

“A Study of Manufacturing Process, Quality Control and Industrial Automation in Compressor Manufacturing Under Industrial Training ”

Mangesh Somnath Supekar¹, Mahendra Bapurao Jadhav², Ramesh Suryabhan Gadakh³

¹ Student Mechanical Department, Sau. Sundarbai Manik Adsul Polytechnic

² HOD Mechanical Department, Sau. Sundarbai Manik Adsul Polytechnic

³ Principal, Sau. Sundarbai Manik Adsul Polytechnic

Abstract - Compressor manufacturing is a critical industrial process in the refrigeration and air-conditioning sector, where manufacturing accuracy, process reliability, quality control and automation play an important role in achieving consistent product performance. This paper presents a technical study of the manufacturing processes, quality control methods and industrial automation used in compressor manufacturing, based on a case study of GMCC India Pvt. Ltd., Supa, Ahilyanagar and practical observations made during an industrial internship.

The study examines major manufacturing and production activities involved in compressor manufacturing, with particular focus on component processing, welding, compressor assembly, inspection, rework and air-leak testing. Quality control practices used for identifying manufacturing defects, including visual inspection of welding and components, process checks and leakage testing, are discussed. The paper also examines the contribution of industrial automation to production efficiency, process consistency, defect reduction and product reliability.

Practical exposure during the internship provided an opportunity to understand the relationship between manufacturing operations and quality assurance in an actual industrial environment. Observations related to welding defects, rework requirements, inspection procedures and leakage testing were considered to understand the importance of systematic process control. The study indicates that effective integration of manufacturing processes, quality control and industrial automation can improve productivity, minimize defects and enhance the reliability of compressors..

Key Words: : Compressor Manufacturing, Manufacturing Process, Quality Control, Industrial Automation, Welding, Rework, Air-Leak Testing, Case Study, GMCC India Pvt. Ltd.

1.INTRODUCTION

Compressors are one of the most important components used in refrigeration and air-conditioning systems. The performance, efficiency and reliability of a refrigeration system depend significantly on the quality and operating characteristics of its compressor. Therefore, compressor manufacturing requires accurate production processes, effective quality control and reliable testing methods to ensure that the finished product meets the required performance and safety standards.

Modern compressor manufacturing involves a combination of mechanical manufacturing operations, welding, component assembly, inspection and testing. As production requirements increase, industries are adopting automated machines and process-control systems to improve productivity, maintain consistency and reduce human error. Along with automation, systematic quality control is essential for detecting defects at different stages of production and preventing defective products from reaching the next process or the customer.

In compressor manufacturing, defects may occur due to improper welding, dimensional variation, incorrect assembly, component damage or leakage. Therefore, inspection and testing activities such as visual inspection, welding inspection, rework and air-leak testing are important parts of the manufacturing process. Effective identification and correction of defects can reduce rejection, minimize rework and improve overall product reliability.

This paper presents a technical study of manufacturing processes, quality control and industrial automation in compressor manufacturing, using GMCC India Pvt. Ltd., Supa, Ahilyanagar as a case study. The study is supported by practical observations and industrial exposure gained during an internship at the company. Activities such as compressor assembly, lower plate welding, visual quality inspection, identification of welding-related defects, rework and air-leak testing provided practical insight into the interaction between production and quality assurance. The objective of this study is to understand how manufacturing processes, quality control practices and automation work together in an industrial compressor manufacturing environment. The paper also discusses the importance of process monitoring, defect prevention, systematic inspection and testing in achieving improved productivity and consistent product quality.

2. COMPANY PROFILE

GMCC is a global manufacturer of compressors for refrigeration, air-conditioning and heat-pump applications. Established in 1995, the company operates under Midea Industrial Technology and focuses on compressor research, development and manufacturing. Its products emphasize energy efficiency, reliability, compact design and low-noise operation.

GMCC India Pvt. Ltd. has a manufacturing facility at Supa-Parner, Maharashtra, developed as part of the company's expansion and the Make in India initiative. The facility combines modern manufacturing processes with assembly, quality inspection, testing and industrial automation.

The compressor manufacturing process consists of various controlled operations such as component preparation, welding, inspection, assembly, rework and air-leak testing. Quality control is carried out at different stages to identify defects and maintain product reliability.

During the internship, practical exposure was gained to compressor assembly, lower plate welding, visual quality inspection, welding-defect identification, rework and air-leak testing. These activities provided an understanding of the relationship between production, quality control and automation in an actual industrial environment.

Thus, GMCC India Pvt. Ltd. provides a suitable industrial case study for analysing the role of manufacturing processes, quality control and industrial automation in achieving improved productivity, reduced defects and consistent compressor quality

3. OBJECTIVES OF THE STUDY

The main objectives of this study are:

- I. To study the major manufacturing processes involved in compressor manufacturing.
- II. To understand the role of quality control and inspection in maintaining compressor quality.
- III. To study the application and importance of industrial automation in production.
- IV. To observe practical activities such as welding, compressor assembly, rework and air-leak testing during the internship.
- V. To identify common manufacturing defects and understand their inspection and corrective actions.
- VI. To relate theoretical mechanical engineering concepts with actual industrial practices.
- VII. To analyse how manufacturing, quality control and automation contribute to productivity, reliability and defect reduction.

4. METHODOLOGY

The study was carried out using a combination of practical industrial observation and technical study during the internship at GMCC India Pvt. Ltd., Supa.

The methodology followed was:

- I. Industrial Observation: Manufacturing and production activities were observed during the internship.
- II. Process Study: Different stages of compressor manufacturing, including welding, assembly, inspection and testing, were studied.
- III. Quality Inspection Study: Visual inspection, identification of welding defects, rework procedures and air-leak testing were observed.

- IV. Automation Study: The role of automated equipment and process-control systems in improving production accuracy and consistency was studied.
- V. Practical Interaction: Information was understood through interaction with operators, supervisors and quality personnel wherever permitted.
- VI. Data and Observation Analysis: Practical observations were analysed to understand the relationship between manufacturing process, quality control and automation.
- VII. Case Study Preparation: The collected technical observations were organized to evaluate the effectiveness and importance of these practices in compressor manufacturing.

This methodology combines practical internship experience with technical analysis, forming the basis of the GMCC compressor manufacturing case study presented in this

5. MANUFACTURING PROCESS, QUALITY CONTROL AND INDUSTRIAL AUTOMATION

5.1 Manufacturing Process

Compressor manufacturing involves component preparation, welding, assembly, inspection and testing. Proper process control ensures accurate assembly and reliable compressor performance.

5.2 Materials Used in Compressor Manufacturing

Table 1. Raw Materials and Consumables Used in Compressor Manufacturing

Raw Materials and Consumables Used in Compressor Manufacturing					
Sr. No.	Material / Component	Image	Material Type	Purpose / Use	Where Used / Application
1. Sheet Metal (Raw Material)	1. Galvanized Sheet Metal (Sheet)		Steel (CRCA)	Used for fabricating compressor shells, base and other sheet metal parts.	Sheet metal processing, stamping, etc.
	2. Industrial Sheet Metal (Sheet)		Steel (Galvanized)	Used for various sheet metal components.	Sheet metal processing, stamping, etc.
	3. Stainless Sheet Metal (Sheet)		Stainless Steel	Used for parts requiring corrosion resistance and strength.	Specific components according to design.
2. Welding Consumables	4. Welding Wire (1.2 mm)		Alloy Steel Wire	Used for welding compressor base plate and shell.	Welding (combs, shells and base).
	5. Welding Wire (1.6 mm)		Alloy Steel Wire	Used for structural welding with shell parts.	Structural welding and shell parts.
	6. Argon Gas (Cylinders)		Gas (Inert)	Provides shielding during welding to prevent oxidation and maintain weld quality.	Welding process (shell, base and other parts).
3. Other Raw Materials / Components	7. Motor (Compressor Motor)		Copper / Aluminum	Used for motor winding of compressor.	Motor assembly.
	8. Air Filter (Cartridge)		High grade steel	Reduces dust in the intake air.	Motor assembly.
	9. Bearing		Steel	Supports the shaft of the motor.	Motor shaft assembly.
	10. Gasket (Gasket/Seal)		Steel / Rubber	Ensures tightness between components.	Motor assembly.
	11. Gasket (Gasket/Seal)		Copper / Rubber	Ensures tightness between components.	Engine, pressure, etc.
	12. Bolt / Nut		Steel / Stainless Steel	Fastens various parts together.	Fast & secure assembly.
	13. Oil (Lubricant)		Oil (Lubricant)	Lubricates moving parts of the compressor.	Assembly and final inspection.

5.3 Quality Control

Quality is maintained through visual inspection, welding-defect identification, secondary inspection, rework and air-leak testing. Defective components are corrected before further processing.

5.4 Industrial Automation

Automation improves production speed, accuracy, repeatability and process consistency. Automated equipment reduces manual errors, while operators monitor processes and perform quality checks.

6. INTERNSHIP OBSERVATIONS

During the internship at GMCC India Pvt. Ltd., practical exposure was gained in compressor manufacturing activities.

- I. The major observations were:
- II. Compressor assembly process
- III. Lower plate welding
- IV. Visual inspection and welding defect identification
- V. Secondary quality inspection
- VI. Rework of defective components
- VII. Air-leak testing

These activities helped in understanding the practical relationship between manufacturing, quality control and process reliability.

7. RESULTS AND DISCUSSION

The study showed that proper manufacturing processes, effective quality inspection and automation are essential for producing reliable compressors. Welding and assembly operations require proper process control to maintain product quality.

Visual inspection helped in identifying welding defects and other abnormalities, while rework provided a method for correcting non-conforming components. Air-leak testing helped verify the sealing and integrity of the compressor.

Overall, the internship observations showed that the proper integration of production, quality control and automation can reduce defects, improve process consistency and increase the reliability of the final product.

8. CONCLUSION

The study concludes that proper manufacturing processes, quality control and industrial automation are essential for reliable compressor production. The internship provided practical understanding of welding, assembly, inspection, rework and air-leak testing. Overall, these practices help reduce defects, improve productivity and ensure product quality.

9. FUTURE SCOPE

Future improvements can include advanced automation, real-time quality monitoring, machine vision inspection and data-based process control. These technologies can further reduce defects, improve productivity and increase compressor manufacturing reliability.

10. REFERENCES

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