

# “Study of Production Processes and Manufacturing Practices at Kinetic Engineering Limited, Ahilyanagar”.

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## Abstract

Automobile component manufacturing requires high precision, productivity, quality and process reliability. Kinetic Engineering Limited (KEL), Ahilyanagar, is an established automotive manufacturing facility involved in the production of various precision-engineered components and assemblies. The facility has integrated manufacturing capabilities for transmissions, shafts, frame chassis and precision-machined components.

This research paper presents a study of the **production line and manufacturing processes at Kinetic Engineering Limited, Ahilyanagar**, with particular emphasis on **gearboxes, axles, chassis and sheet-metal parts**. The study covers material handling, machining, forming, welding, assembly, inspection and quality-control activities. The role of CNC machining, press operations, fixtures, welding systems and inspection methods in achieving production targets and maintaining product quality is discussed. The study also identifies opportunities for productivity improvement through automation, preventive maintenance, process standardization, tool management and quality monitoring.

**Keywords:** Kinetic Engineering, production line, gearbox, axle, chassis, sheet metal, CNC machining, welding, automotive components, quality control.

## 1. Introduction

The automobile industry requires manufacturing systems capable of producing components with high dimensional accuracy, strength, reliability and repeatability. Automotive components such as **gearboxes, axles, chassis and sheet-metal parts** are manufactured using a combination of machining, forging, forming, welding, assembly and inspection processes.

Kinetic Engineering Limited has more than five

decades of manufacturing experience and its Ahilyanagar facility is an important manufacturing location of the company. The facility has integrated capabilities for transmissions, shafts, chassis and precision-machined components.

The present study focuses on understanding the production activities associated with four major product categories:

1. Gearbox and transmission assemblies
2. Axles and shafts
3. Chassis and frame structures
4. Sheet-metal and body parts

## 2. Objectives of the Study

The main objectives of this research are:

- To study the production system at Kinetic Engineering Limited, Ahilyanagar.
- To understand the manufacturing process of automotive gearboxes.
- To study axle manufacturing and machining operations.
- To understand chassis manufacturing and welding operations.
- To study sheet-metal forming and fabrication processes.
- To understand the role of CNC machines in production.
- To study inspection and quality-control practices.
- To identify factors affecting productivity.
- To suggest methods for improving production efficiency and reducing rejection.

## 3. Overview of Kinetic Engineering Limited

Kinetic Engineering Limited is an automotive component manufacturer supplying components and assemblies to various vehicle manufacturers. Its product portfolio includes **gears, shafts, gearboxes, rigid axles, trans-axles, chassis and body parts**, among other automotive components.

The Ahilyanagar manufacturing facility has a large

manufacturing infrastructure with multiple production sheds and hundreds of machines. Public company information describes integrated operations involving machining, assembly, chassis and transmission manufacturing.

The facility also uses modern manufacturing technologies such as:

- CNC machining
- Robotic welding
- Press operations
- Automated inspection
- Assembly lines
- Special-purpose fixtures
- Testing systems

#### 4. Production Line at Kinetic Engineering

The general production flow can be represented as:

**Raw Material → Incoming Inspection → Cutting/Forging/Forming → Machining → Welding → Sub-Assembly → Final Assembly → Inspection & Testing → Finished Product**

Different products follow different process routes.

##### Major Production Categories

###### Product Major Processes

|                   |                                                    |
|-------------------|----------------------------------------------------|
| Gearbox           | Machining → Gear manufacturing                     |
|                   | → Heat treatment → Inspection → Assembly → Testing |
| Axle              | Forging/Machining → Heat treatment                 |
|                   | → Grinding → Assembly → Inspection                 |
| Chassis           | Sheet/Tube preparation → Pressing                  |
|                   | → Welding → Inspection → Painting                  |
| Sheet-metal parts | Blanking → Pressing → Forming → Trimming           |
|                   | → Welding → Inspection                             |

The exact sequence varies according to product design and customer requirements.

#### 5. Gearbox Production

A gearbox is an important automotive transmission component used to transmit power and torque at appropriate speed ratios.

Kinetic Engineering manufactures transmission-related products and gearbox assemblies for automotive applications. Company disclosures also mention upgraded gearbox assembly lines and torque-controlled tools for gearbox assembly.

##### 5.1 Major Components of Gearbox

Typical gearbox components include:

- Gears
- Shafts

- Bearings
- Synchronizing components
- Gear housing
- Bushes
- Seals
- Circlips
- Fasteners

##### 5.2 Manufacturing Operations

Typical operations include:

1. Raw material inspection
2. Cutting/forging
3. Turning
4. Gear cutting
5. Hobbing
6. Broaching
7. Heat treatment
8. Grinding
9. Dimensional inspection
10. Cleaning
11. Gearbox assembly
12. Torque tightening
13. Functional testing

##### 5.3 Quality Parameters

Important gearbox quality parameters include:

- Gear tooth profile
- Gear dimensions
- Runout
- Concentricity
- Shaft dimensions
- Bearing fit
- Backlash
- Torque
- Noise and vibration
- Leakage

#### 6. Axle Production

Axles are important load-bearing and power-transmission components in automotive applications. Kinetic Engineering's product portfolio includes rigid axles and trans-axles.

##### 6.1 Typical Axle Manufacturing Process

**Raw Material → Forging → Machining → Heat Treatment → Grinding → Inspection → Assembly → Testing**

###### Major Operations

- Turning
- Drilling
- Milling
- Grinding
- Broaching
- Spline machining
- Heat treatment
- Dimensional inspection

##### 6.2 Important Quality Parameters

- Diameter
- Length
- Concentricity
- Surface finish

- Hardness
- Spline dimensions
- Runout
- Straightness

Accurate machining is particularly important because axle components experience significant mechanical loads during vehicle operation.

## 7. Chassis Production

The chassis forms the structural foundation of a vehicle. It supports major components and provides structural rigidity.

Kinetic Engineering's Ahilyanagar operations include chassis/frame manufacturing. The company has also introduced a robotic chassis line incorporating robotic welding, automatic clamping fixtures and a dedicated framing cell for the Kinetic DX EV.

### 7.1 Chassis Manufacturing Process

**Raw Material → Cutting → Bending/Forming → Fixture Loading → Welding → Inspection → Surface Treatment → Painting → Final Inspection**

#### Major Operations

- Tube/section cutting
- Bending
- Pressing
- Fixture setting
- Tack welding
- MIG/MAG/spot welding
- Robotic welding
- Dimensional inspection
- Painting

### 7.2 Advantages of Robotic Welding

Robotic welding can provide:

- Consistent weld quality
- Better dimensional accuracy
- Reduced operator variability
- Higher productivity
- Improved workplace safety
- Repeatable welding parameters

The robotic chassis line at Ahilyanagar was specifically developed to improve precision, structural accuracy and productivity.

## 8. Sheet-Metal Parts Production

Sheet-metal components are widely used for vehicle body and structural applications.

The Ahilyanagar facility has upgraded metal body-panel production with **hydraulic and mechanical presses, spot-welding equipment and pneumatic clamping fixtures.**

### 8.1 Sheet-Metal Manufacturing Process

**Sheet Material → Blanking → Pressing → Forming → Trimming → Piercing → Bending → Welding → Inspection**

#### Major Operations

- Shearing
- Blanking
- Punching
- Deep drawing
- Bending
- Forming
- Trimming
- Spot welding

### 8.2 Press Shop

Press machines are used to convert flat sheet material into required shapes.

Important parameters include:

- Press capacity
- Sheet thickness
- Die clearance
- Punch-die alignment
- Press speed
- Material properties

Proper die alignment is essential for preventing defects such as cracks, wrinkles and dimensional variation.

## 9. CNC Machining in Production

CNC machines are important for producing precision automotive components.

Typical CNC operations include:

- Turning
- Facing
- Drilling
- Boring
- Grooving
- Threading
- Milling

### CNC Production Sequence

**Component Loading → Workpiece Clamping → Tool Setting → Program Selection → Trial Component → Inspection → Batch Production → Periodic Inspection**

The CNC operator has an important responsibility in maintaining production quality through correct workpiece setting, tool offset management and process monitoring.

## 10. Quality Control

Quality control is essential because automotive components must satisfy strict dimensional and functional requirements.

### Common Inspection Equipment

- Vernier caliper
- Micrometer
- Bore gauge
- Height gauge
- Dial indicator
- Thread gauges
- Go/No-Go gauges
- Hardness tester
- Special-purpose gauges

Company information also indicates the use of automated gauging systems for selected components and advanced inspection/testing capabilities.

## 11. Production Problems and Their Causes

| Problem               | Possible Cause               | Effect                |
|-----------------------|------------------------------|-----------------------|
| Dimensional variation | Tool wear/incorrect setting  | Component rejection   |
| Welding defect        | Incorrect welding parameters | Structural weakness   |
| Sheet deformation     | Improper clearance           | die Rejection         |
| Gear noise            | Incorrect gear geometry      | Poor gear performance |
| Surface roughness     | Tool condition               | Poor quality          |
| Machine breakdown     | Inadequate maintenance       | Production loss       |
| Fixture misalignment  | Improper setting             | Dimensional variation |
| Excessive cycle time  | Improper process parameters  | Reduced productivity  |

## 12. Productivity Improvement

Production efficiency can be improved through systematic monitoring of:

- Cycle time
- Machine utilization
- Tool life
- Rejection rate
- Setup time
- Downtime
- Production quantity
- Overall Equipment Effectiveness (OEE)

### Productivity

$$Productivity = \frac{Good\ Quality\ Components}{Production\ Time}$$

### Rejection Percentage

$$Rejection\% = \frac{Rejected\ Components}{Total\ Components} \times 100$$

### Machine Utilization

$$Machine\ Utilization = \frac{Running\ Time}{Available\ Time} \times 100$$

## 13. Suggestions for Improvement

The following measures can improve production performance:

### 13.1 Preventive Maintenance

Regular inspection and maintenance of CNC

machines, presses, welding systems and assembly equipment can reduce unexpected downtime.

### 13.2 Tool-Life Monitoring

Monitoring cutting-tool wear can reduce dimensional variation and unexpected tool failure.

### 13.3 Poka-Yoke

Error-proofing devices can prevent incorrect component orientation and assembly mistakes.

### 13.4 5S Implementation

Proper workplace organization can reduce material-search time and improve safety.

### 13.5 Automation

Automation and robotics can improve repeatability and productivity in operations such as welding and inspection.

### 13.6 Operator Training

Continuous operator training in CNC operation, measuring instruments, safety and quality procedures can improve production performance.

## 14. Results and Discussion

The study demonstrates that the production of automotive components requires integration of several manufacturing processes. Gearboxes require high precision in gear and shaft manufacturing, while axles require accurate machining and strength-related properties.

Chassis manufacturing depends heavily on correct fixture positioning and welding accuracy. Sheet-metal production requires proper control of press and die parameters.

The adoption of automated and robotic systems can improve repeatability and productivity. Kinetic Engineering has reported investments in robotic chassis welding, upgraded sheet-metal production and improved inspection systems at its Ahilyanagar operations.

Therefore, an integrated approach combining **machining + automation + quality inspection + preventive maintenance + skilled manpower** is essential for efficient automotive component manufacturing.

## 15. Conclusion

The study of the production line at **Kinetic Engineering Limited, Ahilyanagar** provides valuable insight into modern automotive component manufacturing.

The major products considered in this study are:

- Gearboxes
- Axles
- Chassis
- Sheet-metal parts

Each product requires a specific combination of machining, forming, welding, assembly, inspection and testing operations.

The study concludes that **CNC machining,**

**automated welding, press-shop technology, accurate fixtures, systematic inspection and preventive maintenance** are important factors for achieving high productivity and consistent quality.

The use of advanced automation at the Ahilyanagar facility, including robotic chassis welding and upgraded sheet-metal production systems, demonstrates the increasing role of automation in modern automotive manufacturing.

## 16. Future Scope

Future research can focus on:

1. **OEE analysis of the production line**
2. Cycle-time reduction in gearbox production
3. Tool-life optimization in CNC machining
4. Automation of dimensional inspection
5. AI-based defect detection
6. Robotic welding optimization
7. Energy consumption reduction
8. Industry 4.0-based production monitoring
9. Predictive maintenance of CNC machines
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