

EXECUTIVE SUMMARY

0.1. *General*

0.1.1 The manufacture of diesel engines was initially taken up in 1945 with 5 HP engines. Over the years, the manufacturers have developed capacity to produce engines up to 10,000 HP. There are 34 units in the organised sector, of which 16 are responsible for over 95% of the production. There are successes and failures in units with both imported and indigenous technologies. The only unit in public sector, i. e. GRSE, has not fared well. In the private sector KOEL, KCL, Simpson, Ruston Hornsby, Shriram, Greaves Lombardini, Accumax and Eicher have done well for non-automotive diesel engines and TELCO, Ashok Leyland, M&M and Bajaj Tempo have done well for automotive diesel engines. The two railway units DLW and CLW have done quite well. The number of units in the organised sector and the production of diesel engine during 1977-88 are indicated in table 1.

TABLE - I

DETAILS OF DIESEL ENGINES PRODUCTION IN THE ORGANISED SECTOR

YEAR	NO. OF UNITS	PRODUCTION NOS
1977	32	136,051
1978	32	140,189
1979	32	144,931
1980	27	176,473
1981	31	175,993
1982	31	156,981
1983	NA	156,100
1984	34	170,900
1985	34	170,200
1987	NA	208,843
1988	NA	2,20,155

The figures in Table 1, exclude the following:

- i) Diesel engines manufactured by automotive sector (incl. tractors) for captive use. During 1987-88 this production was 1,67,823 numbers.
- ii) Railways manufacturing diesel engines for locomotive use. This is around 150 engines per year.
- iii) Diesel engines manufactured by small scale sector. Engines up to 15 HP are reserved for small scale and production figures are not available. Based on the production data of diesel fuel pumps, the production of diesel engines in small scale sector, in 1987-88 can be estimated as 7.00 lakh numbers.

0.1.2. Out of 15 units surveyed, 11 were set-up with foreign collaboration and 4 with their own development. The latter had set up production facilities for small HP engines only, initially around 5 HP, though later some of them developed engines up to 20 HP. Almost all the units set-up with foreign collaboration had own R&D departments. The two railway units were backed by Research, Design and Standardisation organisation of Railways. Five of these R&D units had recognition from DSIR. Among the four units without foreign collaboration, only one had an R&D department, which was also recognised by DSIR.

0.2. DIESEL ENGINE GROUPS:

Power rating of a Diesel engines being manufactured in the country vary from 5 HP to 10000 HP. These are being grouped as under:

- a) Up to 15 HP engines.
- b) 15 to 100 HP engines and automotive engines.
- c) 101 to 1000 HP engines.
- d) Over 1000 HP engines and locomotive engines.

0.2.2. **Engines: upto 15 HP:** There are 6 main manufacturers of such engines in the organised sector. In addition, there are a large number of small scale manufacturers. Two manufacturers KOEL and Accumax are having R&D approved by DSIR. Except for these two manufacturers little R&D work has been done by others to improve the engines. During 1970s the then Indian Standard Institute had brought out a number of standards for diesel engines which are implemented and have brought up the quality and standards of the small scale manufacturers.

The engines being made in the country, except for those of M/s Greaves Lombardini, are heavy and slow speed engines. A very large number of engines are in use. It is necessary that a compact light weight fuel efficient engine should be developed which should be licensed to various small scale manufacturers, so that fuel oil can be conserved. Such a study could be sponsored with specialised institutions such as ARAI, CMERI and IITs. The engine should be designed with a matching fuel injection pump.

- 0.2.3. **Diesel Engines 16 to 100 HP:** These engines made by KOEL, Ruston Hornsby, Accumax and Simpson, in addition to the various automotive vehicle manufacturers and tractor manufacturers. Many of the engines made by these manufacturers are also for automotive application. Among the automotive vehicle manufacturers TELCO, Ashok Leyland, Bajaj Tempo M&M are the major manufacturers. It is seen that the latest engines of Bajaj, M&M and TELCO are quite comparable with the diesel engines being manufactured in developed countries. In addition, the LCVs being manufactured with the Japanese collaboration, are also having diesel engines of contemporary design. Thus, in this range the standard of diesel engines being made in the country, is comparable to the world standard. However, there is some scope for improving fuel efficiency and reducing pollution.
- 0.2.4. **101 to 1000 HP Engines :** These engines are being manufactured by KOEL, KCL, Ruston Hornsby and Simposn. In addition some of the automotive engines in use are also above 100 HP. It is seen that the engines being manufactured in India are generally heavier, when compared to engines manufactured in the rest of the world. Thus, there is a scope for improvement in the design of these engines to develop higher HP and better fuel efficiency. Other important factors are initial and operating costs. Weight of the engines is not an important criteria except for automotive applications.
- 0.2.5. **Engines Over 1000 HP:** The main manufacturers are GRSE, KCL, DLW and CLW. A study of their design shows that whereas the GRSE's latest engine with German collaboration is on par with similar engines in the world; for other engines the HP per litre of swept volume is quite low and weight per HP is high. It is, therefore, necessary to optimise the design of these engines for maximising power and efficiency. The ability to use lower grade fuels is an important criterion in this class of engines. Other factors which are important are initial and operating cost, as well as, reliability.
- 0.2.6. With the exception of a few units, the industry has to develop capability for

design and development of a completely new design of engine. Diesel engine manufacturers should be encouraged to enter into collaborations to improve existing engines rather than for manufacture of new designs.

0.3. AREAS FOR IMPROVEMENTS

0.3.1. A study of the trend in the engines manufactured in the world brings out the necessity for further improvement in the following areas:

- i) Fuel efficiency
- ii) Micro processor based fuel injection systems.
- iii) Control on Environment pollution
- iv) Reduction in Noise levels
- v) Increased reliability and reduced main tenance
- vi) Better material for parts subject to wear
- vii) Reduction in Weight per HP.

0.4. CONCLUSIONS

The manufacture of diesel engines in the country was taken up in 1945 and over the years the production of diesel engines has been steadily going up. From a beginning with 5 HP engines, the manufacturers have developed capability to produce engines up to 10,000 HP. The manufacture of small HP engines has also been taken up by numerous manufacturers in the small scale sector which is responsible for production of over 7 lakhs engines out of a total of about 12 lakhs engines per year. The automotive sector is responsible for another 1.67 lakh numbers per year and the organised sector produces about 2 lakh engines/year.

The number of units licensed or registered with DGT for production of diesel engines is 34 . Out of these 16 units are responsible for over 95% of the production in the organized sector. The growth of individual units has been governed by the approach and capabilities of management rather than collaborators or technology. There are successes and failures in units with both imported and indigenous technology. The only unit in the public sector GRSE has not progressed very well. In the private sector KOEL, KCL, Simpson, Ruston & Hornsby, Shriram, Greaves Lombardini, Accumax and Eicher have done well for non-automotive diesel engines and TELCO, Ashok Leyland, Mahindra & Mahindra, Simpson and Bajaj Tempo, have done well for automotive diesel engines.

The technology for 0-15 HP is well-established for many years and except for Greaves Lombardini, who were allowed collaboration for light-weight high speed diesel engines in seventies there have been no foreign collaborations for over 20 years. Most engines are, however, of old design with low power weight ratios.

Even in the ranges of 16-30 HP and 31-100 HP there have been no recent collaborations for general purpose engines. However, four recent collaborations for LCVs would cover diesel engines also. Similarly, there were collaborations for tractors including diesel engine for tractors. The manufacturers of these diesel engines, (except 4 new collaborations) have assimilated and adapted the imported technology and have even brought out improved models.

In the range of over 100 HP diesel engines there have been many imports of technology in seventies and eighties. Here also the technology has been assimilated and some of the manufacturers have incorporated improvements in the models.

Diesel engine industry, specially the successful units, have attained technological stature and maturity and are able to even export diesel engines. The industry has also developed expertise and capability for effecting horizontal transfer of technology.

The ancillary and support industries have also grown with the diesel engine industry and are in a position to supply quality products required by the industry. The areas in which diesel engines manufacturers are not satisfied with the suppliers quality are:

- i) Rubber products such as "O" rings, seals, gaskets, etc.
- ii) Fuel injection equipment, as there is only one manufacturer who can supply quality product. There is need for additional manufacturers.
- iii) Thin walled castings.
- iv) Heavy forgings such as crankshafts for the larger engines.
- v) Aluminium for connecting rods.

With the exception of a couple of units, the industry has yet to develop

capacity to design and develop a completely new design of a diesel engine on its own. Though most successful units have set up R&D facilities and are incurring substantial capital and recurring expenditure, many have not taken up such developments due to the time and expense involved in such work. They prefer to take the easier route of importing the design of a proven foreign model.

0.5.

RECOMMENDATIONS

A. Diesel engines in the range 0-15 HP

- a) The production of these diesel engines in the country is over 7 lakh numbers per year. The total population is likely to be between 30-40 lakh numbers. The specific fuel consumption for engines manufactured is between 175-210 gms/BHP Hr. It is suggested that design of reliable fuel efficient engines in this range at Government/private R&D centres and engineering institutions should be taken up for medium speed engines upto 1800 rpm. A target of 160 gms/BHP hour for the specific fuel consumption is suggested. A suitable prize could be offered for the best engine. The successful engine could be licensed to small scale units. The system should include a matching pumpset design.
- b) BIS should specify material standards for critical components as also keep updating the standards for such engines so that there is continuous improvement in the engines. Compulsory marking could be considered for diesel engines and components.
- c) As the industry has already developed a number of models in this range, further foreign collaboration should not be encouraged except in case of exceptional new technology.
- d) Design and development of compact, light weight diesel engine with 6/8 HP for agriculture use should be sponsored. The engine should retain the good features of the present engine and should be more economical to manufacture and operate. Design & development organisation like ARAI, CMERI, IITS could be considered.

B. Engines over 15 HP.

- a) There are a large number of diesel engine manufacturers producing diesel engines in higher HP ranges. The demand for such engines is limited. A number of collaborations have been permitted. It is therefore, considered that further foreign collaborations should be discouraged except for exceptional new technology.
- b) Individual manufacturers should carry out optimization studies of existing engines-either in house or with specialized institutions-to get more H.P., better fuel efficiency, less pollution from their existing engines.
- c) Individual manufacturers should develop turbocharged versions of existing engines with a view to get increased power, fuel efficiency, etc.
- d) Diesel engine development organization of RDSO should provide test facilities for single cylinder engines and carry out optimization studies on ALCO and MAK engines and then incorporate these in the larger engines
- e) R&D set-ups of individual manufacturers should carry out failure analysis and studies for various components to improve reliability and reduce maintenance.
- f) *Import of Diesel engines and DG sets.* With development of manufacturing capacity for the higher HP ranges with indigenous manufacturers, it is necessary to have a fresh look at import of D.G. sets or diesel engines of higher HP. With a number of manufacturers in private and public sectors, capable of manufacturing such engines, such imports should not be permitted in future. A number of manufacturers reported un-utilized capacity due to such imports being permitted. Here it would be necessary to develop alternators to match different engines being produced.
- g) Diesel engine manufacturers should be encouraged to enter into R&D collaborations for latest developments to improve existing engines rather than entering in fresh collaboration for manufacture of new new designs. Where Indian Institutions have the expertise they should be given preference.

h) Substantial expertise has been developed relating to product technology in national laboratories such as CMERI, IITs and other engineering institutions, ARAL, RDSO, and engineering consultants. Diesel engine manufacturers may consider utilization of this expertise to supplement their own efforts.

C) Incentive & measure for encouraging innovations

a) The development of own designs and their productionizing and launching is a very time consuming and expensive operation. Many entrepreneurs feel shy of this approach when the easier option of foreign collaboration for a proven model is available. It is considered that certain fiscal incentives could be offered to encourage innovative efforts. Following suggestions are given for consideration:

i) Grant of soft loans/subsidy to meet part of the expenses involved in development and launching of new models in areas of national importance e.g. improvement in fuel efficiency, ceramic engines etc. Such development projects would need to be approved by the Government.

ii) Grant of excise exemption for a few years for approved models developed and introduced on the basis of indigenous R&D.

iii) Deduction of recurring expenditure on approved projects with some weightage as was earlier allowed. The projects should be specifically approved by the Government and a watch kept over their progress.

iv) Customs duty benefits as allowed to national laboratories may be permitted for equipment imported for such approved projects.

b) Sponsored R&D in the following areas which are of common interest for all diesel engine manufacturers and where the results would be in the national interest, should be considered.

Exhaust pollution-Study of existing engines with a view to suggest modifications to enable conformation to IS standards.

Noise pollution-Study of existing engines for their noise pollution

levels and suggest levels to be enforced and action necessary to achieve such levels.

Better materials- Study into better materials such as alloys, ceramic coating or ceramics, powder metallurgy components to reduce weight and cost and/or improve life.

Desing of small lightweight fuel-efficient engine of 6-8 HP. with matching Pump. Design of dual fuel engines and engines using alternate fuels such as LSHS, furnace oil or Bio gas.