

# **EXECUTIVE SUMMARY**

## **0.1 INTRODUCTION**

The Indian Gear Industry is dependent on the Automotive Industry, Engineering Industry and Machine Tools Industry for its production. Gears and Gear Transmissions are developed according to the design/drawings/specifications supplied by the end user industry. This also depends upon the availability of Gear Cutting machines, Finishing machines, Cutting Tools and technology required to process the component.

In industrially advanced countries, automated CNC Gear Cutting/ Finishing machines and CAD are increasingly being used in the production of Gears, resulting in consistent quality and high degree of flexibility in production.

In India, the Gear manufacturers are very well aware of the world developments and technology competence in Indian industry is quite comparable to other advanced countries within the restraints of capital investment. Some of the companies are having foreign collaboration for the manufacture of gears.

Generally the Gear manufacturers are equipped with conventional type of imported plant and machinery, testing equipments from Germany, Switzerland, USA, Japan etc. and some of them have CNC Gear Cutting machines.

## **0.2 CAPACITY AND PRODUCTION**

There are mainly 14 units in the Automotive sector in the country who specialise in the manufacture of gears, transmission gears etc. and 4 units who are active in the manufacture of steering gears. The total licensed capacity of specialised automotive gear manufacturers is 36,400 tonnes/annum and that of steering gear manufacturers is 490,000 nos./annum.

Besides, the vehicle manufacturers who procure gears from specialised manufacturers, also manufacture gears for their

captive requirement. The total installed capacity of such manufacturers is estimated to be 28,000 tonnes/annum. Over and above, there are machine tools & industrial machinery manufacturers producing gears for their own use. The total licensed capacity of such manufacturers is estimated to be 10,000 tonnes/ annum.

The total production of specialised automotive gear manufacturers for the year 1993-94 has been estimated to be 25,500 tonnes with a value of Rs. 285 crores. The captive production of gears by vehicle manufacturers in 1993-94 has been estimated to be 9,500 tonnes. Besides, a number of industrial machinery manufacturers produce gears for captive use which has been estimated to be 4400 tonnes valued at Rs. 92.35 crores in 1993-94. Gears are also produced in Machine Tools industry and production is estimated to be 1900 tonnes. Finally there are some SSI units who contribute another 1000 tonnes. Thus the total production of gears in the country in 1993-94 is 42,300 tonnes.

### **0.3 IMPORT & EXPORT**

The Indian Gear manufacturers are equipped with imported gear cutting machines and testing equipments and the quality of gears is comparable with international standards. They have eventually made way into the world market. The exports value from 1990-91 to 1992-93 has been as given below :

<b>Year</b>	<b>Value (Rs. Crores)</b>
1990-91	12.29
1991-92	13.88
1992-93	22.76

There has been some imports of crank transmissions and gear boxes. Imports value from 1990-91 to 1992-93 in automotive industry is given on next page :

Year	Value (Rs. Crores)
1990-91	7.29
1991-92	4.37
1992-93	8.58

#### **0.4 TECHNOLOGY GAP**

The areas where technology import is still required are :

- Design and manufacture of shaving cutters, plunge shaving cutters, involute spline/special profile full form plug and ring gauges.
- Hard gear finishing
- Automated unmanned manufacturing and material handling.
- Cold and warm forging technology for automotive application.
- On line method of inspecting gears.

#### **Capital Equipments**

There is insufficient availability of following equipments:

- Gear shaving and rounding machines.
- Roof-copping and profile gear grinding machines.
- Gear involute and lead testing machines.

#### **Raw Materials and Components**

- Indigenous raw materials lack in consistency. Vacuum degassed alloy steel with controlled oxygen level and steels with lead addition is not available.

- Good quality bearings and oil seals for industrial gear box applications are not available in the country.

## **0.5 R & D FACILITIES**

Gajra Gears Ltd. and Bharat Gears Ltd. have well established R&D facilities. Gajra Gears Ltd has a R&D set up approved by DSIR. Bharat Gears has ISO 9002 certification. Other units have limited R&D facilities. R&D work carried out in the country has been as under :

- Technology absorption and indigenisation of design & development.
- Development of cutting tools, shaving and tandem shaping cutters.
- Design evaluation/modification of gear boxes in the existing vehicles.

## **0.6 FACILITIES IN NATIONAL INSTITUTIONS**

The country has three main such institutions. Central Manufacturing Technology. Institute (CMTI) has facilities for design and inspection of gears and is capable of providing technological support for manufacturing process, heat treatment and inspection of gears. CMTI has developed ground (DIN Class 6) as well as commercial (DIN Class 8) gears in the past.

At Automotive Research Association of India (ARAI), the following facilities are available

- Computer aided gear design
- Dynamic analysis of the gear box design for the matching shafts, bearings and housings.
- Design of gear box housing for low noise.
- Endurance testing of gear boxes.

Indian Institute of Technology, Bombay (IIT) has facilities for computer aided design of gears.

## **0.7 INTERNATIONAL SCENE**

In advanced countries, there is an increasing trend in the use of CNC machines for the development of Gears. This ensures high speed production and repetitive accuracy. Gleason, Klingelberg, Hurth and Oerlikon are some of the leading manufacturers who excel in Gear cutting/finishing machines, testing & measuring instruments.

There have been numerous developments in the areas of manufacturing process, material, design and quality control. Some important developments are Hard Gear Finishing using CNC machines, Cold Rolling of Gears, Powder Metallurgy process, CAD for optimisation, Minimum Weight Gears, Acoustic Intensity instruments for noise measurement etc.

## **0.8 CONCLUSIONS**

0.8.1 The gear industry is over 30 years old. The manufacturers are well equipped with modern gear cutting facilities as well as testing equipments imported from world renowned manufacturers eg. Gleason, Fellow, Magg, Oerlikon, Reishauer, Hurth, Klingelberg, Pfauter, Liebherr etc. The industry has also latest inbuilt facilities to manufacture gear cutting tools for captive requirement as well as for outside sale. CAD is employed for the design of gear cutting tools.

0.8.2 The production of automotive gears by specialised Gear manufacturers during 1993-94 has been estimated to be about 25,500 tonnes with a value of Rs. 285 crores. Besides, the production by vehicle manufacturers for captive use has been estimated to be 9,500 tonnes. In addition, there are some SSI units who account for another 1000 tonnes. Gears are also produced in the Engineering industry for captive consumption. The production of industrial machinery manufacturers has been estimated to be 4400 tonnes with a value of Rs. 92.35 crores in 1993-94 and that of machine tools manufacturers has been estimated to be 1900 tonnes. Hence the total production of Gears in the country has been 42,300 tonnes in 1993-94.

0.8.3 Out of the specialised gear manufacturers, Bharat Gears Ltd. and Gajra Gears Ltd. are two main units who account for 37% and 25% for the production of automotive gears respectively.

0.8.4 Gajra Gears Ltd. has a well organised R&D approved by DSIR. Bharat Gears Ltd. has no separate R&D but it is a part of their engineering setup and also has approval for ISO 9002 certification. Others have R&D as part of the Engineering departments. The R&D expenditure in the country is 0.8% of the total turnover. The companies have to their credit numerous modifications, improvements and developments both in gears and manufacture of gear cutting tools. The technology is comparable with other advanced countries within the restraints of capital investment. Some companies have already adopted ISO 9000 series certification and others are in the process of implementing the same.

## **0.9 RECOMMENDATIONS**

0.9.1 In view of the growing concern on vehicle noise pollution, improved gears need to be developed for vehicle transmissions. Research and Development is one of the activities in improvement of the existing product. The R&D units of gear manufacturers must constantly review their performance against international developments and make suitable modifications/changes justified on techno-economic ground. Gear manufacturers must specially concentrate in the following areas :

- Design & development of Cutting Tool
- Quality improvement
- Reduced noise level
- Improved process of manufacture
- Reduced frictional loss

0.9.2 Some improvements adopted by manufacturers in developed countries are given on next page which should be considered by Indian manufacturers :

- i Automated manufacturing & material handling
- ii Automatic Cycle Annealing Process
- iii Online inspection method
- iv Hard shaving Technology
- v Powder Metallurgy Process
- vi Design and manufacturing of Gear cutting Tools
  - Gear Shaving cutters for special profiled gears
  - Plunge Cut Shaving Cutters
  - Carbide Hobs in fine module.
  - Shaping Cutter for special profile
  - Cutter Blades for Hypoid and Spiral Bevel Gears.
  - Titanium Carbo Nitride coating for hobs and Gear Shaping Cutters.

0.9.3 In order to enhance exports, the gear manufacturers should essentially consider the following steps :

- Make a study of the design parameters used, process of manufacture, facilities available, quality standards, quality control procedures, material specifications etc. prevailing in developed countries.
- Examine requirements against own facilities with respect to plant and machinery, heat treatment, quality control equipment, material, gear cutting tools and identify areas needing improvement.
- Make necessary improvements by own R&D or by purchase of foreign knowhow.
- Investigate possibility for buy back by foreign collaborators.
- Qualify for ISO 9000 series or other equivalent standards to ensure good quality and capability to maintain such quality.

- Use of CAD for optimisation.
- It is suggested to form an Association of gear manufacturers in the country. In such Association, new ideas, problems, interaction and other issues can be discussed to the mutual benefits of the gear industry.

0.9.4 In order to compete in the world market, the following plant & machinery with CNC control may be required to be imported :

- Gear shaving & Rounding machine
- Gear Honing & Grinding machine using CBN wheels
- Gear involute & lead testing machines

0.9.5 Import of technology for cold, warm forging for gear industry

0.9.6 Gear industry should make use of PATSER scheme (Programme Aimed at Technological Self Reliance) of DSIR, who is supporting such projects where technology gaps exist.

0.9.7 For transport vehicle, weight is of great importance. The vehicle and gear manufacturers should look into the possibilities of developing low weight, less space transmission cases in the country. They could discuss with CMERI, IITs, CMTI and ARAI for their development.

0.9.8 SISI must make available facilities for small scale units for heat treatment and testing of gears.