A STUDY ON MINIMIZING REJECTION DUE TO MOUNTING THREAD DAMAGE IN FC4 PRODUCT IN ROOTS INDUSTRIES LIMITED, COIMBATORE

By

NAIR ANOOP JANARDAN

Reg. No. 1120400056

Under the guidance of

Mr. R. Vinayaga Sundaram

ASSOCIATE PROFESSOR IN MANAGEMENT STUDIES

A PROJECT REPORT

submitted

In partial fulfillment of the requirements

for the award of the degree

of

MASTER OF BUSINESS ADMINISTRATION

Kumaraguru College of Technology
(An autonomous institution affiliated to Anna University, Coimbatore)

Coimbatore - 641 047

September, 2012

BONAFIDE CERTIFICATE

Certified that this project report titled, **"A STUDY ON MINIMIZING REJECTION DUE TO MOUNTING THREAD DAMAGE IN FC4 PRODUCT"** is the bonafide work of **Mr. NAIR ANOOP JANARDAN** who carried out the project under my supervision. Certified further, that to the best of my knowledge the work reported herein does not form part of any other project report or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

Faculty Guide	Director
Mr. R. Vinayaga Sundaram	**Dr. Vijila Kennedy**
Assistant Professor	KCTBS
KCTBS	

Submitted for the Project Viva-Voce examination held on _____

Internal Examiner External Examiner

DECLARATION

I affirm that the project work titled "**A STUDY ON MINIMIZING REJECTION DUE TO MOUNTING THREAD DAMAGE IN FC4 PRODUCTS IN ROOTS INDUSTRIES LIMITED , COIMBATORE**" being submitted in partial fulfillment for the award of Master of Business Administration is the original work carried out by me. It is not a part of any other project work submitted for the award of any degree or diploma, either in this or any other university.

Signature of the Candidate

NAIR ANOOP JANARDAN

Reg No: 1120400056

I certify that the declaration made above by the candidate is true.

Signature of the Guide

Mr. R. Vinayaga Sundaram

Associate Professor

KCT Business School

ACKNOWLEDGEMENT

I express my gratitude to our beloved chairman **Arutchelvar Dr. N.MAHALINGAM and Management** for the prime guiding spirit of **Kumaraguru College of Technology** for giving me an opportunity to undergo the MBA Degree course and to undertake this project work.

I take this opportunity to extend my sincere thanks to **Dr. Vijila Kennedy**,Director,KCT Bussiness School, for her dynamic spirit in cheering up our student project efforts.

I wish to express deep sense of obligation to **Mr. R. Vinayaga Sundaram, Assistant Professor,** KCT Business School, for the guidance and moral support throughout the project from its inception to completion.

I whole heartily thank **Mr. N.SAMPATH KUMAR,** Training and Development, **Roots Industries Limited, Coimbatore** for his motivation to complete the project successfully.

At the outset, I wish to submit heartfelt sincere, humble gratitude to my beloved parents, and friends, who lead, guide all through my life and give me the courage and strength for the successful completion of this major project.

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SYNOPSIS

Companies need to compete with their rivals on all aspect due to intense competition in the business environment. One such aspect , is the productivity which could be improved continuously. So, as to improve productivity, various methods are used. But, for ensuring the effectiveness of the work processes measures to decrease in-process rejection are to be carried out. Fishbone diagram is one such technique that helps to determine the various causes and effect of in-process rejection through man, machine, method, measurement and material.

In Roots Industries India Limited (Thoppampatty unit), most of the processing works are done through sub-contracting. Roots Industries India Limited manufactures various two-wheeler and automobile horns. This project involves study of various process of manufacturing of a horn and to find out root causes for the in-process rejection due to mounting thread damage through fishbone diagram. This helps the company to identify the problem and reduce in-process rejection in production and better define their capacity.

The study is carried out by finding out an individual product of the company which has maximum quantity of in-process rejections due to mounting thread damage and cost of expenditure is more . This study will go through various factor like man, material, machine or process to determine the cause for mounting thread damage. This study will try to find suggestions to reduce this problem through fishbone diagram. Decreasing this problem also reduce the cost of expenditure to the company

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION TO THE STUDY :

In this fast moving business environment the industries and companies find it really difficult to cope up with the changing business environment, increasing competitors and technological improvement. Therefore, any manufacturing company may try to cut expenditure by reducing in-process rejection and produce efficiently enough to overcome problems and compete with other companies.

The company which adopts survives and the company which doesn't adopt finds it really difficult to sustain in the industry or completely comes to an end.

In this study we are going to go through such a company, which has sidelined all the obstacles put in front of them. The Roots Industries India Limited was able to make it possible by quickly taking effective measures according to the changing scenario.

1.2 INDUSTRY ANALYSIS :

Car horns have become a part of everyday life. Horns and automobiles are practically synonymous. One can hardly find an automobile without a horn. Car horns date back to the earliest of horseless carriages. In the early 1800's, steam carriages were becoming popular in Britain. For the safety of pedestrians and animals, a law was passed stating that "…self-propelled vehicles on public roads must be preceded by a man on foot waving a red flag and blowing a horn.". Of course, it did not take long to realize that a horn in the automobile itself, operated by the driver, was much more efficient.

The Indian Automobile Industry manufactures over 11 million vehicles and exports about 1.5 million each year. The first car ran on India's roads in 1897. Embryonic automotive industry emerged in India in the 1940s. Mahindra & Mahindra

was established as a trading company in 1945, and began assembly of Jeep CJ-3A utility vehicles under license from Willys.

The company soon branched out into the manufacture of light commercial vehicles (LCVs) and agricultural tractors. Following economic liberalization in India in 1991, the Indian automotive industry has demonstrated sustained growth as a result of increased competitiveness and relaxed restrictions.

Several Indian automobile manufacturers such as Tata Motors, Maruti Suzuki and Mahindra and Mahindra, expanded their domestic and international operations. India's robust economic growth led to the further expansion of its domestic automobile market which has attracted significant India-specific investment by multinational automobile manufacturers.

The majority of India's car manufacturing industry is based around three clusters in the south, west and north. The southern cluster consisting of Chennai and Bangalore is the biggest with 35% of the revenue share. The western hub near Mumbai and Pune contributes to 33% of the market and the northern cluster around the National Capital Region contributes 32%.

Chennai, is also referred to as the "*Detroit of India*"with the India operations of Ford, Hyundai, Renault, Mitsubishi, Nissan ,BMW, Hindustan Motors, Daimler, Caparo, and PSA Peugeot Citroën is about to begin their operations by 2014. Chennai accounts for 60% of the country's automotive exports.

Gurgaon and Manesar in Haryana form the northern cluster where the country's largest car manufacturer, Maruti Suzuki, is based. The Chakan corridor near Pune, Maharashtra is the western cluster with companies like General Motors, Volkswagen, Skoda, Mahindra and Mahindra, Tata Motors, Mercedes Benz, Land Rover, Fiat and Force Motors having assembly plants in the area. Aurangabad with Audi, Skoda and Volkswagen also forms part of the western cluster.

Another emerging cluster is in the state of Gujarat with manufacturing facility of General Motors in Halol and further planned for Tata Nano at Sanand. Ford, Maruti

Suzuki and Peugeot-Citroen plants are also set to come up in Gujarat. Kolkata with Hindustan Motors, Noida with Honda and Bangalore with Toyota are some of the other automotive manufacturing regions around the country.

With the automobile industry growing in such a rapid rate, the auto parts industry gains its advantage from this scenario. One such company is the Roots Industries Limited. They are the leading Horn manufacturing company in India and 11th best throughout the world .

1.3 COMPANY PROFILE :

1.3.1 Company Name : Roots Industries Limited

1.3.2 Company Logo :

1.3.3 Company Vision :

We will stand technologically ahead of others to deliver world-class innovative products useful to our customers. We will rather lose our business than our customer satisfaction. It is our aim that the customer should get the best value for their money. Every member of our company will have decent living standards. We care deeply for our families, for our environment and our society. We promise to pay back in full measure to the society by way of selfless and unstinted service.

1.3.4 Company Website : http://www.rootsindia.com

1.3.5 Company History:

Roots Industries was established in the year 1970 with a vision and commitment to produce and deliver quality products adhering to International standards. The headquarters is located in Coimbatore , Tamilnadu, India. Roots industries has been a dominant player in the manufacturing of Horns and other products like Casting and industrial Cleaning Machines.

1.3.6 Roots Group of Companies:

1. Roots Industries India Ltd
2. Roots Auto Products Private Limited
3. Roots Cast Private Limited
4. Roots Precision Products
5. Roots Metrology Laboratory
6. Roots Polycraft
7. Roots Multiclean Limited
8. Roots Industries Malaysia Sdn. Bhd.

❖ **Roots Industries India Limited:**

It all started with just a honk. Encouraged by the response, we kept on moving ahead. In the beginning, we did not realize that we would make such an impact. Slowly but surely, the reverberations were felt far and wide. Indian automobile market responded to our call. Soon the global market too followed suit. Roots horns, in a very short span of time, got a place of pride in millions of vehicles across the globe.

What more could we ask for? But we did ask more. We indeed made a sound beginning but we could not rest on our laurels. The journey has to go on. There are more miles to go. And more challenging territories to explore.

❖ **Roots Auto Product Private Limited:**

Commercial transportation plays a crucial role in the economic development of nations. Roots Air Horns ensures safe and smooth passage of thousands of heavy vehicles on the move. Roots Auto Products Private Limited (RAPPL) , the largest supplier of Air Horns in India caters to the needs of several OEMs: Ashok Leyland, Caterpillar and JCB Escorts, Roots Air Horns also find a place of pride in Passenger vehicles, Trucks, Earth Moving equipment, Material Handling equipment, etc. Roots Air Horns are exported to countries in North America, Europe, Middle East, Africa and SAARC region.

❖ **Roots Cast Private Limited :**

Roots Cast Pvt. Ltd., (RCPL) (formerly known as Aruna Auto Castings Private Limited) was established in 1984 to meet the captive requirements of the Roots group. With its ever probing eye on the needs of the market, the company in the late 80s expanded its operations to manufacture High Pressure Die Cast Aluminium and Zinc components to the exacting needs of various customers in Automobile and Textile Industries with a high degree of Quality and Perfection. RCPL, now has established itself as a major player in the die cast component manufacturing thanks to the expertise built in the core activities like tool design, tool making and pressure die cast component manufacturing. RCPL supplies machine castings and sub-assemblies as per customer requisitions. An ISO 9002 certified company.

❖ **Roots Precision Products :**

Roots Precision Products was established in 1987 to address the in-house tooling needs of the diverse industries in Roots group. Owing to continuous improvement and investment into better resources, the company has become self-sufficient. It is catering to the needs of various industries. RPP acts as a one-stop solution for tooling and precision machining.

Specialized in design and manufacture of:

- Press tools
- Jigs and fixture
- Die-casting dies
- Injection moulds

❖ **Roots Metrology Laboratory :**

Roots' state-of-the-art Metrology Laboratory is a comprehensive calibration centre in South India that offers mechanical, electrical, torque, pressure and vacuum calibration.

The laboratory is equipped with advanced facilities traceable to national / international standards. RMTL is accredited by National accreditation Board for Testing and Calibration laboratory as per ISO/IEC 17025 : 2005 standards in the field of Mechanical – Dimensions, Pressure/Vacuum, & Force.

The laboratory offers on-site calibration facility and serves the industry to calibrate surface table, coordinate measuring machine, profile projector, Toolmakers Microscope, Pressure switches, Pressure gauges, Temperature indicators, RTDs, Temperature sensors/scanners, Electronic transmitters, Pressure reducing valves, Ovens, etc.

❖ **Roots Polycraft :**

Roots Polycraft (PC) was established in 1988 to manufacture precision plastic components. It is equipped with latest microprocessor injection moulding machines to maintain consistent process parameters.

Over the years, Polycraft has gained skills and unique techniques to manufacture small and medium size components for Automotive, Pump, Textile, and Medical Industries besides meeting the captive requirements of Roots Group. Being fully equipped to provide the best service, Polycraft has satisfied customers who have helped augment its technological advances.

The Company's commitment towards the customer is demonstrated with quality products and service. This has resulted in continuous growth and product diversification. The process is closely monitored with proven techniques to obtain consistently good quality parts.

❖ **Roots Multiclean Limited :**

RMCL started the manufacture of mechanized cleaning equipment in the early 1990s through a techno-financial collaboration with Hako Werke, Germany. The alliance became one of the most successful in the Indian industry.

Today, in India, RMCL is the largest manufacturer and exporter of cleaning equipment. A state of the art manufacturing facility and a comprehensive marketing and After Sales Service network, enabled the company to deliver optimum solutions for customer's cleaning needs. Products from RMCL are built around eco friendly concepts and comply with international quality and safety norms

Today, RMCL has grown into a leader in the Indian cleaning equipment manufacturing industry and has a significant market presence in the world market. Its domain expertise spans design, development and manufacture of cleaning equipment. Strategic alliances have strengthened its presence and broadened the scope of its product offerings. RMCL is also the exclusive representative in India for several well known and specialized manufacturers of cleaning equipment across the world.

The company derives its strength from an experienced talent repository, comprising experts in technology, product design and development, research, manufacturing and marketing.

1.3.7 Company Product Variants :

1. Electric Horns
2. Air horns
3. Cleaning Machines
4. Castings
5. Precision Products
6. Metrology
7. Poly Products

1.3.8 Horn Families At RIL

1. Windtone Super
2. Vibrosonic
3. Cleartone
4. Vibromini
5. Roots 90
6. Megasonic
7. Smartone
8. Windtone 75
9. Windtone 90
10. CSSY
11. FC4 or FD4
12. FSA2
13. R 70

1.3.9 Working procedure Of Horns

The AC current passes through the terminal base leading to the flow of current through the coil via the contact points between the point plate and the point plate holders, which induces an electromagnetic force inside the coil. This force pulls the armature rod and the diaphragm vibrates at a speed of 300 times per second. Then the armature rod automatically goes to its original position that strikes the diaphragm producing the sound at a desired frequency that will be amplified by the tone disc.

1.3.10 Company Milestones :

1970 Promotes American Auto Service for manufacture of Electric Horns.

1972 First to manufacture Servo Brakes for Light Motor Vehicles

1984 Roots Auto Products Private Limited was established to manufacture Air Horns. Die Casting Unit commences commercial operations.

1988 Polycraft, a unit for Plastic Injection Moulding was established.

1990 Roots Industries India Ltd takes over Electric Horn business.

1992 RMCL enters into Techno-Financial collaboration with M/s. Hako Werke GmbH, Germany.

1992 Roots Industries India Ltd obtains the National Certification - ISI mark of quality.

1994 Production of floor cleaning equipment commences. Roots Industries India Ltd wins American International Quality Award.

1999 Becomes the first horn manufacturer in Asia to obtain QS 9000

2000 Becomes the first horn manufacturer in Asia to obtain VDA 6.1 and the first in the world to win ISO / TS 16949.

2000 The first to introduce digitally controlled air horns and low frequency, low decibel irritation free Jumbo Air Horns.

2003 Roots Industries India Ltd., Horn Division is accredited with ISO 14001 : 1996

2003 Roots Industries India Ltd., upgraded its ISO / TS 16949 from 1999 version to 2002 version

2004 Roots Industries India Ltd (RIL) opens its 100% exclusive Export Oriented Unit at their Horn Division, Thoppampatti, Coimbatore to cater the needs of Ford North America.

2004 RIL's EOU commences its supplies to Ford, North America

2004 Roots Multiclean Limited (RMCL) inaugurates its 100% EOU Plant at Kovilpalayam, Coimbatore

2004 Roots Auto Products Pvt Ltd (RAPPL) expands with its Machining Division at Arugampalayam, Coimbatore

2004 RIL successfully launches its Malaysian Plant

2004 The group company American Auto Service is accredited with ISO 9001 : 2000

2005 Roots Industries India Ltd ,is certified with MS 9000, a pre-requisite for Q1 award for Ford Automotive Operations

2005 Roots Metrology & Testing Laboratory has been accredited by National Accreditation Board for testing & calibration in the field of Mechanical – Linear & Angular

2005 Roots Industries India Ltd., is awarded Q1 by Ford Motor Company

2005 Roots Industries India Ltd., Horn Division upgraded its ISO : 14001 from 1996 version to 2004 version.

1.3.11 Global Alliances for Competitive Advantage :

Roots is a leading Original Equipment supplier to major vehicle manufactures like Mercedes Benz, Mitsubishi, Mahindra&Mahindra, Toyota, Fiat, TELCO, Harley Davidson, Navistar etc. the ever demanding requirements of Customers Satisfaction has strengthened the R & D activities and Roots technical competence to international standards.

Roots Multiclean Ltd. (RMCL) is a joint venture with Hako Werke GmbH & Co., Germany , one of the largest cleaning machine manufacturers with global operations. RMCL is the sole representative in India and SAARC countries for Hako Werke's entire range of cleaning equipment.

The quality of RMCL products is so well established that Hako buys back a major portion of their global market. RMCL also represents several global manufacturers of cleaning products and is gearing itself up to provide customized, total cleaning solutions.

1.4 STATEMENT OF PROBLEM:

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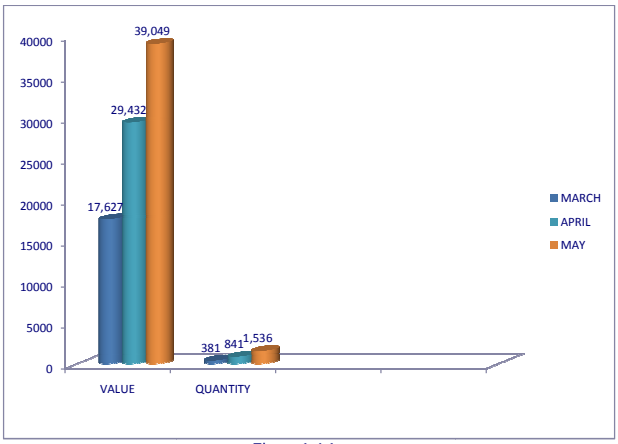


Figure 1.4.1

High quantity of in-process rejection in **FC4** horns due to mounting thread damage of the spool center rod (SCR) which increases the cost of expenditure to the company. This study is conducted to find few suggestions on how to reduce this in-process rejection in FC4 assembly

1.5 OBJECTIVES :

- **Primary Objective :**

To study and minimize the in-process rejections due to mounting thread damage.

- **Secondary Objective :**

To study the various factors leading to rejection due to mounting thread damage and finding the root cause using fishbone diagram.

1.6 SCOPE OF THE STUDY:

By finding a solution to decrease in-process rejection due to mounting thread damage using fishbone diagram, expenditure cost on rejections can be reduced. Thus increasing the productivity and the company can define its capacity.

CHAPTER 2

REVIEW OF LITERATURE

Mr. Jesse Hopps

Cause Analysis is a method that is used to address a problem or non-conformance, in order to get to the “root cause” of the problem. It is used so we can correct or eliminate the cause, and prevent the problem from recurring.

The literature indicates that the **Cause and Effect Diagram (CED)** is an easy-to-use tool for developing and classifying root cause categories. It assumes the existence of enough knowledge to be able to isolate and identify probable root causes, but the identified causes may not be specific or reasonable.

The CED has the potential to highlight information that is lacking or inadequate through the lack of identified causes in certain categories; however, it does not identify relationships between factors, has no formal mechanism for selecting and evaluating root causes, and may be influenced by group bias.

The literature indicates that it is an easy-to-use tool to help clarify intertwined relationships between multiple factors, although the factors may not be causal. Alternatively, root cause analysis tools must also have the characteristics to promote collaboration, stimulate discussion, be readable or understandable, and have mechanisms for evaluating integrity.

Dr.Hathibelagal Roshan

Several technical papers are available on casting defects in the literature. However, quality costs in steel foundries are still mainly due to the rework and scrap related to casting anomalies, which are not acceptable to customers.

In order to minimize the castings which do not meet the customer acceptance specifications, it is not only necessary to identify the process parameters related to the specific defects, but also it is necessary to identify the levels of these parameters to produce acceptable castings. Metal casting process has several sub-processes, which in turn have a number of process variables, which could influence the occurrence of defects in castings.

Conventional statistical techniques with design of experiments involves too much work for the foundries to identify the process variables and their levels responsible for the defects. The use of a process optimization tool which uses foundry production data that can be collected on the castings on a regular basis in the identification of the process variables and their levels will be presented and discussed in this paper. This is useful in converting production data into actionable information that leads to minimization of quality costs in steel foundries.

Walton, Mary (1992) The Deming Management Method, Mercury Business

The Fishbone Diagram(G) is a tool for analyzing process dispersion. It is also referred to as the "Ishikawa diagram," because Kaoru Ishikawa developed it, and the "fishbone diagram," because the complete diagram resembles a fish skeleton. The diagram illustrates the main causes and subcauses leading to an effect (symptom).

It is a team brainstorming tool used to identify potential root causes(G) to problems. Because of its function it may be referred to as a cause-and-effect diagram. In a typical Fishbone diagram, the effect is usually a problem needs to be resolved, and is placed at the "fish head".

The causes of the effect are then laid out along the "bones", and classified into different types along the branches. Further causes can be laid out alongside further side branches. So the general structure of a fishbone diagram is presented below.

CHAPTER 3

RESEARCH METHODOLGY

This chapter explains the research tools that have been applied by the researcher to collect data analyze and interpret results. In this study, the researcher seeks to understand the current situation and process followed by Roots Industries Limited . Results obtained were analyzed and used as a measure to suggest a solution for the improvement in decrease of rejection.

3.1 TYPE OF RESEARCH

A careful investigation or inquiry especially through search for new facts in any branch of knowledge

3.2 DATA COLLECTION METHOD

The data can be classified as;

- . Primary data
- 2. Secondary data

Primary data

The primary data are those which are collected a fresh and for the first time and thus happen. It is original in character.

Secondary data

The secondary data are those which have already been collected by someone else and which already have been passed through the statistical process. Information for this study also has been collected from the secondary data sources.

3.3 LMITATION OF STUDY

This study is only focused towards mounting thread damage in housing assembly of FC4 product.

3.4 SAMPLING TECNIQUE:

Convenience Sampling technique is used in this research

3.5 TOOLS USED IN THIS RESEARCH

- **ROOT CAUSE ANALYSIS WITH CAUSE AND EFFECT DIAGRAM(CED)**
- **BRAINSTORMING**
- **PARETO CHARTS**

Cause-and-Effect Diagram (CED)

The main goal of the Fishbone diagram is to illustrate in a graphical way the relationship between a given outcome and all the factors that influence this outcome. The main objectives of this tool are:

- Determining the root causes of a problem.
- Focusing on a specific issue without resorting to complaints and irrelevant discussion.
- Identifying areas where there is a lack of data.

- **Steps involved in framing a Fish Bone Diagram:**

• Step 1: Decide on the problem to improve or control.

• Step 2: Write the problem on the right side and draw an arrow from the left to the right side

• Step 3: Write the main factors that may be causing the problem by drawing major branch arrows to the main arrow. Primary causal factors of the problem can be grouped into items with each forming a major branch.

• Step 4: For each major branch, detailed causal factors are written as twigs on each major branch of the diagram. On the twigs, still more detailed causal factors are written to make smaller twigs.

• Step 5: Ensure all the items that may be causing the problem are included in the diagram. Major cause category branches can be initially identified using the four Ms: material, methods, machines, and manpower.

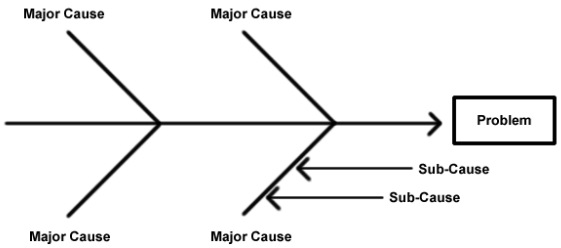


Figure 3.5.1

- **FIELD OF APPLICATION**

The Fishbone diagram could be applied when it is wanted to:

- Focus attention on one specific issue or problem.
- Focus the team on the causes not the symptoms.
- Organize and display graphically the various theories about what the root causes of a problem may be.

- Show the relationship of various factors influencing a problem.
- Reveal important relationships among various variables and possible causes.
- Provide additional insight into process behaviors.

❖ **BENEFITS**

- Helps determine root causes
- Encourages group participation
- Uses an orderly, easy-to-read format to diagram cause and effect relationships
- Indicates possible causes of variation
- Increases knowledge of the process by helping everyone to learn more about the factors at work and how they relate
- Identifies areas for collecting data

Brainstorming :

Brainstorming is a process in which a group quickly generates as many ideas as it can on a particular problem and/or subject. Brainstorming is useful because it can help a group of people utllize its collective brainpower to generate many ideas in a short period of time.

It stimulates creativity and promotes involvement and participation.

CHAPTER 4

ANALYSIS AND INTERPRETATION

PARETO CHART OF REJECTION -MARCH 2012

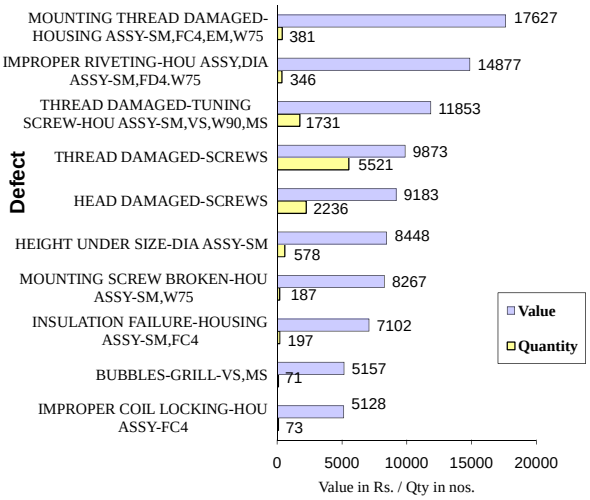


Figure 4.1

Inference: Pareto analysis on factors for rejection done for March 2012 internally shows that mounting thread damage as one of the major rejection factor. Mounting thread damages increase cost of expenditure in FC4 product.

PARETO CHART OF REJECTION -APRIL 2012

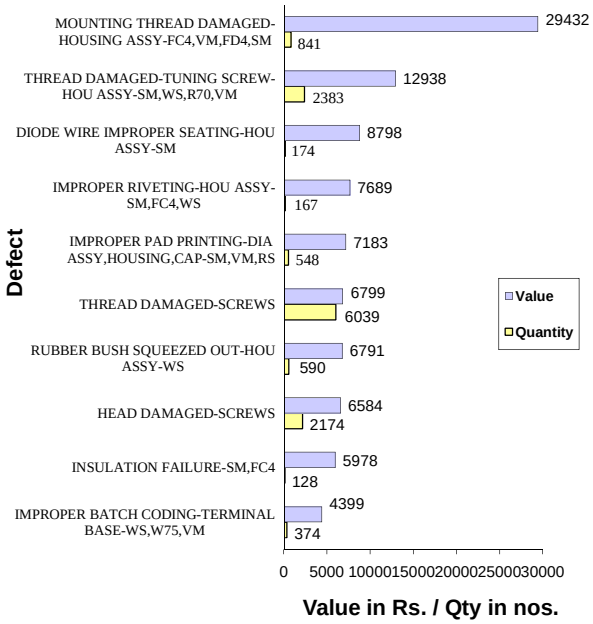


Figure 4.2

Inference: Pareto analysis on factors for rejection done for April 2012 internally shows that mounting thread damage as one of the major rejection factor. Mounting thread damages increase cost of expenditure in FC4 product..

PARETO CHART OF REJECTION -MAY2012

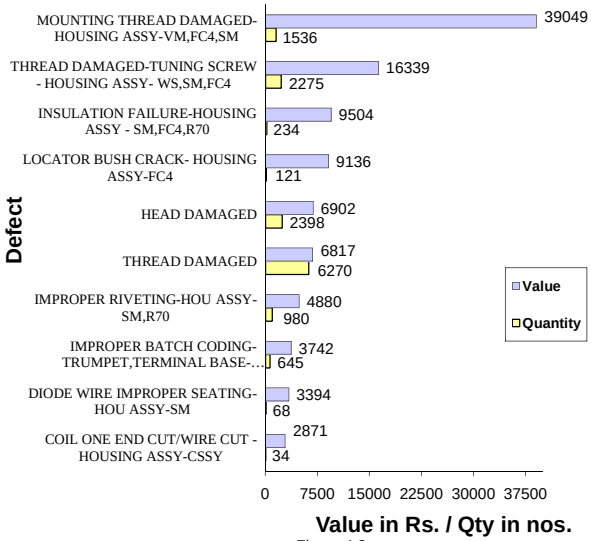
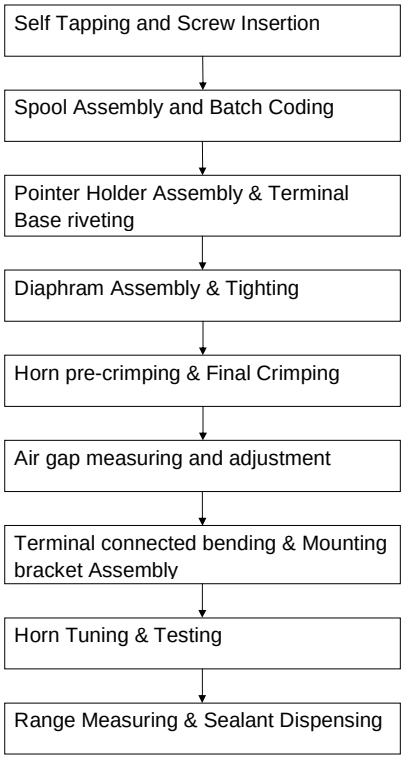


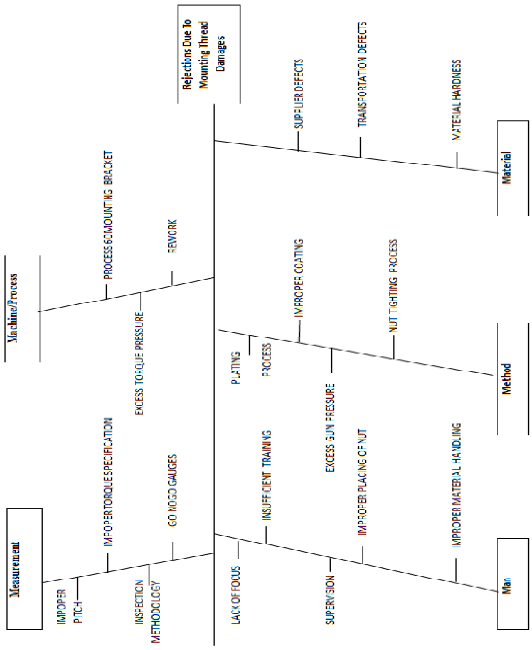
Figure 4.3

Inference: By comparing he given internal data and charts mounting thread damage of housing assembly has been identified as one of the major factor for rejection in FC4 product

PROCESS FLOW FOR FC4 PRODUCT



4.1 FISHBONE DIAGRAM



LEVEL 1

Inference : Various different factors which can lead into mounting thread damage have been identified through brainstorming and process mapping of the product.

On basis of the above factors put in the fishbone diagram below are the details of the test conducted.

- **TORQUE CHECK OF THE SPOOL CENTER ROD(SCR)** without plating

  (M8x1.25) Nominal size x**Thread Pitch**

SCR Sl. no.	**Family**	**Torque Requirement**	**Max Torque (withstood)**
1.	FC4	11-18 Nm	16Nm
2.	FC4	11-18 Nm	16Nm
3.	FC4	11-18 Nm	17Nm
4.	FC4	11-18 Nm	18Nm
5.	FC4	11-18 Nm	19Nm

Table 4.4

Note: Torque measured manually

Inference: Without plating spool centre rod thread can withstand torque up to 19 Nm maximum

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- **TORQUE CHECK OF THE SPOOL CENTER ROD(SCR)** with plating

  (M8x1.25) Nominal size x **Thread Pitch**

SCR Sr no.	Family	Torque Requirement	Max Torque (withstood)
1.	FC4	11-18 Nm	16Nm
2.	FC4	11-18 Nm	16Nm
3.	FC4	11-18 Nm	17Nm
4.	FC4	11-18 Nm	18Nm
5.	FC4	11-18 Nm	18Nm

Table 4.5

Note : Torque measured manually

Inference: After electroplating also the material does withstand torque up to 18Nm.

From the above test conducted it has been observed that electroplating has not affected the torque withstanding power of the spool centre rod thread. So the electroplating process factor is not considered for mounting thread damage

- **TORQUE CHECK OF THE SPOOL CENTER ROD(SCR)** without plating

(M8x1.25) Nominal size x **Thread Pitch**

WITH MK NUT

SCR Sr no.	Family	Torque Requirement	Max Torque (withstood)
1.	FC4	11-18 Nm	18Nm
2.	FC4	11-18 Nm	18Nm

Table 4.6

Inference: Without plating spool centre rod withstands torque up to 18Nm.

- **TORQUE CHECK OF THE SPOOL CENTER ROD(SCR)** with plating

(M8x1.25) Nominal size x **Thread Pitch**

WITH MK NUT

SCR Sr no.	Family	Torque Requirement	Max Torque (withstood)
1.	FC4	11-18 Nm	22Nm
2.	FC4	11-18 Nm	22Nm

Table 4.7

Note : Torque measured manually

Inference: With use of MK nut the thread of plated spool centre rod does withstands the torque up to 22Nm .

- **HARDNESS CHECK OF THE SPOOL CENTER ROD** before plating

SCR Sr no.	Family	Hardness Requirement	Hardness Actual
1.	FC4	180-230HV	217.9HV
2.	FC4	180-230HV	227.5HV
3.	FC4	180-230HV	219.1HV

Table 4.8

Inference: Hardness of material before plating is estimated to be 227.5HV

- **HARDNESS CHECK OF THE SPOOL CENTER ROD** after plating

SCR Sr no.	Family	Hardness Requirement	Hardness Actual
1.	FC4	180-230HV	217.1HV
2.	FC4	180-230HV	213.3HV
3.	FC4	180-230HV	217.5HV

Table 4.9

Inference: Hardness of material after plating has decreased to 213.5HV

- **RAW MATERIAL CHECK OF THE SPOOL CENTER ROD(SCR)**

SCR Sr no.	Family	Raw Material Requirement	Raw Material Actual
1.	FC4	Mild Steel	Mild Steel
2.	FC4	Mild Steel	Mild Steel
3.	FC4	Mild Steel	Mild Steel

Table 4.10

Inference: Material property is the same as the standard requirement

- **SELECTION OF NUT OF THE SPOOL CENTER ROD(SCR) HEX NUT- 909028**

SCR Sr no.	Family	Nut Diameter Standard	Nut Diameter Requirement	Nut Diameter Actual
1.	FC4	8-8.74 mm	8mm	8.60mm
2.	FC4	8-8.74 mm	8mm	8.54mm
3.	FC4	8-8.74 mm	8mm	8.50mm

Table 4.11

Inference: Actual diameter of nut matches the standard requirement.

- **TIGHTING PROCESS OF THE SPOOL CENTER ROD(SCR)**

SCR Sr no.	Family	Pressure Requirement	Pressure Actual	RPM Requirement	RPM Actual
1.	FC4	4-5.6 Bar	4 Bar	8000	8000
2.	FC4	4-5.6 Bar	4 Bar	8000	8000
3.	FC4	4-5.6 Bar	4 Bar	8000	8000

Table 4.12

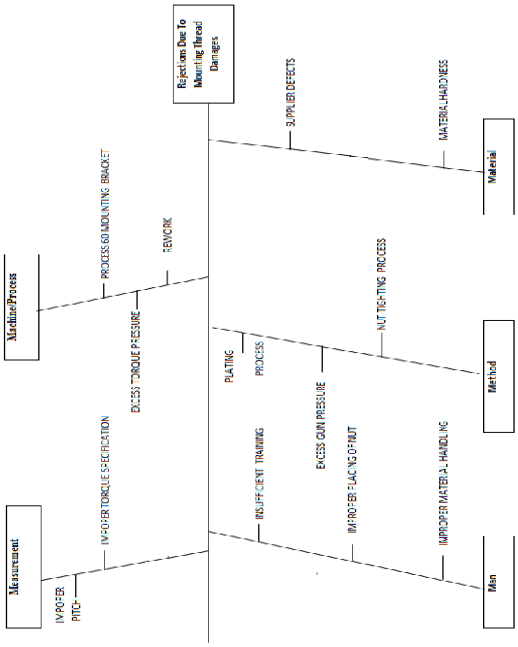
Inference: RPM and Pressure is maintained according the standard requirement.

- **SELECTION OF PNEUMATIC GUN**

SCR Sr no.	Family	Gun Requirement	Gun Actual
1.	FC4	IEC-IW8S	IEC-IW8S
2.	FC4	IEC-IW8S	IEC-IW8S

Table 4.13

Inference: Standard Pneumatic guns are used in mounting nuts.



LEVEL 2

Inference: After brain stroming the key factors are been noted and other factors are eliminated.

4.2 CAUSE & EFFECT MATRIX

Parameter	X	Data Type	Type	Frequency	Severity	RPN
Improper Pitch & Thread	X1	Discrete	Material	3	9	**27**
Improper Torque specification	X2	Discrete	Machine	3	9	**27**
Improper Gun pressure	X3	Discrete	Machine	3	1	3
Improper Placing of nut	X4	Discrete	Man	3	1	3
Lack of Focus	X5	Discrete	Man	1	1	1
Insufficient training	X6	Discrete	Man	1	3	3
Nut Tighting Process	X7	Discrete	Man	1	1	1
Improper Material Handling	X8	Discrete	Man	3	3	**9**
Improper Supervision	X9	Discrete	Method	1	1	1

Table 4.14

Frequency Scale : 0-Never ; 1-Rare ; 3-Sometimes ; 9-Always

Severity Scale : 0-No Effect ; 1-Small Effect ; 3-Moderate Effect ; 9-Sever Effect

RPN- Risk Priority Number

Inference: Improper Pitch & Thread and variations in torque can be few of the important factor according to operators for the occurrence of mounting thread damage.

CHAPTER 5

FINDINGS, SUGGESTIONS AND CONCLUSION

5.1 FINDINGS

- Torque check of spool centre rod thread (without plating) can withstand torque up to 19 Nm maximum.
- Torque check of spool centre rod thread (with plating) can withstand torque up to 18Nm maximum.
- Torque check of spool centre rod thread (without plating) with MK nut can withstand torque up to 18 Nm maximum.
- Torque check of spool centre rod thread (with plating) with MK nut can withstand torque up to 22 Nm maximum.
- Hardness of the spool centre rod (without plating) is 227.5HV
- Hardness of the spool centre rod (with plating) is 213.5HV
- Material property is MS (Mild Steel) the same as the standard requirement.
- Diameter of nut matches the standard requirement of 8-8.74 mm
- RPM at 8000 and Pressure at 4-5 Bar is maintained according the standard requirement.
- IEC-IW8S Standard Pneumatic guns are used in mounting nuts.

5.2 SUGGESTIONS

- Hardness of the spool centre can be increased so that the thread can bear more torque
- Torque applied should be kept constant.
- Supplier defects should be minimized
- Material should be carefully handled during the complete process
- Threading Process should be examined.
- Reducing amount of rework
- Nut should be placed correctly by operator before tighten it

5.3 CONCLUSION

The study has conducted analysis and has collected factors which leads to mounting thread damage in FC4 product and have tried to reduce the amount of in-process rejection due to mounting thread damage.

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