products would also double themselves, approximately. This simple means of determining targets of production would have been reasonably correct if the rate of increase in production capacity were to uniformly double itself in the case of all end uses. Such is, however, not the case. For example, the annual requirements of cast iron sleepers for the Railways—which is one of the largest single item in iron castings—is expected to remain approximately the same. This is due to the targets adopted for new tracks and track renewals. Any attempt, therefore, to determine requirements on such a basis is likely to lead to erroneous results. In fact, this method cannot even serve as a satisfactory indicator.

2.8. A summary of requirements of various Intermediate and Secondary Engineering Products studied in detail by the Working Group may be seen in the Table at Annexure A.2.1. The Table also summarizes the gaps in installed capacity to be covered during the Fourth Plan Period, magnitudes of investments and the various suggestions of the Group relating to creation of new facilities. These requirements and other aspects of capacity build-up etc., relating to each of the semi-products are discussed separately.

3. INSTALLED CAPACITIES IN THE THIRD PLAN

3.1. The Working Group has assumed the installed capacity which is expected to be generated by 1965-66 on the basis of advices received from concerned authorities including the Department of Technical Development, the Small Scale Industries Organisation and the Railways etc. These anticipated installed capacities have been adopted as the basis of indicating the additional capacities which would have to be generated during the Fourth Plan period.

3.2. While in the case of most of the semi-products it has been possible to assess the installed capacity likely to develop by 1965-66, as most of such capacity is identifiable in special manufacturing units, there are a few cases in which such direct assessment of installed capacity has not been possible. The latter include:—

- (i) Gears;
- (ii) Forging Dies; and
- (iii) Patterns.

3.3. The above three items are mostly being produced at present in captive units and installed capacities are not readily identifiable. The installed capacity in such cases can, therefore, be determined only by undertaking a detailed country-wide census. This, the Working Group has not been in a position to undertake. For the purposes of this Report, therefore, reference has been made to the increase in requirements which will occur during the Fourth Plan period and to indicate the additional capacity which would be necessary to cater for this increase in demand. It is, however, appreciated that the actual increase in installed capacity would have to be higher than these figures as it is well-known that the present production capacity for gears, forging dies and patterns falls considerably short of the actual requirements.

The Working Group would suggest that a detailed census be undertaken to accurately determine the installed production capacity for such items which is expected to develop by 1965-66. Such a census would then furnish accurate data for the establishment of additional capacity during the Fourth Plan period.

4. NEW FACILITIES IN THE FOURTH PLAN PERIOD

4.1. Data were obtained by the Working Group on the costs involved in expansion of existing facilities and for the establishment of new production facilities as well as the extent to which benefits could be derived by substantial expansion of existing facilities. It will be appreciated that actual investments would vary considerably from case to case for the same type of product depending upon product-mix, specialised production required, quantum of production etc. The figures indicated in this Report are overall averages for each type and are merely indicative of the extent of investment which would be involved in creating the required facilities during the Fourth Plan period.

4.2. While the Working Group has refrained from making any specific recommendations as to whether particular facilities should be created in the Public or Private Sector, since this is largely dependent on administrative policies, the Group has endeavoured to identify specific schemes which, in its opinion, would be the most beneficial for future development.

4.3. The Working Group is of the opinion that in developing new production facilities during the Fourth Plan period consideration could be advantageously given to the following factors:

- (i) Establishment of production facilities for certain types of semi-products oriented to specific end-user requirements. This approach would lead to the benefits of specialisation and a greater measure of understanding between the producers and users of particular products.
- (ii) Approximation of production facilities for semi-products to actual users, to the extent this is technically and economically possible. This would reduce overall costs including those of transportation and would call for a rational location of new facilities with greater emphasis on regional requirements.
- (iii) Greater emphasis on the establishment of economic sized units which would avoid the economic disadvantages of establishing relatively small production capacities in large numbers or the very great administrative and other difficulties which are encountered in the establishment of single large units.

In determining the extent to which the growth of numbers can be permitted, it is necessary to steer clear both of excessive concentration as well as of wasteful fragmentation of industrial capacities. In reviewing the numbers of programmes already approved it becomes evident that reasonable proportions have already been achieved in most cases to ensure competitive growth.

- (iv) Greater emphasis on expansion of already approved programmes so that economic levels of investment and production can be speedily achieved and to concentrate on the generation of new capacity in specialised fields of application and methods.

The Working Group has endeavoured to keep the above considerations in view while formulating its views on the manner in which additional capacity for Intermediate and Secondary Engineering Products could be generated during the Fourth Plan period.

5. SOME PROBLEMS OF THE INDUSTRY

5.1. Existing facilities for the production of semi-products are already beset with a variety of difficulties. The solution of these can be delayed only at the peril of a further deterioration in the coming years in the availability of semi-products and investment returns, to say nothing of the continuing dependence on imports for such items. These include: —

- (i) Lack of adequate supplies of essential raw materials particularly foundry grade pig iron;
- (ii) Lack of adequate supplies of other graded scrap;
- (iii) Inadequate capacity for the design and manufacture of patterns, dies and moulds;
- (iv) Inadequate attention to the training of technical personnel at all levels;
- (v) Slow growth of manufacture of the special types of plant and machinery required for such facilities; and
- (vi) Research into the use of alternative materials for semi-products.

Frequently, the non-availability of an Intermediate and Secondary Engineering Product results in the end-user having to import not just that item itself but the much more expensive complete unit of which the semi-product is but a single element. Action is, therefore, urgently necessary to ensure that the foregoing difficulties standing in the way of fulfilment of semi-product programmes are speedily removed. Research on the use of more modern alternatives to the conventional materials for the manufacture of semi-products would help considerably in future developments as well as in lowering investments.

5.2. Speedier action in creation of additional capacities for pig-iron production appear to be of vital importance. No doubt, this matter would be engaging the attention of the Study Group concerned.

5.3. The increase in production facilities for Intermediate and Secondary Engineering Products will call for a substantial increase in the requirements of technical personnel. Arrangements must, therefore, be made as early as possible to have technical personnel already employed in the manufacture of semi-products to acquaint themselves with the latest techniques and equipment.

Training of lower cadres should be planned on an overall programme basis to ensure availability at the appropriate time for the new and expanding facilities. It may be desirable to associate the related Manufacturers' Associations in urgently studying this matter in detail and to suggest ways and means for the selection and training of personnel as well as of financing such training schemes.

5.4. A matter calling for urgent action relates to the creation of capacity for the designing and manufacture of patterns and dies. Shortages are already so large and the consequences so disturbing that the formulation and implementation of at least a few new schemes in this respect need not await any elaborate estimations of future demands.

In case, for any reasons, the generation of such capacity in the Private Sector is likely to require any length of time, it would be to the benefit of Industry as a whole if two or three programmes are immediately taken up in the Public Sector.

An important aspect in this connection is die designing. There are not many die-designers in the country and a special programme for having some trained abroad should be taken up urgently.

5.5. In the past, delays in preliminary planning, investigation and development of plant designs have led to serious set-backs in generation of new capacities. Irrespective, therefore, of the ultimate ownership of a new facility, it would be most desirable to immediately order for the preparation of Detailed Project Reports and Engineering Designs for specified new facilities which may be considered as being obviously necessary during the Fourth Plan period.

In most cases of Intermediate and Secondary Engineering Products, considerable technical know-how exists in the country for the Engineering of new projects. The harnessing of such indigenously available resources for preliminary investigations, preparation of detailed project reports and engineering designs as well as for the actual construction and commissioning of new facilities and/or expansion of existing facilities will help conserve appreciable quantities of foreign exchange. A decision to utilize Indian Technical Personnel for the preparation of detailed Project Reports and for the actual planning and implementation of schemes for the production of semi-products would go a long way in providing the necessary experience in this vital field through work on what may be loosely termed as relatively simpler projects.

6. IRON CASTINGS

6.1. The estimated annual requirements of iron castings, excluding cast iron pipes and malleable castings, has been placed at 22.3 lakh tonnes per annum by 1970-71. This would on an average, require an installed capacity of 28.0 lakh tonnes per annum.

6.2. The installed capacity for the production of iron castings (excluding C. I. Pipes, malleable castings), including facilities in the small scale sector and the captive foundries of the Railways, is expected to reach 15.0 lakh tonnes per annum by 1965-66. In other words, an additional installed capacity of $28.0 - 15.0 = 13.0$ lakh tonnes per annum would have to be generated during the Fourth Plan period.

6.3. Most of the foundries in the small scale sector would not lend themselves readily to any substantial expansion. The installed capacity of captive foundries of the Railways is expected to reach around 60,000 tonnes per annum by the end of the Third Plan period. Furthermore, the installed foundry capacity in the steel plants intended to meet the plants' own requirements of ingot moulds, etc., would be of the order of 1.5 lakh tonnes per annum by 1965-66. The capacity with regard to the latter would be subsequently expanded in conformity with the steel plants' own requirements. In other words, out of the total installed capacity of around 15 lakh tonnes per annum by 1965-66, a total of 10 lakh tonnes per annum could be considered for expansion. However, having regard to the initial plant layouts, actual production experience gained etc., it is likely that only around 7 lakh tonnes/annum would really be amenable to further expansion during the Fourth Plan period.

On an average, expansion of such foundries could be placed at around 20% of their installed capacity. Thus, around 1.5 lakh tonnes per annum could be created in the Fourth Plan period by expansion of units in existence in 1965-66. This would leave a total of around 11.5 lakh tonnes per annum additional installed capacity to be generated in the Fourth Plan period by new units.

6.4. The requirements of the Railways would call for a total installed capacity of around 5.5 lakh tonnes. Due to the shift in emphasis from steam locomotive production to other types of motive power and a more or less constant rate of requirements for track materials, the total requirements of the Railways during the Fourth Plan period approximate

those during the Third Plan period. As such, available capacity already catering to the needs of the Railways could continue to meet the requirements during the Fourth Plan period without any substantial additions.

6.5. The requirements of ingot moulds for the production of approximately 18 million tonnes of steel (including alloy steels) would, if all production was to be of ingot steel amount to around 5.4 lakh tonnes per annum, by 1970-71. However, on the assumption that the continuous casting process would be adopted to a limited extent, requirements of ingot moulds has been placed at 4.5 lakh tonnes per annum. It has been assumed in this study that all the requirements for the production of ingot moulds will be catered for by adequate casting capacity being provided in the steel plants themselves to cater for their individual requirements.

6.6. Very heavy castings such as those required for metallurgical equipment, heavy machine tools, large size pumps and compressors etc., would call for an installed capacity of around 1.0 lakh tonnes per annum by 1970-71. Against these requirements, the installed capacity of Heavy Engineering Corporation, Ranchi, is expected to reach around 45,000 tonnes per annum by the end of the Fourth Plan period for such items. The balance of around 55,000 tonnes per annum installed capacity will need to be created in new units during the Fourth Plan period. This could be done by providing a grey iron foundry of around 20,000 tonnes per annum installed capacity in the second Foundry/Forge Plant to cater primarily for heavy electrical equipment manufacture and around 25,000 tonnes per annum installed capacity in yet another specialised foundry producing iron castings for the manufacture of large pumps and compressors, large diesel engines, other heavy tools etc.

6.7. Automotive engines, small pumps and compressors etc., call for high grade thin walled castings. At present, except for the specialised foundries attached to automotive manufacturing plants where such high grade metal is being produced, most of the other requirements in this category are being met with by the use of somewhat lower grades of metal. It would be desirable to switch the capacity of existing suppliers to other types of castings where lower grades of metal are commensurate with specification requirements and to cater to the requirements of these specialised castings through production in special units where quality control and modern techniques of manufacture can be ensured. By the end of the Third Plan period installed capacity available in the country for the production of such high grade thin walled castings would be of the order of 60,000 tonnes per

annum. This could be increased by another 20,000 tonnes per annum during the Fourth Plan period by expansion of some of the existing units, particularly those attached to automotive manufacturing plants. The balance of around 1.7 lakhs tonnes installed capacity per annum would have to be catered for by the installation of new units employing modern techniques of manufacture and quality control.

Economic production of such castings can be achieved in a unit with an installed capacity of around 10,000 tonnes per annum.

6.8. The total requirements of iron based rolls for steel making and other industries would call for an installed capacity of around 55,000 tonnes per annum. Although some schemes have been approved in this connection, it appears doubtful if the capacity which would build up by the end of the Fourth Plan period would be materially greater than the 10,000 tonnes capacity expected to be generated by Heavy Engineering Corporation, Ranchi. The balance of around 45,000 tonnes installed capacity would have to be catered for by the setting up of new units. This figure may be reduced to the extent that programmes already approved are ensured of going into production by 1970-71. The manner in which the requirements of iron-based and other rolls can be covered is discussed elsewhere.

6.9. It will be observed that out of the total increase in installed capacity of 13 lakh tonnes per annum required during the Fourth Plan period, 1.5 lakh tonnes per annum would be through substantial expansion of existing units and 11.5 lakh tonnes through establishment of new capacity. Of the 11.5 lakh tonnes per annum new capacity, specific projects totalling up to around 7 lakh tonnes per annum installed capacity have been identified in the foregoing paragraphs. The balance of the requirements relate to general purpose castings and will have to be ensured by the establishment of new units of economic size suitably designed to allow for subsequent expansions.

6.10. At present day levels of equipment costs etc., the overall average investment for the new foundries would be of the order of Rs. 1,400. per tonne of Iron Castings and Rs. 500 per tonne for the expansion of existing foundries.

On the above basis, the total investment involved during the Fourth Plan period for developing the additional installed capacity, excluding facilities in the Steel Plants will be around Rs. 99.0 crores of which Rs. 38.0 crores will be in foreign exchange.

7. MALLEABLE CASTINGS

7.1. The estimated annual requirements of malleable castings has been placed at 1.1 lakh tonnes per annum by 1970-71. This would, on an average, require an installed capacity of 1.4 lakh tonnes per annum.

7.2. The installed capacity for the production of malleable castings is expected to reach around 80,000 tonnes per annum by 1965-66. In other words, an additional installed capacity of $140,000 - 80,000 = 60,000$ tonnes per annum would have to be generated during the Fourth Plan period.

7.3. The rate of build up of production capacity for malleable iron castings has been relatively slow due to the techniques involved calling for long periods of experience. It may, therefore, not be possible to expand existing facilities to the extent that would otherwise have been possible. Existing units may prefer to concentrate on improving the quality of their castings rather than get involved in expansion programmes. Having regard to this factor, therefore, increase in installed capacity during the Fourth Plan period through substantial expansion of existing units may be limited to around 20,000 tonnes per annum. The balance requirements of 40,000 tonnes per annum installed capacity would have to be met by the setting up of new facilities.

7.4. At present day levels of equipment costs, etc., the overall average investment for expansion of existing plants would be around Rs. 900 per tonne. New facilities would require around Rs. 2,200 per tonne. On this basis, the total investment involved during the Fourth Plan period would be of the order of Rs. 10.6 crores. Of this, the foreign exchange element would be round Rs. 4.3 crores.

8. STEEL CASTINGS

8.1. The estimated annual requirements of steel castings has been placed at 4.75 lakh tonnes per annum by 1970-71. This would, on an average, require an installed capacity of around 5.9 lakh tonnes per annum.

8.2. The installed capacity for the production of steel castings including facilities in the captive foundries of the Railways and steel plants is expected to reach around 2 lakh tonnes per annum by 1965-66. In other words, an additional installed capacity of $5.9 - 2.0 = 3.9$ lakh tonnes would have to be generated during the Fourth Plan period. Excluding the captive steel casting capacity in the steel plants it is estimated that it should be possible to increase the installed capacity through substantial expansion of some of the better planned existing units to the extent of 30,000 tonnes per annum during the Fourth Plan period. Thus, it will be necessary to plan for the provision of the balance of $3.9 - 0.3 = 3.6$ lakh tonnes per annum installed capacity through the establishment of new facilities.

8.3. The maintenance requirements of the steel plants requiring to around 90,000 tonnes per annum and requiring an installed capacity of around 1.1 lakh tonnes would be catered for by the expansion of such facilities in existing plants commensurate with their increased requirements as also the establishment of new facilities in the new steel plants programmed during the Fourth Plan period.

8.4. The manufacture of metallurgical equipment essentially by the Heavy Engineering Corporation, would require a total of around 87,000 tonnes of steel castings per annum involving an installed capacity of about 1.1 lakh tonnes per annum. These requirements are programmed to be substantially met by the installed steel casting facilities being established by the Heavy Engineering Corporation itself.

8.5. Steel rolls for steel plants and other consumers amounting to 24,000 tonnes per annum would require an installed capacity of around 30,000 tonnes per annum. Of this the Heavy Engineering Corporation is programmed to cover around 5,000 tonnes per annum. The balance of around 25,000 tonnes per annum capacity would have to be generated through the establishment of new production facilities since there is no capacity in the country at present for the manufacture of such rolls. Details in this regard are dealt with separately.

8.6. The manufacture of heavy electrical equipment would involve around 15,000 tonnes of steel castings by the end of the Fourth Plan period. This would call for an installed capacity of around 30,000 tonnes per annum. The Second Foundry/Forge Plant as a part of the Heavy Electricals Ltd., would thus cover the requirements of such castings.

8.7. Other heavy castings which would be required for heavy equipment such as the large pumps, compressors, cranes, marine engines etc., amounting to around 15,000 tonnes per annum would call for an installed capacity of 20,000 tonnes per annum. There are no facilities at present in the country for the manufacture of such heavy and specialised castings. It would be desirable to set up two separate facilities each with an annual capacity of around 10,000 tonnes for the production of such heavy castings. These two units could be suitably located to cater for regional requirements.

8.8. The demand survey has determined the requirements of special steel castings for Railways, particularly for cast steel bogies for the broad gauge wagons on the basis of 50% of such wagons produced in 1970-71 being fitted with cast steel bogies instead of fabricated bogies. At present the Railways are continuing to use the fabricated bogie for want of cast steel bogies although the adoption of the former design has reduced the pay-load of the wagon and also tends to increase maintenance costs. There must, therefore, be an endeavour to provide the necessary facilities for the production of cast steel bogies so that full advantage of the new type of wagon can be obtained at an early date. The requirements of such castings would amount to around 24,000 tonnes per annum involving an installed capacity of around 30,000 tonnes per annum by 1970-71. It is understood that one of the leading steel foundries in the country has already made arrangements for the production of around 10,000 tonnes of such cast steel bogies and that the Railways are planning a separate Steel Foundry for the production of around 20,000 tonnes as well. These two programmes should, therefore, substantially cover the requirements of cast steel bogies by the end of the Fourth Plan period.

8.9. Of the remaining requirements of the Railways amounting to around 87,000 tonnes per annum and involving an installed capacity of around 1.1 lakh tonnes per annum by 1970-71 the Railways own foundries would be catering for around 15,000 to 18,000 tonnes per annum. The remaining requirements would have to be met with either from existing units or new units which would come up during the Fourth Plan period for general steel casting production. Most of the

steel foundries in the country—apart from the captive units—are general steel foundries able to cater for average sized castings only. The expansion of such foundries has already been indicated to be of the order of around 30,000 tonnes per annum. A part of this expansion would no doubt cover the additional requirements of the Railways and the balance to be provided by new units.

8.10. Apart from the requirements referred to in the earlier paragraphs the balance requirements of general steel castings for all other users amounting to 1.3 lakh tonnes per annum would call for an installed capacity of around 1.6 lakh tonnes per annum by 1970-71. This installed capacity along with around 90,000 tonnes of installed capacity required for the Railways as referred to in the previous paragraph would have to be met by the capacity generated by the end of the Third Plan period, expansion of some of these units to the extent of around 30,000 tonnes per annum and the establishment of new units during the Fourth Plan period.

8.11 Although licences have been granted to the extent of 3.7 lakh tonnes per annum (including units already in production) indications are that a large number of these may not become effective in a reasonable period of time. It has been shown in the two previous paragraphs that a total of 2.5 lakh tonnes of installed capacity would be required for general steel castings by the end of the Fourth Plan period. Thus, new units would have to be brought into this field to the extent that programmes envisaged at present do not bear fruit. By and large, an economic sized unit for such a product-mix would be of around 5,000—6,000 tonnes per annum.

8.12. At present day levels of equipment costs, the overall average unit investments involved in the above mentioned facilities to be created would be of the following order:—

New Units—Rs. 3,400.

Expansion—Rs. 1,300 per tonne/annum.

On this basis the total investment for the generation of additional installed capacity, excluding facilities in the new steel plants, during the Fourth Plan period would amount to around Rs. 107.3 crores. Of this the foreign exchange element would be around Rs. 43.0 crores.

9. NON-FERROUS CASTINGS

9.1. The estimated annual requirements of non-ferrous castings (of all types of metals) have been placed at 54,500 tonnes per annum by 1970-71. These requirements would, on an average, require an installed capacity of around 68,000 tonnes per annum.

9.2. It has not been possible for the Working Group to get detailed information of the installed capacity likely to be available by the end of the Third Plan period. A large number of existing facilities are captive units and the exact extent of installed capacity can only be determined through a nation-wide census. The increase in demand during the Fourth Plan period itself would call for an additional installed capacity of around 37,000 tonnes.

9.3. In the absence of details regarding existing facilities and their capacities it has also not been possible to determine the extent to which expansion could be considered during the Fourth Plan period. For the purpose of this study, however, it may be assumed that the gap between demand and production at the end of the Third Plan could be substantially covered by expansion of existing facilities and that the additional demands during the Fourth Plan period would be covered by new facilities. On this hypothesis, new facilities to the extent of 37,000 tonnes per annum would have to be created during the Fourth Plan period.

9.4. At present day levels of equipment costs the overall average of investment involved in setting up a new facility would be of the order of Rs. 650 per tonne per annum of non-ferrous castings. On this basis, the total investment for the setting up of 37,000 tonnes per annum of new facilities during the Fourth Plan period would amount to around Rs. 2.4 crores with no element of foreign exchange involved.

9.5. The Working Group would suggest that a census be arranged to get a complete picture of the available installed capacity for the production of various types of non-ferrous castings in the country.

10. CAST IRON PIPES

10.1. After allowing for a substitution of around 1.4 lakh tonnes per annum of cast iron pipes by spun concrete and asbestos cement pressure pipes, the requirements of cast iron pipes has been placed at 9.4 lakh tonnes per annum by 1970-71. This would require an installed capacity of around 11.3 lakh tonnes.

10.2. The installed capacity expected to be generated by the end of the Third Plan period has been placed at 9 lakh tonnes. Considering that the accent in future development of this certain industry would be on the generation of capacity for the manufacture of Spun Iron Pipes in preference to Sand Cast Pipes, additional capacity amounting to 2.3 lakh tonnes per annum of Spun Iron Pipes would have to be created during the Fourth Plan period. Existing production capacity of Sand Cast Pipes would be adequate for meeting the demands for drain pipes, etc.

10.3. The economic size of a spun iron pipe plant is placed at 30,000—40,000 tonnes per annum. Considering that a large number of units already in production and under implementation are somewhat below this level it is estimated that an additional capacity of around 1.7 lakh tonnes per annum could be generated through substantial expansion of units in production at the end of the Third Plan period. The balance of 60,000 tonnes per annum would have to be generated by the establishment of new facilities. On the basis of economic size referred to earlier, this could call for 2 new plants.

10.4. On the basis of an investment norm of Rs. 320 per tonne of installed capacity for the establishment of a new spun iron pipe plant and Rs. 200 per tonne of installed capacity for expansion of existing units, the total investment in the Fourth Plan period would be approximately Rs. 5.3 crores, of which the foreign exchange component would be about Rs. 3.2 crores.

11. STEEL FORGINGS

11.1. The estimated annual requirements of steel forgings has been placed at 3.95 lakh tonnes per annum by 1970-71. This would, on an average, call for an installed capacity of around 4.4 lakh tonnes per annum.

11.2. The installed capacity for the production of steel forgings including the facilities in captive forge plants of the Railways is expected to reach around 1.7 lakh tonnes per annum by 1965-66. Thus, an additional installed capacity of 2.7 lakh tonnes per annum would have to be generated during the Fourth Plan period.

11.3. The requirements of steel forgings for the maintenance of steel plants amounting to 19,000 tonnes/annum shall be essentially met by production facilities in the plants themselves. These would be catered for by expansion of such facilities in existing plants to the extent necessary and creation of new facilities in the new plants to be set up during the Fourth Plan period.

11.4. The requirements for the manufacture of metallurgical and coal mining machinery amounting to around 70,000 tonnes per annum are expected to be covered by the production facilities to be created by the Heavy Engineering Corporation.

11.5. The requirements of forgings for heavy electrical equipment manufacture amounting to 11,000 tonnes would be catered for by the creation of new facilities in the proposed Second Foundry/Forge Plant to be set up by Heavy Electricals Ltd.

11.6. At present there is no facility for the manufacture of pipe moulds in the country and all such moulds are being imported from abroad. It will be necessary to set up facilities for the forging of pipe moulds amounting to 10,000 tonnes/annum in new units to be suitably located in the country to meet the requirements of spun pipe manufacturing units. Since such units are intended to be fairly well distributed all over the country it would perhaps be desirable if two separate Pipe Mould Forging units are established in separate regions to cater for neighbouring requirements. Each plant could have an initial installed capacity of around 6,000 tonnes per annum with planned possibilities for future expansion in the coming year. Pipe mould manufacture calls for specialised

techniques and as such it would be desirable if the production facilities for such forgings are separately identified.

11.7. The total requirements of forged rolls has been estimated at 12,000 tonnes per annum which would call for an installed capacity of around 13,500 tonnes. Of this, the Heavy Engineering Corporation is expected to produce around 3,600 tonnes per annum. The balance of 7,400 tonnes involving an installed capacity of around 8,200 tonnes per annum would have to be created by the establishment of new facilities. The manner in which these facilities may be created is dealt with separately in this Report.

11.8. The requirements of 5,000 tonnes/annum of relatively heavy forgings for the manufacture and maintenance of equipment such as heavy pumps and compressors, marine engines etc., would call for an installed capacity of around 5,600 tonnes per annum. Such facilities do not exist at present and would have to be catered for by the establishment of at least one new unit in the country.

11.9. The forgings required by the Railways by 1970-71 would be around 6,600 tonnes/annum. The increase in requirements during 1970-71 over 1965-66 would be around 6,000 tonnes per annum. The requirements of forgings for Railways is already being met by very substantially by the captive forging facilities of the Railways themselves. The relatively lower increase in the demand is primarily due to the fact that the production of steam locomotives which involves considerable quantities of forgings is intended to be substantially reduced during the Fourth Plan period. This increase in demand would involve an additional installed capacity of around 7,000 tonnes which could quite easily be built by expansion of existing facilities in the Railways and those units in the Trade which are catering essentially to Railway requirements.

11.10. Other forgings which include automotive uses, cement production, building and road construction machinery manufacture and other general forgings amounting to a little over 2.0 lakh tonnes, would require an installed capacity of around 2.24 lakh tonnes per annum by 1970-71. Apart from the expansion in installed capacity for Railway uses amounting to around 7,000 tonnes per annum which has been referred to earlier, it is estimated that existing facilities in the Trade catering to the types of requirements as referred to herein could be expanded by around 30,000 to 35,000 tonnes per annum during the Fourth Plan period. This would necessitate the creation of new facilities for the production of

around 1.0 lakh tonnes by the establishment of new installed capacity of around 1.1 lakh tonnes per annum.

Average economic size units for the production of such general forgings would have to be around 5,000 to 6,000 tonnes per annum installed capacity. In planning such new facilities care should be taken that layouts etc., provide for a adequate expansion in the future to build up capacities to around 12,000 to 15,000 tonnes per annum. Since requirements of such forgings would be fairly well distributed all over the country it would be desirable to ensure that new facilities are created in a manner as to enable localised utilisation of such facilities, to the maximum extent possible.

11.11. Summarising, it will be seen that the total additional installed capacity of 2.7 lakh tonnes per annum to be created during the Fourth Plan period would be met by the expansion of facilities on the Railways and in the Trade to the extent of around 40,000 tonnes per annum and the creation of new facilities for the balance in specific units as detailed above and general purpose forging plants in the Trade.

11.12. At present day levels of equipment costs etc., the overall average investment for the new plants would be of the order of Rs. 4,100 per tonne. As regards expansion of existing facilities the order of investment would be around Rs. 2,500 per tonne.

On the above basis, the total investment for the generation of additional capacity in steel forgings excluding the facilities in the steel plants themselves during the Fourth Plan period would be of the order of Rs. 100 crores. A large proportion of equipment for the heavier vehicles would have to be imported, although in the case of lighter vehicles a somewhat higher proportion would be available indigenously. On this basis, the foreign exchange element has been placed at around Rs. 39 crores.

12. STEEL PIPES AND TUBES

12.1. The estimated annual requirement of steel pipes and tubes has been placed at 14.5 lakh tonnes per annum by 1970-71. This would, on an average, require an installed capacity of around 15 lakh tonnes per annum.

12.2. The installed capacity for the production of steel pipes and tubes including the capacity for large size pipes at Hindustan Steel Ltd., Rourkela, is expected to reach around 4.8 lakh tonnes by 1965-66. In other words an additional installed capacity of 10.2 lakh (15.0—4.8) per annum would have to be generated by the end of the Fourth Plan period.

12.3. The size-wise break up of the additional installed capacity to be generated by the end of Fourth Plan will be as follows:

	(Lakh tonnes)			
	Below 75 mm dia.	75-170 mm. dia.	170-300 mm dia.	Above 300 mm dia.
Installed capacity required by 1970-71.	6.7	3.7	1.6	3.0
Expected installed capacity by 1965-66.	3.3	0.3	0.4	0.8
Additional installed capacity to be generated during Fourth Plan period.	3.4	3.4	1.2	2.2

12.4. The additional capacity of 2.2 lakh tonnes of large sized tubes would have to be met by new facilities. Having regard to the size of pipes in this group (over 300 mm dia.) it would be desirable to have an installed capacity of 75,000-100,000 tonnes/annum in each of the new units.

12.5. The additional installed capacity of 8 lakh tonnes of pipes and tubes up to 300 mm dia. could be partially met by allowing expansion to the existing manufacturers to the extent of 1.7 lakh tonnes. The balance of 6.3 lakh tonnes will have to be met by the establishment of new units during the Fourth Plan period. By and large an economic sized unit for production of pipes and tubes up to 300 mm dia. would be around 24,000 to 30,000 tonnes per annum.

12.6. At present day levels of equipment cost, the overall average unit investment involved in the above-mentioned facilities to be created would be of the following order:

New units for above 300 mm dia. Rs. 600 per tonne/
annum.

New units up to 300 mm dia. Rs. 520 per tonne/annum.

Expansion up to 300 mm dia. Rs. 350 per tonne/annum.

On this basis, the total investment for the generation of additional installed capacity during the Fourth Plan period would amount to around Rs. 51.91 crores. Of this, the foreign exchange element would be around Rs. 20 crores.

13. GEARS

13.1. The Working Group has endeavoured to assess the requirements of spur, bevel, helical, worm and worm wheel gears in 3 different size groups *viz.*, up to 150 mm 150 mm—450 mm and over 450 mm. The requirements of all types and sizes of gears adds up to 13.4 million numbers per annum by 1970-71.

13.2. Since a preponderance of the gear manufacturing facilities in the country today are captive, it has not been possible for the Working Group to make any accurate assessment of the capacity likely to be available by 1965-66. It is, therefore, not possible for the Group to indicate, in absolute terms, the exact extent to which increase in production facilities for gear would have to be provided for during the Fourth Plan period. This would only be possible after a detailed nation-wide census of production facilities for gear manufacture are undertaken.

13.3. However, on the basis of developed norms, it has been ascertained that the increase in demand during the Fourth Plan period would be approximately 7 million numbers of gears per annum. Additional capacity would, therefore, have to be generated to cater not only for this increase in demand but also in the shortfalls in production capacity which would remain towards the end of the Third Plan period.

13.4. Having regard to the various types and size of gears and their proportions in the total product-mix, it is estimated that the investment involved in setting up new facilities would be of the order of Rs. 2 crores per 500,000 gears. On this basis, and assuming that the increase of 7 million gears per annum during Fourth Plan period would be substantially catered for by the establishment of new units, the minimum investment during the Fourth Plan period for gear production would be of the order of Rs. 28 crores. This would be inclusive of approximately Rs. 20 crores in foreign exchange.

13.5. It will be observed that gears beyond 450 mm dia. would be relatively few and apart from facilities available with equipment manufacturers such as for sugar machinery, cement machinery etc., it may not be worthwhile taking up the production of such gears for the present. Creation of new facilities should, therefore, be aimed at primarily for gears up to 450 mm dia.

14. FORGING DIES

14.1. It has not been possible, for the various reasons explained in the detailed Demand Survey, for the Working Group to assess the requirements of forging dies except on the basis of money value. According to data made available to the Working Group on manufacturing costs, production capacity of dies and average life etc., it has been estimated that the requirements of forging dies by 1970-71 would amount to around Rs. 294 lakhs per annum.

14.2. It has also not been possible for the Working Group to accurately assess the installed capacity for die manufacture in the country as most of these facilities are captive and correlated to the requirements of individual forging facilities. Details can only be obtained through a nation-wide census which the Working Group would recommend be undertaken at an early date.

14.3. However, on the basis of established norms, it has been estimated that the increase in requirements of forging dies by 1970-71 over 1965-66 would be approximately Rs. 188 lakhs per annum.

New facilities would, therefore, have to be created for a substantial portion of this increase apart from having to cover the gaps which would exist between demands and production facilities by 1965-66.

14.4. On the basis of present day costs of equipment etc., and assuming that the increase in demands during the Fourth Plan period would be essentially catered for by the establishment of new units, the investment would be of the order of Rs. 150 lakhs for the production of around Rs. 188 lakhs worth of dies per annum. This investment would include approximately Rs. 100 lakhs in foreign exchange.

15. PATTERNS

15.1. Although patterns are now made of wood, metal or synthetic materials, the Working Group has assessed the requirements of patterns on the basis that all patterns being used are of wood. On this basis, the total requirements of patterns by 1970-71 are valued at Rs. 51.0 crores per annum. This figure was arrived at on the assumption that all patterns will be used to their full life. On the same basis, the value of patterns for increase in requirements of all types of castings in 1970-71 over 1965-66 is around Rs. 24.0 crores per annum.

15.2. It has not been possible, in the time available, for the Working Group to assess the installed capacity for the production of patterns, as that would call for a nation-wide census of such production facilities. However, the Working Group would recommend that such a census be undertaken at an early date.

15.3. At present day levels of equipment costs, and with the assumption that the increase in demands during the Fourth Plan period would be essentially catered for by the creation of new facilities, the investment would be of the order of Rs. 2.0 crores for the production of around Rs. 24.0 crores worth of patterns with little element of foreign exchange involved (except for metal patterns).

Equipment for production of metal patterns would undoubtedly call for a higher investment in relation to cost of pattern itself.

16. ROLLING CONTACT BEARINGS

16.1. The annual requirements of rolling contact bearings have been estimated at 37.4 million numbers by 1970-71. In order to effectively meet these requirements it will be necessary to have an installed capacity for the production of around 40 million bearings per annum. It may be noted that these requirements are exclusive of classified requirements.

16.2. Although a fairly large number of units have been licensed it is estimated that only 5 programmes will have made substantial progress by 1965-66 and that their total production would amount to around 15 million bearings per annum by 1965-66.

16.3. With a view to achieving economic levels of production at as early a date as possible it would be desirable to lay emphasis on expansion of production facilities to such levels as would bring down the costs of production to competitive levels. It has been reckoned that this would be possible only when a plant produced around 10 million bearings per annum on multi-shift operation. However, it has to be recognised that some of the units which have only recently commenced production or/are yet to commence production would not be able to make substantial headway towards approaching this figure. It should, however, be possible for at least one of them to achieve such a production level. On this basis, it is assessed that it would be possible for the 5 units which would be substantially in production by the end of the Third Plan period to build up their production to around 21 million bearings per annum by 1970-71.

16.4. It will, therefore, be necessary to plan for the production of around 19 million bearings additionally during the Fourth Plan period.

The plant proposed to be set up in the Public Sector would meet a substantial part of this gap by the end of the Fourth Plan period.

Apart from the production of around 21 million bearings by the 5 units referred to above, it is anticipated that the proposed plant to be set up in the Public Sector would produce around 10 to 11 million bearings per annum by 1970-71. The balance of around 8 million bearings per annum would have to be catered for by other units amongst which would perhaps be some of those already licensed.

16.5. It is estimated that the production of 10 million bearings in a plant would call for an investment of around Rs. 15 crores. The total investment during the Fourth Plan period for increasing production from around 15 million bearings per annum to around 40 million bearings per annum would, therefore, involve a total expenditure of around Rs. 40 crores including expenditure on new units as well as expansion. This expenditure would include approximately Rs. 20 to Rs. 24 crores in foreign exchange.

17. ROLLS

17.1. Although the requirements of rolls have been assessed and included in the total requirements of corresponding semi-products viz. iron castings, steel castings and steel forgings, the Working Group has considered these separately from the point of view of assessing installed capacity and the means for achieving self-sufficiency.

17.2. According to the study, the requirements of various types of rolls by 1970-71 would amount to:

Iron based rolls	44,000 tonnes per annum
Cast Steel rolls	24,000 tonnes per annum
Forged Steel rolls	12,000 tonnes per annum
TOTAL	80,000 tonnes per annum

The capacity for the production of rolls by the Heavy Engineering Corporation, Ranchi, which is expected to develop by 1972-73 would be as follows:

Iron based rolls	11,540 tonnes per annum
Cast Steel rolls	6,200 tonnes per annum
Forged Steel rolls	3,570 tonnes per annum
TOTAL	21,310 tonnes per annum

Although a few schemes have been sanctioned by Government for being set up in the Private Sector, hardly any progress has been made in their implementation. It is not likely that there would be any capacity for the production of rolls by the end of the Third Plan period.

17.3. Excluding the capacity planned for the Heavy Engineering Corporation, therefore, it would be necessary to develop capacity for the production of around 59,000 tonnes per annum or all rolls according to the following break-up:

Iron based rolls	32,500 tonnes per annum
Cast Steel rolls	18,000 tonnes per annum
Forged Steel rolls	8,500 tonnes per annum

17.4. It has not been possible in the time available to arrive at any definite conclusions with regard to the optimum size of a Roll Plant and the product-mix which would be best suited to local conditions. It will be necessary to undertake a detailed investigation in this connection, particularly with regard to the possibilities of manufacturing more than one type of rolls in the same unit. A point for specific consideration in the proposed detailed study should be the extent to which the machining facilities available in steel plants for the dressing up of existing rolls could be utilised for the machining off new rolls. This aspect would have particular significance in the case of forged rolls which are mainly required for the Steel Plants themselves.

Requirements of Semi-products, Capacities to be Generated and Fourth Plan

Sl. No.	Item	*Estimated demand		Installed capacity required by 1970-71	Installed capacity likely to develop by 1965-66
		by 1965-66	by 1970-71		
1.	Iron Castings	13.14 lakh tonnes	22.3 lakh tonnes	28.0 lakh tonnes	15.0 lakh tonnes
2.	Malleable Iron Castings	0.5 lakh tonnes	1.1 lakh tonnes	1.4 lakh tonnes	0.8 lakh tonnes
3.	Steel Castings	2.32 lakh tonnes	4.75 lakh tonnes	5.9 lakh tonnes	2.0 lakh tonnes
4.	Non-ferrous Castings	25,000 tonnes	54,000 tonnes	68,000 tonnes	
5.	Cast Iron Pipes	6.2 lakh tonnes	9.4 lakh tonnes	11.3 lakh tonnes	9.0 lakh tonnes

URE A.2.1

suggestions thereof, and Magnitudes of Investments during the Period

Gap in installed capacity to be covered during the Fourth Plan period			Estimated expenditure for increasing capacity during Fourth Plan period			Suggestions regarding establishment of new units during the Fourth Plan period
By Expansion	By New Units	Total	Foreign Exchange	Indian Currency	Total	
1.5 lakh tonnes	11.5 lakh tonnes	13.0 lakh tonnes	Rs. 38.0 crores	Rs. 61.0 crores	Rs. 99.0 crores*	<p>1. 2nd Foundry/Forge Plant, 20,000 tonnes capacity, for heavy electrical equipment.</p> <p>*2. Plants of capacities totalling 45,000 tonnes for Iron-based Rolls.</p> <p>3. One plant, 25,000 tonnes capacity, for heavy castings of pumps, compressors, large diesel engines and other heavy tools.</p> <p>4. New Units (each around 10,000 tonnes capacity totalling 1.7 lakh tonnes for high grade thin-walled castings.</p>
0.2 lakh tonnes	0.4 lakh tonnes	0.6 lakh tonnes	Rs. 4.3 crores	Rs. 6.3 crores	Rs. 10.6 crores	1. New Units with a total of 40,000 tonnes installed capacity.
0.5 lakh tonnes	3.6 lakh tonnes	3.9 lakh tonnes	Rs. 43.0 crores	Rs. 64.3 crores	Rs. 107.3 crores*	<p>*1. Plants of capacities totalling 25,000 tonnes for Rolls.</p> <p>2. Two Units (each around 10,000 tonnes capacity) for heavy castings of pumps, compressors, marine engines, cranes.</p> <p>3. 2nd Foundry/Forge Plant, 20,000 tonnes capacity, for heavy electrical equipment.</p>
		37,000 tonnes (min.)	Nil.	Rs. 2.4 crores	Rs. 2.4 crores	
1.7 lakh tonnes	0.6 lakh tonnes	2.3 lakh tonnes	Rs. 3.2 crores	Rs. 2.1 crores	Rs. 5.3 crores	1. Two Plants each around 30,000 tonnes capacity, for manufacture of Spun Iron, Pipes.

ANNEX

Sl. No.	Item	*Estimated annual demand		Installed capacity required by 1970-71	Installed capacity likely to develop by 1965-66
		By 1965-66	By 1970-71		
6.	Steel Forgings	2.34 lakh tonnes	3.95 lakh tonnes	4.4 lakh tonnes	1.7 lakh tonnes
7.	Steel Pipes and Tubes	7.0 lakh tonnes	14.5 lakh tonnes	15.0 lakh tonnes	4.8 lakh tonnes
8.	Gears	6.4 million nos.	13.4 million nos.	15.0 million nos.	
9.	Forging Dies	Rs. 106.0 lakhs	Rs. 294.0 lakhs	Rs. 294.0 lakhs	
10.	Patterns****	Rs. 27.0 crores	Rs. 51.0 crores		
11.	Rolling Contact Bearings	19.0 million nos.	37.4 million nos.	40.0 million nos.	15.0 million nos.

*Estimates on basis of norms developed by the Working Group.

**Excluding investment on facilities in the Steel Plants.

***In addition to the facilities of the Heavy Engineering Corporation for their manufacture.

****All figures on the basis that patterns are made of wood.

URE A.2.1

Gap in installed capacity to be covered during the Fourth Plan period			Estimated expenditure for increasing capacity during Fourth Plan period			Suggestions regarding establishment of new units during Plan period
By Expansion	By New Units	Total	Foreign exchange	Indian Currency	Total	
0.4 lakh tonnes	2.3 lakh tonnes	2.7 lakh tonnes	Rs. 39.0 crores	Rs. 61.0 crores	Rs. 100.0 crores**	<p>1. 2nd Foundry/Forge Plant, 11,000 tonnes capacity, for heavy electrical equipment.</p> <p>2. Two Plants, each around 6,000 tonnes capacity, for Pipe Moulds.</p> <p>***3. Plants of capacities totalling 8,200 tonnes for Rolls.</p> <p>4. One Plant, 5,600 tonnes capacity, for heavy forgings of pumps, compressors, marine engines.</p>
1.7 lakh tonnes	8.5 lakh tonnes	10.2 lakh tonnes	Rs. 20.0 crores	Rs. 31.9 crores	Rs. 51.9 crores	<p>1. New Units, each of around 75,000-100,000 tonnes capacity totalling 2.2 lakh tonnes capacity for manufacturing over 300 mm dia. pipes.</p> <p>2. New Units, each around 24,000-30,000 tonnes capacity totalling 6.3 lakh tonnes capacity for pipes below 300 mm. dia.</p>
		7.8 million nos.(min)	Rs. 20.0 crores	Rs. 8.0 crores	Rs. 28.0 crores	
		Rs. 188.0 lakhs (min)	Rs. 100.0 lakhs	Rs. 50.0 lakhs	Rs. 150.0 lakhs	
		Rs. 24.0 crores (min)	—	Rs. 2.0 crores	Rs. 2.0 crores	
6.0 million nos.	19.0 million nos.	25.0 million nos.	Rs. 20-24 crores	Rs. 16-20 crores	Rs. 40-00 crores	<p>1. One plant of around 10 million Nos. (proposed in public sector).</p> <p>2. One or two new plants to the extent licences issued do not materialise.</p>

APPENDIX TO REPORT OF
WORKING GROUP

CONTENTS

	PAGE
1. Introduction	41
2. Overall assessments	49
3. Iron Castings	50
4. Malleable Iron Castings	54
5. Steel Castings	56
6. Non-ferrous Castings	59
7. Cast Iron Pipes	61
8. Steel Forgings	64
9. Steel Pipes and Tubes	66
10. Gears	67
11. Forging Dies	69
12. Patterns	71
13. Rolling Contact Bearings	74

INTERMEDIATE AND SECONDARY ENGINEERING PRODUCTS

(A Survey of Demands)

1. INTRODUCTION

1.1. The Ministry of Steel, Mines and Heavy Engineering entrusted the National Industrial Development Corporation Limited with the task of estimating the requirements of Intermediate and Secondary Engineering Products by the end of the Fourth Plan period.

1.2. Intermediate and Secondary Engineering Products cover a fairly wide range including castings, forgings, pipes, tubes, dies, patterns etc.

Such Intermediate and Secondary Engineering Products which may be briefly referred to as "Semi-products" are as vital as raw materials for ensuring optimum utilisation of machine building facilities. For a variety of reasons capacity in these fields has not kept pace with requirements, with the result that in some instances machine building facilities have been unable to operate at full capacity in spite of existing demands. In other cases, less satisfactory and uneconomic designs have had to be adopted. It is, therefore, in the fitness of things that emphasis should now be placed on ensuring adequate availability of such "Semi-products" so that there is no likelihood of hindrance in the tempo of industrial build-up.

1.3. The Intermediate and Secondary Engineering Products covered in this Report include the following:

1. Iron Castings
2. Malleable Castings
3. Steel Castings (including Alloy Steel Castings)
4. Non-ferrous Castings
5. Cast Iron Pipes
6. Steel Forgings
7. Steel Pipes and Tubes
8. Gears
9. Forging Dies
10. Patterns
11. Rolling Contact Bearings

Each of these items is dealt with separately in this Report although general remarks regarding the method of approach, assumptions made, limitations of the survey, etc., are dealt with in this introductory chapter.

1.4. A Preliminary Report was submitted earlier on the basis of data collected to enable the Planning Group on Machine Building Industries to formulate its recommendations on certain important schemes/projects which need urgent attention. This Final Report is in amplification of the earlier Preliminary Report.

1.5. In respect of some of these items surveys have also been carried out by other authorities, particularly the National Council of Applied Economic Research. Acknowledgment is due to them as well as to all the other Administrations and Organisations which have assisted in the collection of data and preparation of this Report.

1.6. The requirements of Intermediate and Secondary Engineering Products can be undertaken by a number of well known methods including the historical analogy method, the trend method, the end-use method etc. However, the End-Use method provides a means of establishing norms of consumption for each end-use whereby it becomes possible to use such norms—within specified limits—for future assessments as well. Primarily for this reason the End-Use method was adopted for this study.

The End-Use method essentially relates to the determination of the average requirements of the product under consideration for every type of end-use and thereafter utilising the developed consumption norm for determination of total requirements in relation to planned programmes. In the case of well-defined products such as those included in this study, the establishment of suitable norms is not a very difficult one although in some cases it was not possible to make direct assessments.

A note of caution is necessary regarding the application of such norms to future targets of production. Changes in design of product, methods of manufacture and technology, may result in significant changes in specific norms. This implies that norms developed by studies such as the present one, while considered as being well-representative of the current requirements, may have to be revised after some time to ensure that any changes in design or modes of manufacture are duly allowed for. Within relatively short periods of time, however, the use of such norms for the purpose in view is accepted as

being quite satisfactory. Apart from assumptions which have had to be made in certain cases of norms of requirements on the basis of similar consumption in other countries, where it has not been possible to co-relate and develop the norms on local data, it has also been necessary to assume the targets of production of various end-use production as furnished by the Planning Commission in their preliminary estimates for the Machine Building Industry during the Fourth Plan period. Should there be a substantial revision in the targets indicated in the preliminary estimates, the total requirements as assessed in this Report would need to be revised on the basis of the norms established herein. Since, however, considerable thought has already been devoted in the preparation of the preliminary estimates of the Planning Commission, it is assumed that variations in targetted capacity would not be other than marginal.

Norms have been developed both for new construction as well as for maintenance. The maintenance norms are based on past experience of end-users. It is likely that changes in maintenance techniques and a greater emphasis on "Preventive maintenance" may alter the requirements to some extent.

1.7. Total requirements of individual intermediate and secondary products have been estimated on the basis of production programmes envisaged for respective end-use products. Due allowances have been made for periodic production variations of end-products, wastages in actual production of the "semi-products", variations in product-mix etc. In the overall calculations these have been allowed for by correlating the consumption norms to production capacity of respective end-products and by further allowing a percentage differential between "Semi-products" requirements and their installed production capacity.

Requirements relating to maintenance of equipment are the requirements of specific semi-products as such. They do not include the semi-products which form a part of equipment obtained as a whole in replacement.

Wherever practicable allowances have also been made for export and stock build-up.

1.8. Particular mention is to be made of the fact that the requirements of "Semi-products" as determined in this Report are *exclusive* of requirements for classified End-Uses. Due to the difficulty of collecting such data during the period of National Emergency, no attempt was made to obtain details in this connection.

1.9. Various Authorities have suggested that the magnitude of total requirements could also be checked by correlating requirements of semi-products to (i) finished steel production and (ii) to increase proportionate to investments in Machine Building Industries during the 4th Plan period. Such comparisons are useful only to the extent of being indicators to the orders of magnitude. They should not form the basis of determining actual requirements since a variety of factors such as product-mix, export potential, requirements for un-identified uses etc., have a vital bearing on demand patterns.

1.10. An approximate idea of requirements of a semi-product can be had by taking the ratio of the said product to finished steel production in other countries. For example, in U.K. the total production of Iron Castings (including pipes, malleable castings etc.) ranged from 21.1% to 23.6% of total finished steel production during the period 1956 to 1961. As compared to this the ratio for India during 1970-71, according to the present survey works out to 24.3% when all iron castings (including pipes and malleables) are considered. However, this comparison has to be viewed in the light of the fact that the present survey excludes classified requirements, whereas the figures for U.K. appears to be inclusive thereof. Thus, if classified requirements were included, the Indian ratio would be higher than the one obtaining in U.K.

1.11. The total industrial production capacity in 1970-71 is expected to be double that in 1965-66. It has, therefore, been suggested by some authorities that the requirements of semi-products would also double themselves approximately. This would have been correct if the rate of increase were uniformly double in all end-use cases. Such is, however, not the case. For example, the annual requirements of Cast Iron Sleepers for Railways remains approximately the same. Any attempt to determine requirements on such a basis would, therefore, be highly erroneous.

1.12. The method adopted for this study was to obtain information with regard to the requirements—both for new products as well as for maintenance—from end-users through replies to a detailed questionnaire as well as by on-the-spot studies. A list of Firms, Associations and Government Departments who were addressed or contacted is at Appendix A.1.1. The collection of such information involved a considerable amount of engineering time. In spite of their multifarious problems the response of the addressees to the enquiry was very encouraging although some may have felt that such a survey was not likely to benefit them directly. In many cases recourse was also taken to checking the developed norms of actual consumption with the product designs themselves.

1.13. Installed capacities for various semi-products likely to be created by 1965-66 have been projected on the basis of data made available by concerned Authorities.

While in the case of most semi-products such information is readily available, there are a few cases, including gears, forging dies and patterns where this is not so. In such cases installed capacity can be accurately ascertained only through a detailed and nation-wide census. This has not been possible as a part of this Study. In such cases, therefore, reference has been made at the appropriate places only to the increase in demand which would develop during the 4th Plan period and the additional installed capacity which would be necessary to meet this increase in demand.

1.14. The following aspects relating to each of the "Semi-products" survey are discussed in the subsequent chapters of this Report:

- (i) Development of consumption norms;
- (ii) Special considerations for particular end-users;
- (iii) Estimated requirements in 1970-71 on the basis of developed norms and production capacities of end-users indicated by the Planning Commission.
- (iv) Installed capacity likely to be generated by 1965-66;
- (v) Installed capacity necessary to be generated by 1970-71;
- (vi) Additional capacity to be created during the Fourth Plan period.

1.15. Existing facilities for the production of "Semi-products" are already beset with a variety of difficulties. The solution of these difficulties can be delayed only at the peril of a further deterioration in the coming years in the availability of "Semi-products" and investment returns, to say nothing of the continuing dependence on imports. These include—

- (i) Lack of adequate supplies of essential raw materials, particularly foundry grade pig iron;
- (ii) Lack of adequate supplies of graded scrap;
- (iii) Inadequate capacity for design and manufacture of patterns, dies and moulds;
- (iv) Inadequate attention to the training of large numbers of technical personnel at all levels; and
- (v) Slow growth of manufacture of specialised plant and machinery required by such facilities.

1.16. Frequently, the non-availability of an Intermediate or Secondary Engineering Product results in the end-user having to import not only the "Semi-product" itself but the much more expensive complete unit of which the "Semi-product" is but a single element. Action is, therefore, urgently necessary to ensure that the difficulties, some of which are mentioned above, are speedily removed.

2. OVERALL ASSESSMENTS

2.1. This Chapter summarises the assessed requirements of and the additional production facilities for Intermediate and Secondary Engineering products during the 4th Plan period as detailed further in this Report.

The overall position of requirements at the end of the Fourth Plan as determined in this study, the likely capacities to be developed by the end of the Third Plan period and the gaps in installed capacities to be filled during the Fourth Plan are tabulated at Annexure A.2.1.

2.2. **Iron Castings.**—The estimated annual requirements of iron castings (excluding cast iron pipes and malleable castings) amount to 22.3 lakh tonnes per annum by 1970-71. This would require an installed capacity of 28.0 lakh tonnes per annum. Installed capacity is expected to reach about 15.0 lakh tonnes per annum by 1965-66 and the gap would have to be filled by the creation of an additional installed capacity of around 13.0 lakh tonnes.

2.3. **Malleable Iron Castings.**—The annual requirements in 1970-71 for malleable iron castings are placed at 1.1 lakh tonnes which would necessitate an installed capacity of 1.4 lakh tonnes per annum. Since installed capacity by the end of the Third Plan is expected to reach 0.8 lakh tonnes, the gap to be filled by the creation of additional installed capacity during the Fourth Plan would amount to 60,000 tonnes per annum.

2.4. **Steel Castings (including Alloy Steel castings).**—By 1970-71 the requirements of steel castings (including alloy steel castings) are expected to reach 4.75 lakh tonnes. This would necessitate an installed capacity of approximately 5.9 lakh tonnes per annum. Since the installed capacity by 1965-66 is expected to reach around 2.0 lakh tonnes per annum, an additional installed capacity of 3.9 lakh tonnes per annum will have to be generated during the Fourth Plan period.

2.5. **Non-ferrous Castings.**—The estimated annual requirements of non-ferrous castings work out to 54,500 tonnes per annum by 1970-71. This would require an installed capacity of around 68,000 tonnes per annum. It has not been possible to obtain definite data about the installed capacity likely to be achieved by 1965-66. Requirements of non-ferrous castings by 1965-66 are likely to be around 25,000 tonnes per annum requiring an installed capacity of 31,000 tonnes per annum. As a

minimum, therefore, an additional capacity of at least 37,000 tonnes per annum would have to be generated during the Fourth Plan period.

2.6. Cast Iron Pipes.—The annual requirements in 1970-71 for cast iron pipes are placed at 9.4 lakh tonnes after making an allowance of 1.4 lakh tonnes per annum to be replaced by Spun Concrete and Asbestos Cement pressure pipes, which would necessitate an installed capacity of 11.3 lakh tonnes per annum. Since installed capacity by the end of the Third Plan is expected to reach 9.0 lakh tonnes, an additional installed capacity amounting to 2.3 lakh tonnes will have to be generated during the Fourth Plan period.

2.7. Steel Forgings.—By 1970-71 the requirements of steel forgings are expected to be of the order of 3.95 lakh tonnes per annum. This would necessitate an installed capacity of approximately 4.4 lakh tonnes per annum. By 1965-66 the installed capacity is expected to reach around 1.7 lakh tonnes per annum. As such, an additional installed capacity of 2.7 lakh tonnes per annum will require to be generated during the Fourth Plan period.

2.8. Steel Pipes and Tubes.—The annual requirements in 1970-71 for steel pipes and tubes are placed at 14.5 lakh tonnes necessitating an installed capacity of 15.0 lakh tonnes per annum. Installed capacity by the end of the Third Plan is expected to reach 4.8 lakh tonnes. The gap would, therefore, have to be filled by the creation of additional installed capacity amounting to 10.2 lakh tonnes during the Fourth Plan period.

2.9. Gears.—The annual requirements in 1970-71 for Gears of all types and sizes amount to 13.4 million numbers and would necessitate an installed capacity for the production of 15 million numbers per annum. Requirements by 1965-66 are expected to reach 6.4 million numbers calling for an installed capacity of around 7 million gears per annum. It has not been possible to assess the actual capacity likely to be available by 1965-66. However, it is evident that additional capacity to bridge the difference between 1965-66 and 1970-71 at least will have to be generated. This would call for an increase of around 8 million gears per annum.

2.10. Forging Dies.—At current costs, the value of annual requirements of forging dies by 1970-71 has been estimated at around Rs. 294 lakhs. It has not been possible to make an accurate assessment of the present installed capacity for production of dies. The increase in die forging capacity during

the Fourth Plan period itself would require additional dies to the extent of Rs. 188 lakhs per annum by 1970-71.

2.11. Patterns.—On the basis of wood patterns, the total value of patterns required by 1970-71 will be around Rs. 51 crores per annum. The increase in production of castings during the Fourth Plan itself would necessitate an additional production capacity of Rs. 24 crores worth of patterns.

2.12. Rolling Contact Bearing.—The total requirements of all types and sizes of rolling contact bearings (including thrust bearings) by 1970-71 have been placed at 37.4 million numbers per annum. This would mean an installed capacity of around 40 million bearings per annum. Production by 1965-66 is expected to reach 15 million bearings per annum. During the Fourth Plan period, therefore, it will be necessary to create an additional installed capacity of around 25 million bearings per annum.

3. IRON CASTINGS

3.1. With the exception of malleable iron castings and cast iron pipes, all other types of iron castings have been included in this grouping. The term "cast iron" covers a wide range of iron-carbon-silicon alloys with minor amounts of manganese, sulphur, phosphorus and occasionally alloying elements. Manufacturing terms such as "grey", "white" or "mottled" iron refer to the relative amount of free or combined carbon.

Grey cast iron offers outstanding casting characteristics, low cost, good wear resistance, and machinability.

Chilled iron castings with specified depths of white iron, heat treated are favoured for high wear resistant properties, such as for rolls.

Spheroidal graphite iron, otherwise also known as Ductile or Nodular Iron is somewhat analogous to malleable iron in its mechanical properties. Although first introduced in this country over 15 years ago, much headway has not been made in its use essentially because heavy machine building has not yet developed. With increase in the requirements of very large size quality castings there is bound to be greater emphasis on the use of spheroidal graphite iron.

Alloy cast iron is used to describe those cast irons to which elements such as nickel, chromium, molybdenum, vanadium etc. are added in quantities sufficient to alter the structure or properties of the iron and make the beneficial effects of these constituents increasingly felt. Alloy cast irons are generally used for specific purposes such as for acid or alkali corrosion resistance components, cylinder liners, dies etc.

3.2. In assessing the requirements of iron castings they have been sub-divided into light, medium and heavy castings. It was considered desirable to do so as this would assist in determining the types of foundries required and the product mix which would be most economical.

The division into these three types of castings has been determined, apart from the finished weight of castings, also by the complexity of individual designs which call for relatively greater quantities of molten metal to be poured and the handling facilities which such quantities involve in a foundry.

Thus, light castings include such castings which could be handled by a foundry without the need for any mechanised material handling facilities. Medium castings include those cases for which a certain amount of mechanisation, such as mono-rail gantries, would be necessary and heavy castings include such cases where overhead crane facilities, mechanisation of pouring facilities etc., are essential.

3.3. The norms of consumption for various end-uses as assessed by this study may be seen in the Table at Annexure A.3.1. The unit of end-use is either the present day accepted unit capacity, such as 1 million tonnes per annum of steel, or the unit of end-product itself, such as one commercial vehicle or railway wagon etc. As explained earlier in this Report, these norms may need modifications should the unit capacity of the end-user alter or should there be any change in design or methods of manufacture of the end-product. Since such variations generally occur only over relatively longer periods of time, the norms may continue to be used for a realistic assessment of specific requirements at least during the period now under consideration.

The norms developed are indicative both of requirements for new builds as well as for maintenance purposes.

3.4. The requirements of iron castings by 1970-71 may be seen in the Table at Annexure A.3.2. These total up to 22.3 lakh tonnes per annum including requirements for new manufacture as well as maintenance purposes.

3.5. The Railways are the largest single user of iron castings in the country and according to present indications would continue to occupy this position for a considerable time to come. The norms of consumption for various Railway requirements have been derived as the averages of the various designs of similar end-products on the basis of anticipated proportions of production. For example, the norm of requirements for steam locomotives has been assessed by computing the average from amongst those designs of steam locomotives likely to be in production in 1970-71 and with due regard to the proportion of each in the total production. Unless there is a very major change in the anticipated production pattern or designs, the norm is not likely to be affected significantly.

The requirements for railway track have been assessed on the assumption that by and large the vast majority of the requirements would be met with by current designs of cast-iron sleepers. Should, however, there be a shift in emphasis to the use of other materials for railway sleepers, the total require-

ments would be correspondingly affected. The norm of consumption would, however, remain the same since this is derived on a "per kilometer" basis. Similarly, should there be a shift towards the use of synthetics for brake blocks then the total requirements of iron castings for this purpose would also be modified although the norm per unit vehicle would remain the same for those cases where cast iron brake blocks would continue to be used.

3.6. With the increase in production of engines, pumps, compressors etc., there will be a substantial increase in the requirements of heavy duty castings which require specialised techniques of manufacture.

3.7. The requirements for the various types of machine tools and industrial machines will also build-up very substantially during the Fourth Plan period. A significant increase will be with regard to the heavier castings which would be required in considerable numbers for the types of machine tools and machines hitherto not manufactured in the country.

3.8. The requirements indicated under maintenance account relate to the requirements of castings as such by the end-user industries. They do not include castings which form a part of equipment obtained as a whole in replacement. It has to be recognised that maintenance requirements may alter from time to time to a somewhat larger extent depending upon experience and practices, except in such cases as ingot moulds, rolls etc., which on the basis of long experience elsewhere lend themselves to more accurate assessments.

3.9. With the establishment of modern foundries in the country adopting latest techniques and metallurgical controls there is every reason to hope that a substantial quantity of iron castings could be exported, particularly to neighbouring countries. An allowance of nearly 1,45,000 tonnes has been made for this purpose.

3.10. In order to provide for build-up of stocks from year to year, an allowance of 5% of the increase in production in the year of production has been made.

3.11. It has been possible to determine the sub-division between light, medium and heavy castings for about 73% of the total requirements of iron castings. From amongst these, the proportion is approximately 11% light castings, 39% medium castings and approximately 50% of heavy castings. This could serve as an indicator towards the type of product

mix and the direction in which foundry capacity may be built up in the future.

3.12. Under normal working conditions and having regard to the various types and sizes of iron foundries, an average overall productivity of around 80% may be assumed. In other words, the installed capacity necessary for an assured production of 22.3 lakh tonnes in 1970-71 would have to be around 28 lakh tonnes per annum.

3.13. According to data available, the installed capacity for the production of iron castings excluding malleables and cast iron pipes likely to build up by 1965-66 may be placed at around 15.0 lakh tonnes per annum.

It will, therefore, be necessary to generate an additional capacity of $28-15=13$ lakh tonnes per annum during the Fourth Plan period.

3.14. Brief reference has been made earlier to some of the main users of castings whose demands will build up substantially and whose particular types of castings involve special manufacturing techniques and material compositions. As the requirements of such specialised types of castings grows, the case becomes stronger for "user-oriented" production facilities. Thus, for example, it would be desirable to have separate foundries specialising in the production of iron rolls, automotive type castings etc.

4. MALLEABLE IRON CASTINGS

4.1. Malleable cast iron is obtained by the heat treatment of white cast iron which converts substantially the combined carbon into nodular graphite. In general, the mechanical properties of malleable iron are such that they fill the gap between grey iron and cast steel.

Its ability to resist shock combined with the facility with which the melt may be cast into intricate forms with very smooth surfaces and the ease with which it can be machined, make for its universal application in automotive construction and in many other mass production uses including pipe fittings.

4.2. The manufacture of malleable iron castings demands accurate control of molten metal composition and subsequent heat treatment. Chiefly due to these problems of production techniques, the use of malleable castings in this country has not kept pace with actual design requirements. In quite a number of cases, parts and components originally designed to be manufactured from malleable castings, are even now being manufactured as steel castings. However, in assessing the requirements during the Fourth Plan period, the assumption has been made that necessary malleable casting production facilities would be available for all cases where design requirements so dictate.

4.3. As in the case of iron castings, the requirements have been sub-divided into light, medium and heavy castings. The sub-divisions have been determined on the same basis as for iron castings.

4.4. The norms of consumption for various end-uses as assessed by this study may be seen in the Table at Annexure A.4.1. These norms are indicative both of requirements for new builds as well as for maintenance purposes.

4.5. The requirements of malleable iron castings by 1970-71 may be seen in the Table at Annexure A.4.2. These total up to 1.1 lakh tonnes per annum including requirements for new manufacture as well as for maintenance.

4.6. The two major applications of malleable iron castings in the country would be for automotive uses and for pipe fittings.

In so far as automotive castings are concerned, shortage of production capacity has, in the past, resulted in the use of steel castings. This position needs to be remedied as early as possible so as to substantially reduce material costs of the end-use product.

Malleable iron pipe fittings, to the extent that these have to be used within size limitations, generally account for around 5% of the total weight of pipes and tubes of such sizes for which malleable fittings can be adopted.

4.7. No allowance has been made for export of malleable iron castings as the techniques of production are relatively more difficult and the production of quality castings acceptable in export markets may await the development of this industry.

4.8. It has been possible to assess the sub-division between light, medium and heavy malleable iron castings for around 98% of the total requirements. From amongst these, light castings would account for approximately 21%, medium castings for around 59% and heavy castings for around 20%.

4.9. In order to provide for build-up of stocks from year to year an allowance of 5% of the increase in production in the year of production has been made.

4.10. As in the case of iron castings, the average productivity has been placed at around 80%. In other words, the installed capacity necessary for an assured production of 1.1 lakh tonnes per annum in 1970-71 would have to be around 1.4 lakh tonnes per annum.

4.11. By 1965-66 the installed capacity for production of malleable iron castings is expected to reach 0.8 lakh tonnes per annum. It would, therefore, be necessary to generate an additional capacity of 1.4 lakh tonnes—0.8 lakh tonnes=0.6 lakh tonnes per annum during the Fourth Plan period.

5. STEEL CASTINGS

5.1. All types of steel castings have been included under this group. It is estimated that approximately 20% to 25% of the entire requirements of steel castings will be alloy steel castings.

5.2. As explained in the case of iron castings, the requirements of steel castings have also been sub-divided into light, medium and heavy castings. This should assist in determining the types of foundries required and the product-mix which would be most economical.

5.3. The norms of consumption for various end-uses are detailed in the Table at Annexure A.5.1.

Requirements of steel castings estimated on the basis of the derived norms of consumption and estimates of production capacities at the end of the Fourth Five-Year Plan may be seen in the Table at Annexure A.5.2. These total up to 4.75 lakh tonnes per annum.

5.4. Steel castings are required in the main for Steel Plant maintenance, metallurgical equipment manufacture, steel rolls, manufacture of heavy electrical equipment and other machinery, railways and automotive type uses.

While a considerable amount of planning has already gone into generating necessary capacity to meet the requirements of the metallurgical industries, the position with regard to the Railways' requirements lags behind. As a result of the shortage of facilities for production of intricate and relatively large (in size and not in weight) steel castings, the Railways have had to adopt alternative designs of fabricated components and sub-assemblies. An outstanding example of this is the fabricated bogie instead of cast steel bogie for the new wagons. The adoption of such an expedient results in considerable increase in maintenance costs apart from reduction in the pay load of the vehicle. Since the adoption of a particular design by the designer is largely conditioned by the production facilities available, the establishment of proper manufacturing facilities must necessarily precede the adoption of specific designs. If all bogie wagons were to be fitted with cast steel bogies, the requirements of steel castings for wagon production in 1970-71 would be around 1,10,000 tonnes. Since, however the production of a cast steel bogie calls for very special manufacturing techniques it may not be possible to generate

the necessary capacity for meeting such a large demand by the end of the Fourth Plan period. It should, however, be possible for around 50% of such new wagons to be fitted with cast steel bogies by 1970-71. The requirements of steel castings for wagon production have, therefore, been correspondingly reduced.

It is estimated that the steel industry will require in the neighbourhood of 2.0 lakh tonnes of steel castings per annum for new construction and for maintenance.

5.5. The automotive industry uses considerable quantities of steel castings in place of malleable castings. It is assumed that adequate malleable castings facilities will have been generated by 1970-71 and as such the requirement of steel castings has been proportionately reduced.

5.6. The main increase in demand for steel castings during the Fourth Plan period will relate to Steel Plant maintenance, manufacture of metallurgical equipment, manufacture of heavy electrical and other machinery requiring relatively heavy castings, steel rolls and special castings for the Railways. Most of these requirements would be covered either by captive facilities or special user-oriented plants.

5.7. Although an export market could be developed for steel castings, the already wide gap between production and domestic requirements suggests that the necessary efforts for export may not yet be possible. No provision has, therefore, been made on this account.

5.8. In order to provide for stock build up from year to year, an allowance of 5% of the increase in production over the preceding year has been made.

5.9. It has been possible to determine the sub-division between light, medium and heavy castings for about 87% of the total requirement of steel castings. From amongst these the proportion is approximately 9% light castings, 42% medium castings and approximately 49% of the heavy castings by weight. This could serve as an indicator towards the type of product-mix and the direction in which foundry capacity may be built up in the near future.

5.10. Under normal working conditions and having regard to the problems of balancing orders, an average overall productivity of around 80% may be taken for steel castings. In other words, the installed capacity necessary for an assured

production of 4.75 lakh tonnes per annum in 1970-71 would have to be of the order of 5.9 lakh tonnes.

5.11. The present production of steel castings amounts to about 59,000 tonnes/annum. According to data available the installed capacity likely to be built up by 1965-66 can be placed at 2 lakh tonnes per annum. It will, therefore, be necessary to generate an additional capacity of $5.9 - 2.0 = 3.9$ lakh tonnes per annum during the Fourth Plan period.

6. NON-FERROUS CASTINGS

6.1. Under this group all types of non-ferrous castings *viz.*, Aluminium, Brass, Bronze, Gun metal etc., have been taken together. They also include die-cast, pressure die-cast and sand moulded castings.

6.2. Due to the very wide variety of metals and methods of manufacture involved, it has not been possible to accurately assess the requirements under each specific classification. However, from the data collected it has been possible to broadly assess the requirements in the groupings of castings on the basis of parent metal. These include, aluminium and aluminium alloy, copper alloy and zinc alloy castings. Of the total requirements of non-ferrous castings it is estimated that nearly 22% would be aluminium and aluminium alloy castings, 70% copper alloy castings and 8% zinc alloy castings by weight.

6.3. The norms of consumption for various end-uses are detailed in Annexure A.6.1 and have been derived, as for other semi-products, on the basis of data received from actual users.

The norms developed are indicative both of the requirements of new manufacture or construction, as well as for maintenance purposes.

6.4. Requirements of non-ferrous castings have been estimated on the basis of derived norms of consumption and estimates of capacities at the end of Fourth Five-Year Plan and are detailed in the Table at Annexure A.6.2. These add up to 54,500 tonnes per annum and include requirements for new manufacture as well as for maintenance purposes.

Due to paucity of raw materials no allowance has been made for exports.

6.5. In order to provide stock build up from year to year an allowance of 5% in the increase of production over the preceding year has been made.

6.6. Under normal working conditions, an average productive capacity of around 80% may be taken for non-ferrous castings. In other words the installed capacity to be generated for an assured production of 54,500 tonnes per annum in 1970-71 would have to be of the order of 68,000 tonnes per annum.

6.7. No accurate data is available of the present installed capacity or of the capacity likely to develop by the end of the Third Plan period. This is particularly so as most non-ferrous foundries at present are captive units catering to specific end-use requirements. Even if the assumption is made that the requirements at the end of the Third Plan period will be fully met by indigenous production, an additional installed capacity of 37,000 tonnes per annum will have to be generated to meet the needs during the Fourth Plan period. In actual fact, however, the increase in capacity shall have to be higher than this figure.

7. CAST IRON PIPES

7.1. Cast Iron pipes have been treated separately from other types of iron castings as the facilities for manufacturing Spun Iron pipes which form the major portion of the total demand of C.I. pipes cannot be employed for the production of other types of castings. While the melting facilities in these units are no doubt similar to those available in other foundries, the special nature of the casting equipment precludes these units from being used as 'Jobbing Foundries'. Nor is it rational to treat C.I. pipes under Pipes as the latter are generally made from processed metal and are not cast.

7.2. The requirements of Cast Iron pipes in 1970-71 have been assessed on the basis of norms computed from past experience and data collected from actual users. These norms have been applied to anticipated levels of expenditure in 1970-71. The total requirements of Cast Iron pipes have also been subdivided on the basis of experience gathered from projects already constructed or under implementation.

The largest single use of C.I. pipes and Specials is in public water supply and sanitation. The requirements under this head have been estimated on the basis of norms established by the Committee on Plan Projects of the Planning Commission.

7.3. The estimated requirements of C.I. pipes in 1970-71, which may be seen in the Table at Annexure A.7.1 are placed at 9.4 lakh tonnes. Of this quantity, 4.4 lakh tonnes are estimated to be the requirements in the size group greater than 300 mm dia., 2.2 lakh tonnes in the size group 150 mm to 300 mm dia. (both sizes included) and 2.80 lakh tonnes in the size group under 150 mm dia.

Spun Iron pipes have a ready market in the Middle Eastern and Far Eastern countries and in consideration of this, a provision of 3 lakh tonnes has been included in the total estimated requirements for 1970-71 to account for exports and stocks. The domestic requirements are placed at 6.4 lakh tonnes.

7.4. It is desirable from the point of view of conservation of grey iron as well as of affecting economies in expenditure, consistent with technical feasibility, that greater use be made of spun concrete and asbestos cement pipes for purposes where these can readily replace spun iron pipes. In this connection the Report on National Water Supply and Sanitation Schemes

by the Committee on Plan Projects (Building Projects Team) has commented as follows:—

“Side by side with the need for stepping up production of material required for water and sewerage works, there is considerable scope for affecting economy in the cost of the schemes by selecting the type of material to suit the purpose. The Panel observed that even in simple types of rural water supply schemes, ‘B’ class cast iron pipes are being used where spun concrete or asbestos cement pressure pipes would have been a cheaper alternative, and would have also released critical cast iron pipes for better use elsewhere. The hydraulic pressures in rural distribution systems are not high and should, therefore, permit the use of pipes of cheaper material on a larger scale. The Panel considers that this aspect of the problem deserves special attention of the Public Health Engineers in charge of rural programmes.

Even in regard to urban water supply systems, most often, cast iron pipes of Class ‘B’, which is the lowest class manufactured at present, are used even where the hydraulic pressures in the distribution system are low. A lower class of pipe suitable for such a purpose should be manufactured. In the meantime, economy is possible by the judicious use of spun concrete pipes wherever possible, releasing cast iron pipes for more profitable use elsewhere.”

While it is difficult to assess the exact extent of such substitution of cast iron pipes, consideration has been given to this factor in estimating the requirements of cast iron pipes in 1970-71 and a substitution of approximately 1.4 lakh tonnes per annum of cast iron pipes by spun concrete and asbestos cement pressure pipes has been taken into account. This quantity has, therefore, been deducted from the total requirements of C.I. pipes, which would otherwise have amounted to $9.4 + 1.4 = 10.8$ lakh tonnes per annum by 1970-71.

7.5. While Spun Iron pipe manufacturing facilities can be expected to operate at an average of about 85% of their installed capacity, vertical and horizontal C.I. pipe manufacturing units would generally operate at a lower level. On an average, therefore, production capacity for the Spun Iron and Cast Iron pipe industry has been placed at 83% of the installed capacity.

Therefore, the total installed capacity necessary by the end of the Fourth Plan period would have to be 11.3 lakh

tonnes in order to ensure a production of 9.4 lakh tonnes per annum.

7.6. As against an estimated demand of 8 lakh tonnes per annum by the end of the Third Plan period, the present installed capacity for Spun Iron pipes is 2.67 lakh tonnes per annum. According to information available, it is estimated that the installed capacity is likely to build up to around 9 lakh tonnes/annum by 1965-66 for all types of C.I. pipes inclusive of the capacity in the small scale sector.

Thus, an additional installed capacity of 2.3 lakh tonnes per annum would have to be generated during the Fourth Plan period.

7.7. There is a consistently growing preferential demand for Spun Iron pipes on account of their toughness, tensile strength and comparative lightness leading to economies in consumption of metal and higher operational efficiency. Where horizontal and vertical Cast Iron pipes have hitherto been used for water supply and sanitation, this has been mainly on account of the non-availability of Spun Iron pipes. The accent in future development of the industry should, therefore, be on the generation of capacity for the manufacture of Spun Iron pipes in preference to Cast Iron pipes whose existing production capacity would then be quite adequate for meeting the demands for drain pipes etc.

8. STEEL FORGINGS

8.1. This group covers all types of steel forgings including free forgings, open die stampings and closed die stampings using both carbon and alloy steels.

The process of forging covers a variety of applications. These include not only components of parts of machinery and equipment but also final products themselves. The latter include items such as Railway axles, agricultural implements, hand tools etc. Items of such nature have not been included in the study. Similarly, where forging is an essential element in the overall production processes of any item, such as the forging of balls and rollers in rolling contact bearing manufacture, these also have been excluded from the study.

8.2. The requirements of steel forgings have been subdivided into light, medium and heavy forging groups. It is considered that this assessment would assist in determining the types of forging capacities to be developed and the product-mix which would be the most economical.

8.3. The norms of consumption of forgings for various end-uses derived from data collected may be seen in the Table at Annexure A.8.1. The norms are indicated either on the basis of unit end-product or the unit of end-use generally adopted at present. Owing to changes in design or methods of manufacture in the future the norms may have to undergo marginal modifications.

8.4. Based on the capacity targets indicated by the Planning Commission, the requirements of steel forgings as detailed in the Table at Annexure A.8.2 amount to 3.95 lakh tonnes per annum by 1970-71. These requirements include the requirements on maintenance account but do not include forgings obtained in replacement as a part of equipment.

8.5. Due to the already very wide gap between production and domestic requirements no allowance has been made for export although it should not be difficult to develop a sizeable export market with quality products.

In order to provide for stock build up from year to year an allowance of 5% of the increase in production over the preceding year has been made.

8.6. The major consumers of steel forgings during the Fourth Plan period will be metallurgical and mining equipment

manufacture, steel plant maintenance, grinding media, automotive and allied industries, railways, heavy electrical and other machinery manufacture, pipe moulds and forged rolls.

Special mention may be made of pipe moulds and forged rolls for which no production facilities exist in the country.

8.7. Under normal working conditions an average productivity of around 90% has been assumed for steel forging production. In other words, the installed capacity necessary for an assured production of 3.95 lakh tonnes per annum in 1970-71 would have to be of the order of 4.4 lakh tonnes per annum.

8.8. From data available it has been assessed that the product-mix of forgings would be of the order of 25% light, 34% medium, 41% heavy forgings. Furthermore, the total quantum of forgings would include approximately 65% as die stampings.

8.9. The demand patterns indicate that large concentrations of requirements relate to specific end-uses. For example, the requirements of the steel industry alone would be in the neighbourhood of 80,000 tonnes per annum. The requirements for the manufacture and maintenance of heavy electrical equipment will build up to around 11,000 tonnes by 1970-71. Similarly, the requirements of the automotive and allied uses will build up to around 86,000 tonnes per annum during the same period. These factors are indicative of the desirability towards an endeavour to orientate new production facilities towards specialised types of manufacture suited to specific end-use requirements.

9. STEEL PIPES AND TUBES

9.1. Steel pipes and tubes come in a wide variety of sizes, wall thicknesses, kind of steel used, type of joints, manufacturing process and end-use.

Steel pipes and tubes are required for the manufacture of equipment, construction of plants and for maintenance. Norms of requirements on the basis of data obtained and the past experience of various end-users have been developed. The total requirements for manufacture, construction and maintenance for various industries are listed in the Table at Annexure A.9.1.

9.2. The estimated requirements for steel tubes during 1970-71 is placed at 14.5 lakh tonnes. The size-wise grouping would be as follows:

Below 75 mm dia.	6.5 lakh tonnes (45%)
75 mm to 170 mm dia. :	3.6 lakh tonnes (25%)
170 mm to 300 mm dia.	1.5 lakh tonnes (10%)
Above 300 mm dia.	2.9 lakh tonnes (20%)
TOTAL.	<u>14.5 lakh tonnes</u>

9.3. The present installed capacity for steel tubes of all sizes including that of Rourkela amounts to around 3.6 lakh tonnes. It has been estimated that by 1965-66 capacity will build up to around 4.8 lakh tonnes per annum.

9.4. For an assured production of 14.5 lakh tonnes in 1970-71 it will be necessary to develop a total installed capacity of around 15.0 lakh tonnes per annum. In other words, an additional $15.0 - 4.8 = 10.2$ lakh tonnes per annum capacity would have to be generated during the Fourth Plan period.

9.5. A substantial portion of the expansion during the Fourth Plan period would have to be in the large sized tubes so that the requirements for water mains, oil pipelines etc., can be adequately met. So far, such tubes have been included only in the programme of Hindustan Steel Ltd., at Rourkela.

9.6. Having regard to the technical requirements of various end-use applications for steel pipes it is reckoned that, by weight, approximately 20-25% of the requirements would be seamless tubes and the balance welded by different processes.

10. GEARS

10.1. This study covers the following types of metallic gears: Spur, Bevel, Helical, Worm and Worm Wheel gears. It excludes unmachined gears such as those installed in portable cane crushing units, rack and pinion arrangement for doors, etc. Miniature gears such as are used in watches and instruments have also been excluded as the facilities for their manufacture are of a specific nature and cannot normally be employed for the production of gears for other uses.

10.2. Gear blanks are usually formed by casting or forging and then machined. They may also be machined from plates and bars. In the more industrially advanced countries much headway has been made towards adoption of gears made of synthetic materials. Their use in this country is still extremely limited and it will be some time before they are adopted on a large scale.

10.3. The sizes in which gears are required by different industries are numerous. However, in assessing the total requirements for gears, they have been divided into three sizes *viz.*, up to 150 mm, 150 mm to 450 mm and over 450 mm. This size grouping has been made keeping in view the manufacturing facilities that would be required.

10.4. The norms of consumption for various end-users are detailed in the Table at Annexure A.10.1. These are average requirements relating to different designs of similar end-products. Marginal variations in specific instances are, therefore, likely.

10.5. Requirements of gears of all types have been estimated on the basis of derived norms of consumption and estimates of capacities at the end of the Fourth Plan and have been detailed in the Table at Annexure A.10.2. These add up to 13.4 million numbers per annum and include requirements for new manufacture as well as for maintenance.

These requirements have been grouped into the sizes noted in para 10.3 above. Where possible they have been further sub-divided into types, *viz.*, spur, level, etc.

10.6. Of the total requirement of 13.4 million numbers of gears it was possible to ascertain the size groupings for 72% of the total. Of this approximately 85% will be up to 150 mm size, 14.9% from 150 mm to 450 mm and 0.1% over 450 mm.

By grouping according to types, the breakdown is 68.5% for spur gears, 13.4% for Bevel Gears, 17.4% for Helical Gears and the remainder Worm and Wheel arrangements.

10.7. Two major consumers of gears are the automobile and the machine tool industries. It is estimated that the approximate cost of gears expressed as a percentage of total ex-works cost is 2.7% for passenger cars, 2.5% for scooters and motor-cycles and 3.3% for commercial vehicles.

The requirements of gears for machine tools vary widely depending upon the type of machine tool. Thus, a bench grinder requires no gears at all whereas in the case of other machine tools, the cost of gears could be fairly high compared to the total machine cost. For instance, the cost of gears as a percentage of ex-works cost of a machine tool is about 14% for a precision lathe, 5% for a boring machine and 20% for a geared pillar drilling machine.

10.8. At present, automobile manufacturers are meeting most of their requirements of gears from captive manufacturing facilities. Also, most of the machine tool manufacturers either produce their own gears or have plans for establishing such facilities.

Since a preponderance of the gear manufacturing facilities in the country today are captive, the established capacity could not be determined.

On the basis of developed norms, however, it has been ascertained that the increase in demand during the Fourth Plan period would be approximately 7 million numbers per annum. During the Fourth Plan period, therefore, additional capacity will have to be developed to cater not only for this increase in demand, but also for the shortfall in production capacity towards the end of the Third Plan period.

11. FORGING DIES

11.1. Dies, including press tools, in general cover tools used in the cold or hot forming of metal through plastic flow. This Report, however, only covers dies used for hot working and which are generally termed as forging dies.

Although hot forging is also applied to non-ferrous metals, the requirements of such components being small, the requirements assessed in this study relate essentially to such dies as would be required for steel forging operations.

11.2. Reference to a die in this study covers the complete die set comprising of the male and female parts and guides wherever these are required.

Forging dies are made either from alloy steels or plain carbon steels. The heat treatment of such dies may be either by air hardening or oil hardening although for larger dies air hardening steels still find favour. The most popular materials used at present for die steels in the country are 1% nickel alloy steels and plain carbon steels with carbon ranging from 0.55% to 0.65%.

11.3. Unlike other intermediate and secondary engineering products it has not been possible to make a direct assessment of requirements of forging dies either on the basis of numbers or weight. The range and variety of dies with regard to materials, method of manufacture, method of heat treatment, complexity of design and dimensions presents extreme difficulties in assessing the exact requirements under each specific category. Then again, user preferences for one or the other die materials or for one of the many methods of die manufacture would lead to erroneous impressions if exact figures of category-wise requirements were to be attempted.

The procedure adopted for estimating the requirements of dies has, therefore, been an indirect one. While investigating the requirements of steel forgings accurate assessments were made of the proportion by weight, of die forgings and free forgings. Detailed analysis was also made of the average life of various types of dies from data obtained from actual users, as also the costs thereof. From these it has been possible to assess the value of dies required for various types of die forgings per tonne of such forgings. Such developed norms have formed the basis of estimating, by value, the total requirements of all types and categories of forging dies for meeting

the requirements of die forgings during the Fourth Plan period. Die forging requirements have, as indicated in an earlier Chapter, been sub-divided under the groupings of light, medium and heavy forgings. A large number of representative dies employed for each group of die forgings were taken covering both alloy and carbon steels and their overall life determined from experience of the actual users. In assessing the life of such dies due consideration was also given to the extent to which "re-sinking" of such dies is possible within their useful life. The Table at Annexure A.11.1. indicates the average total life of dies for the various groups of die forgings separately for simple and intricate designs.

With the average total life of respective dies and the average weight for each group of forgings so assessed it was possible to determine the total tonnage of forgings which could be expected from one die set. Details thereof may be seen in the Table at Annexure A.11.1.

Thereafter, the cost of an average die for each group of forgings was determined as an average of die costs obtaining in the country at present—ascertained from actual users—with the help of which it has been possible to convert the life of each die into the cost of dies per tonne of die forgings of a particular group. From this it has been possible to assess the total cost of dies required per annum for the production of die forgings required in the Fourth Plan period. Details of this assessment may be seen in the Table at Annexure A.11.2.

11.4. It will be observed that the total cost of forging dies during 1970-71 would amount to approximately Rs. 294 lakhs.

The increase in production of die forgings from 1965-66 to 1970-71 will be of the order of 1.70 lakh tonnes per annum.

This increase in itself will involve the provision of forging dies valued at approximately Rs. 188 lakhs.

11.5. It has not been possible to make an accurate assessment of the actual die manufacturing capacity in the country as most of it is captive and is co-related to the requirements of individual production facilities.

It can only be stated that as a minimum additional die making capacity for the production of Rs. 188 lakhs worth of dies per annum—being the value of dies relating to the increase in die forging production—would have to be established during the Fourth Plan period.

12. PATTERNS

12.1. A pattern is one of the principal tools used in the production of castings. Reference to patterns in this Report includes core boxes used in conjunction with patterns. At times, the importance of pattern-making to the efficiency of a foundry is not fully recognised. A well designed and made pattern can bring about considerable improvements in the productivity of a foundry to say nothing of the improvement in the quality and finish of the castings themselves. Considerable amount of research is being conducted in other industrially advanced countries on the design and manufacture of patterns.

While at one time the most universally used raw material for the manufacture of patterns was good seasoned wood, today patterns are made from a variety of other materials including metal lined wood, metal, synthetic materials and resins etc. This Report, however, discusses the requirements of patterns on the basis that all patterns being used are of seasoned wood.

12.2. There are numerous factors which dictate the preference for particular raw materials to be used in the manufacture of patterns and which affect the cost and life of such patterns. The inter-relation of these factors and the individual preferences of users precludes the possibility of the formulation of any thumb rule for the determination of cost and life of various types of patterns.

12.3. Unlike other Intermediate and Secondary Engineering Products it is not possible to make a direct assessment of the requirements of patterns either on the basis of numbers or weight or any other such directly identifiable unit. Furthermore, any attempt to make an assessment of requirements of patterns by relating these to the requirements of castings also leads to erroneous impressions.

12.4. For the reasons mentioned above, an indirect procedure had to be adopted in assessing the demand for patterns in future. While it is expected that the choice of pattern materials will depend upon a number of factors *viz.*, number of castings to be produced, size and intricacy of the castings, type of moulding etc., for purposes of simplification the requirements indicated in this study have been determined on a common basis of all patterns being of seasoned wood. To the extent actual user's requirements necessitate the adoption of other materials, the quantity requirements assessed herein

would modify the totals. Ratios for comparison between seasoned wood patterns and other types of patterns are provided for easy determination of such modified requirements. Castings have, in other Chapters of this Report, been sub-divided according to their weights and intricacies of design. Average sizes of patterns were determined by actual analysis of sizes, types, life and costs of large numbers of patterns in each casting group. Such determined average total life and cost of patterns for average production of castings in each group form the basis of determining the requirements of patterns by cost value.

12.5. Having estimated the cost of an average pattern per tonne of average casting in each group of castings it was possible to assess the total cost of patterns required per annum for the production of the various types of castings indicated in earlier Chapters of this Report.

The Table at Annexure A.12.1. indicates the total average life of patterns for various groups of castings.

12.6. On the above basis the total cost of patterns which would be required for the production of all types of castings in 1970-71 will be of the order of Rs. 51 crores.

This figure has been arrived at on the assumption that all patterns would be utilised to the full extent of their useful life. In actual practice, however, this would not be the case. In other words, therefore, the actual total cost of patterns in 1970-71 would be somewhat higher than the calculated value of Rs. 51 crores.

12.7. If it is assumed that all patterns in use in 1965-66 would be of wood then, having regard to the average useful life of such patterns, a vast majority of them would have to be replaced by 1970-71. Thus, in effect the requirements of patterns in 1970-71 would have to be met by production during the Fourth Plan period.

The Table at Annexure A.12.2. indicates a relative comparison of cost and life of patterns other than wood,

12.8. It has not been possible to make an exact assessment of the capacity for production of patterns which is likely to be generated by 1965-66. However, on the same basis of determining pattern requirements as herein explained, the value of patterns required by 1965-66 would amount to around Rs. 27 crores. In other words, even if there were adequate facilities for the production of all patterns required during 1965-66, an

additional capacity for pattern making (on the basis of wood patterns) during the Fourth Plan period would have to be for around Rs. 24 crores per annum. It is, however, likely that the actual increase in production capacity would have to be much in excess of this figure.

Then again, the actual production facilities to be established would depend upon user preferences for alternative materials and types of patterns whose estimation is not possible at this stage. By and large, the value of patterns for equal utility, if made from other materials will tend to increase the total life of patterns required in 1970-71. The Table at Annexure A.12.3. is an indicator for choice of pattern materials in relation to number of castings to be obtained. These figures are applicable to castings in the light and medium ranges. For heavier castings patterns are normally of wood due to the disproportionately high cost of other types of patterns as also the fact that, by numbers, the utilisation of patterns for heavier castings is less frequent.

13. ROLLING CONTACT BEARINGS

13.1. This Demand Survey covers the requirements of all types of rolling contact bearings *viz.*, ball, thrust, cylindrical roller, tapered roller etc. Although rolling contact bearings can be sub-divided into a very large variety of types and sizes, such sub-division, for the purposes of this study, has been limited to the following technological size groups which are commonly used in the bearing consuming industries:

- (i) Ball and thrust bearings up to 10 mm bore
- (ii) Ball and thrust bearings between 10 and 30 mm bore
- (iii) Ball and thrust bearings between 30 and 55 mm bore
- (iv) Ball and thrust bearings between 55 and 170 mm bore
- (v) Roller bearings (Cylindrical) up to 10 mm bore
- (vi) Roller bearings (Cylindrical) between 10 and 30 mm bore
- (vii) Roller bearings (Cylindrical) between 30 and 55 mm bore
- (viii) Roller bearings (Cylindrical) between 55 and 170 mm bore
- (ix) Roller bearings (Cylindrical) above 170 mm bore
- (x) Roller bearings (tapered) upto 30 mm bore
- (xi) Roller bearings (tapered) between 30 and 55 mm bore
- (xii) Roller bearings (tapered) between 55 and 170 mm bore
- (xiii) Roller bearings (tapered) between 170 and 250 mm bore
- (xiv) Roller bearings (Spherical) up to 30 mm bore
- (xv) Roller bearings (Spherical) between 30 and 55 mm bore
- (xvi) Roller bearings (Spherical) between 55 and 170 mm bore
- (xvii) Roller bearings (Spherical) between 170 and 250 mm bore

As in the case of other Intermediate and Secondary Engineering products, norms of consumption for various end-uses of rolling contact bearings have been determined and may be seen in the Table at Annexure A.13.1.

13.2. The total number of rolling contact bearings which would be required in 1970-71, on the basis of the aforementioned norms of consumption, may be seen in the Table at Annexure A.13.2. Taking all types and sizes together, these amount to 37.4 million bearings per annum by 1970-71, *excluding classified requirements.*

13.3. The requirements of bearings for replacement account may be computed on the basis of average life of the bearing which is a function of its design and application, and is, in a large measure, dependent on the amount of wear to which the bearing is subjected, the number of hours for which it is actually in use and the quality of maintenance that it receives. Taking all these factors into account, an overall average life span of all types of bearings and all applications may be placed at around 10 years. The annual replacement requirements expressed as a percentage of the total number of bearings in use at the beginning of a year may be taken as 5% on the assumption of an average life of 10 years and an annual rate of growth of about 20 per cent. Another method of computing the replacement requirements of bearings, which is used in some other countries, has shown that the requirements on replacement account during a year amount to between 25 to 30 per cent of the total number of bearings newly installed during that year. Both these methods give very nearly the same results. In this Study, the bearing requirements for replacement purposes have been assessed by both methods and the average figures so obtained are quoted in Table at Annexure A.13.2.

13.4. Estimates of requirements of rolling contact bearings indicated herein are made on the assumption that no major changes in product designs will take place in the intervening period. The norms and the requirements have been determined on the basis of average requirements of various designs of similar end-products. Marginal variations for specific end-uses are, therefore, likely.

13.5. Large size bearings beyond 250 mm bore have been excluded from this study as their requirements are very small and production thereof would be quite uneconomical for some years to come. The requirements of such bearings would have to continue to be met from imports.

13.6. Although the requirements for railway wagon applications are being met with at present by the use of cylindrical bearings it is likely that vehicle design may call for the adoption of the tapered roller bearings in the near future. Attention would, therefore, have to be paid to the possibilities of

switching over from cylindrical to tapered bearings for railway wagon applications.

13.7. It is possible to achieve 95% and even higher rates of productivity in bearing production. Thus, for achieving the requirements of 37.4 million bearings per annum in 1970-71 (excluding classified requirements) the installed capacity would have to be of the order of 40 million bearings per annum, by the same time.

ANNEXURES TO REPORT OF
WORKING GROUP

ANNEXURES

CONTENTS

	PAGE
A.1.1. List of Firms, Associations and Government Departments who were addressed or contacted.	78
A.2.1. Table of Overall Assessments	96
A.3.1. Norms of consumption for Iron Castings	97
A.3.2. Iron Castings	102
A.4.1. Norms of consumption for Malleable Iron Castings	108
A.4.2. Malleable Iron Castings	109
A.5.1. Norms of consumption for steel castings	111
A.5.2. Steel Castings	115
A.6.1. Norms of consumption for Non-ferrous Castings	120
A.6.2. Non-ferrous castings	123
A.7.1. Cast Iron Pipes	125
A.8.1. Norms of consumption for Steel Forgings	126
A.8.2. Steel Forgings	131
A.9.1. Steel Pipes and Tubes	137
A.10.1. Norms of consumption for Gears	138
A.10.2. Gears	142
A.11.1. Approximate Total life and cost of unit sets of Forging Dies.	147
A.11.2. Approximate cost of Forging Die set	148
A.12.1. Average Life of Patterns	149
A.12.2. Comparison of Cost and Life of Patterns	149
A.12.3. Choice of Pattern Materials in Relation to Number of Castings obtained.	150
A.13.1. Norms of consumption for Rolling Contact Bearings	151
A.13.2. Rolling Contact Bearings	152

ANNEXURE A.1.1.

List of Firms, Associations and Government Departments who were Addressed or Contacted

- A.C.C. Vickers Babcock Ltd.,
Durgapur, Bombay.
- A.C.C. Cement Works,
Lakheri (Raj.), Bombay-1, Sindri.
- A.C.C. Engineering Works,
P.O. Shalibad (Mysore).
- A.P.I. Bhandup, Bombay.
- A.P.V. Engineering Company Ltd.,
Calcutta.
- Director of Agriculture,
Calcutta & Ahmedabad.
- Agarwalla's Collieries Concern, Jharia.
- Ahmedabad Manufacturing & Calico Printing Co. Ltd.,
Ahmedabad.
- Alagappa Textiles (Cochin) Ltd.,
Alagappa Nagar.
- Alchemic (P) Ltd.,
Bombay-70.
- Alenbic Chemical Works,
Baroda.
- Alkali & Chemicals Corporation of India Ltd.,
Calcutta.
- All India Bakelite Works,
Bombay-8.
- Aluminium Corporation of India Ltd.,
Calcutta. Asansol.
- Aluminium Industries Ltd.,
Hirakud (Orissa).
- Aluminium Industries (Assam) (P) Ltd.,
Tinsukia (Assam).
- Aluminium Manufacturing Company,
Calcutta.
- Amar Electrical & Mechanical Works,
Ludhiana.
- Amer Dey Chand Ltd.,
Bombay-16.
- Amin Chand Pyare Lal,
Jullundur (Pb.).
- Amrit Vanaspati Works, Ghaziabad.

Anandji Haridas & Co. (P) Ltd.,
Bombay.

Anant Engineering Works,
Bombay.

Angus Engineering Works,
Andus (Hooghly Distt.).

Aniline Dyestuffs & Pharmaceuticals Ltd.,
Bombay-4.

Arvind Mills Ltd.,
Ahmedabad.

Arvind Paper & Straw Boards Mills Ltd.,
Billimore (Gujarat).

Ashok Leyland, Ennore, Madras.

Ashok Paper Mills (P) Ltd.,
Santhal Parganas (Bihar), Calcutta.

Asian Oil & Paints Company (P) Ltd.,
Bombay.

Asiatic Machinery Corporation (P) Ltd.,
Howrah.

Assam Oil Company,
Digboi (Assam).

Assam Pulp Mills Ltd.,
Calcutta, Morogog (Assam).

Associated Cement Company Ltd.,
Katni (M.P.)

Associated Electrical Industries (I) Private Ltd.,
Calcutta.

Associated Engineering Works Ltd.,
Delhi.

Associated Industries Ltd.,
Bhavnagar.

Associated Rubber & Plastic Works,
Calcutta.

Atic Industries Ltd., Atul.

Atlas Cycle Industries Ltd.,
Sonapat (PB).

Atul Products Ltd.,
Atul (Via Bulsar).

Auto Accessories,
Bombay.

Auto Lamps Ltd.,
Delhi.

Automobile Products of India Ltd.,
Bombay.

Avery & Company Ltd.,
Calcutta

Avon Cycle Industries, Ludhiana.

B.K. Khanna & Company,
New Delhi.

B. V. Joshi Brothers,
Karnul (Kerala), Veldurthi (A.P.)

Babu Iron Foundry & Engineering Works,
Howrah.

Bahrakar Engineering & Foundry Works, Ltd.,
Calcutta, Dhanbad.

Bajaj Tempo (P) Ltd.,
Bombay-18.

Bally Jute Company,
Calcutta.

Bawa Glass Company, Delhi.
Bengal Chemicals & Pharmaceuticals,
Calcutta.

Bengal Jute Mills Company Ltd.,
Bengal Refractories (P) Ltd., Jhamgram (Burdwan Distt.).

Bert & Company,
Madras.

Berry Brothers, Calcutta.

Best & Company,
Bombay.

Bhakra & Beas Design Organisation,
New Delhi.

Bhakara Nangal Project,
Nangal (Pb.).

Bharat Mining Corporation Ltd.,
Khrkhasi Manbhum (Bihar).

Bharat Weighing Scales & Engineering Syndicate,
Howrah.

Bhilai Steel Project,
Bhilai (M.P.)

Bhopal Sugar Industries,
Bombay-1, Bhopal.

Bhor Industries Ltd.,
Bombay.

Bhupindra Cement Works,
Surajpur (Punjab).

Bihar Govt. Super-Phosphate Factory,
Sindri.

Binani Metal Works,
Calcutta.

Bird & Company Ltd.,
Calcutta, Bara Jainda (Orissa).

Birla Industries,
Calcutta.

Blue Star Engineering Co., Bombay.

Bombay Electricity Supply & Transport Company,
Bombay-1.

Bombay Metal & Alloy Manufacturing Company,
Bombay-10.

Bombay Port Trust, Bombay.
Bombay Suburban Electric Supply,
Bombay.

Bombay Textile Machinery Manufacturer,
Bombay-4.

Brady Engineering Company,
Bombay.

Braithwaite & Company (I) Ltd.,
Calcutta.

Bridge & Roof Company Ltd.,
Calcutta.

Bright Brothers (P) Ltd.,
Bombay-17.

Britania Engineering Company,
Howrah-Titaghur (Pargnas W.B.).

British Engineering & Electric Co., Ltd.,
Bombay-78.

British India Electric Construction Company,
Calcutta.

Buckau Wolf New India Engineering Industries,
Poona.

Buckingham & Carnatic Company Ltd.,
Madras.

Burmah Shell Refineries, Bombay.

Burn & Company Ltd.,
Raniganj (W.B.) Howrah.

Caltex Oils Refinery,
Visakapatnam (A.P.)

Carburetters (P) Ltd.,
Madras.

Caprihans (India) Ltd.

Ceat Tyres (India),
Bombay-1.

Central Board of Irrigation & Power,
New Delhi.

Central Electric Power Commission,
New Delhi.

Central Water & Power Commission,
New Delhi.

Century Rayons Industries House,
Bombay.

Chanana Bros., Delhi.

Chanderpura Coal Washery, Dhanbad.

Chemical Plant & Equipment,
Calcutta.

Chittaranjan Locomotive Works,
Chittaranjan (W.B.).

Ciba Dyes (P) Ltd.,
Bombay-1.

Coal Mining Machinery Project,
Durgapur.

Cochine Malleable Ltd.,
Trichur.

Consolidated Pneumatic Ltd.,
Bombay.

Cooper Engineering Ltd.,
Satara (Maharashtra) Bombay.

Crompton Parkinson (Works) Ltd.,
Bombay-18.

D.C.M. Chemical Works,
Delhi.

Dalmia Iron & Steel Ltd.,
Calcutta.

Damodar Valley Corporation,
Calcutta.

Dandapani Foundry Ltd.,
Coimbatore.

Dastur & Company, Delhi.

Daurala Sugar Mills,
Delhi.

David Brown Greaves Ltd.,
Bombay.

Davidron of India (P) Ltd.,
Calcutta.

Deepling Tea Estate Factory,
Bhajo (Assam).

Delhi Cloth Mills, Delhi.

Delhi Garage Ltd.,
Delhi.

Delhi Iron & Steel Works, Ghaziabad.

Development Commissioner, Small Scale Industries,
New Delhi.

Devidyal Metal Industries Ltd.,
Bombay-10.

Digvijay Tiles & Potteries Ltd.,
Jammagar.

Director General, Technical Development,
New Delhi.

Directors of Industries, All States.

Drayton Greaves Ltd.,
Bombay.

Dunlop Rubber Company (I) Private Ltd.,
Calcutta.

Durgapur Alloy Steel Plant,
Durgapur (Bengal).

Durgapur Coke Oven Plant,
Durgapur (Ranchi).

Durgapur Projects Limited, Calcutta.

Duston Engineering Corporation,
Calcutta-13.

Dynacraft Machinery Company (P) Ltd.,
Bombay.

Eicher Tractor Corporation Ltd.,
Faridabad.

Electronics Ltd.,
Faridabad.

Elgi Requirements (P) Ltd.,
Coimbatore.

The Enfield (I) Private Ltd.,
Madras.

Engineering Association of India,
Calcutta.

Ennore Foundries Ltd.,
Madras.

Escorts Ltd.,
Faridabad (Ph.).

Esso Refineries,
Bombay, Calcutta.

Excello Industries (P) Ltd.,
Bombay-18.

Fertilizer Chemicals Travancore Ltd.,
Alwaye (Travancore, Kerala State).

Fertilizer Corporation of India,
New Delhi, Sindri.

Finlay Mills Ltd., Bombay.

Firestone Tyers & Rubber Company of India Ltd.,
Bombay-15.

Director of Fisheries,
Madras, Bombay, Trivandrum.

Forge & Blower Company Ltd.,
Ahmedabad.

Fort William Company Ltd.,
Calcutta.

Fuel Industries Ltd.,
Bombay.

Gabriel (India) Private Ltd.,
Bombay.

Ganesh Electricals,
New Delhi.

Ganesh (P) Ltd.,
Bombay-2.

Garden Reach Workshop,
Calcutta.

Garlic & Company Private Ltd.,
Bombay-11.

Garwaie Plastic (P) Ltd.,
Bombay-7.

Gautam Electric Company, Delhi.

General Electric Company of India,
Calcutta.

Glaxo Laboratories (India) Private Ltd.,
Bombay.

Globe Motors (P) Ltd.,
Faridabad.

Godrej & Boyce Manufacturing Company (P) Ltd.,
Bombay-12.

Goetze Ltd.,
New Delhi.

Good Earth Ltd., Faridabad.

Good Year Tyre & Rubber Company of India,
Ballabgarh (Punjab), Calcutta.

The Gopal Paper Mills Ltd.,
Calcutta, Yamnagar.

Government Central Industrial Workshop,
Bangalore.

Government Die Casting Unit,
Madras.

Grand Iron Works, Delhi.

Greater Mysore Rayons Grade Pulp & Paper Mills Ltd.,
Bangalore.

Greaves Cotton & Company Ltd.,
New Delhi.

Greaves Foseco Ltd.,
Bombay.

Guest, Keen, Williams, Ltd.,
Calcutta.

Gujrat Paper Mills Ltd.,
Ahmedabad.

Guru Nanak Engineering Works, Ghaziabad.

Gwalior Rayon Silk Manufacturing (Weaving) Company Ltd.,
Kozhikode (Kerala).

Harison & Cross Fields Ltd.,
Quilon.

Heavy Electricals Ltd.,
New Delhi, Bhopal, Hardwar.

Heavy Engineering Corporation,
Ranchi, Durgapur.

Hero Cycle Industries, Ludhiana.

Himco (I) Private Ltd.,
Bombay.

Hind Die Casting (P) Ltd.,
Calcutta.

Hindustan Aircraft Ltd.,
Bangalore.

Hindustan Aluminium Corporation,
Ranchi.

Hindustan Antibiotics, Pimpri (Poona).

Hindustan Development Corporation,
Calcutta.

Hindustan Heavy Chemicals Ltd.,
Kardah (West Bengal).

Hindustan Industrial Corporation,
Ghaziabad.

Hindustan Iron & Steel Company,
Calcutta.

Hindustan Machine Tools,
Bangalore.

Hindustan Motors Ltd.,
Calcutta.

Hindustan Pilkington Glass Works Ltd.,
Asansol (West Bengal).

Hindustan Shipyard Ltd.,
Visakhapatnam.

Hindustan Steel Ltd.,
Bhilai, Rourekla, Durgapur, Dhurva (Ranchi).

- Hoechst Pharmaceuticals Ltd.,
Bombay.
- Hooghly Docking & Engineering Company Ltd.,
Howrah.
- Hyderabad Allwyn Metal Works,
Hyderabad.
- Hyderabad Chemical Fertilizers,
Bellampillai (Adilabad Distt).
- Hyderabad Laminated Products Ltd.,
Hyderabad.
- Ice Machinery Mart,
Gwalior.
- Imperial Chemical Industries (I) Private Ltd.,
Calcutta, Bombay.
- Indian Aluminium Company,
Hirakud, Alwaye, Belur (Calcutta), Ranchi.
- Indian Aluminium Products,
Calcutta.
- Indian Bureau of Mines,
Nagpur.
- Indian Cable Co. Ltd., Calcutta.
- Indian Copper Corporation Ltd.,
Ghatshila (Bihar).
- Indian Die Casting Company Ltd.,
Calcutta.
- Indian Drugs & Pharmaceuticals Ltd.,
New Delhi.
- Indian Engineering Association, Calcutta.
- Indian Furnace Company (P) Ltd., Bombay.
- Indian, Hume Pipe Company, Ltd.,
Bombay.
- Indian Iron and Steel Company,
Calcutta, Asansol (W.B.), Burnipur, Singhbhum.
- Indian Jute Mills Association,
Calcutta.
- Indian Jute Mills Company,
Calcutta.
- Indian Mining Association, Calcutta.
- Indian Machine Tool Manufacturing Company (P) Ltd.,
Calcutta.
- Indian National Diesel Engine Co. Ltd., Calcutta.
- Indian Non-Ferrous Metal Manufacturing Association,
Calcutta.

Indian Oil Company,
 New Delhi, Assam, Bihar.

Indian Plastic Ltd., Bombay.

Indian Pistons Ltd., Madras.

Indian Rubber Manufacturer Ltd., Calcutta.

Indian Standard Metal Company Ltd.,
 Bombay.

Indian Standard Wagons Co. Ltd.,
 Calcutta, Asansol.

Indian Sugar & General Engineering Company,
 Ambala (Pb).

Indian Synthetic & Refineries Company, Bombay.

Indian Tube Company, Calcutta, Tatanagar.

Indo Kem (P) Ltd., Bombay.

Industrial Dvestuffs Chemicals Works, Bombay-16.

Industrial Plastics (India) Ltd., Calcutta.

Integral Coach Factory,
 Madras.

Investa Machine Tools & Engineering Company Ltd.,
 Bombay.

Ishwar Industries Ltd., Delhi, Niwar (M.P.)

J.H. Fenner & Company (F) Private Ltd.,
 Calcutta.

J.K. Iron & Steel,
 Kanpur.

Jagjit Sugar Mills, Delhi.

Jaipur Metal & Elect. Ltd., Jaipur.

Jaipur Mining Corporation, Jaipur.

Jaipur Udvog Ltd.,
 Swai Madhupur (Rajasthan).

Jamshedpur Engineering Manufacturing Company Ltd.,
 Tatanagar.

Jay Engineering Works Ltd.,
 Calcutta.

Jay Shree Textile Mills, Ltd., Rishra.

Jessop & Company,
 Calcutta.

Joyti Ltd., Baroda.

K. G. Khosla & Company (P) Ltd.,
 New Delhi.

K. T. Rolling Mills, Thana (Bombay).

Kalinga Tube Ltd., Calcutta.
 Kamani Metals & Alloys Ltd.,
 Bombay-70.
 Kangali Washery, P.O. Darma,
 Distr. Hoyalilugh (Bihar).
 Karam Chand Thapar & Sons,
 Calcutta.
 Kemp & Company Ltd.,
 Codell Road-9.
 Keso Ram Cotton Mills,
 Calcutta.
 Keso Ram Rayons, Calcutta.
 Khargpur Railway Workshops, Kharagpur.
 Kilburn & Company (P) Ltd., Calcutta.
 Kirloskar Bros. Ltd., Kirloskar Wadi (Satara Distt.).
 Kirloskar Oil Engineering Ltd., Poona.
 Kirloskar Pneumatic Tools Company Ltd.,
 Poona.
 Kumar Dhubi Engineering Works,
 Dhanbad (Bihar).
 Kusum Engineering Company Ltd.,
 Calcutta.
 Larson & Toubro Ltd., Bombay.
 Loyalpur Engineering Works, Ghaziabad.
 Laxmi-Narayan Dyestuffs & Chemicals Works (P) Ltd.,
 Calcutta.
 Leader Sewing Machine Company,
 Delhi.
 Lohchu Tea Estate Factory,
 Lohchu (West Bengal).
 Loyabad Coking & Bye-Products Recovery Plant, Jharia.
 Lucas Indian Service Ltd., Madras-2.
 Lumina Elect. Industries,
 Bombay.
 Machinery Manufacturing Works, Ahmedabad.
 Madras Rubber Factory, Madras-21.
 Mahavir Engineering Co., Delhi.
 Mahindra & Mahindra Ltd., Bombay.
 Malleable Cast Iron Foundry, Ranchi (Bihar).
 Martin Burn, Calcutta.
 Maya Engineering Works (P) Ltd., Calcutta.

Mazagaon Docks Ltd., Bombay-1.
 Mc. Nally Bird & Co.,
 Asansol.
 McKenzie Ltd., Bombay.
 Mcleod & Company Ltd., Calcutta, Bilaspur (MP).
 Meameco (P) Ltd., Dhanbad.
 Metal Box of India Ltd., Faridabad, Calcutta, Bombay.
 Microtec Castings (P) Ltd.,
 Madras.
 National Instruments Factory, Calcutta.
 National Insulated Cable Co. of India Ltd., Calcutta.
 National Iron and Steel Company,
 Asansol (W.B.).
 National Mineral Development Corporation,
 Kiriburu (Orissa), New Delhi, Faridabad.
 National Newsprint and Paper Mills, Neapanagar.
 National Pipes & Tubes Co. Ltd.,
 Calcutta.
 National Project Construction Corporation Ltd.,
 New Delhi.
 National Rayon Corporation Ltd., Bombay-1.
 National Steel & Engineering Works, Ghaziabad.
 Neyveli Lignite Project,
 Neyveli.
 New Cycle Industries, Ludhiana (Pb.).
 New India Mining Corporation Ltd.,
 Bombay.
 Nilgiri Neevgundi Estate, Kilokotagin.
 Nivea Pharmaceuticals Ltd., Calcutta.
 North India Light Weight Steels Ltd.,
 New Delhi-15.
 Oil India Ltd., New Delhi, Duliajan (Assam).
 Oil & Natural Gas Commission,
 Dehradun (U.P.).
 Orient General Industries Ltd.,
 Calcutta-11.
 Orient Jute Mills Company Ltd., Calcutta.
 Oriental Metal Industries,
 Puraganas (West Bengal).
 Orissa Cement, Rajgorj (Orissa).
 Orissa Mineral Development Corp., Barabil.
 P.S.G. & Sons, Coimbatore.
 Panser Mechanical Works, Ludhiana.

- Paper & Pulp Conversions Ltd., Poona-2.
- Pearl Machine Tools, Ludhiana.
- Pearl Scooters, Ludhiana.
- Phakde Industries Works (P) Ltd., Karda,
Distt. Satara (Maharashtra).
- Planning Commission, New Delhi.
- Plastic Product of India, Satara.
- Polychen Ltd., Bombay-1.
- Port Engineering Works Ltd.,
Calcutta.
- Praga Tools Corporation Ltd.,
Secundrabad (A.P.).
- Prem Engineering Co., Delhi.
- Premier Automobile Ltd., Bombay.
- Premier Rubber & Cable Industries, Bombay.
- Premier Rubber Works Ltd., Calcutta.
- Punjab Manufacturing Co., Ludhiana.
- Punjab Oil Expellers, Ghaziabad.
- Punjab Flour Mills, Delhi.
- Public Utility Co. Ltd., Delhi.
- Quality Steel Casting & Engineering Company,
Bombay.
- Remington Rand of India Ltd., Calcutta.
- Richardson & Cruddas Ltd.,
Bombay-1, Madras.
- Rita Sewing Machine Works, Ludhiana (Pb).
- R.K. Machine Tools, Ludhiana.
- Road King Cycle Company, Delhi.
- Road Star Cycle Industries, Ratlam.
- Rohit Mills Ltd., Ahmedabad.
- Rohtas Industries Ltd.,
Dalmianagar (Bihar), Calcutta.
- Ruby Rubber Works, Ruby Nagar (Kerala).
- Ruby Sewing Machine Company, Ludhiana.
- Ruston & Morusly India Ltd.,
Poona.
- Sahu Chemicals Ltd., Varanasi (U.P.).
- Sahu Jain Ltd., Calcutta.

Sangavi & Company, Bombay.
 Sanitary Goods Manufacturer,
 New Delhi.
 Sarabhai Chemicals, Bombay.
 Saraswati Sugar Mills, Ambala.
 Sen Releigh Industries, Calcutta, Asansol.
 Scientific India Glass Co., Calcutta.
 Shambur Nath and Sons Ltd., Amritsar.
 Shaparia Dock & Steel Co. Ltd.,
 Bombay.
 Shaw Wallace & Company Ltd.,
 Calcutta, Madras.
 Simpson & Company (P) Ltd., Madras.
 Sindri Iron Foundry, Dhanbad.
 Sirpur Paper Mills Ltd., Sirpur (Hyderabad Deccan).
 Small Industries Service Institute, New Delhi.
 Sodepur Glass Works Ltd., Sodepur (W.B.).
 St. Joseph Asylum Industrial Workshop,
 Mangalore
 Standard Motor Products of India Ltd.,
 Madras.
 Star Paper Mills, Saharanpur.
 Stewarts & Llyods, Calcutta-14.
 Steel Plant (Pvt.) Limited, Bombay.
 Structural Fabrication (P) Ltd.,
 New Delhi.
 Super Tubes, Ghaziabad.
 Sur Industries, Calcutta.
 Swatantra Bharat Mills, New Delhi.
 Swastik Rubber Products Ltd., Poona-3.
 Synthetic & Chemicals, Bareilly.
 T.I. Cycles of India, Ltd.,
 Madras.
 T. Manak Lall, Bombay-17.
 Tata Chemicals Ltd., Gujarat.
 Tata Engineering & Locomotive Company Ltd.,
 Bombay, Jamshedpur.
 Tata Industries, Bombay.
 Tata Iron & Steel Company Ltd.,
 Jamshedpur & Singhbhum.

Tata Johnson Ltd., Jamshedpur.
 Tee Key Tee Estate, Kerala.
 Textile Ball Bearing Products & Equipment,
 Bombay-11.
 Textile Machinery Corporation, Calcutta.
 Textool Company Ltd., Coimbatore.
 Thermo Electric Equipment Company, Bombay.
 Titagarh Paper Mills Ltd.,
 Calcutta, Orissa.
 Tractors & Bull Dozers, Bombay.
 Travancore Rayon Ltd., Rayonpuram (Kerala).
 Triveni Engineering Works, Allahabad.
 Tube Products of India Ltd., Madras.
 U.P. Govt. Cement Factory, Mirzapur (U.P.).
 Union Carbide India Ltd., Bombay-71.
 Universal Engineering Company, Amritsar (Pb).
 Voltas Limited, Bombay.
 Messrs. Wall Chand, Poona.
 Wear-Well Cycle Company India (P) Ltd.,
 Faridabad.
 West Coast Paper Mills Ltd., Bombay-1, Mysore.
 Western Manufacturing Company, Bombay-1.
 Wilcoz & Buck Well Ltd., New Delhi.
 V.S. Hazare & Brother,
 Bombay-4.
 Zenith Cycle Industries, New Delhi.
 Zenith Cycles Ltd., Bombay.
 Zenith Steel Pipe Ltd., Bombay.

ANNEXURE A.2.1

Table of Overall Assessments

Sl. No.	Semi-Products	Estimated capacity at the end of III Plan i.e. 1965-66	Installed capacity at the end of IV plan i.e. 1970-71	Requirements at the end of IV plan i.e. 1970-71	Capacity required by 1970-71	Additional capacity to be generated during the IV Plan period
1.	Iron Castings	15.0 Lakh Tonnes	22.3 Lakh Tonnes	28.0 Lakh Tonnes	13.0 Lakh Tonnes	
2.	Malleable Iron Castings	80,000 Tonnes	1.1 Lakh Tonnes	1.4 Lakh Tonnes	60,000 Tonnes	
3.	Steel Castings	2.0 Lakh Tonnes	4.75 Lakh Tonnes	5.9 Lakh Tonnes	3.9 Lakh Tonnes	
4.	Non-ferrous Castings . . . . .	..	54,500 Tonnes	68,000 Tonnes	37,000 Tonnes (min.)	
5.	C.I. Pipes	9.0 Lakh Tonnes	9.4 Lakh Tonnes	11.3 Lakh Tonnes	2.3 Lakh Tonnes	
6.	Steel Forgings	1.7 Lakh Tonnes	3.95 Lakh Tonnes	4.4 Lakh Tonnes	2.7 Lakh Tonnes	
7.	Steel Pipes and Tubes	4.8 Lakh Tonnes	14.5 Lakh Tonnes	15.0 Lakh Tonnes	10.2 Lakh Tonnes	
8.	Gears . . . . .	..	13.4 Million numbers	15 Million numbers	8 Million numbers (min.)	
9.	Forging Dies . . . . .	..	Rs. 2.94 crores	Rs. 2.94 crores	Rs. 1.88 crores (min.)	
10.	Patterns . . . . .	..	Rs. 51 crores	Rs. 51 crores	Rs. 24 crores (min.)	
11.	Rolling Contact Bearings	15 Million numbers	37.4 Million numbers	40 Million numbers	25 Million numbers	

ANNEXURE A.3.1

Norms of Consumption for Iron Castings

Sl. No.	Industry	Unit	Requirements of Iron Castings in Kilogrammes/ annum/unit of industry		Remarks
			Manufacture of construction	Maintenance	
1	2	3	4	5	6
1.	Iron Ore Mining	600,000 Tonnes/annum		..	17,150
2.	Coal Mining	600,000 ,,		..	57,000
3.	Coal Washeries	2,000,000 ,,		..	21,820
4.	Hard Coke	300,000 ,,		..	171,000
5.	Coal and other Mining Machinery	50,000 Tonnes	13,083,000	..	..
6.	Steel (Ingot)	1,000,000 Tonnes/annum		..	4,742,200
7.	Alloy Tool and Special Steel (Ingot)	40,000 ,,		..	184,000
8.	Aluminium	20,000 ,,		..	252,850
9.	Others (Incl. Copper, Zinc, Lead etc.)	20,000 ,,		..	245,100
10.	Metallurgical and other heavy equipment	80,000 Tonnes	18,066,700	..	..
11.	Petroleum Refining	2,000,000 Tonnes/annum		..	4,000

ANNEXURE A. 3.1—contd.

1	2	3	4	5	6
12.	Fertilizers—N ₂	100,000 Tonnes/annum	}	..	59,560
13.	Fertilizers—P ₂ O ₅	100,000 ,,			
14.	Caustic Soda (Chemical)	10,000 ,,	..	10,000	
15.	Caustic Soda (Electrolytic)	10,000 ,,	..	7,080	
16.	Soda Ash	130,000 ,,	..	78,000	
17.	Sulphuric Acid	30,000 ,,	..	6,170	
18.	Dye Stuffs	10,000 ,,	..	68,750	
19.	Intermediates	25,000 ,,	..	175,000	
20.	Drugs and Pharmaceuticals	Rs. 1,500,000	..	1,030	
21.	Chemicals, Drugs and Pharmaceuticals Machinery.	Rs.100,000,000	99,350	..	
22.	Sugar	20,000 Tonnes/annum	..	5,555	
23.	Sugar Machinery	Rs. 10,000,000	126,000	..	
24.	Paper and Paper Board	20,000 Tonnes/annum	..	1,520	
25.	Newsprint	10,000 ,,	..	1,041	
26.	Paper Machinery	Rs. 30,000,000	681,600	..	

27. Printing Machinery	Rs. 1,000,000	67,000	..	
28. Cement	200,000 Tonnes/annum	..	137,692	Chilled C.I. = 43,100 kgs.
29. Cement Machinery	Rs. 10,000,000	183,500	..	Chilled C.I. = 50,875 kgs.
30. Refractories	10,000 Tonnes/annum	..	24,589	
31. Cotton Yarn	2,000 ,,	}	..	12,810
32. Cotton Cloth	2,000,000 Metres/annum			
33. Cotton Textile Machinery	Rs. 10,000,000	1,381,000	..	
34. Jute	1,000 Looms	..	27,000	
35. Jute Machinery	Rs. 10,000,000	3,071,428	..	
36. Tyres and other Rubber Products	1,000,000 Tyres and other rubber products.		123,000	Includes a small percentage of chilled C.I.
37. Motor Cycles and Scooters	U.A.P.	10	0.1	
38. Motor Cars . . . . .	..	155	2	
39. Jeeps and Station Wagons . . . . .	..	250	7	
40. Commercial Vehicles . . . . .	..	595	9	
41. Steam Locomotives . . . . .	..	11,280	695	
42. Diesel Locomotives . . . . .	..	5,500	73	
43. Electric Locomotives . . . . .	..	700	133	

1	2	3	4	5	6
44.	Wagons	„	300	51.6	
45.	Railway Coaches	„	250	24	
46.	Railway Track	Kilometre	125,000	..	
47.	Marine Diesel Engine	1,000 h.p.	20,500	..	
48.	Merchant Ships	10,000 GRT	216,660	..	
49.	Diesel Engines (excl. engines for U.A.P.transport equipment)		72	2.5	
50.	Tractors	„	820	30	
51.	Crawler Tractors	„	1,500	..	
52.	Dumpers and Scrapers	„	1,170	..	
53.	Shovels	„	2,800	..	
54.	Road Rollers	„	6,786	..	
55.	Building and Road Construction Machinery	Rs. 100,000	8,333	..	
56.	Air Compressors	Rs. 50,000	3,052	..	
57.	Power Driven Pumps	U.A.P.	373	..	
58.	Refrigerators	„	6	..	
59.	Air Conditioners	„	6	..	

60.	Water Coolers	„	2.5	..
61.	Machine Tools	Rs. 30,000	2,031	..
62.	Gear Cutting (Reduction Gear Units)	100 Tonnes	43,400	..
63.	Cranes	15 Tonnes capacity	1,250	..
64.	Structural Fabrication	5,000 Tonnes	3,400	..
65.	Power Boilers (incl. the coal pre- paration etc.)	Rs. 10,000,000	69,500	..
66.	Industrial Boilers	Rs. 10,000,000	1,000,000	..
67.	Transformers (i) Up to 33 KV	1,000,000 KVA	106,400	..
68.	Electric Motors (i) Up to 150 KW	1,000 MW	2,280,400	..
	(ii) Over 150 KW	1,000 MW	588,500	..
69.	Switchgear	Rs. 10,000,000	100,000	..
70.	Electric Fans	U.A.P.	6.7	..
71.	Sewing Machines	„	13.5	..
72.	Lifts	„	3,500	..
73.	Precision Instruments	Rs. 10,000,000	7,860	..
74.	Ingot Moulds	1 Tonne of Ingots	..	30

NOTE.—U.A.P.=Unit Average Product.

ANNEXURE A.3.2

Iron Castings

Sl. No.	Industry	1970-71 target capacity	Requirements in tonnes/annum 70-71			Sub-division of requirements in tonnes			Remarks
			Manufact- ure or construction	Mainten- ance	Total	Light	Medium	Heavy	
1	2	3	4	5	6	7	8	9	10
1.	Iron Ore Mining	70,000,000 Tonnes	..	2,000	2,000				
2.	Coal Mining	160,000,000	..	15,200	15,200				
3.	Neyveli Lignite Integrated Project		..	50	50	6	30	14	S.G. Iron 12 tonnes
4.	Coal Washeries	55,000,000	..	600	600	185	415	..	
5.	Hard Coke	5,000,000	..	2,850	2,850	250	1,500	1,100	
6.	Coal and other Mining Machinery	75,000	..	19,625	19,625	..	..
7.	Steel (Ingot)	18,000,000	..	85,360	85,360	..	..	85,360	
8.	Alloy Tool and Special Steel (Ingot)	500,000	..	2,300	2,300	..	..	2,300	
9.	Aluminium	280,000	..	3,540	3,540	900	2,300	340	
10.	Others (incl. Copper, Zinc, Lead etc.)	155,000	..	1,900	1,900	1,130	385	385	

11.	Metallurgical and other heavy equipment	240,000	„	54,200	..	54,200	..	5,000	49,200
12.	Petroleum Refining	30,000,000	„	..	60	60	1	28	31
13.	Fertilizers—N ₂	2,000,000	„	..	960	960			
14.	Fertilizers—P ₂ O ₅	1,250,000	„						
15.	Caustic Soda (Chemical)	50,000	„	..	50	50			
16.	Caustic Soda (Electrolytic)	600,000	„	..	425	425			
17.	Soda Ash	700,000	„	..	420	420			
18.	Sulphuric Acid	3,500,000	„	..	720	720	35	200	485
19.	Dye-stuffs	16,000	„	..	110	110			
20.	Intermediates	40,000	„	..	280	280			
21.	Drugs and Pharmaceuticals	Rs.800,000,000		..	550	550			
22.	Chemical, Drugs and Pharmaceuticals Machinery	Rs.450,000,000		447	..	447			Chilled C.I=282 Tonnes
23.	Sugar	4,500,000 Tonnes		..	1,250	1,250	9	970	271
24.	Sugar Machinery	Rs.150,000,000		1,883	..	1,883	16	317	1,550
25.	Paper and Paper Board	1,500,000 Tonnes		..	115	115			

1	2	3	4	5	6	7	8	9	10
26.	Newsprint	240,000 ,,	..	25	25				
27.	Paper Machinery	Rs.250,000,000	5,680	..	5,680				
28.	Printing Machinery	Rs.100,000,000	6,700	..	6,700				
29.	Cement	26,000,000 Tonnes	..	17,900	17,900				Chilled C.I. = 5,600 Tonnes.
30.	Cement Machinery	Rs.160,000,000	2,936	..	2,936	236	600	2,100	Chilled C.I. = 1,814 Tonnes.
31.	Refractories	2,800,000 Tonnes	..	6,885	6,885				
32.	Cotton Yarn	1,360,000 ,,	..	11,700	11,700	2,510	3,860	5,330	
33.	Cotton Cloth	6,400,000,000 Metres							
34.	Cotton Textile Machinery	Rs.500,000,000	69,100	..	69,100	21,000	13,600	34,500	
35.	Jute	117,000 Looms	..	3,260	3,260	2,505	395	360	
36.	Jute Machinery	Rs. 35,000,000	10,750	..	10,750				
37.	Tyres and other Rubber Products	..	..	7,300	7,300	2,920	2,920	1,460	Includes a small percent- age of chilled C.I.

38.	Motor Cycles and Scooters	150,000 Nos.	1,500	50	1,550	1,550	..	..
39.	Motor Cars	45,000 ,,	6,975	900	7,875	2,033	5,842	..
40.	Jeeps and Station Wagons	20,000 ,,	5,000	600	5,600	1,250	2,320	2,030
41.	Commercial Vehicles	150,000 ,,	89,000	4,800	93,800	20,840	38,880	34,080
42.	Steam Locomotives	100 ,,	1,128	6,950	8,078	80	985	7,013
43.	Diesel Locomotives	300 ,,	1,650	2,210	3,860	74	90	3,696
44.	Electric Locomotives	150 ,,	105	1,995	2,100	2,100		
45.	Wagons	60,000 ,,	18,000	31,000	49,000	35,800	13,200	..
46.	Railway Coaches	2,200 ,,	550	1,320	1,870	1,870	..	..
47.	Railway Track . . . . .	..	375,000	..	375,000	..	375,000	..
48.	Other Railway Uses . . . . .	..	1,000	3,000	4,000			
49.	Marine Diesel Engines	2,000,000 h.p.	4,100	..	4,100	90	1,810	2,200
50.	Merchant Ships	120,000 GRT	2,600	..	2,600			
51.	Diesel Engines (excl. engines for transport equipment).	140,000 Nos.	10,200	350	10,550	3,100	7,450	
52.	Tractors	25,000 ,,	20,500	750	21,250	3,100	10,350	7,800
53.	Crawler Tractors	1,200 ,,	1,800	..	1,800	120	130	1,550
54.	Dumpers and Scrapers	1,200 ,,	1,400	..	1,400	90	100	1,210
55.	Shovels	250 ,,	700	..	700	49	49	602

1	2	3	4	5	6	7	8	9	10
56.	Road Rollers	1,500 Nos.	10,180	..	10,810	30	150	10,000	
57.	Building and Road Construction Machinery	Rs. 60,000,000	5,000	..	5,000				
58.	Air Compressors	Rs.200,000,000	12,210	..	12,210	1,800	5,200	5,210	
59.	Power Driven Pumps	300,000 Nos.	112,000	..	112,000	31,000	78,000	3,000	
60.	Refrigerators	120,000 ,,	700	..	700	700	..	..
61.	Air Conditioners	100,000 ,,	550	..	550	550	..	..
62.	Water Coolers	30,000 ,,	75	..	75	75	..	..
63.	Machine Tools	Rs.1000,000,000	67,700	..	67,700	300	12,000	55,400	
64.	Gear cutting (Reduction Gear Units).	15,000 Tonnes	6,500	..	6,500				
65.	Cranes	120,000 ,,	10,020	..	10,020	1,020	3,240	5,760	
66.	Structural Fabrication	2,200,000 ,,	1,500	..	1,500		1,500		
67.	Power Boilers (incl. coal preparation, etc.).	Rs.600,000,000	4,170	..	4,170	..	4,170	..	
68.	Industrial Boilers	Rs.300,000,000	30,000	..	30,000	..	30,000	..	
69.	Transformers: Up to 33 KVA	11,000,000 KVA	1,170	..	1,170	1,170	..	..

70. Electric Motors:

(i) Up to 150 KW	. . .	8,000 MW	18,243	..	18,243	4,650	12,180	1,413
(ii) Over 150 KW	. . .	2,000 MW	1,177	..	1,177	392	736	49
71. Switchgears	. . .	Rs.600,000,000	6,000	..	6,000	4,000	2,000	..
72. Electric Fans	. . .	4,000,000 Nos.	25,000	..	25,000	25,000	..	..
73. Sewing Machines	. . .	1,200,000 ,,	16,128	..	16,128	16,128	..	..
74. Lifts	. . .	1,000 ,,	3,500	..	3,500			
75. Precision Instruments	. . .	Rs.700,000,000	550	..	550	550		
76. Iron Based Rolls	. . .	various users	5,000	39,000	44,000	..	..	44,000
77. Ingot Moulds	. . .			450,000	450,000	..		450,000
78. Miscellaneous (Man-hole covers, gratings, Cisterns etc.).			75,000	..	75,000			
TOTAL	. . .		1,124,902	208,735	1,833,637			
Unaccounted	. . .				250,000			
Allowance for Export and Stock- building					150,000			
GRAND TOTAL	. . .				2,233,637			

ANNEXURE A.4.1

Norms of consumption for Malleable Iron Castings

Sl. No.	Industry	Unit	Requirements of Malleable Iron Castings in Kilogrammes/annum/unit of industry	
			Manufacture or construction	Maintenance
1	2	3	4	5
1.	Tyres and Rubber Products	1,000,000 tyres and other rubber products.	..	1,37,000
2.	Wagons	Unit Average Product	1.43	-
3.	Tractors	Do.	25.6	..
4.	Motor-cars	Do.	66	..
5.	Jeeps and Station Wagons	Do.	80	..
6.	Commercial Vehicles	Do.	230	-
7.	Motor Cycles and Scooters	Do.	6.8	..
8.	Bicycles	Do.	0.3	..
9.	Machine Tools	Rs. 30,000	3.12	..
10.	Chemical, Drugs and Pharmaceuticals Machi- nery	Rs. 100,000,000	19,111	..
11.	Cotton Textile Machinery	Rs. 10,000,000	26,140	..
12.	Pipe Fittings	5% of total weight of pipes and tubes of sizes requiring malleable iron fittings.		..

ANNEXURE A.4.2

Malleable Iron Castings

6-5 M of IAS/65.

Sl. No.	Industry	1970-71 target capacity	Requirements in Tonnes per annum—1970-71			Sub-division of requirements (Tonnes)			Remarks
			Manufac- ture or construc- tion	Maintenance	Total	Light	Medium	Heavy	
1	2	3	4	5	6	7	8	9	10
1.	Tyres and Rubber Product	..	..	9,200	9,200	..	9,200	..	
2.	Wagons	60,000 Nos.	86	..	86	86	..	..
3.	Tractors	25,000 Nos.	640	..	640	330	310	..	
4.	Motor Cars	45,000 Nos.	2,970	..	2,970	45	2,925	..	
5.	Jeep and Station Wagons	20,000 Nos.	1,600	..	1,600	104	800	696	
6.	Commercial Vehicles	150,000 Nos.	34,500	..	34,500	2,250	17,250	15,000	
7.	Motor Cycles and Scooters	150,000 Nos.	1,020	..	1,020	420	600	..	
8.	Bicycles	3,500,000 Nos.	1,050	..	1,050	1,050	..	..
9.	Heavy Electrical Equipment		210	..	210	..	..	..
10.	Machine Tools	Rs.1,000,000,000	104	..	104	104	..	..

ANNEXURE A.5.1

Norms of consumption for Steel Castings

Sl. No.	Industry	Unit	Requirements of steel castings in Kilogrammes/annum/unit of industry		Remarks
			Manufacture or construction	Maintenance	
1	2	3	4	5	6
1.	Iron Ore Mining	600,000 tonnes/ annum	..	7,710	
2.	Coal Mining	600,000 ,,	..	2,880	
3.	Coal Washeries	2,000,000 ,,	...	33,400	
4.	Hard Coke	300,000 ,,	...	18,000	
5.	Coal and other Mining Machinery . .	50,000 ,,	4,500,000	..	
6.	Steel (Ingot)	1,000,000 ,,	..	5,000,000	
7.	Alloy Tool and Special Steel (Ingot) . .	40,000 ,,	..	160,000	
8.	Aluminium	20,000 ,,	..	21,600	
9.	Others (incl. Copper, Zinc and Lead etc.) .	20,000 ,,	..	20,000	
10.	Metallurgical and other heavy equipment .	80,000 Tonnes	29,000,000	..	

ANNEXURE A. 5.1—Contd.

U.A.P. = Unit AVERAGE Product.

1	2	3	4	5	6
11. Petroleum Refining		2,000,000 Tonnes/ annum	..	19,333	
12. Fertilizers—N ₂		100,000 „	}	..	5,900
13. Fertilizers—P ₂ O ₅		100,000 „			
14. Chemicals, Drugs and Pharmaceuticals .	Rs.	1,500,000	..	4,500	
15. Chemicals, Drugs and Pharmaceuticals Machinery.	Rs.	100,000,000	1,666,000	..	Alloy steel = 1,670 kgs.
16. Sugar		20,000 Tonnes/ annum	..	200	
17. Sugar Machinery	Rs.	10,000,000	40,000	..	
18. Paper and Paper Board		20,000 Tonnes/ annum	..	1,200	
19. Newsprint		10,000 „	..	830	
20. Paper Machinery	Rs.	30,000,000	100,200	..	Alloy and stainless steel = 12,000 kgs.
21. Cement		200,000 Tonnes/ annum	..	37,000	Alloy steel = 740 kgs.

22.	Cement Machinery	Rs. 10,000,000	325,000	.. Alloy steel = 148,000 kgs.
23.	Refractories	10,000 Tonnes/ annum	—	5,714
24.	Textile Machinery	Rs. 10,000,000	44,000	..
25.	Tyres and Rubber Product.	1,000,000 Tyres and other rubber products.	..	65,100
26.	Commercial Vehicles	U.A.P.	60	0.75
27.	Steam Locomotives	„	26,150	355
28.	Diesel Locomotives	„	14,000	157
29.	Electric Locomotives	„	16,400	143
30.	Wagons	„	1,183	39 On the basis that 50% of bogie wagons shall have cast steel bogies.
31.	Railway Coaches	„	1,320	8
32.	Marine Diesel Engines	1000 hp.	7,000	..
33.	Merchant Ships	10,000 GRT	75,000	..
34.	Diesel Engines (Excl. Engines for transport equipment)	U.A.P.	6	..
35.	Tractors	„	160	..
36.	Crawler Tractors	„	4,670	..

ANNEXURE A. 5.1—*Concl'd.*

1	2	3	4	5	6
37.	Dumpers and Scrapers	U.A.P.	3,420	..	
83.	Shovels	„	18,500	..	Alloy steel=15,500 kgs.
39.	Road Rollers	„	50	..	
40.	Building and Road Construction Machinery.	Rs. 100,000	1,000	..	
41.	Air Compressors	Rs. 50,000	500	..	
42.	Power Driven Pumps	U.A.P.	40	..	
43.	Machine Tools	Rs. 30,000	10	..	Alloy steel mostly.
44.	Gear Cutting (reduction gear units) . . .	100 Tonnes	7,600	..	
45.	Cranes	15 ”	1,350	..	
46.	Structural Fabrication	5,000 ”	1,000	..	
47.	Power Boilers (incl. coal preparation) . .	Rs. 10,000,000	65,000	..	
48.	Industrial Boilers	Rs. 10,000,000	35,400	..	
49.	Turbine and Generators:				
	(i) Steam	120 MW	64,200	..	
	(ii) Hydro	120 MW	326,000	..	
50.	Electric Motors:				
	(i) Up to 150 KW	1000 MW	1,100,000	..	
	(ii) Over 150 KW	1000 MW			
51.	Switchgears	Rs. 10,000,000	585	..	
52.	Lifts	U.A.P.	100	..	
53.	Precision Instruments	Rs. 10,000,000	860	..	

ANNEXURE A. 5.2

Steel Castings

Sl. No.	Industry	1970-71 target capacity	Requirements in Tonnes per annum 1970-71			Sub-division of requirements (Tonnes)			Remarks
			Manufacture or construction	Maintenance	Total	Light	Medium	Heavy	
1	2	3	4	5	6	7	8	9	10
1.	Iron Ore Mining	70,000,000 Tonnes		900	900	..	..	..
2.	Coal Mining	160,000,000 ,,		768	768	..	..	..
3.	Neyveli Lignite Integrated Project	1,600,000 ,,		251	251	1	250	..	
4.	Coal Washeries	55,000,000 ,,		919	919	229	690	..	
5.	Hard Coke	5,000,000 ,,		300	300	20	195	85	
6.	Coal and other Mining Machinery	75,000 ,,	6,725		6,725	..	..	..
7.	Steel (Ingot)	18,000,000 ,,		90,000	90,000	124	45,900	43,976	
8.	Alloy Tool and Special Steel (Ingot).	500,000 ,,		2,000	2,000	45	860	1,095	
9.	Aluminium	280,000 ,,		302	302	..	..	..
10.	Others (incl. Copper, Zinc, Lead, etc.).	155,000 ,,		155	155	93	31	31	

ANNEXURE A.5.2—*Contd.*

1	2	3	4	5	6	7	8	9	10
11.	Metallurgical and other heavy equipment.	240,000 Tonnes	87,000		87,000	..	8,600	78,400	
12.	Petroleum Refining	30,000,000 ,,		290	290	..	150	140	
13.	Fertilizers—N ₂	2,000,000 ,,		70	70	5	33	32	
14.	Fertilizers—P ₂ O ₅	1,250,000 ,,		25	25	1	12	12	
15.	Chemicals, Drugs and Pharmaceuticals.	Rs. 800,000,000		2,315	2,315	1,068	1,247	..	
16.	Chemicals, Drugs and Pharmaceuticals Machinery.	Rs. 450,000,000	7,500		7,500	3,460	4,040	..	Alloy steel = 7.5 tonnes
17.	Sugar	4,500,000 Tonnes		45	45	..	..	..
18.	Sugar Machinery	Rs. 150,000,000	600	..	600	..	150	450	
19.	Paper and Paper Board	1,500,000 Tonnes		90	90	..	..	..
20.	Newsprint	240,000 ,,		20	20	..	..	..
21.	Paper Machinery	Rs. 250,000,000	835	..	835	..	271	564	Alloy & stainless steel = 100 tonnes.
22.	Cement	26,000,000 Tonnes		4,810	4,810	..	4,810	..	Alloy steel = 96.2 tonnes.

23.	Cement Machinery	Rs. 160,000,000	5,200		5,200	200	400	4,600	Alloy steel = 2,368 tonnes.
24.	Refractories	2,800,000 Tonnes		1,600	1,600	..	..	..
25.	Textiles Machinery	Rs. 500,000,000	2,200	..	2,200	700	500	1,000	
26.	Tyres and Rubber Products .			4,400	4,400	..	2,200	2,200	
27.	Commercial Vehicles . . .	150,000 Nos.	9,100	400	9,500	2,375	7,125	..	
28.	Steam Locomotives	100 ,,	2,615	3,800	6,415	643	3,849	1,923	
29.	Diesel Locomotives	300 ,,	4,200	300	4,500	534	3,206	760	Alloy steel = 3,420 tonnes for manu- facture.
30.	Electric Locomotives	150 ,,	2,460	150	2,610	153	1,998	459	
31.	Wagons	60,000 ,,	71,000	20,000	91,000	22,000	46,000	23,000	
32.	Railway Coaches	2,200 ,,	2,900	400	3,300	900	2,400	..	
33.	Other Railway Uses . . . .	..	1,000	..	1,000	800	200	..	
34.	Marine Diesel Engines . . .	200,000 h.p.	1,400		1,400	100	940	360	
35.	Merchant Ships	120,000 GRT	900	..	900	..	..	..
36.	Diesel Engines (excl. engines for transport equipment).	140,000 Nos.	850	..	850	100	750	..	

ANNEXURE A.5.2—Contd.

1	2	3	4	5	6	7	8	9	10
37.	Tractors	25,000 Nos.	4,000	..	4,000	700	3,300	..	
38.	Crawler Tractors	1,200 ,,	5,600	..	5,600	1,205	4,595	..	
39.	Dumpers and Scrapers	1,200 ,,	4,100	..	4,100	738	3,362	..	
40.	Shovels	250 ,,	4,625	..	4,625	831	3,794	..	Alloy steel = 3,875 tonnes.
41.	Road Rollers	1,500 ,,	75	..	75				
42.	Building and Road Construction Machinery.	Rs. 60,000,000	600	..	600	..	..	..
43.	Air Compressors	Rs. 200,000,000	2,000	..	2,000	133	1,132	735	
44.	Power Driven Pump	300,000 Nos.	12,000	..	12,000	1,200	9,216	1,584	
45.	Machine Tools	Rs. 1,000,000,000	337	..	337				Alloy Steel mostly.
46.	Gear Cutting (Reduction gear Units).	15,000 Tonnes	1,140	..	1,140				
47.	Cranes	120,000 Tonnes	10,800	..	10,800	240	2,640	7,920	
48.	Structural Fabrication	2,200,000 ,,	440	..	440	..	440	..	

49.	Power Boilers (incl. coal preparation etc.).	Rs. 600,000,000	3,900	..	3,900	..	3,900	..
50.	Industrial Boilers	Rs. 300,000,000	1,062	..	1,062	..	1,062	..
51.	Turbines and Generators:							
	(i) Steam	2,600 MW	1,385	..	1,385	..	.. 1,385	} Accounts for entire output of HEL 4700 tonnes are over 20 tonnes a piece.
	(ii) Hydro	2,100 MW	5,710	..	5,710	..	.. 5,710	
52.	Electric Motors:							
	(i) Up to 150 KW	8,000 MW	5,500	..	5,500	..	..	..
	(ii) Over 150 KW	2,000 MW						
53.	For other heavy electrical equipment.	..	2,500	..	2,500			
54.	Switchgears	Rs. 600,000,000	35	..	35			
55.	Lifts	1,000 Nos.	100	..	100			
56.	Precision Instruments	Rs. 700,000,000	60	..	60	60	..	..
57.	Steel Rolls	Various Users	4,000	20,000	24,000	..	..	24,000
	TOTAL		276,454	154,310	430,764			
	Unaccounted				40,000			
	Allowance for stock-building				4,000			
	GRAND TOTAL				474,764			

ANNEXURE A.6.1

Norms of Consumption for Non-ferrous Castings

U.A.P.-Unit Average Product.

Sl. No.	Industry	Unit	Requirements of Non-Ferrous castings in Kilogrammes/annum/unit of industry		REMARKS
			Manufacture or Construction	Maintenance	
1	2	3	4	5	6
1.	Coal Mining	600,000 Tonnes/annum	..	1.5	Gun Metal only.
2.	Neyveli Lignite Integrated Project	..	..	220	Aluminium=120 kgs. Brass=100 kgs.
3.	Steel (Ingot)	1,000,000 Tonnes/annum	..	300,000	Gun Metal only.
4.	Aluminium	20,000 ,,	..	..
5.	Others (Incl. Copper, Zinc, Lead etc.)	20,000 ,,	..	4,900	Brass Castings only.
6.	Petroleum Refining	2,000,000 ,,	..	2,660	Bronze Castings only.
7.	Sugar Machinery	Rs. 10,000,000	5,660	..	White Metal=1660 Kgs.
8.	Paper and Paper Board	20,000 Tonnes/annum	..	4,200	Gun Metal Only.
9.	Paper Machinery	Rs. 30,000,000	2,830	..	Bronze Castings only.

10. Cement	200,000 Tonnes/annum	..	1,480	
11. Cement Machinery . . .	Rs. 10,000,000	69,250	..	Bronze castings = 356 kgs.
12. Cotton Yarn	2,000 Tonnes/annum	}	..	6,250
13. Cotton Cloth	2,000,000 Metres/annum			
14. Cotton Textile Machinery .	Rs, 10,000,000	100,000	..	Bronze = 3,800 kgs. Pressure Die Cast = 96,200 kgs.
15. Jute	1,000 Looms	..	8,560	Brass = 8,340 kgs. Aluminium = 220 kgs.
16. Tyres and other Rubber Products	1,000,000 Tyres and other rubber products.	..	18,000	Bronze = 890 kgs. Aluminium = 890 kgs.
17. Motor Cycles and Scooters .	U.A.P.	15.2	..	Aluminium = 15 kgs.
18. Motor Cars	"	11	..	Aluminium Cast- ings, Pressure Die Castings = 7 kgs.
19. Commercial Vehicles	"	24	..	Aluminium Cast- ings, Pressure Die Castings = 10 kgs.

ANNEXURE A.6.1—Contd.

U.A.P.=Unit Average Product.

1	2	3	4	5	6
20.	Steam Locomotives	U.A.P.	1,080	..	
21.	Railway Coaches	„	615	..	
22.	Tractors	„	6	..	Bronze=2kgs. Pressure Die cast- ings=4 kgs.
23.	Road Rollers	„	120	..	Bronze castings only.
24.	Power Driven Pumps	„	20	..	Brass Castings only.
25.	Transformers	25 KVA	2.1	..	
26.	Refrigerators	U.A.P.	0.2	..	Pressure Die Castings.
27.	Machine Tools	Rs. 30,000	37	..	Aluminium=31.2 kgs. Phospor Bronze=1.3 kgs. Other Non-fer- rous=4.4 kgs.
28.	Cranes	15 Tonnes capacity	50	..	Bronze=21 kgs. G.M.=30 kgs.

ANNEXURE A.6.2

Non-Ferrous Castings

Sl. No.	Industry	1970-71 target capacity	Requirements in tonnes per annum 1970-71		TOTAL
			Manufacture or construction	Maintenance	
1	2	3	4	5	6
1.	Coal Mining	160,000,000 Tonnes	..	0.4	0.4
2.	Neyveli Lignite Integrated Project	1,600,000 ,,	..	0.22	0.22
3.	Steel (Ingot)	18,000,000 ,,	..	5,400	5,400
4.	Aluminium	280,000 ,,	..	..	..
5.	Others (incl. Copper, Zinc, Lead etc.)	155,000 ,,	..	38.1	38.1
6.	Petroleum Refining	30,000,000 ,,	..	40	40
7.	Sugar Machinery	Rs. 150,000,000	85	..	85
8.	Paper and Paper Board	1,500,000 Tonnes	..	315	315
9.	Paper Machinery	Rs. 250,000,000	23.6	..	23.6
10.	Cement	26,000,000 Tonnes	..	192	192
11.	Cement Machinery	Rs. 160,000,000	1,108	..	1,108
12.	Cotton Yarn	1,360,000 Tonnes	}	5,660	5,660
13.	Cotton Cloth	6400,000,000 Metres			
14.	Cotton Textile Machinery	Rs. 500,000,000	5,000	..	5,000
15.	Jute	117,000 Looms	..	1,002	1,002
16.	Tyres and Rubber Products . . . . .	..	..	1,208	1,208

ANNEXURE A.6.2.—*Contd.*

1	2	3	4	5	6
17.	Motor Cycles and Scooters	150,000 Nos.	2,278	..	2,278
18.	Motor Cars	45,000 "	485	..	485
19.	Commercial Vehicles	150,000 "	3,600	..	3,600
20.	Steam Locomotives	100 "	108	..	108
21.	Railway Coaches	2,200 "	1,353	..	1,353
22.	Tractors	25,000 "	150	..	150
23.	Road Rollers	1,500 "	180	..	180
24.	Power Driven Pumps	300,000 "	8,600	..	8,600
25.	Transformers	11,000,000 KVA	950	..	950
26.	Electric Transmission	..	50	..	50
27.	Refrigerators	120,000 Nos.	26	..	26
28.	Machine Tools	Rs.1000,000,000	1,232	..	1,232
29.	Cranes	120,000 tonnes	415	..	415
30.	Miscellaneous (domestic uses like taps, kitchen ware, decoration, pieces, etc.)		10,000	..	10,000
	TOTAL		35,644	13,856	49,500
	Unaccounted 10% of total		..	..	4,900
	Allowance for Stock-building		..	..	100
	GRAND TOTAL		..	..	54,500 Tonnes

Of this grand total, nearly 22% will be aluminium or aluminium alloy castings, 70% copper alloy castings and 8% zinc alloy castings by weight.

ANNEXURE A.7.1

Estimated Demand of C.I. Pipes and Specials during 1970-71

	Lakh tonnes
1. Public water supply and sanitation (urban and rural)	2.55
2. Private building construction	0.53
3. Private sector industry	1.03
4. Public sector industry excluding oil and mining	1.01
5. Mining industry	0.15
6. Oil industry	0.15
7. Other sectors	0.75
8. Maintenance and replacements	0.20
9. Allowance for exports	3.00
10. Allowance for stock build-up	0.02
TOTAL	9.39

ANNEXURE A.8.1

Norms of Consumption for Steel Forgings

Sl. No.	Industry	Unit	Requirements of Steel Forgings in Kilogrammes/annum/unit of industry		REMARKS
			Manufacture or construction	Maintenance	
1	2	3	4	5	6
1.	Iron Ore Mining	600,000 Tonnes/annum	..	2,140	
2.	Coal Mining	600,000 ,,	..	4,320	
3.	Coal Washeries	2,000,000 ,,	..	3,260	
4.	Coal and other Mining Machinery	50,000 ,,	13,230,000	..	
5.	Steel (Ingot)	1,000,000 ,,	..	1,070,000	
6.	Alloy Tool and Special Steel (Ingot)	40,000 ,,	..	434,400	
7.	Aluminium	20,000 ,,	..	36,900	
8.	Others (incl. Copper, Zinc, Lead etc.)	20,000 ,,	..	441,000	
9.	Metallurgical and other heavy equipment.	80,000 ,,	16,856,000	..	
10.	Petroleum Refining	2,000,000 ,,	..	18,700	

11.	Fertilizers N ₂	100,000	..	4,000
12.	Fertilizers P ₂ O ₅	100,000	..	1,200
13.	Caustic Soda (Chemical)	10,000	..	200
14.	Caustic Soda-Electrolytic	10,000	..	4,820
15.	Soda-Ash	130,000	..	1,110
16.	Sulphuric Acid	30,000	..	9,375
17.	Dye-stuffs	10,000	..	12,500
18.	Intermediates	25,000	..	165
19.	Drugs and Pharmaceuticals	Rs. 1,500,000	..	..
20.	Chemicals Drugs and Pharmaceuticals Machinery	Rs. 100,000,000	565,000	..
21.	Sugar	20,000 Tonnes/annum	..	140
22.	Sugar Machinery	Rs. 10,000,000	80,000	..
23.	Paper and Paper Board	20,000 Tonnes/annum	..	425
24.	Newsprint	10,000	..	340
25.	Paper Machinery	Rs. 30,000,000	65,500	..
26.	Printing Machinery	Rs. 1,000,000	2,600	..
27.	Cement	200,000 Tonnes/annum	..	96,600
28.	Cement Machinery	Rs. 10,000,000	30,750	..

U.A.P.=Unit Average Product

1	2	3	4	5	6
29.	Cotton Yarn	2,000 Tonnes/annum	..	4,260	
30.	Cotton Cloth	2,000,000 metres	..	1,140	
31.	Cotton Textile Machinery .	Rs. 10,000,000	27,000	..	
32.	Jute	1,000 Looms	..	12,650	
33.	Jute Machinery	Rs. 10,000,000	695,000	..	
34.	Tyres and Rubber Products .	1,000,000 Tyres and other rubber products.	..	5,300	
35.	Bicycles	U.A.P.	1.54	..	
36.	Motor Cycles and Scooters .	„	11.9	0.4	
37.	Motor Cars	„	180	1.6	
38.	Jeeps and Station Wagons .	„	136	5.5	
39.	Commercial Vehicles	„	280	3.3	
40.	Steam Locomotives	„	18,970	696	
41.	Diesel Locomotives	„	8,040	460	
42.	Electric Locomotives	„	6,000	670	
43.	Wagons	„	502	26.5	
44.	Railway Coaches	„	1,050	19	

45.	Marine Diesel Engine	1,000 hp.	5,400	..
46.	Merchant Ships	10,000 GRT	112,500	..
47.	Diesel Engines (Excl. Engines for transport).	U.A.P.	135	3
48.	Tractors	„	140	5
49.	Crawler Tractors	„	795	..
50.	Dumpers and Scrapers	„	450	..
51.	Shovels	„	8,180	..
52.	Road Rollers	„	435	..
53.	Building and Road Construction Machinery.	Rs. 100,000	35,400	..
54.	Air Compressors	Rs. 50,000	510	1
55.	Power Driven Pumps	U.A.P.	4.5	..
56.	Machine Tools	Rs. 30,000	130	..
57.	Gear Cutting (Reduction gear units).	100 Tonnes	54,650	..
58.	Cranes	15 Tonnes	45	..
59.	Structural Fabrication	5,000 Tonnes	1,700	..

1	2	3	4	5	6
60.	Power Boilers (Incl. Coal Preparation etc.).	Rs. 10,000,000	80,670	..	
61.	Industrial Boilers	Rs. 10,000,000	60,000	..	
62.	Turbines and Generators:				
	(i) Steam	120 MW	167,000	..	147,000 kg. of forgings are over 20 tonnes a piece.
	(ii) Hydro	120 MW	125,000	..	117,000 kg. of forgings are over 20 tonnes a piece.
63.	Electric Motors:				
	(i) Below 150 KW	1,000 MW	112,500		Including traction motors.
	(ii) Above 150 KW	1,000 MW	360,000		Industrial Motors.
64.	Switch Gears	Rs. 10,000,000	4,115		
65.	Lifts	U.A.P.	20		
66.	Precision Instruments	Rs. 10,000,000	1,785		
67.	Surgical Instruments	U.A.P.	0.04		
68.	Sewing Machines	„	0.3		

ANNEXURE A.8.2

Steel Forgings

Sl. No.	Industry	1970-71 target capacity (tonnes)	Requirements in tonnes per annum 1970-71			Sub-division of requirements (tonnes)			Remarks
			Manufacture or Construction	Maintenance	Total	Light	Medium	Heavy	
1	2	3	4	5	6	7	8	9	10
1.	Iron Ore Mining	70,000,000	Tonnes		250	250			
2.	Coal Mining	160,000,000	,,		1,152	1,152			
3.	Neyveli Lignite Integrated Project.	1,600,000	,,		0.3	..	0.1	0.2	..
4.	Coal Washeries	55,000,000	,,		92	92	92	..	..
5.	Coal and other Mining Machinery	75,000	,,	19,850		19,850			
6.	Steel (Ingot)	18,000,000	,,		19,200	19,200	450	6,500	13,250
7.	Alloy, Tool and Special Steel (Ingot).	500,000	,,		5,430	5,430	151	1,510	3,769
8.	Aluminium	280,000	,,		516	516			
9.	Others (Including Copper, Zinc and lead etc.).	155,000	,,		3,418	3,418	3,139	279	..

1	2	3	4	5	6	7	8	9	10
10.	Metallurgical and other heavy equipment.	240,000 Tonnes	50,570	..	50,570	..	2,925	47,645	
11.	Petroleum Refining	30,000,000	„	280	280	90	184	6	
12.	Fertilizers	3,250,000	„	65	65	3	3	59	
13.	Caustic Soda—Chemical	50,000	„	6	6				
14.	Caustic Soda—Electrolytic	600,000	„	12	12				
15.	Soda Ash	700,000	„	26	26				
16.	Sulphuric Acid	3,500,000	„	130	130				
17.	Dye-stuffs	16,000	„	15	15				
18.	Intermediates	40,000	„	20	20				
19.	Drugs and Pharmaceuticals	Rs. 800,000,000		88	88				
20.	Chemicals, Drugs and Pharmaceuticals Machinery.	Rs. 450,000,000	2,540	..	2,540				
21.	Sugar	4,500,000 Tonnes		32	32				
22.	Sugar Machinery	Rs. 150,000,000	1,200	..	1,200				
23.	Paper and Paper Board	1,500,000 Tonnes	..	32	32				
24.	Newsprint	240,000	„	8	8				

25.	Paper Machinery	. . .	Rs. 250,000,000	545	..	545	110	435	..
26.	Printing Machinery	. . .	Rs. 100,000,000	260	..	260			
27.	Cement	. . . . .	26,000,000 Tonnes		12,557	12,557	305	1,915	10,337
28.	Cement Machinery	. . .	Rs. 160,000,000	492		492	12	43	437
29.	Cotton Yarn	. . . . .	1,360,000 Tonnes		2,900	2,900	680	1,360	860
30.	Cotton Cloth	. . . . .	6,400,000,000 Metres		3,655	3,655	1,355	1,400	900
31.	Cotton and Textile Machinery	. . . . .	Rs. 500,000,000	1,350	..	1,350	1,350	..	..
32.	Jute	. . . . .	117,000 Looms		1,480	1,480	490	981	9
33.	Jute Machinery	. . . . .	Rs. 35,000,000	2,435	..	2,435	850	1,547	38
34.	Tyres and Rubber Products	. . . . .	..		360	360	..	150	210
35.	Bicycles	. . . . .	3,500,000 Nos.	5,400	140	5,540	5,540	..	..
36.	Motor Cycles and Scooters	. . . . .	150,000 ,,	1,785	190	1,975	1,975	..	..
37.	Motor Cars	. . . . .	45,000 ,,	8,100	760	8,860	4,430	4,430	..
38.	Jeeps and Station Wagons	. . . . .	20,000 ,,	2,730	480	3,210	1,605	1,605	..
39.	Commercial Vehicles	. . . . .	150,000 ,,	42,500	1,800	44,300	22,150	22,150	..
40.	Steam Locomotives	. . . . .	100 ,,	1,897	6,825	8,722	862	2,686	5,174
41.	Diesel Locomotives	. . . . .	300 ,,	2,412	870	3,282	467	1,602	1,213
42.	Electric Locomotives	. . . . .	150 ,,	900	705	1,605	250	710	645

1	2	3	4	5	6	7	8	9	10
43.	Wagons	60,000 Nos.	30,150	15,000	45,150	12,650	32,500	..	
44.	Railway Coaches	2,200 „	2,320	1,040	3,360	1,000	2,360	..	
45.	Other Railway Uses . . . . .	..	2,760	740	3,500				
46.	Marine Diesel Engines	200,000 hp.	1,080	100	1,180	20	335	825	
47.	Merchant Ships	120,000 GRT	1,350		1,350				
48.	Diesel Engines (excl. engines for transport equipment).	140,000 „	19,000	790	19,790	8,925	9,965	900	
49.	Tractors	25,000 Nos.	3,480	640	4,120	2,884	1,236	..	
50.	Crawler Tractors	1,200 „	950	55	1,005	351	452	202	
51.	Dumpers and Scrapers	1,200 „	540	..	540	135	162	243	
52.	Shovels	250 „	2,046		2,046	656	..	1,390	
53.	Road Rollers	1,500 „	650	..	650	..	650	..	
54.	Building and Road Construction Machinery.	Rs. 60,000,000	21,200	..	21,200				
55.	Air Compressors	Rs. 200,000,000	2,050	75	2,125	610	570	945	
56.	Power Driven Pumps	300,000 Nos.	1,300	230	1,530	175	630	725	
57.	Machine Tools	Rs. 1,000,000,000	4,335	..	4,335	705	2,630	1,000	

58.	Gear Cutting (Reduction Gear Units).	15,000 Tonnes	8,200	..	8,200				
59.	Cranes	120,000	„ 360		360	280	80		
60.	Structural Fabrication	2,200,000	„ 750	..	750	750	..	..
61.	Power Boilers (Incl. coal preparation etc.).	Rs. 600,000,000	4,840	..	4,840				
62.	Industrial Boilers	Rs. 300,000,000	1,800	..	1,800				
63.	Turbines and Generators:								
	(i) Steam	2,600 MW	3,613	..	3,613	..	219	3,394	(3175 tonnes are over 20 T a piece.)
	(ii) Hydro	2,100 MW	2,190	..	2,190	..	60	2,130	(2055 tonnes are over 20 T a piece.)
64.	Electric Motors:								
	(i) Below 150 KW	8,000 MW	900		900	100	900	..	
	(ii) Over 150 KW	2,000 MW	720		720	..	50	670	Industrial Motors.
65.	Switchgears	Rs. 600,000,000	247		247				
66.	Other Uses by Heavy Electricals Ltd.	..	3,500		3,500	..	..	3,500	All forgings over 20 tonnes a piece.

1	2	3	4	5	6	7	8	9	10
67.	Lifts	1,000 Nos.	20		20				
68.	Precision Instruments . . .	Rs. 700,000,000	125		125	125	..	..
69.	Surgical Instruments	5,000,000 pieces	200		200	200	..	..
70.	Pipe Moulds . . . . .	..	10,000		10,000				
71.	Rolls . . . . .	..	12,000		12,000				
72.	Mandrills for Seamless Pipes .	..	740		740				
73.	Sewing Machines	1,200,000 Nos.	360		360	360	..	..
	TOTAL		2,88,742	82,164	3,70,906				
	Unaccounted 5% of Total . . .				20,000				
	Allowance for Stock-building .				3,600				
	GRAND TOTAL				3,94,506				
					Say 3.95 lakh tonnes				

ANNEXURE A.9.1

Estimated Demand for Steel Tubes during 1970-71

	Tonnes
1. Agriculture and Irrigation	25,000
2. Oil Prospecting and Refining	1,08,000
3. Mining Industries	19,000
4. M/C Tools and Instruments	6,300
5. Heavy Mechanical Engineering Industries (including vehicles)	87,000
6. Process Industries	58,000
7. Chemical Industries	97,200
8. Electrical Engineering Industries	15,500
9. Metallurgical Industries	81,000
10. Constructional works (excluding Metallurgical)	3,45,000
11. Power	25,300
12. Public Water supply and sanitation	3,17,000
13. Transportation :	
(i) Railways	32,700
(ii) Petroleum pipe lines	85,500
(iii) Shipping	13,000
(iv) Civil Aviation	75
(v) Posts and Telegraphs	2,150
	13,17,800
Miscellaneous (10% of total)	1,31,800
	14,49,600
	Say: 14.5 lakh tonnes.

ANNEXURE A.10.1

Norms of Consumption for Gears

Sl. No.	Industry	Unit	Requirements of gears in Nos. per unit of industry		Remarks
			Manufacture or construction	Maintenance	
1	2	3	4	5	6
1.	Iron Ore Mining	600,000 tonnes/annum	..	3	Spur Bevel Helical
			..	2	
			..	2	
2.	Coal Mining	600,000 "	..	36	Spur
3.	Coal Washeries	2,000,000 "	..	365	Spur Helical Worm
			..	15	
			..	22	
4.	Hard Coke	300,000 "	..	108	Spur
5.	Steel (Ingot)	1,000,000 "	..	720	Spur Bevel Helical Worm Wheels
			..	140	
			..	100	
			..	48	
6.	Aluminium	20,000 "	..	..
7.	Others (Copper, Zinc, Lead etc.)	20,000 "	..	10	Spur
8.	Petroleum Refining	2,000,000 "	..	11	Helical Worm Wheels
			..	7	

9.	Fertilizers-N ₂	100,000 tonnes/annum	..	22	Spur
			..	5	Helical
10.	Fertilizers-P ₂ O ₅	100,000 "	..	15	Worm
11.	Sulphuric Acid	30,000 "	..	90	Spur
12.	Dye-Stuffs	10,000 "	..	49	Worm Wheels
13.	Chemicals, Drugs and Pharmaceu- ticals Machinery.	Rs. 100,000,000	125 4,260	..	Spur
				..	Bevel
14.	Sugar	20,000 tonnes/annum	..	19	Spur
			..	2	Bevel
			..	4	Worm
15.	Sugar Machinery	Rs. 10,000,000	100 47 27	..	Spur
				..	Bevel
				..	Helical
16.	Paper Machinery	Rs. 3,000,000	68	..	Spur and a few Helical.
			13	..	Bevel
17.	Cement	200,000 tonnes/annum	..	2	Spur
			..	2	Bevel
			..	1	Helical
			..	12	Worm Wheels
18.	Cement Machinery	Rs. 10,000,000	712	..	All types of Gears.
19.	Cotton Yarn	2,000 tonnes/annum	..	300	Spur
			..	32	Bevel
			..	17	Helical

U.A.P.=Unit Average Product.

1	2	3	4	5	6
20.	Cotton Cloth	2,000,000 metres	.. .. ..	506 43 26	Spur Bevel Helical and Worm.
21.	Cotton and Textile Machinery	Rs. 10,000,000	27,370 92 3,300	.. .. ..	Spur Bevel Helical
22.	Tyres and Rubber Products .	1,000,000 Tyres and other rubber products.	.. .. ..	28 15 43	Spur Bevel Helical
23.	Motor Cycles and Scooters .	U.A.P.	12	..	Spur
24.	Motor Cars	"	5 6 10	.. .. ..	Spur Bevel Helical
25.	Jeeps and Station Wagons .	"	10 6 8	.. .. ..	Spur Bevel Helical
26.	Commercial Vehicles . . .	"	11 6 10	.. .. ..	Spur Bevel Helical
27.	Diesel Locomotives	"	10 7 9	.. .. ..	Spur Bevel Helical

28.	Electric Locomotives	.	.	„	24	..	All types
29.	Marine Diesel Engines	.	.	1000 hp.	5	..	Spur
30.	Tractors	.	.	U.A.P.	25	..	Spur
					9	..	Bevel
31.	Shovels	.	.	„	19	..	Spur
					5	..	Bevel
					2	..	Helical
32.	Road Rollers	.	.	„	18	..	Spur
					6	..	Bevel
33.	Building and Road Construction Machinery.	Rs.	100,000		79	..	Spur
34.	Machine Tools	.	.	Rs. 30,000	30	..	Spur
					2	..	Bevel
					1	..	Helical
					2	..	Worm and Worm Wheel Pairs.
35.	Cranes	.	.	15 tonnes	27	..	Spur only

ANNEXURE A.10.2

Gears

Sl. No.	Industry	1970-71 target capacity	Requirements in numbers per annum 1970-71			Sub-division of requirements			Remarks
			Manufacture or construction	Maintenance	Total	Up to 150 mm	150 mm to 450 mm	Over 450 mm	
1	2	3	4	5	6	7	8	9	10
1.	Iron Ore Mining	70,000,000 Tonnes	..	350	350	140	140	70	Spur
			..	245	245	140	70	35	Bevel
			..	175	15	70	70	35	Helical
2.	Coal Mining	160,000,000 "	..	9,600	9,600	..	..	..	Spur
3.	Neyveli Lignite Integrated Project	..	..	72	72	40	20	12	Spur
			..	43	43	25	10	8	Bevel
			..	14	14	7	7	..	Helical
			..	52	52	24	18	10	Worm
4.	Coal Washeries	55,000,000 Tonnes	..	10,000	10,000	..	..	..	Spur
			..	400	400	..	..	..	Helical
			..	600	600	..	..	..	Worm
5.	Hard Coke	5,000,000 "	..	1,800	1,800	..	1,500	300	Spur
6.	Steel (Ingot)	18,000,000 "	..	12,960	12,960	..	..	..	Spur
			..	2,520	2,520	..	..	..	Bevel
			..	1,800	1,800	..	..	..	Helical
			..	864	864	..	..	..	Worm Wheels
7.	Aluminium	280,000 "	..	..	..	..	..	..	..

8.	Others (Incl. Copper Zinc, Lead etc.)	155,000	„	..	78	78	..	..	78	Spur
9.	Petroleum Refining	30,000,000	„	..	157	157	45	22	90	Helical
				..	110	110	110	..	..	Worm Wheels
10.	Fertilizers-N ₂	2,000,000	„	..	212	212	125	62	25	Spur
				..	50	50	25	25	..	Helical
				..	151	151	50	38	63	Worm
11.	Fertilizers-P ₂ O ₅	1,250,000	„	..	134	134	79	39	16	Spur
				..	32	32	16	16	..	Helical
				..	96	96	32	24	40	Worm
12.	Sulphuric Acid	3,500,000	„	..	10,445	10,445	10,445	..	..	Spur
13.	Dye-Stuffs	16,000	„	..	79	79	..	79	..	Worm Wheels
14.	Chemicals Drugs and Pharmaceu- ticals Machinery.	Rs. 450,000,000		562	..	562	..	..	562	Spur
				19,200	..	19,200	19,200	..	..	Bevel
15.	Sugar	45,000,000 Tonnes	..	4,320	4,320	270	1,890	2,160	Spur	
			..	540	540	..	540	..	Bevel	
			..	810	810	..	..	810	Worm	
16.	Sugar Machinery	Rs.150,000,000	1,500	..	1,500	..	150	1,350	Spur	
			670	..	670	..	70	600	Bevel	
			400	..	400	..	650	156	Helical	
17.	Paper Machinery	Rs.250,000,000	565	..	565	..	565	..	Spur and a few Helical Bevel	
			105	..	105	..	105	..	..

U.A.P.=Unit Average Product.

1	2	3	4	5	6	7	8	9	10
18.	Cement	26,000,000 Tonnes	..	300	300	110	90	.100	Spur
			..	280	280	100	100	80	Bevel
			..	200	200	..	120	80	Helical
			..	1,580	1,580	820	760	..	Worm Wheel
19.	Cement Machinery	Rs.250,000,000	11,400	..	11,400				All types
20.	Cotton yarn	1,360,000 Tonnes	..	202,400	202,400				Spur
			..	22,100	22,100				Bevel
			..	11,900	11,900				Helical
21.	Cotton Cloth	6,400,000,000 metres	..	1,624,000	1,624,000				Spur
			..	139,200	139,200				Bevel
			..	84,800	84,800				Helical and Worm
22.	Cotton Textile Machinery	Rs.500,000,000	1,368,500	..	1,368,500	..	..	..	Spun
			4,610	..	4,610	..	..	..	Bevel
			165,000	..	165,000	..	..	..	Helical
23.	Tyres and Rubber products . . . . .	..	..	1,510	1,510	576	288	646	Spun
			..	808	808	576	174	58	Bevel
			..	2,310	2,310	1,386	576	348	Helical
24.	Motor Cycles and Scooters	150,000 Nos.	1,800,000	..	1,800,000	1,800,000	..	..	Spur

25.	Motor Cars	45,000	,,	225,000	..	225,000	180,000	450,000	..	Spur
				450,000	..	450,000	450,000	..	..	Helical
				270,000	..	270,000	270,000	..	..	Bevel
26.	Jeep and Station Wagons	20,000	,,	200,000	..	200,000	180,000	20,000	..	Spun
				120,000	..	120,000	120,000	..	..	Bevel
				160,000	..	160,000	160,000	..	..	Helical
27.	Commercial Vehicles	150,000	,,	1,650,000	..	1,650,000	1,500,000	150,000	..	Spur
				900,000	..	900,000	750,000	150,000	..	Bevel
				1,500,000	..	1,500,000	1,050,000	450,000	..	Helical
28.	Diesel Locomotives	300	,,	3,000	..	3,000	..	..	..	Spur
				2,100	..	2,100	..	..	..	Bevel
				2,700	..	2,700	..	..	..	Helical
29.	Electric Locomotives	150	,,	3,600	..	3,600				All types
30.	Marine Diesel Engines	200,000	hp.	9226	..	922	450	424	48	Spur
					..	6	6	..	..	Worm and Wheel
32.	Tractors	25,000	Nos.	625,000	..	625,000	250,000	375,000	..	Spur
				225,000	..	225,000	200,000	25,000	..	Bevel
33.	Shovels	250	,,	4,750	..	4,750	1,000	1,250	2,500	Spur
				1,250	..	1,250	..	1,000	250	Bevel
				500	..	500	..	..	500	Helical
34.	Road Rollers	1,500	,,	27,000	..	27,000	10,500	16,500	..	Spur
				9,000	..	9,000	7,500	1,500	..	Bevel
35.	Building and Road Construction Machinery.	Rs. 60,000,000		47,500	..	47,500	35,000	7,500	5,000	Spur

1	2	3	4	5	6	7	8	9	10
36.	Machine Tools	Rs.1,000,000,000	1,013,800 52,000 77,700	..	1,013,800 52,000 77,700	955,000 50,800 77,700	51,800 1,160 ..	7,000 40 ..	Spur Bevel and Worm wheel pairs Helical
37.	Cranes	120,000 Tonnes	216,000	..	216,000	84,000	132,000	..	Spur
	TOTAL		11,168,370	2,150,067	13,318,437				
	Allowance for stock-buildings				80,000				
	GRAND TOTAL				13,398,437				
							Say 13.4 Million.		

ANNEXURE A.11.1

Approximate total life and cost of unit sets of forgings dies (including Re-sinking)

Range of Forgings	Forging Material=Plain Carbon Steel Die Material="60" Carbon or 1% nickel steel block				Forging Material=Plain Carbon Steel Die Material=High Carbon High Chromium Steel				Forging Material=Alloy Steel Die Material=Hot Die Steel			
	Simple Forgings		Intricate Forgings		Simple Forgings		Intricate Forgings		Simple Forgings		Intricate Forgings	
	Life (M/Ton- nes)	Cost (Rs.)	Life (M/Ton- nes)	Cost (Rs.)	Life (M/Ton- nes)	Cost (Rs.)	Life (M/Ton- nes)	Cost (Rs.)	Life (M/Ton- nes)	Cost (Rs.)	Life (M/Ton- nes)	Cost (Rs.)
Light . . .	24	1,500	16	2,200	120	4,500	80	5,500	40	6,000	28	7,200
Medium . . .	90	2,900	50	3,900	440	9,500	260	12,000	150	12,500	88	18,000
Heavy . . .	100	5,800	60	6,900	700	18,000	400	25,000	225	26,000	100	33,000

ANNEXURE A. 11.2

Approximate cost of forgings die sets

Range of Forgings	“60” Carbon or 1% nickel steel dies	High Carbon high chromium steel dies	Hot die steel dies
Light	Rs. 32 lakhs	Rs. 58 lakhs	Rs. 46 lakhs
Medium	Rs. 36 lakhs	Rs. 50 lakhs	Rs. 42 lakhs
Heavy	Rs. 6 lakhs	Rs. 14 lakhs	Rs. 10 lakhs
TOTAL	Rs. 74 lakhs	Rs.122 lakhs	Rs. 98 lakhs

ANNEXURE A.12.1

Average life of patterns

Group	Cost of pattern for simple/intricate castings	Average cost of pattern	Average total life of pattern (Number of castings obtained)
Light	Simple Casting	Rs. 30	Rs. 100 150
	Intricate Casting	Rs. 170	
Medium	Simple Casting	Rs. 160	Rs. 500 60
	Intricate Casting	Rs. 840	
Heavy	Simple Casting	Rs. 400	Rs. 1000 28
	Intricate Casting	Rs. 1600	

ANNEXURE A.12.2

Comparison of cost and life of patterns

	Wooden Pattern	Resin Pattern	Al-Alloy Pattern	Gun metal, Brass, Bronze pattern	C.I. Pattern
Cost	A	2.5A	3A	4.5A	12A
Life	B	4.5B	4.5B	7B	Life Long

ANNEXURE A.12.3

Choice of pattern materials in relation to member of castings to be obtained

No. of castings to be obtained	Choice of pattern material
Up to 10 nos.	Small patterns of hard wood large patterns of soft wood
25 to 100 nos.	Hard wood
100 to 200 nos.	Hard wood. Core Boxes should be metal faced. With proper care, it could yield as many as 500 castings.
500 to 5000 nos.	Small patterns should be of metal such as Aluminium, Bronze, Cast Iron etc. For high production of large castings it is economical to construct patterns of hard wood in dupli- cate, or even of triplicate.
5000 to 50,000 nos.	Aluminium, machined all over to the tolerances required.

ANNEXURE A.13.1

Norms of consumption for rolling contact bearings

Sl. No.	Industry	Unit	Requirements per unit of industry per annum	Sub-division of requirements	
			Manufacture or construction	Ball Bearings	Roller Bearings
1.	Motor Cars	Unit average product	28	14	14
2.	Jeeps and Station Wagons	„	25	3	22
3.	Commercial Vehicles	„	42	17	25
4.	Motor Cycles and Scooters	„	12	10	2
5.	Electric Motors				
	(i) Up to 1/2 KW	„	1	1	..
	(ii) 1/2 to 150 KW	„	2	..	2
	(iii) Over 150 KW	„	2	..	..
6.	Electric Fans	„	Average 1.5	1.5	..
7.	Diesel Engines (Excl. engines for transport)	„	1	1	..
8.	Crawler Tractors	„	70	50	20
9.	Tractors	„	42	15	27
10.	Power Driven Pumps	„	2	2	Heavy Pumps.
11.	Textile Machinery	Rs.10,000,000	1,151	737	414

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Rolline Con

Sl. No.	Industry	1970-71 target capacity	Ball Bearings (including thrust bearings)					Total ball bearings	Roller Up to 10mm bore
			Upto 10mm bore	10 to 30mm bore	30 to 55mm bore	55 to 170mm bore	Above 170mm bore		
1	2	3	4	5	6	7	8	9	10
1.	Railway Rolling Stock . . .	62,750 Nos.	..	..	..	..	..	..	..
2.	Motor Cars	45,000 Nos.	..	378	427	..	..	805	748
3.	Jeep and Station Wagons	20,000 Nos.	..	152	171	..	..	323	296
4.	Commercial Vehicles . .	1,50,000 Nos.	..	758	427	..	..	1185	..
5.	Motor Cycles and Scooters	1,50,000 Nos.	..	351	624	..	..	975	..
6.	Electric Motors	Upto 150 KW 8000 MW above 150 KW 2000MW	..	1864	89	9	..	2640	..
7.	Electric Fans	4,000,000 Nos.	..	249	..	..	..	7950	..
8.	Diesel Engines	1,40,000 Nos.	..	..	27	..	..	117	..
9.	Power Driven Pumps . . .	3,00,000 Nos.	..	70	392	90	..	598	..
10.	Heavy Machinery Plant & Mining Machinery Plant.	315,000 tonnes/ annum	..	..	1290	119	..	1439	..
11.	Chaff Cutters . . . . .	..	..	..	134	172	..	306	..
12.	Crawler Tractors	1,200 Nos.	..	18	14	..	..	49	..
13.	Heavy Earth Moving Machinery	..	..	..	..	17	..	17	..
14.	Tractors	25,000 Nos.	26	135	470	..	..	878	..
15.	Textiles . . . . .	..	1600	11	37	207	45	1900	9
16.	Machine Tools	Rs. 1000,000,000	..	323	253	189	..	765	31
17.	Sugar Machinery	Rs. 150,000,000	..	..	111	..	..	111	..
	TOTAL		1626	4309	4466	803	45	20058	1084
18.	Other users not specially listed above (5% of the above figures)		81	215	223	40	2	981	54
	TOTAL		1707	4524	4689	843	47	21039	1138
19.	Replacement requirements		426	1131	1172	210	11	4850	284
	TOTAL		2133	5655	5861	1053	58	25889	1422

XURE A. 13.2

tact Bearings

(Figures in thousand Nos.)

Roller Bearings (including thrust bearings)												Total Roller Bearings	Total ball and roller bear- ings
Cylindrical			Tapered					Spherical					
10 to 30mm bore	30 to 55mm bore	55 to 170 mm bore	Above 170 mm bore	Upto 30 mm bore	30 to 55 mm bore	55 to 170 mm bore	170 to 250 mm bore	Upto 30mm bore	30 to 55 mm bore	55 to 170 mm bore	170 to 250 mm bore	23	24
..	..	..	..	..	..	..	..	..	..	..	..	354	354
..	..	..	..	65	122	..	..	..	..	..	..	935	1740
..	..	..	..	27	20	..	..	..	..	..	..	343	666
1820	125	..	..	..	730	993	..	..	..	..	..	3668	4853
237	..	..	..	..	..	..	..	..	..	..	..	237	1212
..	52	13	..	..	..	..	..	..	..	..	..	85	2725
..	..	..	..	..	..	..	..	..	..	..	..	..	7950
..	15	..	..	..	..	..	..	..	..	..	..	15	132
..	38	..	..	..	..	..	..	..	..	..	..	38	636
..	..	..	..	..	..	..	..	..	..	..	..	..	1439
..	..	..	..	..	..	124	..	..	..	..	..	124	430
1	2	8	..	..	..	33	..	..	..	..	..	44	93
..	..	..	..	..	..	..	..	..	..	6	4	10	27
47	..	..	..	..	195	50	..	..	..	..	..	292	1170
1300	..	9	..	..	..	..	..	..	..	..	..	1318	3218
95	146	110	..	..	236	100	60	..	..	..	336	1164	1929
..	..	..	..	..	..	..	..	..	..	..	..	4	115
3500	378	140	..	92	1332	1300	60	..	33	360	340	8631	28689
175	18	7	..	4	66	65	3	..	1	18	17	432	1413
3675	396	147	..	96	1398	1365	63	..	34	378	357	9063	30102
918	99	36	..	24	349	341	15	..	8	94	89	2266	7116
4593	495	183	..	120	1747	1706	78	..	42	472	446	11329	37218
Allowance for stock building												..	170
GRAND TOTAL												..	37388
												Say 37.4 million	

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