PRACTICAL TRAINING

At

Mahindra Gears & Transmissions Pvt. Ltd.

Shapar Road, Rajkot. (Gujarat)

Submitted in the partial fulfillment of
Bachelor of Technology Degree Of
The Jodhpur National University, Jodhpur.

SUBMITTED:

Department of MECH
Faculty of E & T
.

SUBMITTED BY :

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4TH YEAR (7TH SEM)

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Declaration

I here by declare that the project work entitled "Industrial Training Report" Submitted to the Mahindra Gears & Transmissions is a record of an original work Done by me under he guidance of Mr. Hemang sir & Mr. P.K. Shahu sir in Mahindra Gears. It has not been altered or corrected as a result of assessment and it may contain errors and omissions. The views expressed in it together with any Recommendations by me.

FALDU KRUNAL.

Acknowledgement

As part of my industrial training I am look up the training of Mahindra Gears when I joined in the company I don't have actual idea what to do, but I glad to get the most help and tremendous support from the training officer and supervisor

It is always a pleasure to remind the fine people in the Engineering Workshops for their sincere guidance I received to uphold my practical as well as theoretical skills in engineering.

- Firstly I would like to thank Mr. Roney John (DGM- Projects) to permitting me for take training in Mahindra Gears.
- Secondly I would like to thank Mr. Vibhu Datta Panda (H.R.Manager) for the positive attitude he showed for my work, always allowing me to question him and giving prompt replies for my uncertainties in all the fields.
- Thirdly I would like to thank Mr. Sanjay Parmar Sir (Supervisor of Production control) and Mr. Prashant Joshi Sir (Setter of machine) of Department of Production. For extending their Behavior towards me and making a pleasure-training environment in the Engineering Workshops. A paper is not enough for me to express the support and guidance I received from them almost for all the work I did there.
- Mr. Keyur sir (Supervisor of tool room) is always guiding me to the different tool use in production shop.

Workshop Superintendents and all other workers are also greeted. I thank all the person the mutual support I received from them.

Finally I apologize all other unnamed who helped me in various ways to have a good training.

PREFACE

This is a report based on my experience at Mahindra Gears &Trasmissions Pvt. Ltd. Rajkot. Being a student of mechanical engineering, I wished to gain exposure to the various aspects of working in an industry. This was a perfact opportunity for me since the plant of MGTPL at Rajkot is one of the biggest production setups in India. My primary goal was to gain some insight into methods of manufacturing and design, and during my time at the shop-floor, I have achieved it to some extent. It was a good learning experience and will stand me in good stand me in good stead in future.

I have divided the report in to here part as follow- chapter 1: Introduction, chapter 2: Analysis, chapter 3: Process Explination

FALDU KRUNAL

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Chapter 1.Introduction

We are one of the leading manufacturers of proven quality gears and other transmission components in India, since 1987.The facility comprises of 3 workshops of sizes 800 sq.mts. 1000 sq.mts. And 4000 sq.mts. With a complete standby power for the entire premises. We are constantly undergoing expansion and introducing newer technologies and equipment. The manufacturing processes are : Turning on CNC turning centers, Gear cutting on CNC Hobbing, Shaping , Gear shaving, Broaching (horizontal & Vertical), Tooth rounding / Chamfering, Gear cleaning (Shot Blasting), Milling and Grinding, External, Surface & Root with In process gauging system and CNC Hard Turning. Mahindra gears is also equipped for Heat treatment processes like : Gas Carburizing, Induction Hardening, Salt bath HT, Nitriding, Annealing & Normalizing. We also have a TOOL ROOM for manufacture of jigs, fixtures, etc. In most case $20MnCr_5$ material is used to make gear.

1.1 Services And Major Functions

The infrastructure of the Engineering Workshops could provide the following listed services to its consumers both in academic and non-academic terms.

We produce more than 2,50,000 quality assured gears a month, conforming to German specification DIN 7 to DIN 9 class of accuracy. We are certified to TS 16949 quality system requirements, from TUV.

Mahindra Gears & Transmissions Pvt. Ltd. manufactures auto components comprising of automobile gears like Spur, Helical, Straight Bevel, Sprockets along with Transmission Spline Shaft, Couplings and Power Takeoff Clutches which are used for Transmission, Engine and Differential gear boxes.

1.2 Various Department/Shop

- New Production Development Department
- Vendor Supplied Area / Raw material Storage
- SCM department
- Primary Inspection Department
- Maintenance Department
- Production Shop
- Heat Treatment shop
- Shot Blasting Shop
- Grinding Shop
- Eaton Hub Cell
- Pre Dispatch Inspection Department
- Final Inspection (Domestic/Export)

1.3 Customers & Vendors

❖ **Customers:**

- International Tractor Ltd.
- Tata Motors Ltd.
- DANA India Ltd.
- Eaton

❖ Vendors:

1. Forging

- Kadvani Forge Ltd.
- Niku Forging Pvt. Ltd.
- Hindustan Motors Pvt. Ltd.

2. Machining

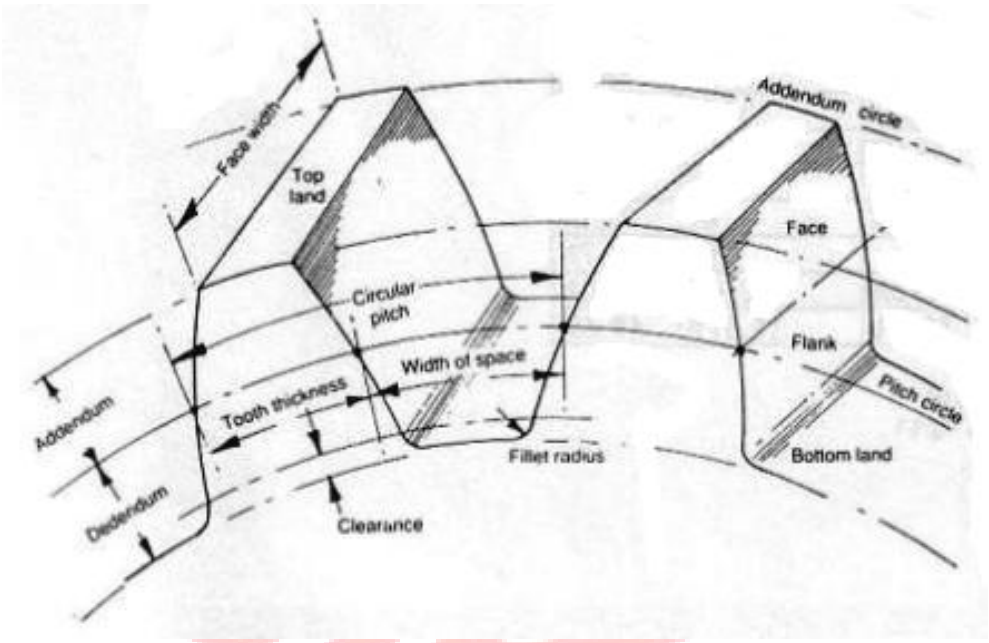
- Jyoti CNC Automation
- Turn well Industries
- Krishna Engineers

3. Heat Treatment

- Ravi Metal Treatment
- Inducto Hardening
- Advance Mechanical Works

Chapter 2. Analysis

2.1 Gear Geometry



2.2 Various Machines

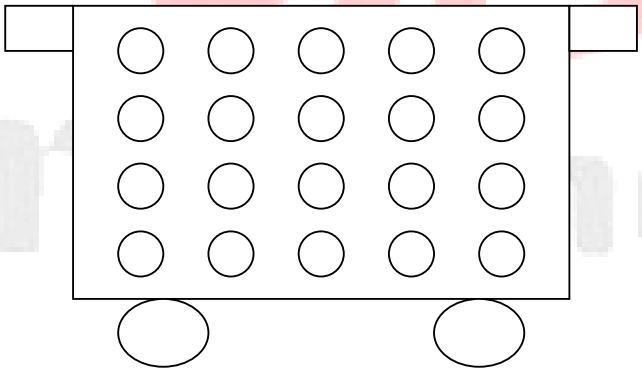
- Computerized Numerical control(CNC)
- Vertical Machining Center(VMC)
- Horizontal Machining Center(HMC)
- Turning Machining Center(TMC)
- Co-ordinate Measuring Machine(CMM)
- Dia. Of X-axis 250 mm(DX 250)
- Slant Turning Center(STC)
- 200 Travel in X-axis

2.3 Various Processes

- Turning
- Broaching
- Gear Cutting
- Tooth Rounding
- Gear Shaving
- Heat Treatment
- Cleaning
- Grinding
- Cutter Resharpening

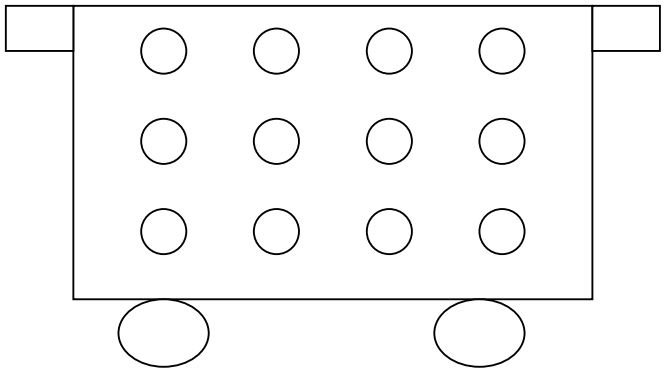
2.4 Material Movement Trolley

- Component Range: up to 125 mm dia.



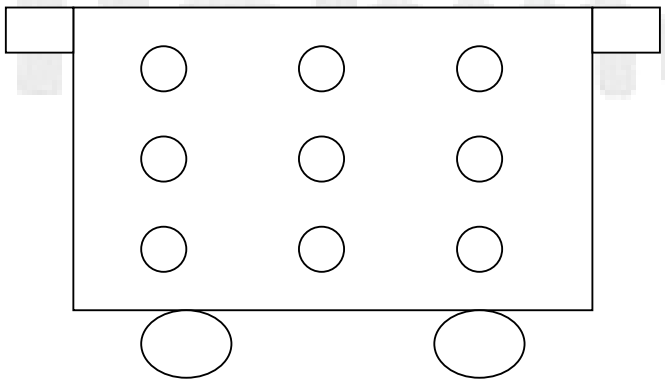
Model No.	Ext. pipe Dia.	Qty of Pipe
Troly 1 A	15.00 mm	40
Troly 2 B	25.05 mm	40
Troly 3 C	31.40 mm	40
Troly 4 D	37.75 mm	40
Troly 5 E	50.45 mm	40

- Component Range: 125 to 200 mm dia.



Model No.	Ext. pipe Dia.	Qty of Pipe
Troly 1 A	15.00 mm	24
Troly 2 B	25.05 mm	24
Troly 3 C	31.40 mm	24
Troly 4 D	37.75 mm	24
Troly 5 E	50.45 m	24

- Component Range: 200 to 250 mm dia.



Model No.	Ext. pipe Dia.	Qty of Pipe
Troly 1 A	15.00 mm	18
Troly 2 B	25.05 mm	18
Troly 3 C	31.40 mm	18
Troly 4 D	37.75 mm	18
Troly 5 E	50.45 mm	18

Chapter 3. Brief Process Explanation

3.1 Hobbing

- **Process :**

Hobbing is a machining process for making gears, splines, and sprockets on a hobbing machine, which is a special type of milling machine. The teeth or splines are progressively cut into the work piece by a series of cuts made by a cutting tool called a hob. Compared to other gear forming processes it is relatively inexpensive but still quite accurate, thus it is used for a broad range of parts and quantities. It is the most widely used gear cutting process for creating spur and helical gears and more gears are cut by hobbing than any other process since it is relatively quick and in expensive.Hobbing uses a hobbing machine with two non-parallel spindles, one mounted with a blank work piece and the other with the hob. The angle between the hob's spindle and the work piece's spindle varies, depending on the type of product being produced. For example, if a spur gear is being produced, then the hob is angled equal to the helix angle of the hob; if a helical gear is being produced then the angle must be increased by the same amount as the helix angle of the helical gear.

- **Hob :**

The hob is the cutter used to cut the teeth into the work piece. It is cylindrical in shape with helical cutting teeth. These teeth have grooves that run the length of the hob, which aid in cutting and chip removal. There are also special hobs designed for special gears such as the spline and sprocket gears.

- **Process Parameter :**

1. Hob Cutter O.D Run Out On Machine : 0.010 mm
2. Locator O.D Run Out : 0.010 mm
3. Locator Face Run Out : 0.010 mm
4. Top Center Run Out With Respect To Workable : 0.010 mm

- **Product Parameter :**

1. D.O.P : Micrometer
2. R.O.P : Bench Center With Dial Stand
3. T.C.E : Gear Roll Tester
4. T.T.C.E : Gear Roll Tester
5. Helix Error : Lead Profile Tester
6. Lead Variation : Lead Profile Tester
7. Profile Error : Lead Profile Tester
8. Profile Variation : Lead Profile Tester
9. Root Dia. : Vernier Caliper
10. Semi Topping : Vernier Caliper

3.2 Shapping

- **Process :**

A gear shaper is a machine tool for cutting the teeth of internal or external gears. The name shaper relates to the fact that the cutter engages the part on the forward stroke and pulls away from the part on the return stroke, just like the clapper box on a planer shaper. The cutting tool is also gear shaped having the same pitch as the gear to be cut. However number of cutting teeth must be less than that of the gear to be cut for internal gears. For external gears the number of teeth on the cutter is limited only by the size of the shaping machine. For larger gears the blank is usually gashed to the rough shape to make shaping easier.

- **Shapping Cutter :**

SHB Manufacture Gear Shaping Cutters in Module, DP and CP series. Spur as well as Helical Shaper Cutters can be supplied in Disc, Hub and Shank Type Varieties. Material used is generally AISI M35 Grade and accuracies are as per DIN-1829 Standard Class 'AA' and Class 'A'. Profile modifications including Chamfer, Semi-Topping, Topping , Protuberance, Flat or Fillet Root can be provided.

- **Process Parameter :**

1. Cutter O.D Run Out On Machine : 0.010 mm
2. Cutter Rake Face Run Out : 0.010 mm
3. Locator O.D Run Out : 0.010 mm
4. Locator Face Run Out : 0.010 mm

- **Product Parameter :**

1. D.O.P : Micrometer
2. R.O.P : Bench Center With Dial Stand
3. Helix Error : Helix Tester
4. Root Dia. : Vernier Caliper
5. Semi Topping : Vernier Caliper
6. Free Entry Of Matting Part : Go gauge
7. Teeth Finish : Visually
8. Spline Rotation Must Be Not Enter : No Go gauge

3.3 Broaching

- **Process :**

Broaching is a machining process that uses a toothed tool, called a broach, to remove material. There are two main types of broaching: linear and rotary. In linear broaching, which is the more common process, the broach is run linearly against a surface of the work piece to affect the cut. Linear broaches are used in a broaching machine, which is also sometimes shortened to broach. In rotary broaching, the broach is rotated and pressed into the work piece to cut an axis symmetric shape. A rotary broach is used in a lathe or screw machine. In both processes the cut is performed in one pass of the broach, which makes it very efficient. Broaching is used when precision machining is required, especially for odd shapes. Commonly machined surfaces include circular and non-circular holes, splines, keyways, and flat surfaces.

- **Broaching Cutter :**

SPLINES:

1.Straightn

2. Involute

3. Serrations

4. Trapezoidal

INTERNAL HOLE:

1. Square

2. Round

3. Rectangular, Hexagonal

4. Irregular Shapes etc.

KEYWAY:

1. With or without Chamfer

2. Convex/Concave.

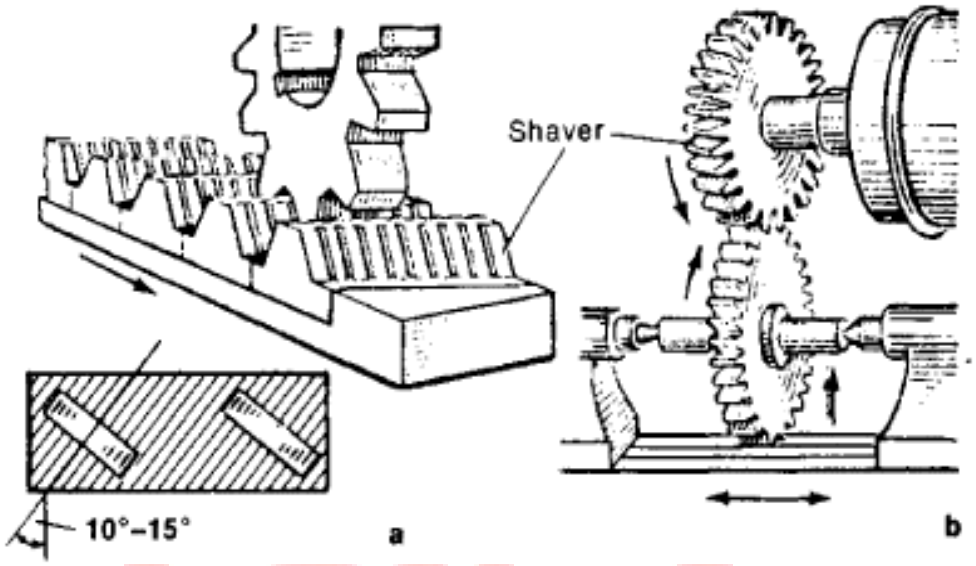
3. Combined Round & Single Keyway

- **Product Parameter :**

1. Major Dia. : Paddle Gauge
2. Minor Dia. : Plug Gauge
3. Face R/O & O.D R/O : Bench Center With Dial Stand
4. Finishing Spline : Visually

3.4 Shaving

- **Process :**



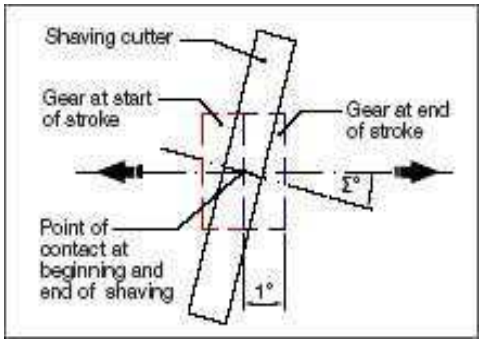
Gear shaving is basically a finishing operation. This takes place after the operations of roughing with a hob or cutting with a shaper cutter is over. The Shaving process consists of the removal of tiny particles of metal from a gear teeth's working surface. Gear shaving produces fine hair like chips. The cutter comes in the form of helical gear. It has special serrations in the flank area of gear teeth. These serrations act as the cutting edges.

1. Advantages :

1. Improves tooth surface finish.
2. Eliminates, the problem of tooth end load concentrations.
3. Effective reduction in the noise of gears with modification in the tooth profile.
4. Increase the gear's load capacity Improved safety and service life.

2. Shaving Cutters :

1. Transverse Shaving Cutters :



The gear that is shaved reciprocates in the direction of its own axis. The tool and the gear are in mesh. With each step of reciprocation, there is an occurrence of small quantity of radial feeding of the shaving cutter.

2. Diagonal Shaving Cutters :

Here the gear selected for shaving reciprocates obliquely in direction to its own axis. The gear and the tool are made to stay in a mesh. The diagonal angle can be got by positioning of the work piece table in an oblique manner or by the process of interpolating of the two machine axes. As with each reciprocation, there is a radial feeding of the shaving cutter. This is described in the diagram.

3. Plunge Shaving Cutters :

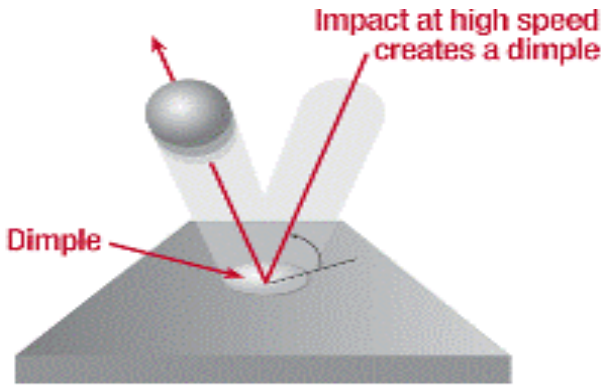
In this method there is no worktable translation. Instead there takes place a radial feed of the work piece against the tool that is used as shaving cutter. Plunge shaving is particularly good for shaving of shoulder gear.

4. Underpass Shaving Cutters :

Underpass shaving is primarily identical to diagonal shaving with a small variation in the form of a diagonal angle of 90 degrees. In underpass shaving no axial table reciprocation takes place. In its place, the work piece reciprocates at right angles to its own axis.

3.5 Shot Blasting

- **Process :**



Shot Blasting is the process after Heat treatment in which remove the product darkness which occurs in heat treatment process . In this Process 52 to 60 HRC hardness stainless steel small particles strike on product.

3.6 Deburring

- **Process :**

Gear deburring machines are designed to correctly remove burrs or sharp edges as a result of castings, drilled holes, cut grooves and other machining operations used to complete parts. The Deburring process of gears makes the parts capable of a performance for which they were designed. It eliminates all the unwanted elements that obstruct their productivity.

- **Deburring cutter:**

SHB manufacture Gear Deburring Cutters to remove burrs formed during teeth cutting and chamfering operation. These cutters are used in conjunction with Gear Chamfering Cutters. Material used is mainly HSS M-2. Gear Deburring Cutters for Samputernsilli Machines can be manufactured in standard form as well as to the specific requirements of the customer.

3.7 Chamfering

- **Process :**

Chamfer is a beveled edge connecting two surfaces. If the surfaces are at right angles, the chamfer will typically be symmetrical at 45 degrees. A fillet is the rounding off of an interior corner.

3.8 Rounding

- **Process :**

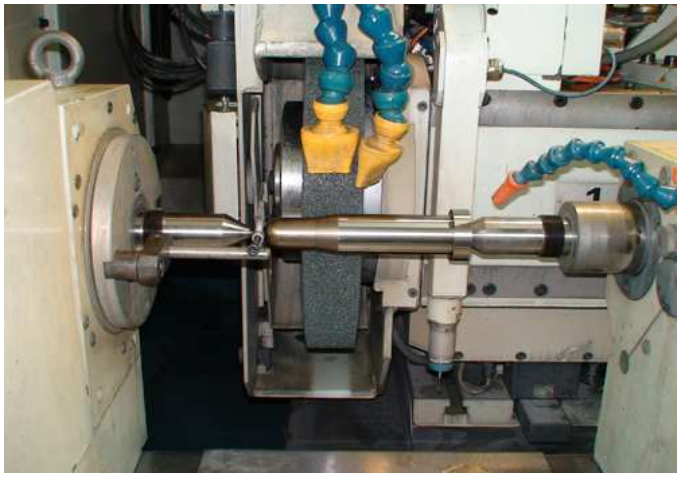
Rounding is a process in which the tooth sharp corner is cut by the rounding cutter A rounding of an exterior corner is called a "round" or a "radius".

3.9 Lapping

- **Process :**

Lapping is a machining operation, in which two surfaces are rubbed together with an abrasive between them, by hand movement or by way of a machine. This can take two forms. The first type of lapping (traditionally called grinding), typically involves rubbing a brittle material such as glass against a surface such as iron or glass itself (also known as the "lap" or grinding tool) with an abrasive such as aluminum oxide, jeweler's rouge, optician's rouge, emery, silicon carbide, diamond, etc., in between them. This produces microscopic conchoidal fractures as the abrasive rolls about between the two surfaces and removes material from both.

3.10 Grinding machine



- **Process :**

Grinding machine consists of a power driven grinding wheel spinning at the required speed (which is determined by the wheel's diameter and manufacturer's rating, usually by a formula) and a bed with a fixture to guide and hold the work-piece. The grinding head can be controlled to travel across a fixed work piece or the work piece can be moved whilst the grind head stays in a fixed position. Very fine control of the grinding head or table's position is possible using a vernier calibrated hand wheel, or using the features of numerical controls. Grinding machines remove material from the work piece by abrasion, which can generate substantial amounts of heat; they therefore incorporate a coolant to cool the work piece so that it does not overheat and go outside its tolerance. The coolant also benefits the machinist as the heat generated may cause burns in some cases.

- **Diamond tool :**

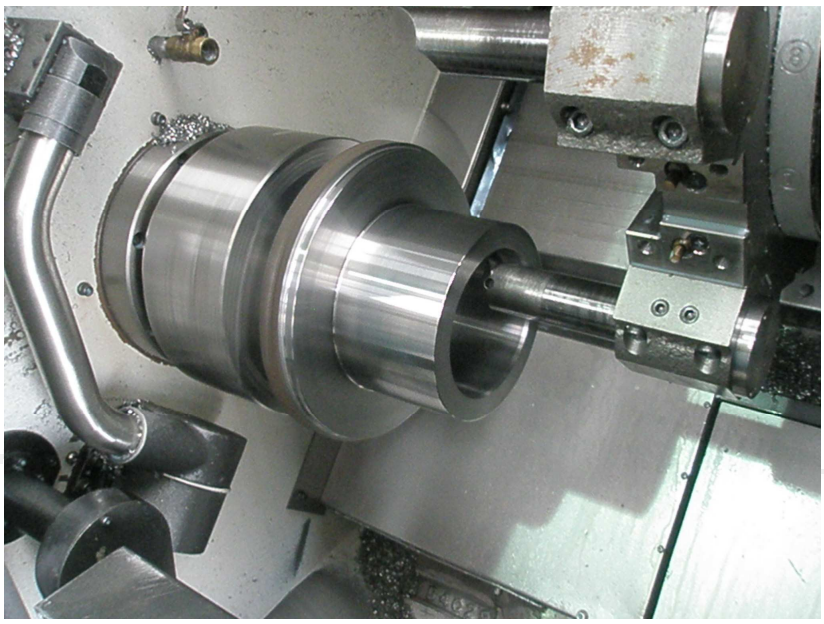
A diamond tool is a cutting tool with diamond grains fixed on the functional parts of the tool via a bonding material or another method.

- **Advantages of diamond grinding tools :**

1. High grinding efficiency, Low grinding force
2. High wear resistance.
3. Long lifespan, Long dressing period:.
4. Low comprehensive cost

3.11 Turning Machine

- **Process :**



Turning is the process whereby a single point cutting tool is parallel to the surface. It can be done manually, in a traditional form of lathe, which frequently requires continuous supervision by the operator, or by using a computer controlled and automated lathe which does not. This type of machine tool is referred to as having computer numerical control, better known as CNC. and is commonly used with many other types of machine tool besides the lathe.

- **Hard turning**

Hard turning is a turning done on materials with Rockwell C hardness greater than 45. It is typically performed after the work piece is heat treated.

The process is intended to replace or limit traditional grinding operations. Hard turning, when applied for purely stock removal purposes, competes favorably with rough grinding. However, when it is applied for finishing where form and dimension are critical, grinding is superior.

- **Soft turning**

Soft Turning is turning done to soft materials which are without heat treatment process and its hardness is lower than Rockwell C hardness 45.

3.12 Milling machine

- **Process :**

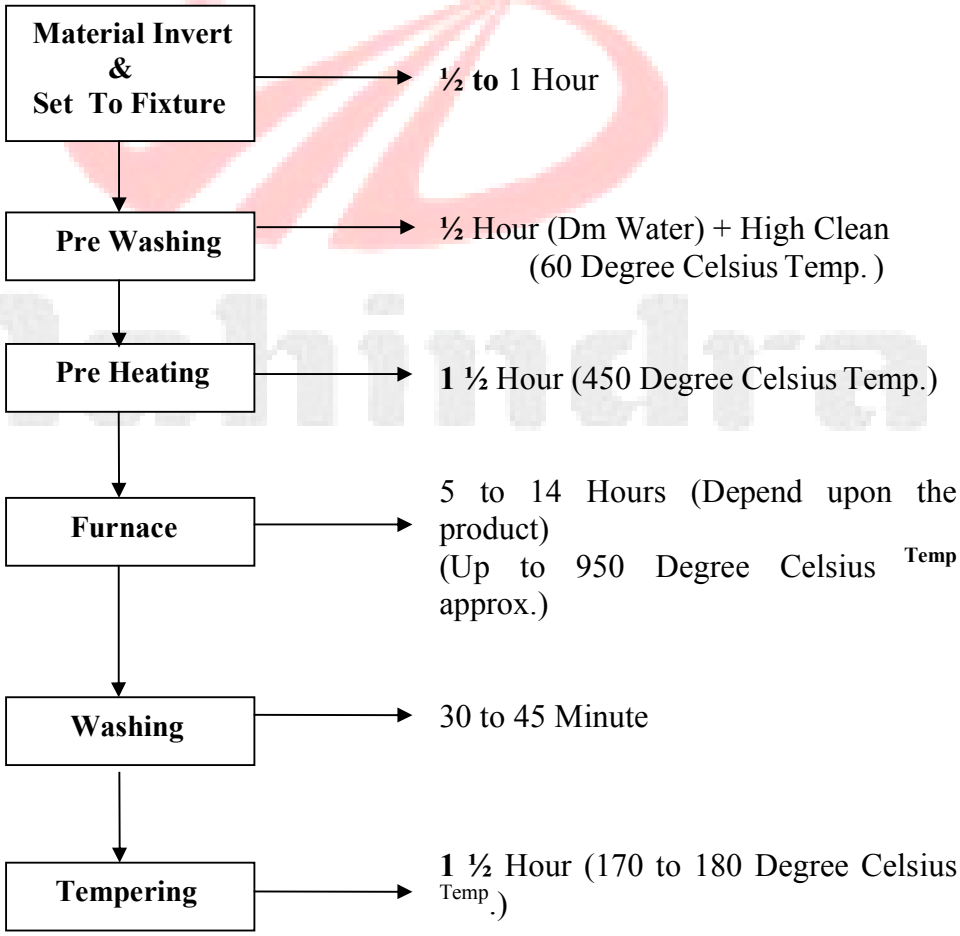
A milling machine is a machine tool used to machine solid materials. Milling machines are often classed in two basic forms, horizontal and vertical, which refer to the orientation of the main spindle. Both types range in size from small, bench-mounted devices to room-sized machines. Unlike a drill press, which holds the work piece stationary as the drill moves axially to penetrate the material, milling machines also move the work piece radially against the rotating milling cutter, which cuts on its sides as well as its tip? Work piece and cutter movement are precisely controlled to less than 0.001 in (0.025 mm), usually by means of precision ground slides and lead screws or analogous technology. Milling machines can perform a vast number of operations, from simple (e.g., slot and keyway cutting, planning, drilling) to complex (e.g., contouring, die sinking).

3.13 Heat treatment process

- **Process :**

Heat treatment process is a series of operations involving the heating and cooling of metals in the solid state. Its purpose is to change a mechanical property or combination of mechanical properties so that the metal will be more useful, serviceable, and safe for definite purpose. By heat treating, a metal can be made harder, stronger, and more resistant to impact; Heat treatment process can also make a metal softer and more ductile. No one heat-treating operation can produce all of these characteristics. In fact, some properties are often improved at the expense of others. In being hardened, for example, a metal may become brittle.

- **Process Flow Chart :**



3.14 Induction Hardening Process

- **Process :**

1. Completion of all machining operations.
2. Pre heat inspection and punching.
3. Stress relieving (at 250c, 2 Hr.)
4. Oiling
5. Job resting faces cleaning by polishing paper.
6. Induction hardening (Internal/External)
7. Oiling
8. Tempering must be within 4 hr.
9. Oiling

- **Advantages :**

1. Induction Hardening is very use full to increasing the hardness of product either internally or externally.

2. It is use to make brittle material of product.

3.15 Conclusion:

After completing the industrial training at 'MAHINDRA GEARS & TRANMISSION PVT. LTD.' I can say that the industrial training is very important for Engineering students like me. Practical knowledge is a very important in the every field. It was great experience during the industrial training and I learnt practically knowledge about the different machines like Hobbing, Shapping, Shaving etc. uses to cut the various gear like spur, helical, spline,etc.. I also took some experience about the organization's work. The employees of the company were supportive during the industrial training. They provide me the proper guidance and information about all the departments like marketing, production and personnel, etc.

3.16 Referance

- WWW.MAHINDRAGEARS.COM
  - The company
  - Product
  - Infrastructure
  - Qualities

- WWW.GOOGLE.COM
  - Google Images
  - Gear Cutter

- WWW.WIKIPEDIA.COM
  - http://En.Wikipedia.Org/Wiki/Bevel
  - http://En.Wikipedia.Org/Wiki/Numerical_Control
  - http://En.Wikipedia.Org/Wiki/Solid

- WWW.USEDDEBURRINGMACHINES.COM

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