



**STREAMLINING OPERATIONS: THE IMPACT OF A QIP INITIATIVE IN THE  
FRAME BODY PART OF MOTORCYCLE**

Lappeenranta–Lahti University of Technology LUT

Master's Programme in Mechanical Engineering Master's thesis

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## ABSTRACT

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### **Streamlining Operations: The impact of a QIP initiative in the frame body part of motorcycle**

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The primary goal of this research is to create a comprehensive quality improvement program, with a marked emphasis on the seamless integration of the 5S and QIP Module Systems. A key focus of the study revolves around obtaining a substantial reduction in part rejection rates, leading a detailed examination of the existing quality culture to find potential for enhancements within the manufacturing processes. Leveraging the 5S technique, the research attempts to streamline activities, minimise waste, and boost overall operational efficiency within the organizational structure. By adopting this systematic method, the study aims to promote a culture of continual improvement and efficiency throughout the production environment. The findings of this extensive research have demonstrated the considerable impact of excellent quality management methods in boosting both productivity and product quality inside the organisation. Notably, the integration of the 5S and QIP Module Systems has resulted in a notable reduction in part rejection rates, indicating a marked improvement in the production process. The methodical use of the 5S methodology has effectively streamlined production operations, resulting to a reduction in waste generation and resource utilization. Moreover, the research findings underline the essential importance of these quality improvement programmes in increasing the organization's competitive edge, optimising operational processes, and promoting sustained growth within the industry. The findings from this research are compelling evidence of the transformative power of rigorous quality management systems, which can be used to develop an atmosphere that is characterised by excellent operational performance and continual improvement.

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## ABBREVIATIONS

AHL	Atlas Honda Limited
EFQM	European Foundation for Quality Management
FIFO	First in First Out
IHI	Institute for Healthcare Improvement
IPP	Initial Part Production
JIS	Japanese Industrial Standards
NG	Not Good
PQCT	Process Quality Control Table
QA	Quality assurance
QC	Quality control
QI	Quality Improvement
QIP	Quality Improvement Programme
RCI	Rapid-Cycle Improvement
SOP	Standard Operational Procedure
SPC	Statistical process control
TQM	Total Quality Management

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# 1 Introduction

The Quality Improvement Programme (QIP) is essential for ensuring that the products, services, and processes of an organisation consistently satisfy high quality standards. This thesis concentrates on the strategic implementation of a QIP to improve the quality culture and performance of an organisation (Juran J. M. & Godfrey A. B. 1999). The objective of the study is to evaluate current quality culture in the organization, to propose tailored strategies through QIP integration, to significantly decrease part rejection rates in the manufacturing sector, aiming to achieve a rejection rate of 0.3%, thereby enhancing product quality and reducing wastage, and to establish standardized quality control processes organization-wide, ensuring uniform part quality, and fostering a culture of continuous improvement to boost overall operational efficiency.

The research will consist of evaluating the organization's quality mission and objectives for alignment with the QIP, as well as proving the necessity of QIP implementation by analysing extant quality practises and addressing obstacles. Focusing on aspects such as control, inspection, and analysis systems, the scope of QIP integration will be determined by prioritising key departments, processes, and products/services (Oakland J. S. 2014). The 5-S system and the 6-Module system will be utilised to ensure effective workspace organisation and quality control. Evans J. R. and Lindsay W. M. (2017) will validate QIP success through auditing, followed by a comprehensive presentation of results, including insights into implementation outcomes and challenges. In its conclusion, the thesis will interpret results within the context of existing literature, acknowledge limitations, and suggest future research directions and possible industry implications.

## 1.1 Background

In organizations and the manufacturing industry, the pursuit of Quality Improvement (QI) has taken on a vital role. Improving operational efficiency and attaining product excellence are given high priority in this division. However, fundamental issues frequently become

challenges in achieving these major goals. A significant challenge is the occurrence of rejected manufactured components during the manufacturing process, which leads to operational inefficiency, increased costs, and the potential for decreased customer satisfaction. The primary causes of this issue are inadequate quality control procedures, deviations from defined inspection requirements, and apparent gaps in both process controls and product traceability. Resolving these issues appears to be a crucial task for maintaining efficient operations and high-quality standards within the realm of Quality Improvement initiatives.

Atlas Honda Limited (AHL) main client of Steel Craft (Pvt.) Ltd., a well-known company in the automotive industry, is a significant manufacturer and distributor of automobiles and auto parts. As the AHL aspires for excellence, a challenging matter has emerged that requires immediate attention. A considerable and unusually high percentage of components are rejected by AHL to the Steel Craft organization's manufacturing processes, which is a recurrent issue. Low audit compliance, deviations from intended part inspection criteria, a lack of effective process controls, and a lack of product traceability exacerbate the situation. Existing quality assurance systems are flawed, costing firm's money and effort while lowering customer satisfaction. Sloppy adherence to auditing standards has hampered the efficiency with which problems can be identified and resolved. Furthermore, due to the mismatch between desired and actual component inspection, the lack of precision in the manufacturing process has contributed to poor part quality.

The analysis conducted revealed that there are three key elements that require careful consideration due to their high rejection rates. These elements include hole NG, jig touch, and mishandling. Notably, the rejection rates of March-23 received from AHL for these individual stages exceed the total rejection rate of 8.83% as shown in figure 1 and the breakup of the rejection is shown in figure 2. This increased level of rejection highlights a large disparity between expected and actual outcomes during various stages of manufacturing. This pattern indicates potential inefficiencies or risks in operations related to mishandling, jig touch, and hole NG/hole out. Addressing these high rejection rates in figure 3 & figure 4 is critical for improving product quality and operating efficiency. These identified areas offer

prospective options for significant enhancements that can positively impact the overall production process through focused examination and targeted quality improvement initiatives.

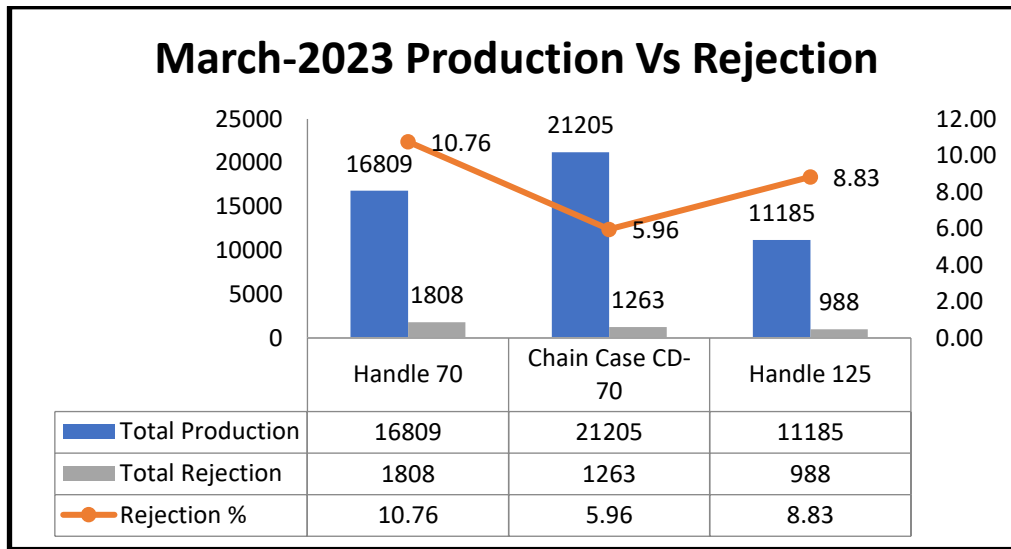


Figure 1. Rejection Rate From AHL

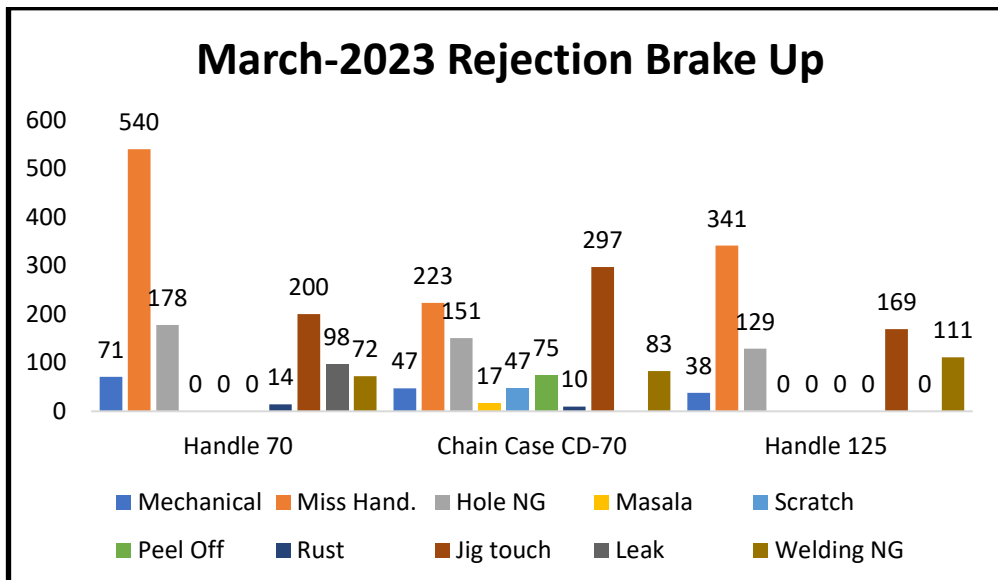


Figure 2. Rejection Breakup Received From AHL

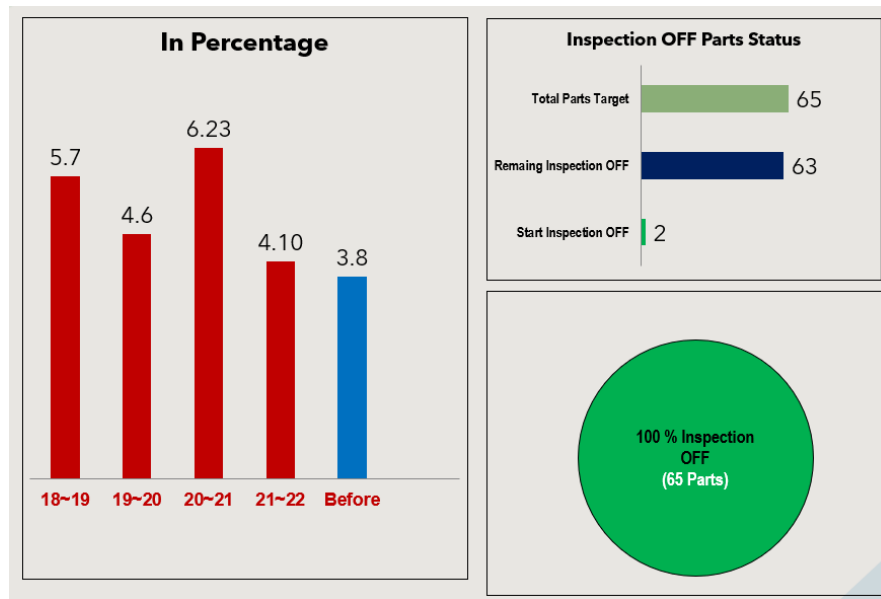


Figure 3. Year Wise Rejection Data From Atlas Honda Limited (AHL)

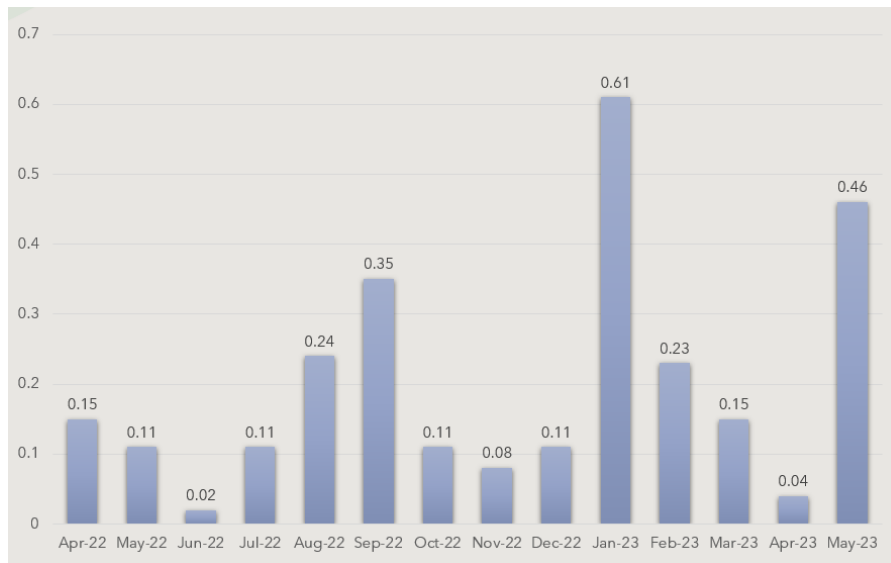


Figure 4. Rejection Trend from AHL for April-2022 to May-2023

The Pipe Steering Handle CG-125 have been plagued by high rejection rates in their manufacturing processes. This challenge has underlined the importance of focusing on quality improvement. The primary goal of this effort is to systematically determine the causes of these inhouse repairable and non-repairable rejections shown in figure 5 and to apply specific actions that will improve the overall production process. By effectively

addressing these challenges, the initiative hopes to drastically reduce rejection rates and raise the quality standards of these items.

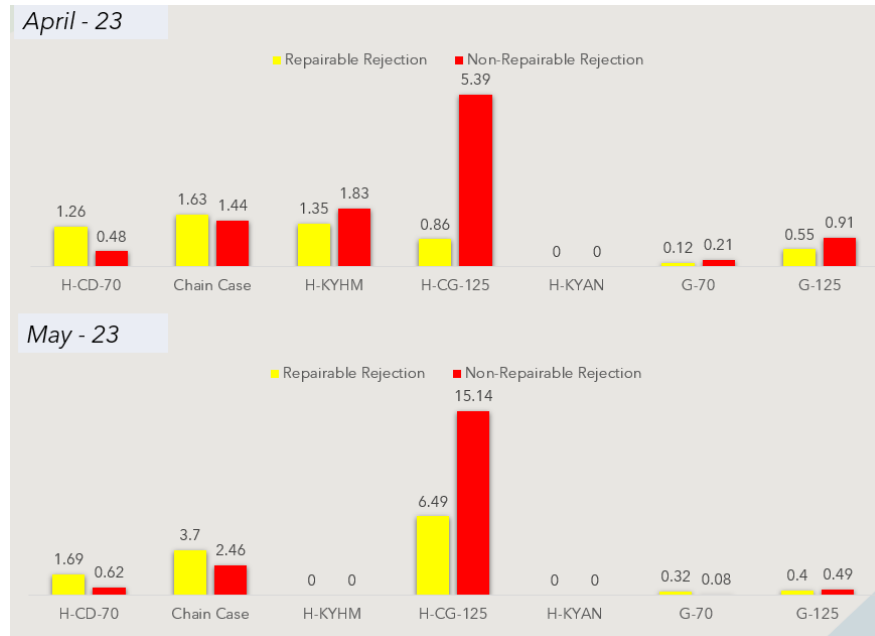


Figure 5. Inhouse Repairable/Non-Repairable Rejection Rates of Pipe Steering Handle CG-125

One of the most fundamental aims of this research is to confront these challenges head-on and effect radical change. The objective is to reduce the current rejection rate to an overly ambitious 0.3%. This transition is extremely difficult, but it aligns with AHL's mission to produce excellent products and enhance the consumer experience. AHL seeks to establish a culture of continuous improvement and optimize its processes holistically through the application of the 5S system methodology and the QIP Module System. By implementing these strategies, AHL hopes to improve part quality, streamline operations, strengthen process controls, and establish reliable product traceability. This initiative not only addresses the immediate issue of high rejection rates, but also establishes AHL as an industry pioneer, demonstrating its unwavering commitment to excellence.

## 1.2 Theoretical Concepts

Quality Improvement (QI) is a formal, methodical way to evaluate a practice's performance and improve it. The idea is that continuously evaluating and improving processes and procedures improves results, efficiency, and service delivery. (Aggelogiannopoulos D. R. O. S. I. N. O. S. Drosinos E. H. & Athanasopoulos P. (2007)).

### 1.2.1.1 Tools for Assessing Quality Improvement

Quality improvement models help organizations establish QI processes. These models guide development planning, execution, and evaluation. Many QI models are popular, including:

1. Improvement Model (Plan-Do-Study-Act Cycles): The Institute for Healthcare Improvement (IHI) created this paradigm, which blends Total Quality Management (TQM) with Rapid-Cycle Improvement (RCI) principles. It uses PDSA cycles shown in figure 6 to evaluate interventions on a small scale, allowing for iterative changes.



Figure 6. PDCA, Available at: <https://qi.elft.nhs.uk/collection/pocketqi-pdsa-stories/>  
(Accessed: 14 November 2023).

2. QIP Sigma: QIP Sigma is a rigorous methodology aimed at reducing process variation and failures. It strives for a degree of performance in which errors are extremely rare.

3. Lean: The Lean technique seeks to decrease waste while increasing the efficiency of work operations. By removing non-value-added procedures, lean strives to ensure that all work activities contribute to the overall value of the organization.

#### 1.2.1.2 Quality Improvement Tools

Evaluation, analysis, and communication tools aid Quality Improvement Programs. These tools are crucial to effective operations and practices. These tools are common for quality improvement projects. (Aggelogiannopoulos D. R. O. S. I. N. O. S. Drosinos E. H. & Athanasopoulos P. (2007))

- |  |  |
|--|--|
| 1. Run Charts                                      | 11. Control Charts                                       |
| 2. Process Maps                                    | 12. Gantt Charts   |
| 3. Fishbone Diagrams (Ishikawa Diagrams)           | 13. Root Cause Analysis (RCA)                            |
| 4. Pareto Charts                                   | 14. Failure Mode and Effects Analysis (FMEA)             |
| 5. SWOT Analysis                                   | 15. Value Stream Mapping (VSM)                           |
| 6. Checklists and Scorecards                       | 16. Kaizen Events  |
| 7. Brainstorming and Nominal Group Technique (NGT) | 17. PDCA (Plan-Do-Check-Act) Cycle                       |
| 8. 5 Whys Analysis                                 | 18. Cause-and-Effect Matrix                              |
| 9. Histograms                                      | 19. 5S (Sort, Set in order, Shine, Standardize, Sustain) |
| 10. Scatter Plots                                  |  |

### 1.3 Problem Statement

The project aims to improve manufacturing operations by lowering part rejection rates and increasing product quality overall. The focus is on implementing effective quality control methods, assuring product traceability, and encouraging a culture of waste reduction and continual development. With a stated objective of achieving a rejection rate of 0.3%, the

project intends to streamline operations, minimize inefficiencies, and implement sophisticated quality control technologies to maintain consistent part quality and customer satisfaction.

#### 1.4 Objectives

- To drastically reduce part rejection rates in the manufacturing business, with a goal of achieving a rejection rate of 0.3%.
- To establish and standardise effective quality control processes and procedures across the organisation to ensure consistent part quality.
- To improve the traceability of the product.
- To increase productivity, detect and correct inefficiencies, streamline operations, and optimise resource utilisation.
- To develop waste reduction strategies and promote a culture of efficiency.
- To implement sustainable practises to eliminate waste and promote ongoing improvement.
- To develop a feedback system to address complaints and defects proactively.
- To implement modern quality control technology to reduce production rejections.

#### 1.5 Aim

The aim of this research is to employ the QIP Module System to implement a complete quality improvement programme. The major goal is to achieve a rejection rate of 0.3% while improving processes, lowering rejection rates, and cultivating a culture of continuous improvement within the manufacturing industry.

#### 1.6 Research Questions

- How does the current quality culture of the organization effect the achievement of a good rejection rate and the deployment of standardized quality control systems, as specified in the objectives, and aim?

- What practical benefits and outcomes can be attributed to the use of the 5S system methodology and the QIP Module System within the context of the Quality Improvement Programme in terms of lowering rejection rates?
- How can the Quality Improvement Programme be strategically scoped and targeted to minimize rejection rates while also addressing the organization's most critical areas and processes?
- What improvements and recommendations can be developed within the Quality Improvement Programme, with a focus on reducing rejection rates to 0.3% and improving product quality, in accordance with the objectives and aim of the research?

## 1.7 Limitations

This Quality Improvement Program (QIP) project can be improved as there are some limitations in this project. To begin with, the research's application was most likely limited because it was done within a single organization or sector. For quality control, the project used both the 5-S system and the 6-Module system; however, the usefulness and profitability of each technique may differ based on the specifics of each organization. Furthermore, due to time and resource restrictions, the QIP's implementation and measurement may not have been as complete as intended, which could have an impact on the dependability and accuracy of the results. Furthermore, despite efforts to validate the data and eliminate any outliers or missing data, the gathered data quality may have been impaired due to limitations in the data gathering technique or unanticipated circumstances. It is critical to be aware of these constraints in order to create fair expectations for the implemented QIP and avoid unpleasant surprises.

## 1.8 Summary

In Chapter 1, we discussed the core issue of the study project: the effort to considerably reduce part rejection rates in the manufacturing industry. The goal is to address difficulties relating to audit compliance, meeting part inspection goals, improving process controls and product traceability, and to reduce rejection rates to a target of 0.3%, promoting both increased operational efficiency and overall product quality. We stated the research's precise

objectives, which include promoting continuous improvement, improving part quality through standardized methods, optimizing efficiency, minimizing waste, streamlining operations, and increasing customer satisfaction. The study also coincides with the introduction of the 5S system methodology and the QIP Module System, both of which are expected to generate complete quality improvement. We developed additional research questions that addressed components of the organization's quality culture, the outcomes of the Quality Improvement Programme, scoping strategies, and program maintenance and enhancement measures.

## 2 Quality ISO 9001-2015

In this chapter, I am going to inform you about the quality of a product. Regarding quality, I will discuss both aspects: quality assurance (QA) and quality control (QC).

### 2.1 Literature Review

The success and long-term viability of firms across a range of industries depend heavily on quality management and improvement (Fryer K. J. & Ogden S. M. (2014)). Numerous studies have been conducted on these topics, with a focus on organizational excellence, quality management, and comprehensive quality management (Dale B. G.; Van Der Wiele; T. & Van Iwaarden, J. (2007); Oakland J. S. (2014); Carnerud D. (2018)). These guidelines are considered essential for companies and governmental institutions since they help to continuously improve goods and services while maximizing effectiveness and efficiency to meet customer expectations (Lazerson, M.; Wagener U.; & Shumanis N. (2000)).

A number of studies (Schoengrund, C. (1996); Lo; Q. Q. & Chai K. H. (2012)) have emphasized the importance of quality management in academic research and its impact on organizational success. However, practical implementations of quality management education at academic institutions usually fall short (Chalmers; D. (2017); Cheng M. (2011); Brady N. & Bates A. (2016) Raisinghani; M. S. Ette; H. Pierce R.; Cannon G. & Daripaly P. (2005)). Managers and decision-makers must have access to relevant material in order to understand and carry out quality improvement operations.

QIP Sigma methodologies and the European Foundation for Quality Management (EFQM) Excellence Model have grown as significant frameworks for achieving quality excellence. The EFQM Excellence Model was created to help European firms integrate many quality standards in order to boost their efficiency and effectiveness (Price O. M.; Pepper; M.; & Stewart M. (2018)). It provides a comprehensive approach to quality management by emphasizing leadership, people management, process improvement, and customer focus.

These ideas were adopted in Europe as a result of the Japanese and American markets' success, which was powered by a focus on quality.

The QIP Sigma methodologies, first described by Bill Smith at Motorola, have gained global acclaim for their ability to evaluate, assess, and improve quality. The methods were created in response to Motorola's competitive needs in the semiconductor industry, and they were based on Gauss' development of the normal distribution (Arnheiter E. D. ; Maleyeff, J. (2005) ; Antony J. (2006) & Coronado R. B. (2002)). QIP Sigma focuses on mistake reduction, process variability reduction, and overall organizational performance improvement (Kwak, Y. H. ; Anbari F. T. (2006) ; Lock, I & Seele, P. (2017)).

The EFQM Excellence Model, QIP Sigma, and other fundamental ideas of quality management has sustainability research strongly influenced all. Both academics and assessors agree that sustainability principles must be implemented into quality management procedures to build, maintain, and improve an organization's competitive advantage (Seele P. ; Lock I. (2017); Martensson A. ; Snyder K. ; Ingelsson, P. (2019) ; Chesbrough H. & Rosenbloom, R. S. (2002)). Promoting social responsibility, environmental stewardship, and long-term corporate performance through the integration of sustainable practices into quality management.

The combination of the EFQM Excellence Model and QIP Sigma approaches has yielded meaningful results in a variety of industries. These frameworks have been used in industry to improve process efficiency, reduce waste, and improve product quality (Siddiqui S. Q. ; Ullah F. ; Thaheem M. J. & Gabriel ; H. F. (2016) ; Antony J ; Palsuk P. Gupta ; S. Mishra D. & Barach P. (2018)). They have aided the healthcare industry by improving patient outcomes, reducing errors, and increasing operational effectiveness (Dellifraigne J. L. ; Wang Z. ; McCaughey D. ; Langabeer J. R. & Erwin C. O. (2013) ; Chakrabarty A. & Chuan Tan K. (2007)). Furthermore, the strategies have been successfully applied in companies delivering public services to improve service delivery, reduce unpredictability, and discover and resolve operational flaws (Antony J. & Douglas A. (2010) ; Antony J. Snee R. & Hoerl, R. (2017) ; Linderman K. ; Schroeder R. G. ; Zaheer S. & Choo, A. S. (2003) ; Oprime P. C.

; Pimenta M. L. ; Jugend D. & Anderson R. (2019) ; Cho J. H. ; Wang, K. & Galas D. J. (2011)).

Beyond process improvement, QIP Sigma implementation has demonstrated significant benefits. It improves a company's ability to adopt innovation, respond to market movements, and improve financial performance (Stensaker B. (2003)). QIP Sigma has surpassed other quality methodologies in terms of cost reduction, customer satisfaction, and overall organizational performance (Harvey L. & Newton, J. (2004)).

However, the adoption of quality improvement programs may result in increased costs and the bureaucratic procedures associated with quality assurance (Magretta J. (2002) ; Taraza E. & Anastasiadou S. (2019)). Within an organization, strong quality management practices must coexist with ensuring operational effectiveness and cost-effectiveness.

Total quality management standards provide a comprehensive framework for businesses to continually examine and improve their operations. By focusing on all aspects of design, production, and distribution, these standards ensure ongoing improvement in efficiency, effectiveness, and customer satisfaction (Alblooshi M. ; Shamsuzzaman M. ; Chong Khoo M. B. ;Rahim, A. & Haridy S. (2021) ; Tenner A. R. & DeToro I. J. (1992) ; Demi B. & Lecocq X. (2010)). The EFQM Excellence Model and QIP Sigma methodology are two practical strategies for achieving and maintaining elevated levels of quality performance.

## 2.2 Quality Assurance and Quality Control

A comprehensive quality management system must incorporate both quality assurance (QA) and quality control (QC), which work in tandem to ensure that goods, services, or operations meet or exceed established quality standards. Although these terms are frequently used interchangeably, they refer to distinct processes with distinct foci and purposes.

### 2.2.1 Quality Assurance (QA)

Quality assurance refers to all planned and structured efforts carried out within a corporation to guarantee that quality criteria are met (Carnerud, D. (2018)). It is a preventative technique that focuses on ensuring that procedures are in place to consistently produce high-quality outputs.

QA prioritizes a product's or service's development procedures (figure 7) over the actual product itself. Early discovery and repair of any problems or deviations will aid in the avoidance of errors or non-conformities. Typical QA duties include.



Figure 7. Quality Assurance, Pharma advisor. Available at: <https://pharmaadvisor.com/about-us/staff/quality-assurance/> (Accessed: 14 November 2023).

1. **Quality Planning** Developing a comprehensive quality plan that outlines the goals, procedures, and resources required to meet the intended quality requirements (Klugt R. & Olivetti L. (2019)).
2. **Process Definition and Documentation** Defining and documenting the steps involved in the creation of a product or the provision of a service, as well as recording the associated protocols and work instructions (Antony J. & Banuelas, R. (2018)).

3. Training and Competence Ensuring that all parties participating in the process have received the relevant training, possess the requisite skills, and are aware of their quality commitments (Ferreira A. I. & Azevedo C. (2019)).
4. Risk Management: Risk management is the process of identifying and analyzing potential risks or hazards that could affect the quality of a product or service and then controlling those risks (Santos-Vijande ; M. L. López-Sánchez ; J.. & Trespalacios J. A.2018).
5. Document Control: Developing a system for monitoring and regulating documents, including version control, approvals, and dissemination, to guarantee the use of current and accurate information (Han K. ; Kim J. Y. & Srivastava R. K. 2017).
6. Internal Auditing: Regular internal audits are performed to determine if quality criteria are being met, to identify nonconformities, and to suggest corrective actions (Natarajan S. & Sohal A. S., 2018).
7. Management Review: A periodic evaluation of the quality management system's overall effectiveness, including its application and capacity for improvement (Gronroos, C. (2018)).

By engaging in these QA tasks, organizations can develop dependable procedures, eliminate errors or defects, and improve overall quality performance.

### 2.2.2 Quality Control (QC)

Quality control is a proactive technique that focuses on checking and testing items, services, or procedures to identify and correct defects or nonconformities (Vokurka, R. J. ; Cho, D. W., & Ellis, T. J. (2019)). It comprises monitoring and confirming the output to ensure that it meets the defined quality standards.

QC activities can include inspecting the finished product or service and can include the following:

1. Inspection The product or service is physically checked to determine whether it meets the quality criteria (Yang, C. L.; Tsai, C. Y ; Chen, T. H. & Lin, S. F. (2018)).
2. Testing Performing various tests and measurements to assess the efficacy, dependability, and other needed qualities of a product (Fahimnia, B. ; Sarkis, J. & Davarzani, H. (2015)).
3. Sampling Selecting representative samples from a larger batch or population to assess the quality of the entire lot (Sousa, R. ; Voss, C. A. & Zhu, M. (2019)).
4. Statistical Process Control (SPC) The use of statistical tools to monitor and manage processes, identify deviations or changes, and execute corrective actions as needed (Lillrank, P. & Kano, N. (2017)).
5. Corrective Actions Taking steps to remedy any detected defects or nonconformities, such as revising, repairing, or changing the process (Powell, T. C. (2018)).

By implementing QC processes, organizations can identify and solve quality issues before the finished commodity or service reaches the consumer, ensuring that only things that meet the desired quality requirements are shipped out.

In summary, quality assurance emphasizes the development of effective procedures and preventative measures, whereas quality control involves examining and testing goods and services to detect and correct any nonconformities. Both QA and QC are critical in ensuring that firms consistently produce high-quality goods or services, increasing client satisfaction and keeping them competitive.

### 2.3 7-QC Tools

The Seven Quality Control Tools (figure 8) are a set of problem-solving and data-analysis approaches that can be used in quality assurance and process development. Another name for these tools is the Seven Basic Quality tools. These tools, pioneered by a renowned

Japanese quality expert named Kaoru Ishikawa, have been a vital part of quality management methods since their introduction.

The seven quality control instruments offer a systematic and scientific approach to identifying, investigating, and addressing quality-related issues in a wide range of corporate operations and industries. They give a framework for gathering, organizing, and evaluating data to evaluate the current state of a process, identify problems or chances for change, and make decisions based on facts.

These materials were created to help quality experts and groups analyse data methodically, discover trends and patterns, identify root causes of problems, and propose practical solutions. Each instrument in the quality development process serves a unique role and provides critical information about the process's success or failure as well as areas that require additional attention.

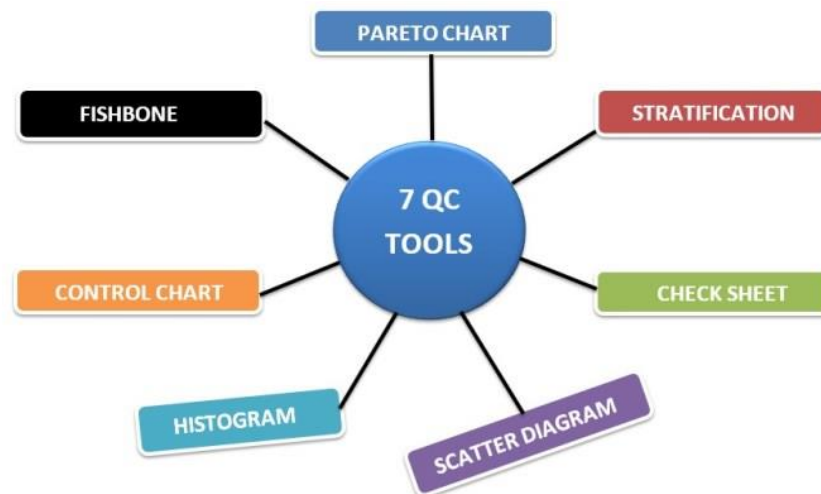


Figure 8. 7-QC Tools Shaikat, N.M. (2023) 7 QC tools in apparel industry, ORDNUR.

Available at: <https://ordnur.com/industrial-engineering-ie/7-qc-tools-in-apparel-industry/> (Accessed: 14 November 2023).

### 2.3.1 Cause-and-Effect Diagram (Fishbone Diagram)

The cause-and-effect diagram, also known as fishbone diagram due to its resemblance to a fishbone is used to identify and assess the causes and effects of an issue or desired objective. It is helpful to use visual classification and categorization of the various aspects that may contribute to a specific circumstance. The "6 M's," which stand for "Manpower, Machine, Method, Material, Measurement, and Environment," are the most visible categories on the diagram. This technique facilitates understanding of the underlying variables that contribute to a problem and gives a logical approach to problem solving (Pyzdek, T. & Keller P. A., 2019).

### 2.3.2 Check Sheets

A check sheet is an efficient and simple method for collecting and organizing data. It is a document or template used to record and tally specific observations or occurrences. Using review sheets, standardized and consistent data collection is possible. This instrument facilitates the identification of data patterns, trends, and anomalies, which can then be further investigated (Smith, R. E., & Reid, K., 2020).

### 2.3.3 Control Charts

Control charts are utilized to monitor and manage the temporal progression of a process. They graphically represent data points plotted on a graph, with control limits at the graph's top and bottom. By analysing the pattern of data points and their variation within the control boundaries, it is possible to determine if the process is under control or if specific causes of variation exist. Control charts are frequently employed in statistical process control (SPC) to maintain process stability and identify potential issues early on (Montgomery, D. C., & Runger, G. C., 2018).

### 2.3.4 Histogram

A histogram is a statistical diagram that represents the frequency distribution of discrete or continuous values. It is comprised of a series of bars, each of which represents a specific range or bin of data values, and the height of each bar indicates the frequency or number of observations within that range. Histograms allow us to analyse the shape, central tendency, and distribution of data, making it easier to identify patterns or anomalies (Levine, D. M.; Stephan, D. F. ; Szabat, K. A., & Berenson, M. L., 2017).

### 2.3.5 Pareto Chart

The Pareto chart is a combination of a histogram and a line graph. By identifying the most significant variables contributing to a problem, it is used to prioritize and direct development efforts. The chart's bars display, in decreasing order, the frequency or occurrence count for each category. The line graph illustrates the cumulative proportion of all occurrences. According to the Pareto principle, also known as the 80/20 rule, approximately 80% of the effects stem from 20% of the causes. Consequently, the Pareto chart assists in identifying the few critical issues that must be addressed to have the greatest impact (Breyfogle, F. W. III; Cupello, J. M. & Meadows, B. (2019)).

### 2.3.6 Scatter Diagram

A scatter plot, also called a scatter diagram, is a graph used to analyse the relationship between two variables. It involves plotting points of data with one variable along the x-axis and another along the y-axis. The scatter diagram can demonstrate whether or not there is a correlation between the two variables and aid in identifying patterns or trends in the data. (Devore, J. L., & Berk, K. N., 2019) This method is useful for identifying potential areas for improvement and analysing cause-and-effect relationships.

### 2.3.7 Stratification

Stratification is the process of dividing data into distinct groups or categories based on predetermined criteria. It facilitates the analysis of data from multiple perspectives and the identification of significant differences or patterns between groups. Data stratification makes it easier to understand and compare different subsets of information, which can provide essential insights for problem-solving and decision-making. Stratification can be performed using time, geography, product type, consumer segmentation, or any other suitable parameter (Pande, P. S. ; Neuman, R. P. & Cavanagh, R. R. (2018)).

### 3 5-S System

“5S strategy is consisting set of 5 steps (figure 9) for continuous improvement with respect to the organizational performance. The original concept was based on five Japanese words that begin with "S," i.e., Seiri, Seiton, Seiso, Seiketsu, and Shitsuke. The English equivalents are Sort, Set in order (Simplify), Shine (Swipe), Standardize, and Sustain” (Saito, S., & Nejhad, M. (2019)).



Figure 9. 5-S Strategy

#### 3.1 Elements of 5-S Strategy

##### 3.1.1 Sort

The initial step in implementing 5S in industries is to create zones and teams. Next, team leaders are chosen, and training is provided to all employees, not just team members. The initial five stages of the 5S methodology are then implemented sequentially.

The primary objective of the "S" Sort is to enhance the quality of the working environment and reduce distractions. Materials, equipment, supplies, and the like are categorised as "required," "might be required," and "not required" for optimal utilisation. Additional

elements may be classified as "frequently required," "occasionally required," or "rarely required." (Tari, J. J., et., (2017)).

To distinguish between mandatory and optional elements, red tags containing the item's description, category, cause for tagging, action to be performed, and remark are used. Items that are no longer needed are returned to the store, the red tag zone, or another specified destination.

### 3.1.2 Set in Order

The second "S" stands for Seiton, which means "set in order," and it refers to the process of allocating locations to the sorted things. Because each item has been assigned a distinct area, the cliché "a place for everything, and everything in its place" applies (Montes, F. J. L. ; Moreno, A. M. S., & Rubio, M. C. M. (2019)).

When selecting where to place goods, an ABC analysis of the contents could be utilised as a reference. Once everything is in order, you may file items away and easily find what you need, reducing your "non-productive time."

### 3.1.3 Shine

The third "S" is for Seiso (Shine), and all materials, machinery, gauges, equipment, and workplaces are cleaned during this stage. During the shine stage, issues in machines, equipment, and dirt sources can be discovered.

“Cleaning on a regular basis enables the identification and elimination of sources of disorder, as well as the maintenance of clean workplaces. The cleanliness of the machine, workplace, and floor, the tightness of the equipment, and the cleanliness of the lines, pipelines, and light sources are all verified during cleaning.” (Nordin, N. ; Abdullah, N., & Al-Ashraf, A. (2021)).

### 3.1.4 Standardization

In organization, standardization means ensuring that everyone follows the same rules and applies the same procedures. SOPs, visual signals, and guidelines must be designed and executed so that everyone follows the same procedures and achieves the same results (Gijo, E. V. ; Antony, J., & Bhimaraya, A. (2018)).

### 3.1.5 Sustain

The 5S method's final phase is named "Sustain," and its major goal is to retain the progress gained in "Sort," "Set in Order," "Shine," and "Standardise." Maintaining the 5S principles necessitates creating a culture of continuous improvement and incorporating them into daily operations (Bhasin, S. ; Burcher, P., & Chhotray, V. (2018)).

To ensure compliance and detect any concerns, 5S standards must be audited and inspected on a regular basis. It also entails teaching staff that why 5S is advantageous and how to effectively adopt it. Maintaining the 5S plan comprises rewarding and honouring individuals and teams for their efforts to maintain 5S standards and foster a culture of continuous improvement, in addition to awarding and recognising them for their contributions. Long-term implementation of the 5S technique benefits a company's production, safety, staff morale, and bottom line.

## 4 Organization Introduction & Methodology

STEEL CRAFT (PVT.) LTD., founded in 1983 in Karachi and currently operating three units in Lahore, has emerged as a leading manufacturer of High-Quality Automotive Components. Initially specializing in the production of Brake Pedals & Rear-View Mirrors for two and four-wheelers, the company has expanded its portfolio to encompass an impressive array of 65 components. In the pursuit of excellence, STEEL CRAFT (PVT.) LTD. has established a reputation for its unwavering commitment to superior craftsmanship and customer satisfaction. And Now, STEEL CRAFT stands as a premier vendor for ATLAS HONDA LIMITED (AHL), a prominent motorcycle company. Within this partnership, Steel Craft supplies an array of components to AHL, encompassing handles, chain cases, seat grips, and more. The monthly average production for handles alone totals approximately thirty thousand pieces.

The focus of this thesis centres around essential component frame body part of motorcycle: Handle CG-125 (as shown in figure 10 & 22) both meticulously crafted by STEEL CRAFT (PVT.) LTD. These components play vital roles in the motorcycle industry, and their manufacturing process requires a deep understanding of precision engineering and quality assurance. By studying these components, this research aims to shed light on the intricate manufacturing techniques employed by the company, their adherence to stringent quality standards, and the factors contributing to the exceptional performance and durability of Handle CG-125.



Figure 10. Handle CG-125

#### 4.1 Methodology

The Quality Improvement Program comprises QIP modules, each consisting of various submodules. These submodules offer opportunities for implementation to control rejection rates and enhance product quality. The QIP modules are designed to address specific aspects of the manufacturing process, and through their effective deployment, the program aims to achieve substantial improvements in overall product quality. The overview of all submodules is given in table 1:

Table 1. Overview of QIP Submodules

Sr #	Area	Description	Overview
1	Drawing Specs Control System	SOP	SOP Stands for standard Operational Procedure, which describes about the standard working method for drawing and specs control system. (Figure 21)
		Master Drawing File	Master Drawings file contains all about the data, drawings, specifications, and dimension of the product being made. (Figure 22)
		Under Deviation Part File	Deviation part file contains all the record of the product which are not available at standard sizes as well as the sizes which are deviate from drawing to actual sizes.
		Part Files update status	Part File Update status contain all up-to-date data which is improved with the passage of time to time like formats, sizes, drawing modification, specs etc.
		Initial Part Production (IPP) Record	IPP Stand for Initial Part Production record which contain all initial data of the product from development to initial lot (before starting the mass production).
		Deviation Record	Keep a file in record of all deviated sizes of the products.

2	Incoming inspection System	SOP's	SOP Stands for standard Operational Procedure, which describes about the standard working method for incoming inspection System. (Figure 23 & 24)
		Incoming Insp Check Sheets	This is the inspection check sheet as per incoming material sizes are being verified. (figure 25)
		Action / Countermeasure	In case of trouble shoot or any kind of problem, check the root cause of the problem and take countermeasure action to control and prevent the previous problem and keep it in the record for future use. (Figure 29)
		Limit Samples	Limit samples are OK & NG appearance-based samples as per raw material and sub-part received.
		FIFO	FIFO stands for First in First Out means raw material and finished product must have to out first product received first. (Figure 30)
3	In-process Inspection System	SOP	SOP Stands for standard Operational Procedure, which describes about the standard working method for in process inspection System. (Figure 31)
		In process Insp Check Sheets	In-process check sheet refers to as inspection standard sheet as per manufacturing product is checked out frequently and keep it in record. (Figure 34)
		Work Instructions + PQS	Work instructions and Process Quality Standards are the basic safety precautions described in a list and shown by the fluxes in each of the working shop or a department in their local language. (Figure 35)
		SOP of Machines/ Colour Coding	SOPs of machines are the working instructions about the given machine how to operate and work on it. (Figure 36)/ (Figure 37)
		Inspection Jigs / Gauges	These are the jigs and gauges being made on standard size of the manufacturing process standard of the process of the product so that large quantity can be easily verified through the inspection jig.

		PQCT I & II	PQCT stands for Process Quality Control Table 1 & Process Quality Control Table 2 in which PQCT1 shows the part and flow process details whereas PQCT2 shows the all the manufacturing and machining parameters of the product along with their pictures. (Figure 32 & 33)
4	Die & Tool Management & Calibration System	SOP's	SOP Stands for standard Operational Procedure, which describes about the standard working method for Die & Tool Management & Calibration System. (Figure 38 & 39)
		Die/ Tool, Jig/Gauge & Instrument Identification	This is the tagging system on the dies, tools, jigs, fixtures, gauges, and instruments identification according to the sizes, departments etc. (Figure 41)
		Jig / Gauge Drawing	It contains all the drawings of required jigs, fixtures, and gauges with standard or with go/not go sizes.
		Jig/Gauge & Instrument Calibration	It contains all the description about the jigs/fixtures/gauge's calibration plan, calibration and warn out history. (Figure 42 & 43)
		Die/ Tool Maintenance Schedule	It contains all the description about the dies/tool's maintenance plan, maintenance and warn out history. (Figure 44)
		Back up of Die / Tool	It contains the number of dies and tools as the backup if one of the dies is damaged then other one can be used to make production continuous.
5	Final Inspection System	SOP	SOP Stands for standard Operational Procedure, which describes about the standard working method for Final Inspection System. (Figure 45)
		Final Inspection Check Sheets	Final Inspection check sheet refers to as inspection standard sheet as per final inspection of the product is done as finished product received and keep it in record before dispatch to the customer. (Figure 46)
		Action / Countermeasure	In case of trouble shoot or any kind of problem, check the root cause of the problem and take countermeasure action to control and prevent the previous problem and keep it in the record for future use.
		Final Inspection Area'	Make a specified area for the final's inspection of the product and to sort OK,

			NG, and re-work parts from the manufactured lot. (Figure 49)
		Inspection Jigs / Gauges	These are the jigs and gauges being made on standard size of the manufacturing process standard of the process of the product so that large quantity can be easily verified through the inspection jig when the product is in finished condition
		Limit Samples	Limit samples are OK & NG appearance-based samples as per finished product parts are compared and sort out visually as well as dimensionally. (Figure 47)
		Part Audit Record	This contains the fully postmortem of the product from the raw material received till the finished product along with each parameter of part and machine given in the PQCT 1 and PQCT 2. (Figure 48)
6	Warranty Parts Analysis System	SOP	SOP Stands for standard Operational Procedure, which describes about the standard working method for Warranty Parts Analysis System. (Figure 51)
		Warranty Parts analysis status	After dispatching of the product, it gives the warranty claim of the product and make analysis on rejection received from the customer. (Figure 52)
		Action / Countermeasure	In case of trouble shoot or any kind of problem, check the root cause of the problem and take countermeasure action to control and prevent the previous problem and keep it in the record for future use.

#### 4.2 Objectives of QIP Modules System

- Drive Continuous Improvement through the enhancement of processes, including jig touch, and mishandling, within our Company.
- Sustainable / Consistent Parts Quality.
- Improving productivity.
- Reduction of waste.
- Improve cycle time.

- Reduction of complaints or defects.
- Reduce In-house rejection / line loses.
- Improve customer satisfaction.
- Improve on time delivery.

#### 4.3 Expected outcomes of project

This project would give us!

- Ninety-nine percent of decent quality products & customer care quality is achieved.
- Easy to identify the cause before making changes.
- Traceability and documentation of a product easy to manage and collect.

#### 4.4 Phase-1 Audit Report

The audit report (shown in figure 11) evaluates several crucial systems, including Drawing/Specs Control, Incoming Inspection, In-Process Inspection, Die Tool Management, Calibration, Final Inspection, and Incoming Line/Warranty Parts Analysis. Examining these areas thoroughly can facilitate data-driven decision making and continuous improvement initiatives by identifying their strengths, weaknesses, and opportunities for development.

QIP System & Performance Review (Audit Report)							Date: 01-June-2023								
Vendor: M/S Steel Craft (Pvt.) Ltd.			1st Audit FY 2023		<table border="1"> <tr> <td colspan="2">Steel Craft Limited</td> <td colspan="2">Auditor</td> </tr> <tr> <td>Management</td> <td>Client</td> <td>M. Iqbal</td> <td>M. Husnain Ali</td> </tr> </table>			Steel Craft Limited		Auditor		Management	Client	M. Iqbal	M. Husnain Ali
Steel Craft Limited		Auditor													
Management	Client	M. Iqbal	M. Husnain Ali												
Audit Participants															
Vendor: Faisal Rehman, M. Ifan, M Husnain Ali															
Sr #	Area	Description	Status		Weightage	Judgment		Remarks							
			Document	Implement		Document	Implement								
1	Drawing / Specs Control System	SOP	<input type="checkbox"/>	<input type="checkbox"/>	5%	71.4 @ 5% = 3.5%	44 @ 5% = 2.21%	Not aware with Drawing symbols (View Associates) Needs to update all files with respect to countermeasure & rejection trend IPP record not available against countermeasure							
		Master Dwg File	<input type="checkbox"/>	X											
		Under Dev & Obsolete Part File	<input type="checkbox"/>	<input type="checkbox"/>											
		Drawing Knowledge	<input type="checkbox"/>	<input type="checkbox"/>											
		Part Files update status	X	X											
		IPP Record (Spec Change, Quality Improvement & Self Control)	<input type="checkbox"/>	<input type="checkbox"/>											
		Deviation Record	----	----											
2	Incoming Inspection System	SOP's	<input type="checkbox"/>	<input type="checkbox"/>	15%	66.67 @ 15% = 10%	37 @ 15% = 5.625%	Not received from sub vendor  1-Verbal communication against rejection Verbal implement, need to system define against finish goods							
		Incoming Insp Check Sheets	X	X											
		Incoming Insp Jigs / Fixtures	<input type="checkbox"/>	<input type="checkbox"/>											
		Limit Samples	X	<input type="checkbox"/>											
		In coming Countermeasures	<input type="checkbox"/>	<input type="checkbox"/>											
FIFO	<input type="checkbox"/>	<input type="checkbox"/>													
3	In process Inspection System	SOP	<input type="checkbox"/>	<input type="checkbox"/>	25%	88.88 @ 25% = 22.22%	62.22 @ 25% = 15.56%	Not display at unit 2  1-No root cause analysis 2-No rework data 3-No CAR raising system Not maintain at both units No inspection data after Die repairing / new die							
		In process Insp Check Sheets	<input type="checkbox"/>	<input type="checkbox"/>											
		In process Insp Jigs / Fixtures	<input type="checkbox"/>	<input type="checkbox"/>											
		Work Instruction + PQS	<input type="checkbox"/>	<input type="checkbox"/>											
		SOP of Machines	<input type="checkbox"/>	<input type="checkbox"/>											
		PQCI & II	<input type="checkbox"/>	<input type="checkbox"/>											
		In process Countermeasures	<input type="checkbox"/>	<input type="checkbox"/>											
SS	X	<input type="checkbox"/>													
Startup Inspection System (After die repair / New die) (Machine and Parts)	<input type="checkbox"/>	<input type="checkbox"/>													
4	Die / Tool Management & Calibration System	SOP's	<input type="checkbox"/>	<input type="checkbox"/>	25%	71.42 @ 25% = 17.85%	57.14 @ 25% = 14.28%	Instruments identification not available Drawings are not match with jig / gauge (One CG-125) Calibration done, but data not match with jig / Gauges Done but no record No die production history							
		Die / Tool, Jig/Gauge & Instrument Identification	<input type="checkbox"/>	<input type="checkbox"/>											
		Jig / Gauge Dwg	X	<input type="checkbox"/>											
		Jig/Gauge & Inst Calibration	<input type="checkbox"/>	<input type="checkbox"/>											
		Die/ Tool Maintenance Schedule and Record	X	<input type="checkbox"/>											
		Back up of Die / Tool	<input type="checkbox"/>	<input type="checkbox"/>											
Die / Mold Control (Production Status)	<input type="checkbox"/>	<input type="checkbox"/>													
5	Final Inspection System	SOP	<input type="checkbox"/>	<input type="checkbox"/>	20%	100 @ 20% = 20%	67 @ 20% = 13.33%	Appearance standards are not display at final inspection  Available, but not signed & duration defined Done but no action against NG points record							
		Final Inspection Check Sheets	<input type="checkbox"/>	<input type="checkbox"/>											
		Final Inspection Std. sheets	<input type="checkbox"/>	<input type="checkbox"/>											
		Master Sample	<input type="checkbox"/>	<input type="checkbox"/>											
		Limit Samples	<input type="checkbox"/>	<input type="checkbox"/>											
Part Audit Record	<input type="checkbox"/>	<input type="checkbox"/>													
6	Incoming, Line & Warranty Parts Analysis System	SOP	<input type="checkbox"/>	<input type="checkbox"/>	10%	100 @ 10% = 10%	43.75 @ 10% = 4.37%	No root cause analysis & countermeasure Done but no countermeasure against toe Co Needs to log record							
		Parts analysis, Improvement record & monitoring	<input type="checkbox"/>	<input type="checkbox"/>											
		Statistical Process Control (Control Charts and Process Capability Analysis)	<input type="checkbox"/>	<input type="checkbox"/>											
		Process FMEA	<input type="checkbox"/>	<input type="checkbox"/>											
Observed System Compliance					100%	84%	55%								
Comments: <b>Legend</b> <input type="checkbox"/> = 100% <input type="checkbox"/> = 85% <input type="checkbox"/> = 75% <input type="checkbox"/> = 50% <input type="checkbox"/> = 25% X = 0% 1-Die's maintenance record not available 2-Root cause analysis required against rejection															



Figure 11. QIP System and Performance Review (Audit Report)

## 5 Method

Documentation and Implementation of 5S as well as QIP modules are as following:

### 5.1 5-S QUALITY SYSTEM

The following document outlines the structured approach to maintaining, checking, and ensuring the effectiveness of the 5S methodology within our organization daily. The 5S principles (figure 12), which stand for Sort, Set in Order, Shine, Standardize, and Sustain, are integral to fostering a clean, organized, and efficient workplace environment. This protocol aims to promote consistency, accountability, and continuous improvement in adhering to 5S practices across all departments and work areas. (Saito, S., & Nejhad, M. (2019)).

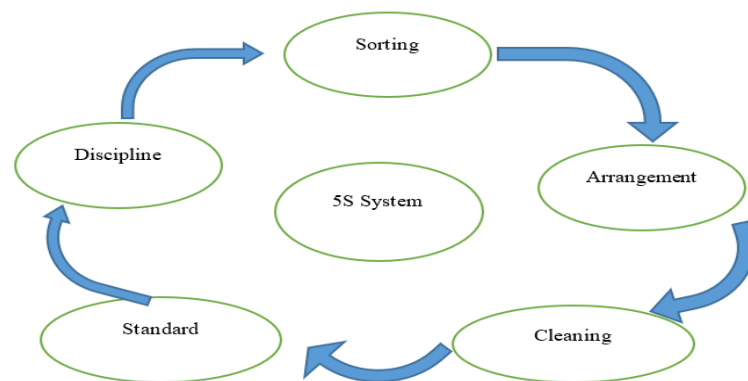


Figure 12. 5S Flow Chart

Following were the key issues and their resolution to reduce the rejection rate.

### 5.2 Hole NG

The "hole NG" problem previously referred to a recurring issue with the integrity of holes generated during the manufacturing process. This problem was causing faults in the finished

products, which was leading to an increase in product rejections, and the underlying reasons of these problems were unknown.

A detailed inspection approach was designed to solve this issue. Precision and quality of openings are ensured by the creation of specialized gauges. By incorporating this equipment into the manufacturing process, hole measurements may be monitored in real time. Using a 100%-hole inspection technique meant that every hole made was thoroughly scrutinized for defects. This initiative-taking strategy significantly improved hole quality, lowering faults and associated product rejections.

### 5.3 Jig Fitment

The jig fitment problem was previously defined as improper jig fitment during the production process, which could lead to misalignment and assembly issues. The nature of these fitment issue was uncertain.

To overcome this issue, a two-pronged approach was utilized. Specialized jigs were created and used to ensure precise fit during the manufacturing process. These fixtures were created specifically for the assembly line. A consistent technique for fitting and utilizing these jigs was also developed, assuring consistency across all related tasks. As a result, fixture fitment significantly improved, minimizing assembly errors and misalignments throughout the manufacturing process.

### 5.4 Mishandling

Previously, the mishandling problem was caused by steel parts being improperly stored, resulting in rubbing and scratching. These visual flaws could jeopardize the structural integrity of the pieces.

Several steps were implemented to reduce the risk of mistreatment. Rubber sheets were strategically placed to the steel storage racks, preventing direct metal-to-metal contact and



		STEEL CRAFT (PVT) LTD																																		
		SS Evaluation Sheet																																		
Shop Name: <i>Press Shop (Chain case CD-70)</i>		Responsible Person: <i>Shop Supervisor</i> Sign: <i>[Signature]</i> MONTH: <i>July-2023</i>																																		
S#	SS	CHECK POINTS	Freq	Time	Rating	DATE																														
						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
1	Sort	No irrelevant things on shop floor	1/Shift	Start of shift	5	4	4	3	4	4	4	3	4	4	4	4	3	4	4	4	4	3	4	4	4	4	3	4	4	4	4	4				
		Check the Chip Mixing	1/Shift	Start of shift	5	3	4	3	3	4	3	4	3	3	4	4	3	4	4	3	4	4	3	4	4	4	3	4	3	4	3	4				
		Trolleys Bins arrangements SS	1/Shift	Start of shift	5	4	5	4	5	4	5	4	5	5	5	5	4	3	4	3	5	4	5	4	4	3	5	4	5	4	4	4				
2	Stabilize	Checking of uniforms	1/Shift	In Shift	5	5	4	5	5	4	5	4	5	5	5	5	4	5	5	5	4	5	4	5	4	5	4	5	5	5	5					
		Cleaning of cutting oil on the floor for each machine	1/Shift	In shift end	5	3	4	3	4	4	3	4	4	4	3	4	3	4	4	3	4	3	4	4	4	4	3	4	3	4	4					
3	Shine	Cleaning of Chip under the machines	1/Shift	In shift end	5	3	2	3	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3					
		Disposal of Cotton rags Gloves	1/Shift	Start of shift	5	5	4	4	4	5	5	5	5	5	5	5	5	5	4	3	4	5	5	4	4	3	4	5	4	3	5					
		Cleaning of Chip Trolleys	Daily At Start	As required	5	4	4	4	4	3	4	5	4	4	3	3	4	3	4	3	4	3	4	4	3	4	3	4	4	3	4					
		Cleaning of Display boards	1/Day	In shift start	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4				
4	Standardize	Stacking of Parts (No Bin / Gatta)	when receiving	Receiving	5	4	3	4	4	3	3	4	3	3	4	4	3	4	4	3	4	4	3	4	3	4	4	3	3	4	4	3				
		Proper Parts Stacking OIC Card	1/Shift	Start of shift	5	5	5	5	5	5	5	5	4	5	5	5	4	5	5	5	4	5	5	5	4	5	4	5	5	4	5					
		Proper Parts Stacking OIC Card	1/Shift	End of shift	5	4	5	5	5	4	4	4	5	5	4	4	4	4	5	5	4	4	4	4	4	4	4	4	4	4	4	5				
5	Sustain	Shop visit regarding SS	1/Shift	Frequently	5	4	3	4	4	5	5	3	4	4	5	4	3	4	4	5	4	3	4	4	5	5	3	4	5	4	5	4				
CONFIRMED BY: (SS member)			Day wise	✓	5																															
Remarks Comments: <i>Regarding SS Evaluation, This Shop needs to be more improvements.</i>																											Month Average	4.65								

Figure 14. 5S Implementation

5.6 5S Safety Moon

The "5S Safety Moon" was implemented, enhancing workplace safety by systematically organizing tools and materials, maintaining cleanliness, and fostering a culture of safety awareness among employees. Document for this is shown in figure 15.

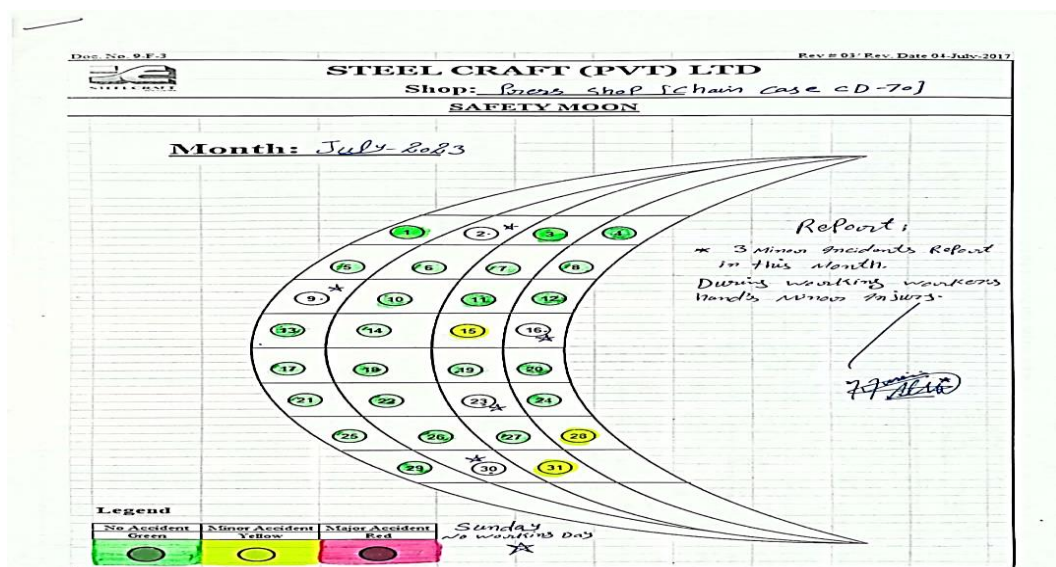


Figure 15. 5S Safety Moon

### 5.7 5S Comparison at different areas

The efficiency of manufacturing and storage room, press shop and Handle CG-125 Final Inspection Quality Gate increased after 5S strategies were implemented. Keeping the manufacturing area clean, uncluttered, and orderly helped expedite processes, cut down on waste, and boost output. Improved inventory control and less time wasted searching for items in storage were the results of clearly marked shelves and bins. Following images show (16, 17, 18, 19, 20 & 21) comparison of before and after the implementation of 5S strategy.



Figure 16. 5S Implementation at Press Shop

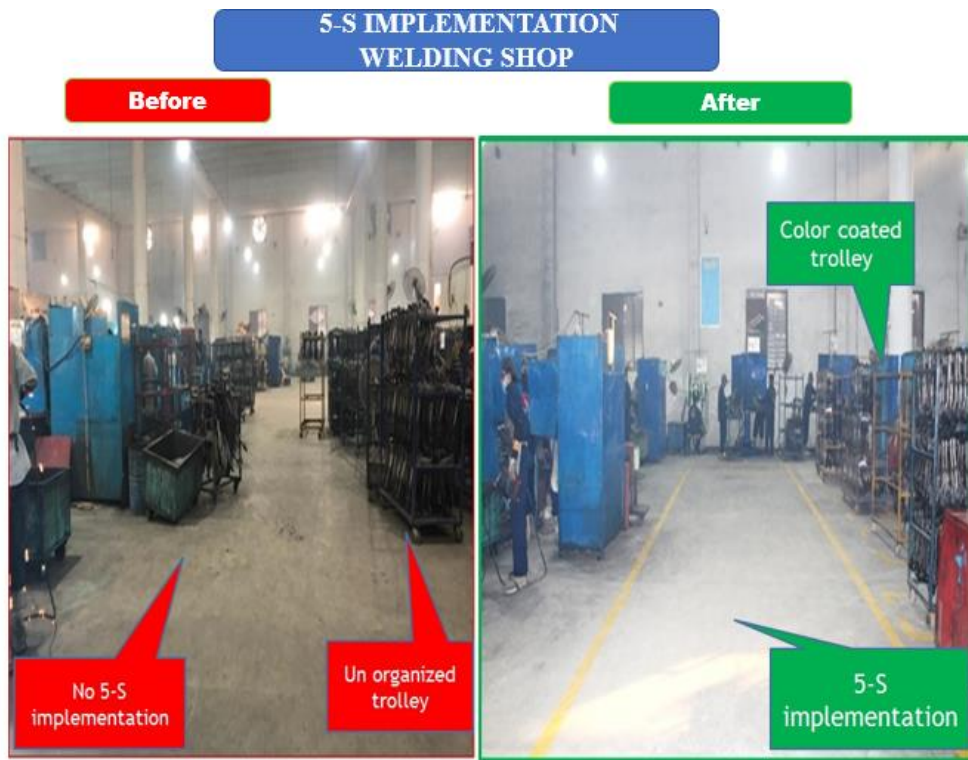


Figure 17. 5S Implementation at Welding Shop

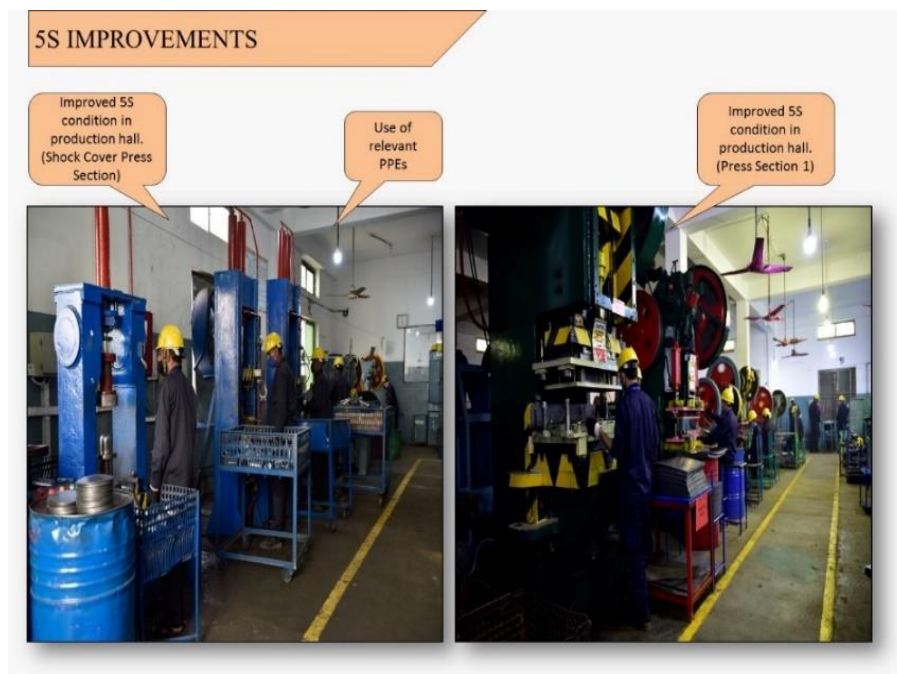


Figure 18. 5S Improvements at Production Hall



Figure 19. 5S Implementation at storage



Figure 20. 5S Implementation at Handle CG-125 Final Inspection Quality Gate

## 5.8 Quality Improvement Modules Documentation

### 5.8.1 SOP (Standard Operational Procedure)


 <b>STEEL CRAFT (PVT) LTD</b> <b>SOP</b>	
<b>Specification Control Department</b>	
<b>ہدایات برائے Specification Control ڈیپارٹمنٹ</b>	
<p>(۱) کسٹمر سے مطلوبہ تعداد کے مطابق ڈرائنگ کی Request کریں۔</p> <p>(۲) کسٹمر سے نئی ڈرائنگ موصول ہونے کی صورت میں QIP کی اسٹیمپ لگا کر ماسٹر ڈرائنگ کی فائل میں لگائیں۔</p> <p>(۳) متعلقہ ڈیپارٹمنٹ کو کسٹمر سے موصول کردہ ڈرائنگ Issue کریں اور اس کا اندراج Drawing Control Sheet میں کریں۔</p> <p>(۴) ڈرائنگ Obsolete ہونے کی صورت میں ماسٹر ڈرائنگ فائل، پارٹ فائل اور فیکٹری میں موجود تمام متعلقہ ڈیپارٹمنٹ سے ڈرائنگ نکال کر Obsolete کی اسٹیمپ لگا کر Obsolete ڈرائنگ کی فائل میں لگائیں۔</p>	
<hr/> Prepared By	<hr/> Approved By

Figure 21. SOP (Specification Control Department)

In English, these points can be translated as:

1. Request the drawing according to the required number from the customer.
2. In case of receipt of new drawing from customer stamp QIP and save in master drawing file.
3. Issue the drawing received from the customer to the concerned department and enter it in the Drawing Control Sheet.

- In case the drawing is Obsolete, extract the drawings from the Master Drawing File, Part file and all relevant departments in the factory and affix Obsolete Stamp then save in the file of Obsolete Drawings.

### 5.8.2 Drawing Study Notes

The drawing notes were implemented for better precision and accuracy of parts. This increased the efficiency and reduced the rejection rate as the parts became more accurate after implementing drawings. The figure 22 shows the detailed drawing of frame body part (Handle CG-125) of motorcycle.

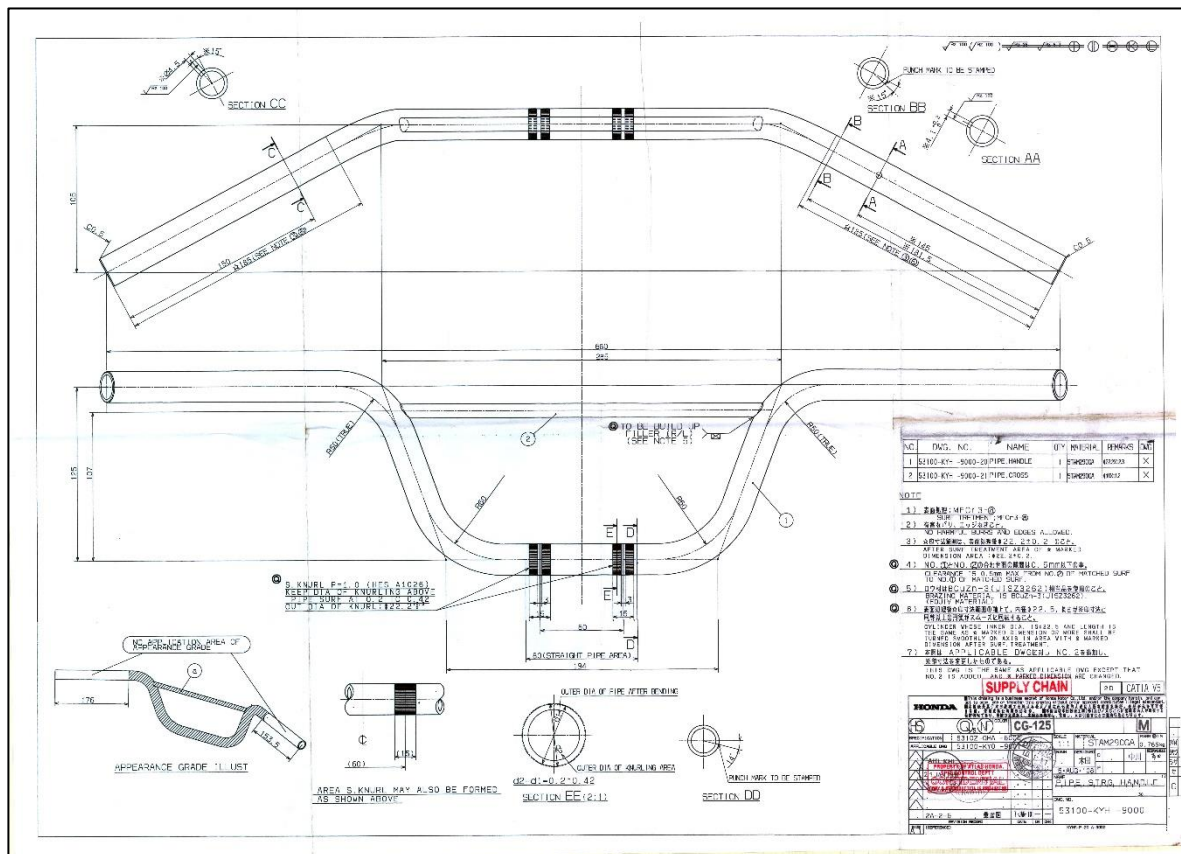


Figure 22. Drawing Handle CG-125

### 5.8.3 Incoming inspection System

#### 1. SOP of Incoming Inspection of Raw Material


	<b>STEEL CRAFT (PVT) LTD</b>
<b>SOP</b>	
<b>Incoming Inspection of Raw Material</b>	
ہدایات برائے Raw Material انکمنگ انسپیکشن	
(۱) Raw Material کے ساتھ موصول ہونے والی Mill Test Report کو JIS کے اسٹینڈرڈ کے مطابق چیک کریں۔	
(۲) کوالٹی انسپیکٹر Mill Test Report کو Sign کرے اور فائل کرے۔	
(۳) Raw Material کو چیک شیٹ میں دیئے گئے Standard کے مطابق چیک کریں	
(۴) کوالٹی انسپیکٹر انسپیکشن چیک شیٹ کو Fill کرنے کے بعد Sign کرے اور فائل کرے۔	
Prepared By	Approved By

Figure 23. SOP (Incoming Inspection of Raw Material)

#### In English

1. Received mill test report along with raw material check according to JIS (Japanese Industrial Standards) standard.
2. The quality inspector should sign and file the mill test report.
3. Check the raw material as per the standard given in the check sheet.
4. Quality inspector should sign and file the inspection check sheet after filling it.

## 2. SOP of Incoming Inspection of Vendor Part


 <b>STEEL CRAFT (PVT) LTD</b>	
<b>SOP</b>	
<b>Incoming Inspection of Vendor Parts</b>	
ہدایات برائے (وینڈر پارٹس) انکمنگ انسپیکشن	
(۱)	انکمنگ کوالٹی انسپیکٹر Sub Vendor سے موصول کردہ تمام وینڈر پارٹس کی فائنل انسپیکشن رپورٹس کو چیک کر کے اپنے Sign کرنے کے بعد فائل کریں۔
(۲)	تمام وینڈر پارٹس کو انکی انکمنگ انسپیکشن چیک شیٹ میں دیئے گئے کوالٹی اسٹینڈرڈز اور سپلائینگ پلان کے مطابق چیک کریں۔
(۳)	انکمنگ انسپیکشن چیک شیٹ میں ڈیٹا ریکارڈ کرنے کے بعد Sign کر کے فائل کریں۔
(۴)	وینڈر پارٹس انکمنگ انسپیکشن چیک شیٹ میں دیئے گئے کوالٹی اسٹینڈرڈز کے مطابق نہ ہونے کی صورت میں Reject کریں اور Countermeasure Sheet وینڈر کو Issue کریں۔
(۵)	انکمنگ انسپیکشن سے متعلقہ تمام Jigs/Guage اور Instruments کی Calibration دی گئی Frequency کے مطابق کروائیں۔
Prepared By	Approved By

Figure 24. SOP (Incoming Inspection of Vendor Parts)

## In English

1. Incoming quality inspector check the final inspection report of all vendor parts received from Sub Vendor and file after signing.
2. Check all vendor parts against the quality standards and manufacturing plan given in their accompanying inspection sheet.
3. After recording the data in the incoming inspection check sheet, sign, and file it.
4. If the parts are not conforming to the standard given in the incoming Inspection Check Sheet, reject them and issue the Countermeasure Sheet to the vendor.
5. Calibrate all Jigs/Gauges and Instruments related to incoming inspection system according to the given frequency.

3. Incoming Inspection Check Sheet for Raw Material

<b>STEEL CRAFT (PVT) LTD</b>											
<b>Incoming Inspection Check Sheet Raw Material</b>											
PART NAME: MS PIPE				MATERIAL:		STAM 290GA		DATE: 11-07-2023			
MODEL: CG-125 KYHA								REC.QTY: 9600 FT			
VENDOR: Annayat inds.								CHALLAN No. 7437			
DRAWING											
S. No.	INSPECTION ITEM	STANDARD	METHOD	SAMPLE PLAN	SAMPLE QTY	OBSERVATIONS / Actual/Difference					REMARKS
						1	2	3	4	5	
1	Outer Dia	∅ 10 <sup>+0.2</sup> <sub>-0.2</sub>	Vernier Caliper	C	5/1000	10.1	10.0	10.2	10.1	10.0	OK
2	Thickness	1.2 <sup>+0.05</sup> <sub>0.05</sub>	↑	C	↑	1.2	1.2	1.2	1.2	1.2	OK
3	Appearance	No Rust	Visual	C	↑	OK	OK	OK	OK	OK	OK
		No Crack		C	↑	OK	OK	OK	OK	OK	OK
		No Pitting		C	↑	OK	OK	OK	OK	OK	OK
		No Deformation		C	↑	OK	OK	OK	OK	OK	OK
Remarks:				Status			Grand Total/Lot Size:				
				OK	NG	CA	CHECKED BY			APPROVED BY	
				<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	QA/QC Inspector			Manager QA/QC	

Figure 25. Incoming Inspection Check Sheet Raw Material

4. Lot Wise Incoming Inspection Frequency

Figures 26 and 27 depict the required inspection frequency during incoming inspections based on the size and criticality of the received items.

SAMPLE SIZE CODE LETTERS							
Lot Size	General Inspection Levels			Special Inspection Levels			
	I	II	III	S1	S2	S3	S4
2 to 8	A	A	B	A	A	A	A
9 to 15	A	B	C	A	A	A	A
16 to 25	B	C	D	A	A	B	B
26 to 50	C	D	E	A	B	B	C
51 to 90	C	E	F	B	B	C	C
91 to 150	D	F	G	B	B	C	D
151 to 280	E	G	H	B	C	D	E
281 to 500	F	H	J	B	C	D	E
501 to 1,200	G	J	K	C	C	E	F
1,201 to 3,200	H	K	L	C	D	E	G
3,201 to 10,000	J	L	M	C	D	F	G
10,001 to 35,000	K	M	N	C	D	F	H
35,001 to 150,000	L	N	P	D	E	G	J
150,001 to 500,000	M	P	Q	D	E	G	J
500,001 and over	N	Q	R	D	E	H	K

Figure 26. Sample Size Code Letters

SINGLE SAMPLING PLANS FOR NORMAL INSPECTION												
Sample Size Code Letter	Sample Size	Acceptable Quality Levels (Normal Inspection)										
		0.065 Ac Re	0.10 Ac Re	0.15 Ac Re	0.25 Ac Re	0.40 Ac Re	0.65 Ac Re	1.0 Ac Re	1.5 Ac Re	2.5 Ac Re	4.0 Ac Re	6.5 Ac Re
A	2											0 1
B	3										0 1	1 2
C	5									0 1	1 2	2 3
D	8								0 1	1 2	2 3	3 4
E	13						0 1		1 2	2 3	3 4	4 5
F	20					0 1	1 2		2 3	3 4	4 5	5 6
G	32				0 1	1 2	2 3		3 4	4 5	5 6	6 7
H	50			0 1	1 2	2 3	3 4		4 5	5 6	6 7	7 8
J	80		0 1	1 2	2 3	3 4	4 5		5 6	6 7	7 8	8 9
K	125	0 1	1 2	2 3	3 4	4 5	5 6		6 7	7 8	8 9	9 10
L	200	1 2	2 3	3 4	4 5	5 6	6 7		7 8	8 9	9 10	10 11
M	315	2 3	3 4	4 5	5 6	6 7	7 8		8 9	9 10	10 11	11 12
N	500	3 4	4 5	5 6	6 7	7 8	8 9		9 10	10 11	11 12	12 13
P	800	4 5	5 6	6 7	7 8	8 9	9 10		10 11	11 12	12 13	13 14
Q	1250	5 6	6 7	7 8	8 9	9 10	10 11		11 12	12 13	13 14	14 15
R	2000	6 7	7 8	8 9	9 10	10 11	11 12		12 13	13 14	14 15	15 16

Figure 27. Single Sampling Plans for Normal Inspection

## 5. Colour Coding Scheme For Incoming Inspection Parts

The colour coding was implemented for properly putting all the parts in specified colour bins/trolleys/racks as shown in image 28.

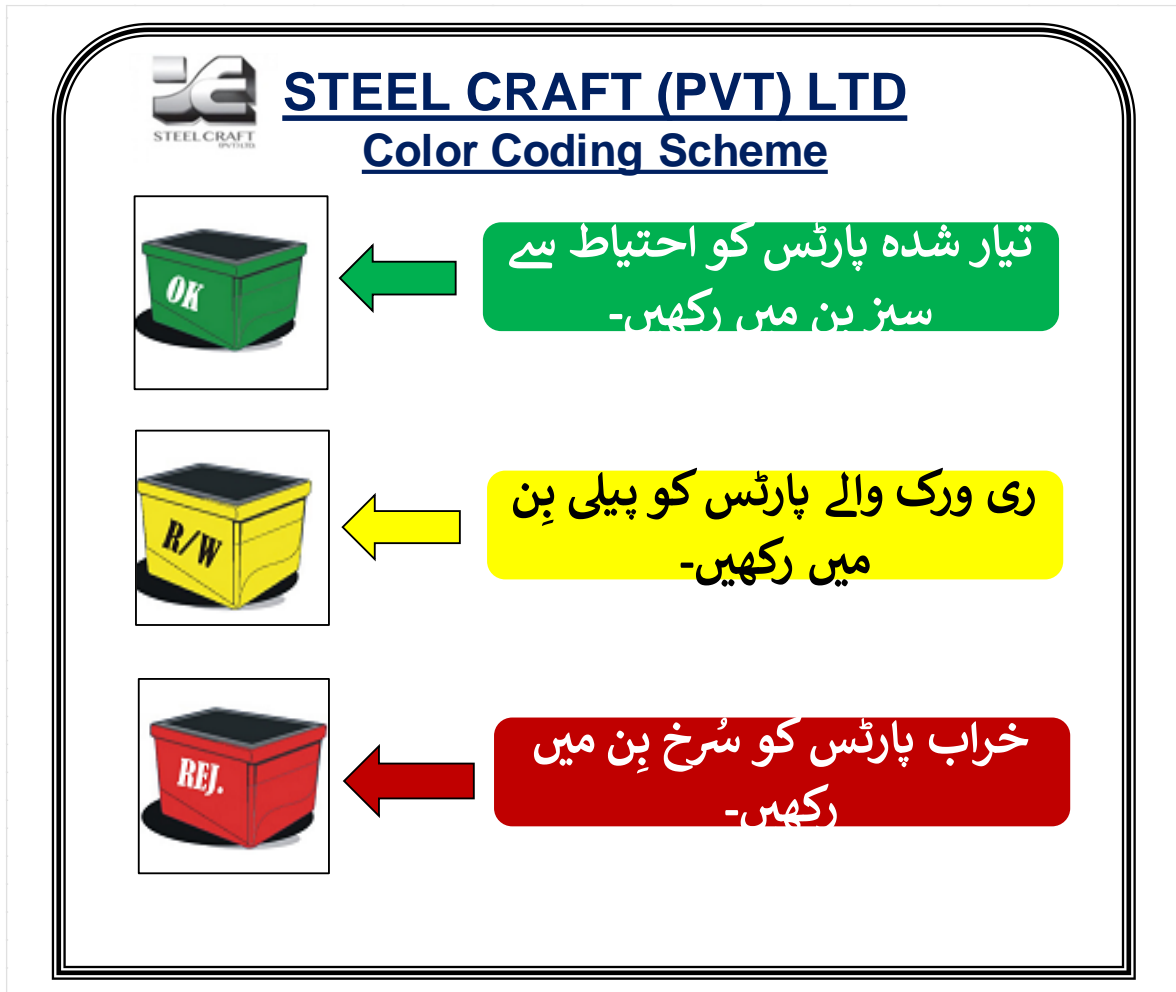


Figure 28. Colour Coding Scheme

In English

1. Ready parts must be placed in green bins.
2. Reworks parts must be placed in yellow bins.
3. Rejected parts must be placed in red bins.

6. Corrective Action Report English Format

ISSUED BY ( Shop )		ISSUED TO ( Shop )		ISSUE DATE		
Part Name	DATE				REPLY TIME	
	MODEL					
	NO. OF NG PARTS					
	INSPECTED QUANTITY					
Problem				MAX:ONE WEEK		
Picture Exploded		CAUSE/ANALYSIS (Problem and Reason of problem)		COUNTER MEASURE ACTIVITIES	EFFECTIVE DATE	REMARKS
PREP.BY	SHOP I/C	SHOP MANAGER	RECEIVED BY	SHOP I/C		MGR.Q.A.

Figure 29. Corrective action report

This CAR report (shown in figure 29) is used when within the organization quality inspector caught the defect at incoming area from vendor material or subpart while checking then corrective action report is raised to find the root cause of the defect and give permanent solution to prevent it.

7. First In First Out (FIFO) Colour Coding Plan

FIFO Moth wise Colour Coding

STEEL CRAFT (PVT) LTD													
FIFO PLAN													
Sr No	COLOURS	Year-2023											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	<b><u>GREEN</u></b>	■				■				■			
3	<b><u>BLUE</u></b>		■				■				■		
2	<b><u>YELLOW</u></b>			■				■				■	
4	<b><u>RED</u></b>				■				■				■

Figure 30. Moth-Wise FIFO Colour Coding

8. First In First Out (FIFO) Colour Coding Chart

The deployment of a month-by-month First In First Out (FIFO) Colour Coding Chart (shown in figure 30) is a critical component of our quality improvement plan. This strategic charting strategy streamlines our inventory management by using a color-coded methodology based on the First In First Out idea. Using a different hue for each month, merchandise can be easily identified and tracked based on the order in which it was received. This method enhances inventory management by reducing material waste or obsolescence. By following this FIFO colour coding chart, we may maximize inventory turnover, reduce holding costs, and ultimately encourage a more effective and well-organized manufacturing process.

## 5.8.4 In process Inspection System

### 1. SOP of In-Process Inspection System


Doc. #9-F-3		Rev #03 / Rev. Date: 4-july-2023	
 <b>STEEL CRAFT (PVT) LTD</b>			
<b>Standard Operating Procedure</b>			
<b>Inprocess Inspection System</b>			
<b>ہدایات برائے ان پراس انسپیکشن</b>			
<p>(۱) Inprocess انسپیکشن کے دوران کوالٹی انسپیکٹر تمام پارٹس کے Process کوڈی گئی Frequency کے مطابق چیک کریں۔</p>			
<p>(۲) اگر کسی Process کے دوران کوئی NG پارٹ ملے تو فوری طور پر پروڈکشن رکوا کر تمام مال کی Sorting 100% کروائیں، تاکہ خراب مال آگے نہ جانے پائے۔</p>			
<p>(۳) Inprocess انسپیکشن شیٹ میں ڈیٹا ریکارڈ کرنے کے بعد Sign کریں اور اپنے انچارج سے Sign کروا کر فائل کریں۔</p>			
<p>(۴) Inprocess انسپیکشن سے متعلقہ تمام Jigs/Guage اور Instruments کی Calibration دی گئی Frequency کے مطابق کروائیں۔</p>			
Prepared By		Approved By	

Figure 31. SOP (In process Inspection System)

In English:

1. During in-process inspection quality inspector check all parts of process according to given frequency.
2. If any NG (Not Good) part is found during any process, immediately stop the production and sort all the goods 100%, so that the defective goods cannot go forward.
3. After recording the data in the In-process Inspection check sheet, sign, and file with the signature of your in-charge.

4. Calibrate all Jigs/Guage and Instruments related to in-process inspection as per given frequency.

2. Process Quality Control Table1 & Table2

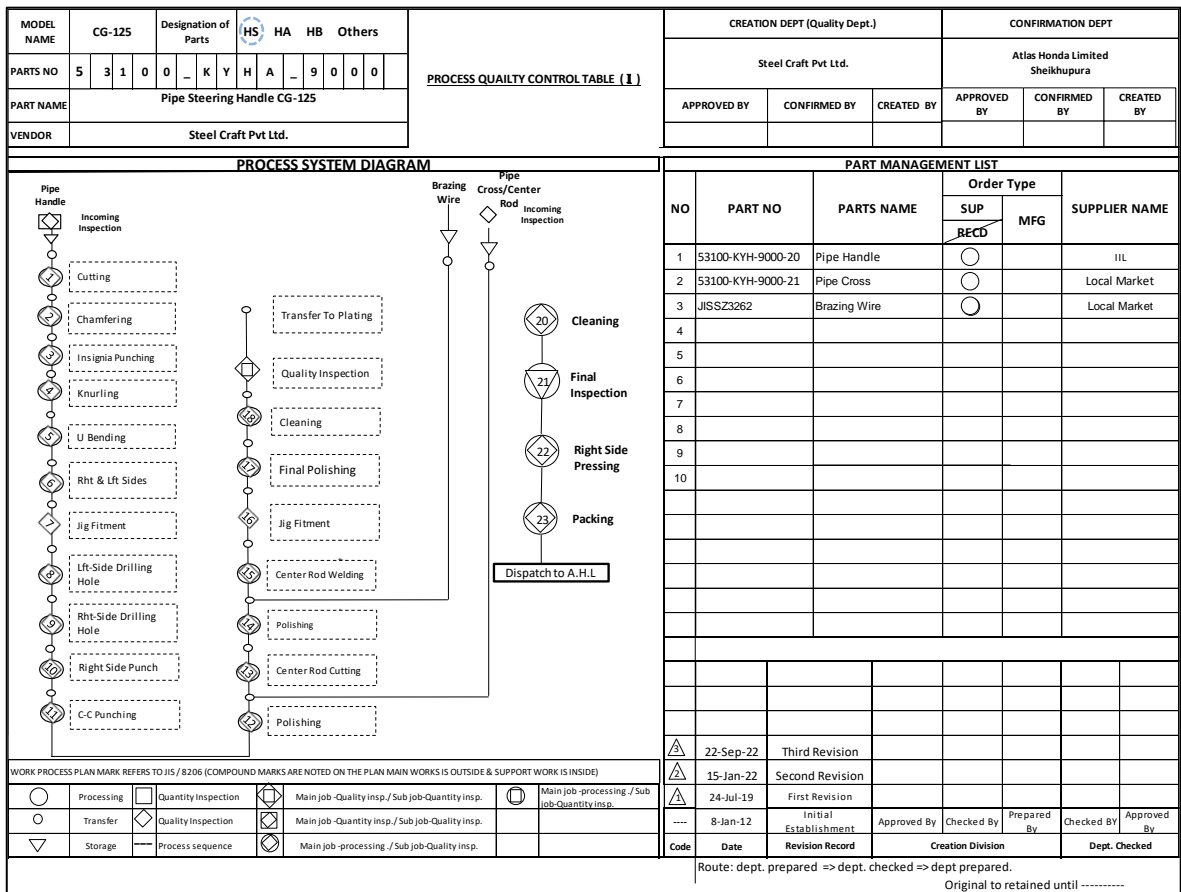


Figure 32. PQCT-1 Handle CG-125

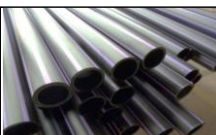



Pipe Steering Handle CG-125																		
Process Quality Control Table (II)																		
MFG Order	PROCESS NAME FACILITY NAME (Supplier Name)	Critical Item	NO	QUALITY CHARACTERISTIC							Critical Item	Control of Manufacturing Conditions (facilities, dies, fail safe equipment, pressure, voltage, temperature, and others).						SCHEMATIC DRAWING
				CONTROL ITEM	SPECIFICATION	PERSON IN CHARGE	CHECK METHOD	FREQUENCY	DATA FORMAT	SUBMISSION FREQUENCY OF DATA		CONTROL ITEM	CONTROL VALUE	PERSON IN CHARGE	CHECK METHOD	FREQUENCY	DATA FORMAT	
<b>A. Pipe Incoming</b>																		
A	Material Receiving Steering Handle Pipe	6	1	Material	M6 Pipe	Quality Inspector	Attached data Sheet	As per ADL	Incoming Check Sheet	On Each Arrival	-	-	-	-	-	-		
			2	Outer Dia & Thickness	Ø 22.2 ± 0.2 x t2 ± 0.12		VC				Instrument Calibration	full range Calibration	Inspector	Calibration Tag and Record	6 Month	Calibration Check Sheet		
			4	Appearance	No rust No deformation		Visual				-	-	-	-	-	-		
<b>B. Pipe Cross (Center Rod) Incoming</b>																		
C	Material Receiving Center Rod Pipe	6	1	Material	MS	Quality Inspector	Attached data	As per ADL	Incoming Check Sheet	On Each Arrival	-	-	-	-	-	-		
			2	Dia & Thickness	Ø 10 ± 0.2 x t1 ± 0.12		VC				Instrument Calibration	full range Calibration	Inspector	Calibration Tag and Record	6 Month	Calibration Check Sheet		
			4	Appearance	No rust no deformation		Visual				-	-	-	-	-	-		
<b>Process</b>																		
1	Cutting	1	1	Length	860± 2mm	Quality Inspector	Measuring tape	1 piece Detail Inspection	Inprocess Check Sheet	2/shift	-	Cutter Speed	35mm/s	Operator	Dial Indicator	Start Up	Start up inspection sheet	
			2	Appearance	No Burrs		Visual				-	-	-	-	-	-		
2	Chamfering	1	1	Chamfer Size	0.5 ± 0.4mm	Quality Inspector	V.C	1 piece Detail Inspection	Inprocess Check Sheet	2/Shift	-	Chamfer tool life	800 pcs	Operator	Production data	-	-	
			2	Appearance	No Burrs		Visual				-	Motor Rpm	900	Operator	Techo Meter	Start Up	Start up inspection sheet	
3	Insinia 2...2) Punching	1	1	Appearance	Punch Should Be Visible	Quality Inspector	Visual	1 piece Detail Inspection	Inprocess Check Sheet	2/shift	-	punch life	28000-30000 pcs	Supervisor	Production Report	-	-	
4	Knurling	1	1	One side Width	15± 0.3	Quality Inspector	V.C	1 piece Detail Inspection	Inprocess Check Sheet	2/Shift	-	Tool Life	9000-12000 pcs	Operator	Production data	-	Die and Tool Change Record	
			2	Outer Length	75± 0.3		V.C				-	Tool Dia	20mm	Operator	V.C	-	-	
			3	Inner Length	45± 0.3		V.C				-	Tool Width	6mm	Operator	V.C	-	-	
			5	Knurling Dia	22.4 ~ 22.62		V.C/Gauge				-	//	//	//	//	//	//	
			6	Appearance	No Deformation		Visual				-	Motor Rpm	1400 rpm	Operator	Techo Meter	Start Up	Start up inspection sheet	
5	U Bending	1	1	Jig	Proper Seated	Quality Inspector	Jig	1 piece Detail Inspection	Inprocess Check Sheet	2/Shift	-	Bending Die	Die Life 70000-80000	Supervisor	Production Report and Visual Inspection of Die	Daily	Production Report and Die Calibration Sheet	
			2	Appearance	Dent, Cuts Not Allowed		Visual				-	Jig Calibration	Dimensions as per Calibration sheet	Quality Inspector	as per Calibration Sheet	6 Monthly	Calibration Sheet	
6	Rht & Lft Sides Bending	1	1	Bended Length	680 ± 1.5	Quality Inspector	Height Gauge	1 piece Detail Inspection	Inprocess Check Sheet	2/Shift	-	Bending Die	Die Life 70000-80000	Supervisor	Production Report and Visual Inspection of Die	Daily	Production Report and Die Calibration Sheet	
			2	Bended Height	125 ± 1.0		Height Gauge				-	//	//	//	-	-		
			3	Appearance	Dent, Cuts Not Allowed		Visual				-	-	-	-	-	-		
7	Jig Fitment	1	1	Fitment	Proper Seated	Quality Inspector	Visual	100%	-	-	Jig Calibration	Dimensions as per Calibration sheet	Quality Inspector	as per Calibration Sheet	6 Monthly	Calibration Sheet		

Figure 33. PQCT-2 Handle CG-125

7	Jig Fitment	1	1	Fitment	Proper Seated	Quality Inspector	Visual	100%	-	-	Jig Calibration	Dimensions as per Calibration sheet	Quality Inspector	As per Calibration Sheet	6 Monthly	Calibration Sheet		
8	Lft-Side Drilling Hole	1	1	Dia	4.5 ±0.2	Quality Inspector	VC	1 piece Detail Inspection	Process Check Sheet	2/Shift	-	Drill size	4.6mm	Operator	V.C	-	-	
		1	2	Distance to Corner	150 ±0.5	Quality Inspector	VC	1 piece Detail Inspection	Process Check Sheet	2/Shift	-	Fixture setting	As per Master sample	Supervisor	Master Sample	-	-	
		1	3	Angle	15° ±3°	Quality Inspector	Height Gauge	1 piece Detail Inspection	Process Check Sheet	2/Shift	-	Fixture setting	As per Master sample	Supervisor	Master Sample	-	-	
9	Rht-Side Drilling Hole	1	1	Dia	4.1 ±0.2	Quality Inspector	VC	1 piece Detail Inspection	Process Check Sheet	2/Shift	-	Drill size	4.3mm	Operator	V.C	-	-	
		1	2	Distance to Corner	145 ±0.5	Quality Inspector	VC	1 piece Detail Inspection	Process Check Sheet	2/Shift	-	Fixture setting	As per Master sample	Supervisor	Master Sample	-	-	
10	Rht - Side Punch mark	1	1	Distance to Corner	181.5 ±1	Quality Inspector	VC	1 piece Detail Inspection	Process Check Sheet	2/Shift	-	Punch Life	28000-30000 pcs	Supervisor	Production Report	-	-	
		1	2	Angle	15° ±3°	Quality Inspector	Height Gauge	1 piece Detail Inspection	Process Check Sheet	2/Shift	-	Fixture setting	As per Master sample	Supervisor	Master Sample	-	-	
11	C - C Punching	1	1	Strength Pipe Area	80 ±0.7	Quality Inspector	VC	1 piece Detail Inspection	Process Check Sheet	2/Shift	-	Fixture setting	As per Master sample	Supervisor	Master Sample	-	-	
		1	2	Angle	14° ±3°	Quality Inspector	Height Gauge	1 piece Detail Inspection	Process Check Sheet	2/Shift	-	Fixture setting	As per Master sample	Supervisor	Master Sample	-	-	
12	Polishing	6	1	Appearance	No scratches no burr and dents	Quality Inspector	Visual	-	-	-	Emery Belt	220	Quality Inspector	Label	-	-		
13	Bar Cross (Center Rod) Tapper Cutting	1	1	Length	263 ±1.2	Quality Inspector	V.C	1 piece Detail Inspection	-	2/Shift	-	-	-	-	-	-	-	
		1	2	Appearance	No Burrs	Quality Inspector	Visual	-	-	-	-	-	-	-	-	-	-	
14	Polishing (Bar Cross)	6	1	Appearance	No scratches no burr and dents	Quality Inspector	Visual	-	-	-	Emery Belt	220	Quality Inspector	Label	-	-		
15	Center Rod Welding	1	1	C - C Distance	107 ±1	Quality Inspector	Height Gauge	1 piece Detail Inspection	-	2/Shift	-	Pressure	100psi	Operator	Gauge	-	-	
		1	2	Appearance	No Pits holes	Quality Inspector	Visual	100%	-	-	-	-	-	-	-	-	-	
16	Jig Fitment	1	1	Jig	Proper Seated	Quality Inspector	Visual	100%	-	-	Jig Calibration	Dimensions as per Calibration sheet	Quality Inspector	As per Calibration Sheet	6 Monthly	Calibration Sheet		
17	Final Polishing	6	1	Appearance	No scratches,cuts, dents	Inspector	Visual	100%	-	-	Emery Belt	Emery belt #120	Operator	Label	After 80-100 pcs	Prod. Report		
		6	2	Appearance	No scratches no burr and dents	Inspector	Visual	100%	-	-	Emery Belt	Emery belt #220	Operator	Label	After 80-100 Pcs	Prod. Report		
		6	3	Appearance	No scratches no burr and dents	Inspector	Visual	100%	-	-	Emery Belt	Emery belt #320	Operator	Label	After 300 Pcs	Prod. Report		
		6	4	Surface Cleaning	No Polish Line	Inspector	Visual	100%	-	-	Cotton wheel	Buff	Operator	Label	After 800 Pcs	Prod. Report		
18	Cleaning	6	1	Oil Duct, kerosene oil	No Duct ,Oil Allowed proper cleaning, clear surface	Quality Inspector	Visual	100%	-	-	-	-	-	-	-	-		
19	Quality Inspection	6	1	Appearance	Defects, polish line Burr not allowed	Q.C. Inspector	Visual	100%	-	-	-	-	-	-	-	-		

Figure 33. Continue PQCT-2 Handle CG-125

Electro Plating (See Plating PQCT)																	
20	Cleaning	1	1	Cleaning	Should be proper Clean	Ope	Visual	100%	Nil	Nil							
21	Final Inspection	1	1	Length	580 ±1.5 mm	Inspector	M.T	1/2000	F.I.C Sheet	On Every Dispatch							
		2	2	Punch Mark Position	181.5 ±1 mm	Inspector	V.C	1/2000	F.I.C Sheet	On Every Dispatch							
		1	3	Height	125 ±0.3 mm	Inspector	H/S/Fig	1/2000	F.I.C Sheet	On Every Dispatch							
		1	4	Inner Knurling	45 ±0.3mm	Inspector	V.C/Gauge	1/2000	F.I.C Sheet	On Every Dispatch							
		1	5	Knurling Dia	22.4 ±0.22	Inspector	V.C/Gauge	1/2000	F.I.C Sheet	On Every Dispatch							
		6	6	Pipe Outer Dia	Ø22.2 ±0.2 mm	Inspector	V.C	1/2000	F.I.C Sheet	On Every Dispatch							
		2	7	Rht Side Hole Distance	(145 ±0.3) mm	Inspector	V.C/ALG	1/2000	F.I.C Sheet	On Every Dispatch							
		6	8	Chamber	Ø 6 ±0.4 mm	Inspector	V.C	1/2000	F.I.C Sheet	On Every Dispatch							
		2	9	Lft Side Hole Distance	157 (150±0.3) mm	Inspector	V.C/ALG	1/2000	F.I.C Sheet	On Every Dispatch							
		1	10	Hole Dia (RHS)	Ø 1 ±0.2 mm	Inspector	V.C	1/2000	F.I.C Sheet	On Every Dispatch							
		1	11	Hole Dia (LHS)	Ø 1.50 ±0.2 mm	Inspector	V.C	1/2000	F.I.C Sheet	On Every Dispatch							
		6	12	Nickel Thickness	20µ Min	Nickel testing	Nickel Tester	1/2000	F.I.C Sheet	On Every Dispatch							
		6	13	Appearance	No Peel Off	Inspector	Visual	1/2000	F.I.C Sheet	On Every Dispatch							
		6	14	Installation	No Rough Buffing	Inspector	Visual	1/2000	F.I.C Sheet	On Every Dispatch							
22	Rht - Side Pressing	1	1	Dia	Ø22.2 ±0.1	Inspector	Ring Gauge	100%	Nil	Nil	Press Type	Mechanical	Ope	Label	Once At Start		
		2	2	Appearance	Dent, Cuts Not Allowed	Ope	Visual	100%	Nil	Nil	Press Capacity	30 Ton	↑	↑	↑		
											Press Stroke	3 Inch	↑	MTape	↑		
											Dia	No Burr, No Deformation	↑	Visual	After 50000		
											Lubrication	Oil	↑	Once at start up	Once at start up		
23	Packing	1	1	Packing material	Polythene	Inspector	Visual	100%	-	-	Ring Gauge	Calibrated	Inspector	V.C	Tag / C.S		

COMPLETE VEHICLE'S FAILURE MODE CLASSIFICATION:  
 1) Driving Function Failure 2) Turning Function Failure 3) Stepping Function Failure 4) Guarding Function Failure  
 5) Insulation Function Failure 6) Protection Function Failure 7) Exhaust gas Control Function Failure 8) Identification Function Failure (Label, Engraving, etc.)

Figure 33. Continue PQCT-2 Handle CG-125

### 3. In-Process Inspection Check Sheet

The In-process check list was implemented. This enabled us in inspecting all the parts which are being produced. This helped us in better investigation of parts which are being produced. The image of this sheet is shown below in image 34.



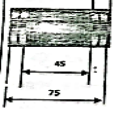


IN-PROCESS CHECK SHEET														
PRT NAME		PIPE STEERING HANDLE		DOCUMENT #		Date						QC Inspector		
MODEL		CG-125 KYEA		SC-FM-01-196, Issue No. 01		SHEETS 1/2						Checked By		
Sr #	Points Controlled /Sketch	Qualitative Characteristic	Insp. Method	FRQ.	Shifts	13-7-23	14-7-23	17-7-23	18-7-23	19-7-23	19-7-23	19-7-23	19-7-23	
					9:00	2:30	9:00	2:30	9:00	2:30	9:00	2:30	9:00	2:30
1		Length	86±2	M/T,Jig	1st	861	860	860	861	861	861	861	861	861
		Apperance	No Burr	Visual	2nd	OK	OK	OK	OK	OK	OK	OK	OK	OK
2		Length	0.5 ± 0.4	V.C	1st	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
		Apperance	No Burr	Visual	2nd	OK	OK	OK	OK	OK	OK	OK	OK	OK
3		One Side Width	15±0.3	V.C	1st	15.2	15.3	15.2	15.3	15.2	15.3	15.2	15.3	
		Outer Length	75±0.3	V.C	2nd	75.2	75.2	75.2	75.2	75.2	75.2	75.2	75.2	
		Inner Length	45±0.3	V.C	1st	45.2	45.2	45.2	45.2	45.2	45.2	45.2	45.2	
		Knurling above surface Dia	22.4 ± 22.62	V.C	2nd	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5	
		Apperance	No Much Deep Knurling Marks	Visual	1st	OK	OK	OK	OK	OK	OK	OK	OK	OK
		2nd	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	
4		Jig	Proper Seated	Jig	1st	OK	OK	OK	OK	OK	OK	OK	OK	
		Apperance	Dents, Cut Marks Not Allowed	Visual	2nd	OK	OK	OK	OK	OK	OK	OK	OK	
5		Total Bended Length	680 mm ± 1.5	M/T,Jig	1st	681	680	680	681	680	680	680	680	
		Jig	Proper Seated	Jig	2nd	OK	OK	OK	OK	OK	OK	OK	OK	
		Bended Height	125 mm ± 1	Height Gauge	1st	124	124	125.2	125.2	125.2	125.2	125.2	125.2	
					2nd	125	125	125.2	125.2	125.2	125.2	125.2	125.2	

Figure 34. In-Process Inspection Check List


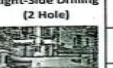


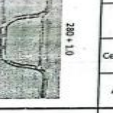
IN-PROCESS CHECK SHEET														
PRT NAME		PIPE STEERING HANDLE		DOCUMENT #		Date						QC Inspector		
MODEL		CG-125 KYEA		SC-FM-01-196, Issue No. 01		SHEETS 1/2						Checked By		
Sr #	Points Controlled /Sketch	Qualitative Characteristic	Insp. Method	FRQ.	Shifts	13-7-23	14-7-23	17-7-23	18-7-23	19-7-23	19-7-23	19-7-23	19-7-23	
					9:00	2:30	9:00	2:30	9:00	2:30	9:00	2:30	9:00	2:30
6		Hole Dia	4.5 ± 0.2	V.C	1st	4.5	4.5	4.5	4.6	4.5	4.5	4.5	4.5	
		Distance to Corner	150 ± 0.5	V.C	2nd	150.4	150.3	150.2	150.3	150.3	150.4	150.4	150.4	150.4
7		Angle	15° ± 3°	Height Gauge	1st	OK	OK	OK	OK	OK	OK	OK	OK	
		Hole Dia	4.1 ± 0.2	V.C	2nd	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	
8		Distance to Corner	145 ± 0.5	V.C	1st	145.3	145.1	145.2	145.3	145.2	145.4	145.3	145.4	
		Angle	2° ± 3°	Height Gauge	2nd	OK	OK	OK	OK	OK	OK	OK	OK	
9		Distance to Corner	181.5 ± 1	V.C	1st	181.6	181.5	182	182.3	182.4	182.3	182.3	182.3	
		Angle	15° ± 3°	Height Gauge	2nd	OK	OK	OK	OK	OK	OK	OK	OK	
10		Straight Pipe Area	80 ± 0.7	V.C	1st	80.1	80.2	80.1	80.2	80.2	80.3	80.6	80.7	
		Angle	14° ± 3°	Height Gauge	2nd	OK	OK	OK	OK	OK	OK	OK	OK	
		Center Rod Height	107 ± 1.0	Height Gauge	1st	107.4	107.4	107.7	107.9	107.7	107.8	107.6	107.5	
		C-C Distance	263 ± 1.2	Height Gauge	2nd	263.5	263.2	263.5	263.3	263.2	263.4	262.2	262.2	
		Length	263 ± 1.2		1st	263.2	263.4	263.4	263.2	263.2	263.2	262.2	262.2	
		Center Rod Pipe	Proper Seated	Jig	1st	OK	OK	OK	OK	OK	OK	OK	OK	
		Apperance	No Pin holes	Visual	2nd	OK	OK	OK	OK	OK	OK	OK	OK	
Inspected By QA Inspector		Name	Muzamir	Signature	1st	Muzamir	Muzamir	Muzamir	Muzamir	Muzamir	Muzamir	Muzamir	Muzamir	
		Name	Muzamir	Signature	2nd	Muzamir	Muzamir	Muzamir	Muzamir	Muzamir	Muzamir	Muzamir	Muzamir	

Figure 34. Continue In-Process Inspection Check List



## 5. Standard Machine Instructions


Doc. # 9-F-3		Rev # 03 / Rev. Date: 4-july-2023	
		<b>STEEL CRAFT (PVT) LTD</b> <b>Standard Operating Procedure</b> <b>Standard Machine Instructions</b>	
<b>ہدایات برائے مشین</b>			
۱-	مشین چلانے سے پہلے اس کی صفائی کریں اور اس کے سلائڈنگ پارٹس پر آئل ڈالیں		
۲-	انچارج کی ہدایت کے مطابق ورک پیس کو مشین میں لگائیں		
۳-	اگر ضرورت ہو تو کٹنگ والے حصے پر آئل ڈالیں		
۴-	انچارج کی دی گئی ہدایت کے مطابق ورک پیس کو کاٹیں اور انچارج سے چیک کروائیں		
۵-	مشین میں کسی خرابی کی صورت میں اپنے انچارج کو مطلع کریں		
۶-	مشین میں کام ختم ہونے کے بعد مشین کو بند کر کے مشین کی صفائی کریں		
Prepared By		Approved By	

Figure 36. SOP Standard Machining Instructions

## English Translation

1. Before operating the machine, clean it and apply oil to its sliding parts.
2. Install the workpiece in the machine as per the instructions of the in-charge.
3. If needed, add oil to the cutting tool.
4. Cut the workpiece as per the instructions given by the in-charge and get it checked by the in-charge.
5. In case of any malfunction in the machine, inform your in-charge.
6. After finishing the work in the machine, turn off the machine and clean it.

## 6. Colour Coding Scheme For In-Process Inspection System

A Colour Coding Scheme for the In-Process Inspection System (shown in figure 37) was implemented as a strategic addition to assist quality improvement initiatives. This scheme employs color-coded containers, each of which represents a different stage of the production process. To indicate completion, completed components are placed in specific green boxes during implementation. Parts in preparation are assigned blue boxes, whereas modified parts are awarded yellow boxes. Damaged parts are represented by red boxes, whereas discarded parts are represented by orange boxes. This color-coded scheme serves as a visual assistance for identifying and distinguishing distinct manufacturing phases and statuses. The goal of this methodical approach is to speed up the inspection process, decrease errors, and encourage a more organized and structured manufacturing workflow, all of which contribute to overall product quality improvement.



Figure 37. Colour Coding Scheme

### 5.8.5 Die & Tool Management & Calibration System

#### 1. SOP of Die & Tool Management System


Doc. # 9-F-12		Rev. No. 02 / Rev. Date: 04-July-2023	
		<b>STEEL CRAFT (PVT) LTD</b>	
<b>Standard Operating Procedure</b>			
<b>Die &amp; Tool Management System</b>			
<b>ہدایات برائے Die &amp; Tool Management</b>			
<p>(۱) نئی ڈائی بننے کی صورت میں ڈائی کو اس کلر کوڈ کے مطابق کلر کریں  <u>کلر کوڈ۔</u></p> <p>1- CD70/CD Dream (Blue) 2- Pridor (Green) 3- CG125/CG Dream/ Deluxe (Brown) 4-Common Models (Gray)</p> <p>(۲) نئی ڈائی بننے کے بعد مندرجہ ذیل طریقے سے کوڈ نمبر Issue کریں اور ڈائی پر لگائیں۔  <b>ڈائی کوڈ</b> ← <b>Process No.</b> (A-1) → <b>Part Code No.</b></p> <p>(۳) پروڈکشن مکمل ہونے کے بعد ڈائی کو آخری پارٹ کے ساتھ وصول کریں</p> <p>(۴) آخری پارٹ کی ظاہری حالت اور کوالٹی کو دیکھتے ہوئے ڈائی کی مینٹیننس کریں۔</p> <p>(۵) ڈائی کی مینٹیننس ہونے کی صورت میں پارٹ کو QA سے <b>Approve</b> کروائیں۔</p> <p>(۶) ڈائی OK ہونے کی صورت میں صرف <b>Clean</b> کر کے <b>Rack</b> میں رکھیں۔</p> <p>(۷) پروڈکشن شاپ کو ڈائی <b>Issue</b> کرتے وقت رجسٹر میں تاریخ نوٹ کریں اور واپس وصول کرتے وقت واپسی کی تاریخ اور ڈائی سے ہونے والی پروڈکشن کی <b>Quantity</b> نوٹ کریں۔</p>			
Prepared By		Approved By	

Figure 38. SOP Die and Tool Management

In English

1. Colour the dye accordingly, If Its

CD70/CD Dream (Blue) 2- Pridor CD-100 (Green) 3- CG125/CG Dream/ Deluxe (Brown) and 4- Common Models (Gray)

2. After manufacturing new die, give die code and issue it.
3. Receive the die with the last part after the production is complete.
4. Do the maintenance by inspection dimensions and the appearance of the last part if needed.
5. If the die is repaired or maintenance happened, get the approval from QA department.
6. If the die is OK, just clean it and keep it in the rack.
7. Note the date while issuing the die to the production shop and while receiving and the quantity of daily production as well.

## 2. SOP of Jigs/Gauges & Instrument Calibration System

Doc. #9-F-12	Rev. No.02 / Rev. Date: 04-July-2023
 <b>STEEL CRAFT (PVT) LTD</b>	
<b>Standard Operating Procedure</b>	
<b>Jig / Gauges &amp; Instrument Calibration</b>	
<b>Calibration کی Instruments اور Jig/Gauges سے متعلق ہدایات</b>	
<p>1) Jig/Gauges بنانے سے پہلے اس کی ڈرائیونگ بتائیں اور متعلقہ ڈیپارٹمنٹ سے Approve کروائیں۔</p>	
<p>2) Jig/Gauges کی Manufacturing کے بعد اس کی انسپیکشن کریں اور ڈیٹا ریکارڈ کر کے فائل کریں۔</p>	
<p>3) Jig/Gauges کو بنانے کے بعد اس کو کوڈ نمبر لائے کریں اور Jig / Gauges پر کوڈ نمبر Mension کریں۔</p>	
<p>4) Jig/Gauges اور Instruments کی Calibration دیئے گئے شیڈول کے مطابق کروائیں۔</p>	
<p>5) فیکٹری میں موجود تمام Jig/Gauges اور Instruments کی Calibration کے بعد Calibration Tag لگائیں۔</p>	
Prepared By	Approved By

Figure 39. SOP of Jigs/Gauges & Instrument Calibration System

### 3. Gauges Tolerance Chart According to A.H.L Standard



## Gauges Tolerance Chart

Gauge Size Limit at 20 °C for ranges of work piece tolerance						
1	2	3	4	5	6	7
Work Tolerance, Difference Between High (H) limit and low (L) Limit Shaft or Hole	Tolerance T, for GO and for NOT GO Gauges	Wear Allowance, W for GO Gauges Only	Plug Type Gauges		Ring or snap Gauges	
			Limit Expressed with respect to H minus L for work piece (Hole)		Limit Expressed with respect to H minus L for work piece (shaft)	
			GO	NOT GO	GO	NOT GO
mm 0.009 + up to and Including 0.018	mm 0.001	mm 0.001	mm L +0.002 +0.001	mm H + 0.00 -0.001	mm H -0.001 -0.002	mm L + 0.001 -0.00
Above 0.018 up to and Including 0.032	0.002	0.001	L + 0.003 +0.001	H + 0.00 -0.002	H -0.001 -0.003	L + 0.002 -0.00
Above 0.032 up to and Including 0.058	0.003	0.002	L + 0.005 +0.002	H + 0.00 -0.003	H -0.002 -0.005	L + 0.003 -0.00
Above 0.058 up to and Including 0.100	0.004	0.004	L + 0.008 +0.004	H + 0.00 -0.004	H -0.004 -0.008	L + 0.004 -0.00
Above 0.100 up to and Including 0.180	0.006	0.007	L + 0.013 +0.007	H + 0.00 -0.006	H -0.007 -0.013	L + 0.006 -0.00
Above 0.180 up to and Including 0.320	0.009	0.012	L + 0.021 +0.012	H + 0.00 -0.009	H -0.012 -0.021	L + 0.009 -0.00
Above 0.320 up to and Including 0.580	0.014	0.025	L + 0.039 +0.025	H + 0.00 -0.014	H -0.025 -0.039	L + 0.014 -0.00
Above 0.580 up to and Including 1.000	0.025	0.048	L + 0.073 +0.048	H + 0.00 -0.025	H -0.073 -0.048	L + 0.025 -0.00
Above 1.000 up to and Including 1.800	0.040	0.080	L + 0.120 +0.080	H + 0.00 -0.040	H -0.080 -0.120	L + 0.040 -0.00
Above 1.800 up to and Including 3.200	0.050	0.155	L + 0.205 +0.155	H + 0.00 -0.050	H -0.205 -0.155	L + 0.050 -0.00

Errors of size from of the Gauges are to be Contained within these limits.

Workpieces with a tolerance less than 0.009 Min should be Measured directly, or by means other than the Gauges described in this standard.

**NOTE:**

Gauge wear and wear allowance. Provision is made for the wear of GO Gauges by introduction of a wear allowance (W) between the ( ) zone for the Gauge and the maximum material limit for the workpiece wear allowance is not applied to the NOT GO Gauge. Gauge users have to watch for the effect of wear upon sizes of the Gauges. Regular examination and measurement of Gauges in use ( ) so that a Gauge and in particular GO Gauge which has worn outside its limit detected and withdrawn from service to avoid accepting workpiece exceeding the maximum material limit.

Figure 40. Gauges Tolerance Chart

#### 4. Jigs/Gauges Coding Method

The effective implementation of jigs into the manufacturing process represented a significant quality improvement achievement. Improving the precision and uniformity of component assembly was impossible without this crucial addition. Utilizing specialized jigs has considerably reduced variations in part alignment, ensuring precise and uniform fitting—a crucial aspect of adhering to high quality standards. This method has drastically reduced the number of human errors, streamlined processes, and improved the overall quality of the finished products.

We introduced the Jigs/Gauges Coding Method (shown in figure 41) as part of a concerted effort to improve our quality enhancement initiatives. Each jig or gauge used in our production operations is given a unique alphanumeric code using this manner. These codes provide essential information such as particular measurements, part compatibility, and intended application. This methodical approach enables our assembly teams to easily select and use the appropriate jigs and gauges for each operation, ensuring precise and consistent assembly procedures. This coding approach is an essential component of our larger quality improvement programs, streamlining procedures, reducing errors, and eventually contributing to the elevated overall product quality that we strive for.

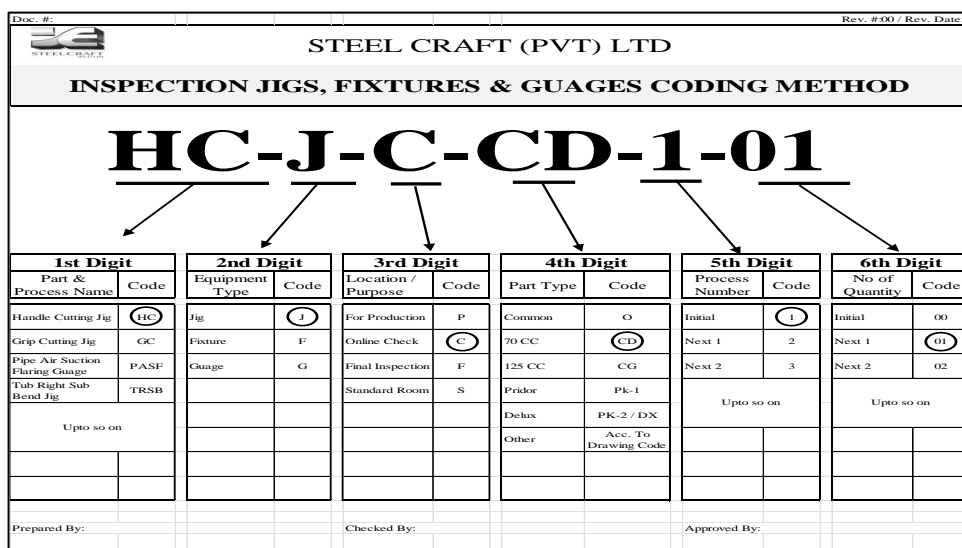


Figure 41. Jigs Coding Method

## 5. Jigs/Gauges Calibration Plan

The development and implementation of a comprehensive Jigs/Gauges Calibration Plan (shown in figure 42) was a significant milestone in our quality improvement plan. This plan provides a methodical approach for regularly calibrating and evaluating the precision of our production jigs and gauges. By adhering to this methodical calibration procedure, we ensure that our instruments and equipment are always in accordance with predetermined standards. This calibration strategy enhances the precision and dependability of our manufacturing processes by minimizing variances and inconsistencies. This method of calibration allows us to maintain a consistent level of accuracy and uphold our commitment to producing products of exceptional quality.

Part No.		Sr. No.	Part Name	Model	Process	Type	Code No	Shop	Calibration		Due Date	Calibrated By
									Frequency	Date		
1	1		Pipe Steering Handle	CG-125 (KYHA)	Cutting	Jig	HC-J-C-CD-1-00	Cutting Shop	6 Months	07-Jul-23	03-Jan-24	
	2	Knurling			Snap Ring Gauge	HK-G-C-O-2-00	Knurling Shop	4 Months	04-Jul-23	----	Obsolete	
	3	Knurling			Snap Ring Gauge	HK-G-C-O-2-01	Knurling Shop	4 Months	07-Jul-23	04-Nov-23		
	4	U-Bend			Jig	HUB-J-C-CD-3-00	Bending Shop	6 Months	05-Jul-23	01-Jan-24		
	5	L/R Bend			Jig	HLRB-J-C-CD-4-00		6 Months	06-Jul-23	02-Jan-24		
	7	Right Side Grip Hole			Fixture	HRSF-F-P-CD-6-00	Drill Shop	3 Months	06-Jul-23	04-Oct-23		
	8	Left Side Grip Hole			Fixture	HLSH-F-P-CD-7-00		3 Months	05-Jul-23	03-Oct-23		
	9	Right Side Grip Hole			Fixture	HRSF-F-C-CD-6-00		4 Months	05-Jul-23	02-Nov-23		
	10	Left Side Grip Hole			Fixture	HLSH-F-C-CD-7-00		4 Months	05-Jul-23	02-Nov-23		
	11	Right Side Grip Hole			Pin Gauge	HRSF-G-C-CD-6-00		6 Months	10-Jul-23	06-Jan-24		
	12	Left Side Grip Hole			Pin Gauge	HLSH-G-C-CD-7-00		6 Months	10-Jul-23	06-Jan-24		
	13	Right Side Grip Hole			Pin Gauge	HRSF-G-F-CD-6-00	Polish Shop	6 Months	12-Jul-23	08-Jan-24		
	14	Left Side Grip Hole			Pin Gauge	HLSH-G-F-CD-7-00		6 Months	12-Jul-23	08-Jan-24		
	15	Punch Mark			Fixture	HPM-F-P-CD-8-00	Punch Shop	4 Months	13-Jul-23	10-Nov-23		
	16	Punch Mark			Fixture	HPM-F-S-CD-8-00	Standard Room	1 Year	13-Jul-23	12-Jul-24		
	17	Punch Mark			Pin Gauge	HPM-G-C-CD-8-00	Punch Shop	4 Months	15-Jul-23	12-Nov-23		
	18	Punch Mark			Pin Gauge	HPM-G-F-CD-8-00	Polish Shop	4 Months	15-Jul-23	12-Nov-23		
	19	Final Inspection			Jig	HFI-J-F-CD-9-00	F.I Shop	1 Year	15-Jul-23	14-Jul-24		

Figure 42. Jigs calibration plan

## 6. Instrument Calibration Plan

The parts were rejecting at higher rate due to instruments which were not properly calibrated. We implemented a plan to regularly calibrate instruments so that even a minor error may be

removed from instruments allowing accurate dimensions of parts. This is shown in figure 43.

Doc. # : CIT/I-10-2.1 Rev. # 01 / Rev. Date 06-Jun-2023

 <b>STEEL CRAFT (PVT) LTD</b>								
Instruments Calibration Plan								
Sr	Instruments Name	Range	Code No	Shop	Calibration		Due Date	Calibrated By
					Frequency	Date		
1	Steel Rule	0 ~ 12Inch	SR-Q-S-7-00	Standard Room	Annually	23-Apr-23	22-Apr-24	Out Source
2	Measuring Tape (5m/16')	0 ~ 5m (16inch)	MT-Q-S-8-00	Standard Room	Annually	23-Apr-23	22-Apr-24	Out Source
3	Manual Vernier Caliper	0 ~ 200mm	VC-Q-S-5-00	Standard Room	Annually	23-Apr-23	22-Apr-24	Out Source
4	Manual Vernier Caliper	0 ~ 300mm	VC-Q-S-6-00	Standard Room	Annually	24-Apr-23	23-Apr-24	Out Source
5	Manual Vernier Caliper	0 ~ 600mm	VC-Q-S-9-00	Standard Room	Annually	25-Apr-23	24-Apr-24	Out Source
6	Dial Vernier Caliper	0 ~ 150mm	AVC-Q-S-4-00	Standard Room	Annually	26-Apr-23	25-Apr-24	Out Source
7	Dial Vernier Caliper	0 ~ 200mm	AVC-Q-S-5-00	Standard Room	Annually	27-Apr-23	26-Apr-24	Out Source
8	Dial Vernier Caliper	0 ~ 300mm	AVC-Q-S-6-00	Standard Room	Annually	28-Apr-23	27-Apr-24	Out Source
9	Digital Vernier Caliper	0 ~ 150mm	DVC-Q-S-4-00	Standard Room	Annually	29-Apr-23	28-Apr-24	Out Source
10	Digital Vernier Caliper	0 ~ 200mm	DVC-Q-S-5-00	Standard Room	Annually	30-Apr-23	29-Apr-24	Out Source
11	Digital Vernier Caliper	0 ~ 300mm	DVC-Q-S-6-00	Standard Room	Annually	01-May-23	30-Apr-24	Out Source
12	Manual Micrometer	0 ~ 25mm	MM-Q-S-1-00	Standard Room	Annually	02-May-23	01-May-24	Out Source
13	Manual Height Gauge	0 ~ 450mm	HG-Q-S-8-00	Standard Room	Annually	03-May-23	02-May-24	Out Source
14	Digital Height Gauge	0 ~ 300mm	DHG-Q-S-6-00	Standard Room	Annually	04-May-23	03-May-24	Out Source

Figure 43. Instruments Calibration Plan

## 7. Dies Breakdown Maintenance Sheet

The implementation of the Dies Breakdown Maintenance Sheet has streamlined the maintenance process for dies, thereby enhancing response times and ensuring repairs are completed on time. This standardized documentation facilitates the recording of failure details and the scheduling of maintenance tasks, thereby minimizing downtime and optimizing die performance. The sheet is shown in image 44.



In English

1. Check all the parts according to the given quality standard and final inspection check sheet during satisfactory final inspection.
2. During file inspection if NG parts found then inform your in-charge immediately and do 100% inspection of all goods.
3. For rejected parts use Red-Bin, For rework parts use Yellow-Bin, and for OK parts use Green / Blue bins.
4. After satisfactory inspection, record the data in the check sheet and after signing the check sheet, get it signed by your in-charge and send it to AHL.
5. Calibrate all Jigs/Guage and Instruments related to final inspection according to given frequency.

2. Final Inspection Check Sheet Format

A final inspection check sheet was implemented to inspect the parts which are finalised. This sheet helped in thoroughly inspecting and checking all the parts which then helped in removing the parts which are faulty, eventually helped in reducing rejection. This sheet is shown in image 46.

Doc. # 9-F-9		STEEL CRAFT (PVT) LTD				Rev. No. 02 / Rev. Date: 04 July 2023													
STEEL CRAFT (PVT) LTD		PART NAME		Pipe Steering Handle C-G-125		VENDOR													
FINAL INSPECTION CHECK SHEET		DRAWING NO.		53100-KYHA-3000		MODEL		ATLAS HONDA											
		PART GRADE		CG-125 KYHA		Inspected By		Approved By											
						FOR VENDOR USE													
						Date:													
						Challan No.		Lot Size											
						FOR ATLAS HONDA USE													
Lot Size		Total Bin		Sample Plan		Sample Size													
Check		OK		Reject		Pending													
Part Bin																			
NO	REV	INSPECTION ITEM	STANDARD	METHOD	SAMPLE SIZE	OBSERVATIONS ( VENDOR )					OBSERVATIONS ( ATLAS HONDA LTD )					Status OK/CANCEL			
						1	2	3	4	5	1	2	3	4	5				
1		Length	680 ± 1.00 mm	V.C/fig	5/2000														
2	Q	Punch Mark Position	181.5 ± 0.5 mm	H.G	5/2000														
3	Q	Height	125 ± 3.0 mm	V.C	5/2000														
4		Center Knurling	45± 1.5 mm	V.C	5/2000														
5	Q	Knurling Height	22.4 ± 22.62 mm	V.C/fig	5/2000														
6		Pipe Outer Dia	22.2 ± 0.5 mm	V.C	5/2000														
7	J	Rht side Hole Distance	145-1.0 mm	V.C	5/2000														
8		Chamfer	0.5 mm	V.C	5/2000														
9	J	Lft side Hole Distance	150 -1.0 mm	V.C	5/2000														
10		Hole Dia (Rht)	4.1 ± 0.2 mm	V.C	5/2000														
11		Hole Dia (Lft)	4.50 ±0.2 mm	V.C	5/2000														
12		Electroplating Thickness	20 µ Min	thickness Meter	5/2000														
13		Appearance	No Sharp Edges	VISUAL	5/2000														
			No Rough Buffing	VISUAL	5/2000														
			No Scratch	VISUAL	5/2000														
			No Dent	VISUAL	5/2000														
			No Rust	VISUAL	5/2000														
		No Peel Off	VISUAL	5/2000															

Certified that the goods/parts supplied under this challan/invoice is/are as per stated P.O./contract conditions and conform to all the quantity requirements and specifications stated therein.

Figure 46. Final Inspection Check Sheet

3. F.I Appearance Standard Sheet






LoGo		Final Inspection Appearance Standard		
Prepared By.		Approved By.		Stamp
Date:				
PART NAME		COLLAR 17MM		
MODEL		CD70		
<b>NG PART</b>				
<b>RUSTED</b>				
 زنگ آلود۔				
<b>NG PART</b>				
<b>OUT CHAMFER</b>				
 شراب ہینچر				
<b>OK PART</b>				
				
<b>NG PART</b>				
<b>ROUGH SURFACE</b>				
 نامواریخ				
<b>NG PART</b>				
<b>CRACK</b>				
 کرک ہے۔				

Figure 47. Final Inspection Appearance standard

4. Part Audit Schedule

STEEL CRAFT (PVT) LTD			Part Audit Schedule											
			Month 2023											
Sr No	Part Code	Parts Names	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
<b>Handles</b>														
1	6010188006	PIPE STEERING HANDLE (GGJA) - CD70	▲				▲				▲			
2	6020146001	PIPE STRG HANDLE (KYHA) CG125		▲				▲				▲		
3	6040146001	PIPE STEERING HANDLE-CG125DX			▲				▲				▲	
4	6070146001	PIPE,STRG HANDLE KYAN				▲				▲				▲
5	405201989000	Chain Case CD-70					▲						▲	
<b>Grips</b>														
1	6010952002	GRIP COMP REAR-GGJJ CD-70	▲				▲				▲			
2	6020999000	Grip SEAT BAR RR-CG125		▲				▲				▲		
3	6040120001	GRIP COMP RR-CG125DX			▲				▲				▲	
4		Electroplating				▲				▲				▲

Figure 48. Part Audit Schedule

## 5. Colour Coding Scheme For F.I System

The Colour coding (shown in figure 49) for keeping the prepared, reworked, and damaged parts is implemented and shown below with instructions in local language.

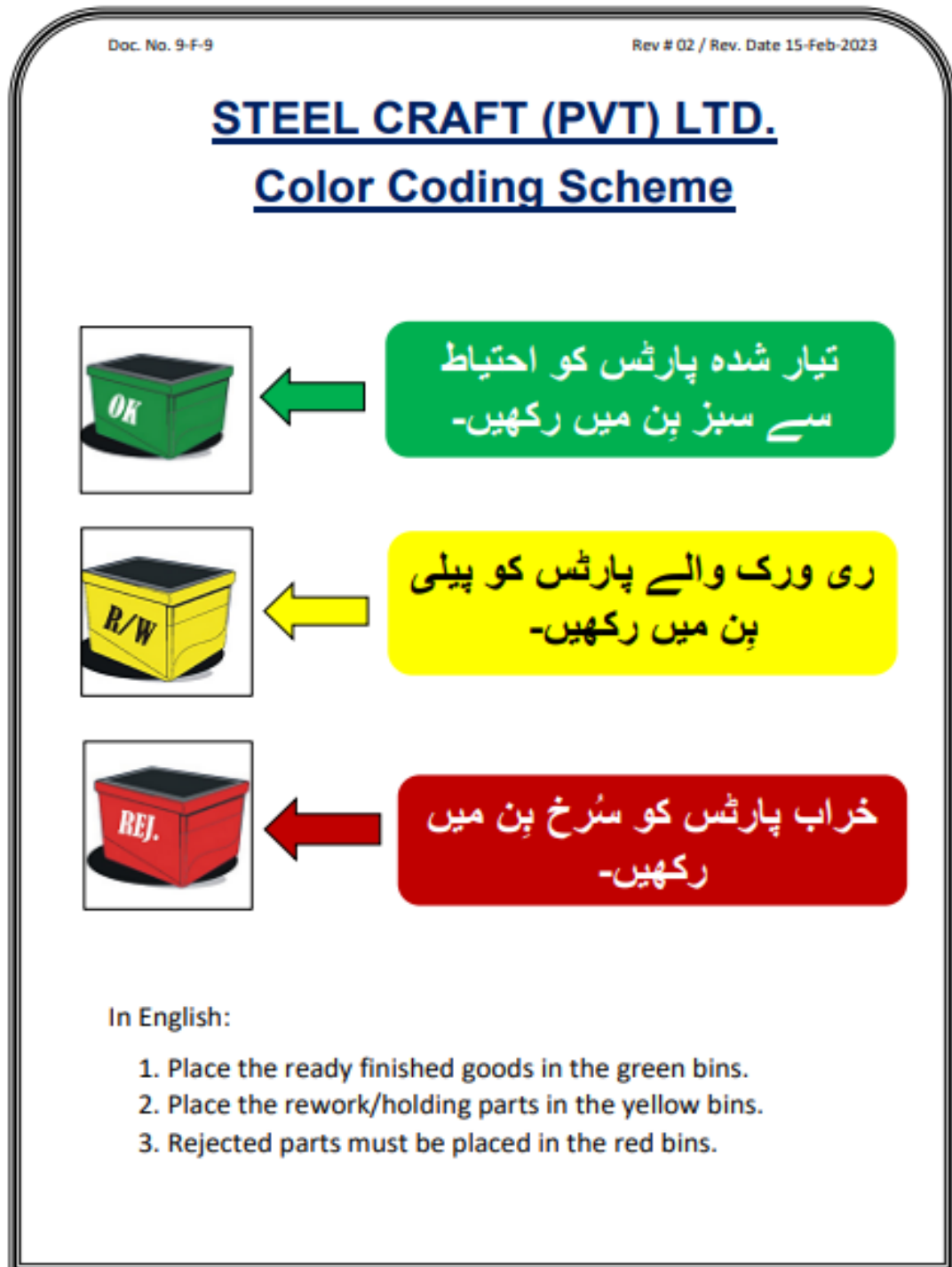


Figure 49. Colour Coding Scheme

### 6. Daily Rejection Data Sheet

A daily rejection sheet was implemented to frequently examine the rejections of parts. This allowed us understating the rejection and their reason which helped in improving that shortcoming. This sheet is shown in image 50.

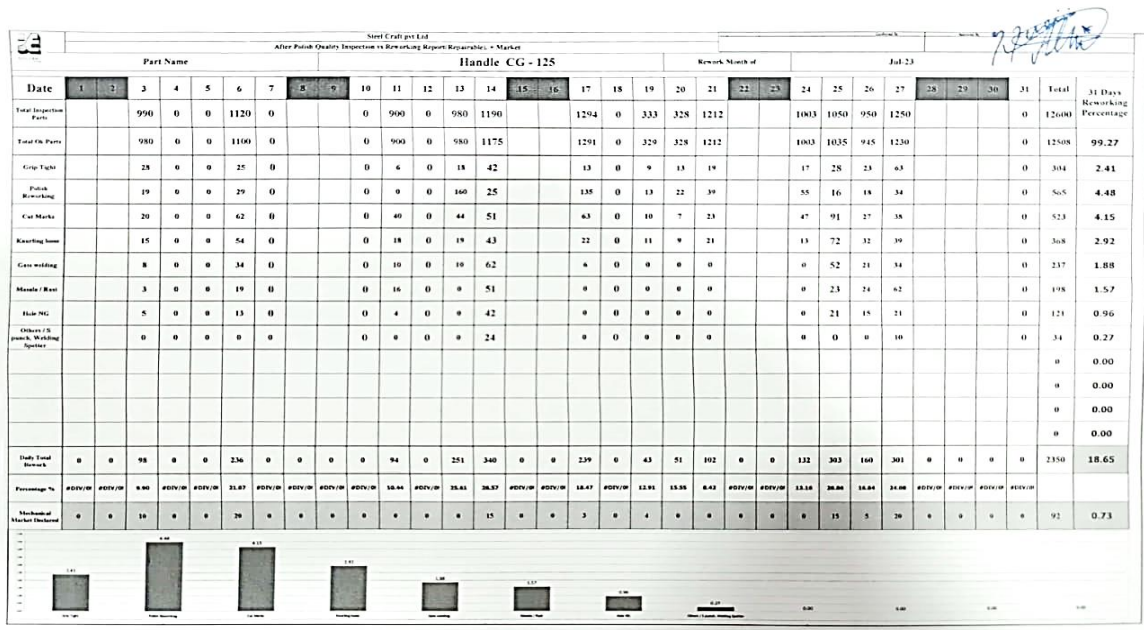


Figure 50. Daily Rejection Data Sheet

## 5.8.7 Warranty Parts Analysis System

### 1. SOP of Warranty Part Analysis System


Doc No: 11-F-1		Rev. No. 02 / Rev. Date: 04-July-2023	
		<b>STEEL CRAFT (PVT) LTD</b>	
<b>Standard Operating Procedure</b>			
<b>Warranty Parts Inspection</b>			
<b>وارنٹی پارٹس کی انسپیکشن سے متعلق ہدایات</b>			
(۱) وارنٹی پارٹس کی انسپیکشن مہینے میں دو مرتبہ AHL جا کر کریں۔			
(۲) وارنٹی پارٹس کو وارنٹی رپورٹ سے Verify کریں۔			
(۳) وارنٹی پارٹس کی Detail Inspection کے لئے Returnable Gate Pass پر پارٹ کو فیکٹری لائیں اور انسپیکشن کے بعد واپس کر دیں۔			
(۴) Defect Analysis کے بعد متعلقہ انچارج کو فوری طور پر مطلع کریں اور Countermeasure لیں۔			
(۵) Defect Analysis کے بعد Countermeasure Sheet کو Fill کریں اور AHL کے کوائٹی ڈیپارٹمنٹ میں جمع کروائیں۔			
(۶) ضرورت پڑنے پر وارنٹی پارٹس کا Reproduce اور Endurance Test کریں۔			
(۷) Improvement کے بعد اس کا Date Code اور Improvement Mark Countermeasure Sheet میں نوٹ کریں اور AHL کو Inform کریں۔			
Prepared By		Approved By	

Figure 51. SOP Warranty Part Inspection

#### In English

1. Do the inspection of warranty parts by going to AHL twice in a month.
2. Verify the warranty parts using warranty reports.
3. Bring the parts to the factory at the returnable gate pass for detail inspection of the warranty parts and return them after inspection.

4. After Defect Analysis immediately inform concerned in-charge and take countermeasure.
5. Fill countermeasure sheet after defect analysis and submit to AHL's quality department.
6. Do Reproduce and Endurance Test warranty parts if required.
7. After improvement note its Date Code and Improvement Mark in Countermeasure Sheet and inform AHL.

2. Warranty Analysis Counter Measure Sheet

The introduction of the Warranty Analysis Countermeasure Sheet has improved our approach to warranty-related issues. This standardized instrument enables the systematic analysis of warranty claims, allowing for the efficient implementation of countermeasures to improve product quality and customer satisfaction. This sheet is shown in image 52.


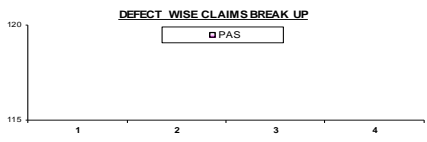
WARRANTY ANALYSIS & COUNTERMEASURE SHEET					Rev. No. 02 / Rev. Date: 04-July-2023		
PART		VENDOR					
MODEL		DATE			Prepared By	Checked By	Approved By
SYMPTOMS		ILLUSTRATION			GRAPH		
Point 1							
Point 2							
NO	DEFECT	ANALYSIS	CAUSE	COUNTER MEASURE		RESULT	
1	What is the problem: Flange C.C Out.  Where: At AHL Line.  When: 27-07-2023.  How Many: 30-50/day.  Problem description: During Fitment Flange C.C out on top cover.	New Jigs & Fixtures are manufactured at process & final (As Shown In Picture). -Current production on new welding fixture & pieces checked at new Final Inspection Jig which are found OK. -New improve lot OF 900 Pieces sent to AHL & found ok.	Final Inspection Jig & Welding Fixture Hole Size over. -Deviate from Standard sizes.  Std:10.3 + 0.2mm  Actual:11mm	<b>Temporary Countermeasure:</b> -Stop the checking & Production at old final inspection jig & welding fixture. -Sorting/rework status in AHL:900/5700 -Sorting/rework status In-house:1100/6000 <b>Permanent Countermeasure:</b> -Make a new final inspection jig & welding fixture on urgent basis. -After making the new jig reset these pieces on new final inspection jig. -New Welding fixture is manufactured (29-07-23).		●	
2						●	
Defect Occurance Date		Improvement Date		Improvement Mark		Verified By (AHL)	
Problem Occurred:27-07-23 Analysis:28-07-23 C/M:28-07-23		Improvement Lot:08-08-23		Inspection by operator, on-line inspector and management will be monitored and avoid the repetition of problem in future. -Maintenance plan will be monitored.			

Figure 52. Warranty Analysis Counter measure sheet

## 5.9 QIP Implementation Comparison

In this comparison pictures (figure 53 & 54) of all the documents implemented and displayed in respective shops or departments in the organisation in their local language so that a helper or worker can be able to understand it, are shown below:

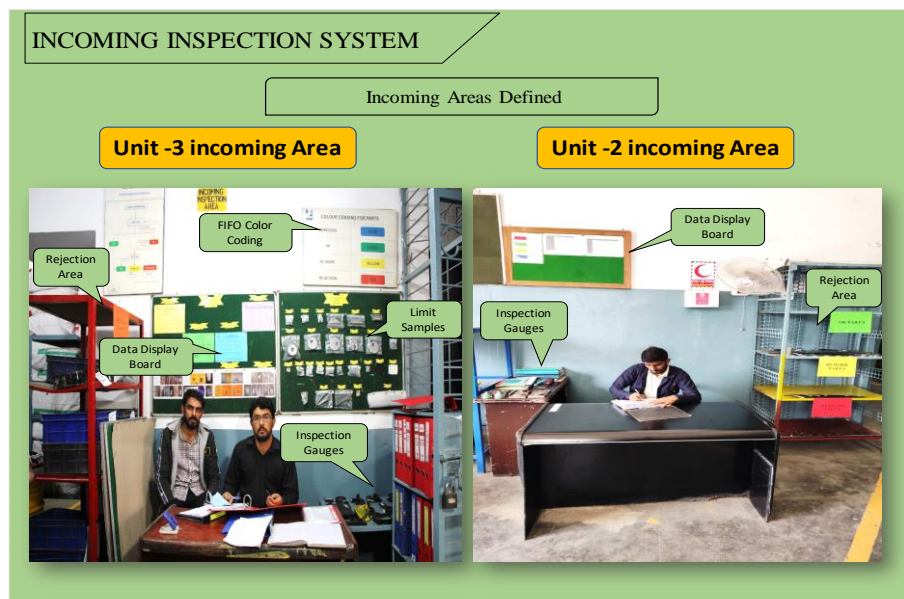


Figure 53. Incoming Areas Defined at Both Units



Figure 54. Jigs, Fixture & Gauges Arranged

## 6 Results

The Quality Improvement Programme (QIP) Audit Sheet (shown in figure 55) is a tool for evaluating the QIP's current condition as well as the program's overall success within the company. It aids in the process of analysing the execution of several quality improvement modules and identifying opportunities for improvement.

QIP System & Performance Review (Audit Report)							Date: 20-July-2023								
Vendor: M/S Steel Craft (Pvt.) Ltd.							2nd Audit FY 2023								
Audit Participants Vendor: Faisal Rehman, M. Ifan, M Husnain Ali							<table border="1"> <tr> <td>Auditor</td> <td>CEG/IT</td> <td>Auditor</td> <td>M. Husnain Ali</td> </tr> <tr> <td>Facilitator</td> <td></td> <td>Witness</td> <td>M. Husnain Ali</td> </tr> </table>	Auditor	CEG/IT	Auditor	M. Husnain Ali	Facilitator		Witness	M. Husnain Ali
Auditor	CEG/IT	Auditor	M. Husnain Ali												
Facilitator		Witness	M. Husnain Ali												
Sr #	Area	Description	Status	Weightage	Judgment	Remarks									
			Document Implementation		Document Implementation										
1	Drawing / Specs Control System	SOP	<input type="checkbox"/>	5%	100 @ 5% = 5%	76.67 @ 5% = 3.83%	QA management aware with symbols, team training required to fully aware. Need to update both files. IPP record not available against countermeasure.								
		Master Dwg File	<input type="checkbox"/>												
		Under Dev & Obsolete Part File	<input type="checkbox"/>												
		Drawing Knowledge	<input type="checkbox"/>												
		Part Files update status	<input type="checkbox"/>												
		IPP Record (Spec Change, Quality Improvement & Self Control)	<input type="checkbox"/>												
		Deviation Record	<input type="checkbox"/>												
2	Incoming Inspection System	SOP's	<input type="checkbox"/>	15%	100 @ 15% = 15%	75 @ 15% = 11.25%	Keep updated record in file. 1-Verbal communication against rejection.								
		Incoming Insp Check Sheets	<input type="checkbox"/>												
		Incoming Insp Jigs/ Fixtures	<input type="checkbox"/>												
		Limit Samples	<input type="checkbox"/>												
		In coming Countermeasures	<input type="checkbox"/>												
		FIRG	<input type="checkbox"/>												
3	In process Inspection System	SOP	<input type="checkbox"/>	25%	100 @ 25% = 25%	66.67 @ 25% = 16.67%	1-No rework data. 2- CAR Documents Available Proper Implementation Record required. No inspection data after Die repairing / new die.								
		In process Insp Check Sheets	<input type="checkbox"/>												
		In process Insp Jigs / Fixtures	<input type="checkbox"/>												
		Work Instruction + PQS	<input type="checkbox"/>												
		SOP of Machines	<input type="checkbox"/>												
		PQC I & II	<input type="checkbox"/>												
		In process Countermeasures	<input type="checkbox"/>												
		SS	<input type="checkbox"/>												
Startup Inspection System (After die repair / New die) (Machine and Parts)	<input type="checkbox"/>														
4	Die / Tool Management & Calibration System	SOP's	<input type="checkbox"/>	25%	100 @ 25% = 25%	71.42 @ 25% = 17.85%	Need identification as per die coding system. Drawings are not match with jig / gauge (Chain Case CD- 70). Need Calibration Plans for future inspection. Document Available but no implement record. No Rework IPP data Available.								
		Die/ Tool, Jig/Gauge & Instrument Identification	<input type="checkbox"/>												
		Jig / Gauge Dwg	<input type="checkbox"/>												
		Jig/Gauge & Inst. Calibration	<input type="checkbox"/>												
		Die/ Tool Maintenance Schedule and Record	<input type="checkbox"/>												
		Back up of Die / Tool	<input type="checkbox"/>												
		Die / Mold Control (Production Status)	<input type="checkbox"/>												
5	Final Inspection System	SOP	<input type="checkbox"/>	20%	100 @ 20% = 20%	79.16 @ 20% = 15.83%	Appearance standards are display at final inspection. But Reports are not. QJK Points not highlighted.								
		Final Inspection Check Sheets	<input type="checkbox"/>												
		Final Inspection Std. sheets	<input type="checkbox"/>												
		Master Sample	<input type="checkbox"/>												
		Limit Samples	<input type="checkbox"/>												
		Part Audit Record	<input type="checkbox"/>												
6	Incoming, Line & Warranty Parts Analysis System	SOP	<input type="checkbox"/>	10%	100 @ 10% = 10%	68.75 @ 10% = 6.88%	No root cause analysis & countermeasure. More awareness required regarding CPK. Plan review and action required against both shift.								
		Parts analysis, improvement record & monitoring	<input type="checkbox"/>												
		Statistical Process Control (Control Charts and Process Capability Analysis)	<input type="checkbox"/>												
		Process FMEA	<input type="checkbox"/>												
Observed System Compliance				100%	100%	72%									
Comments: Legend <input type="checkbox"/> = 100% <input type="checkbox"/> = 85% <input type="checkbox"/> = 75% <input type="checkbox"/> = 50% <input type="checkbox"/> = 25% 'X' = 0%															

Figure 55. QIP Audit Sheet

## 6.1 QIP Progress Bar-Graph

The QIP Progress Bar Graph (shown in figure 56) is a graphical representation of how the Quality Improvement Programme has improved through time. It provides a graphical representation of the program's development, indicating how it has evolved and improved over time.

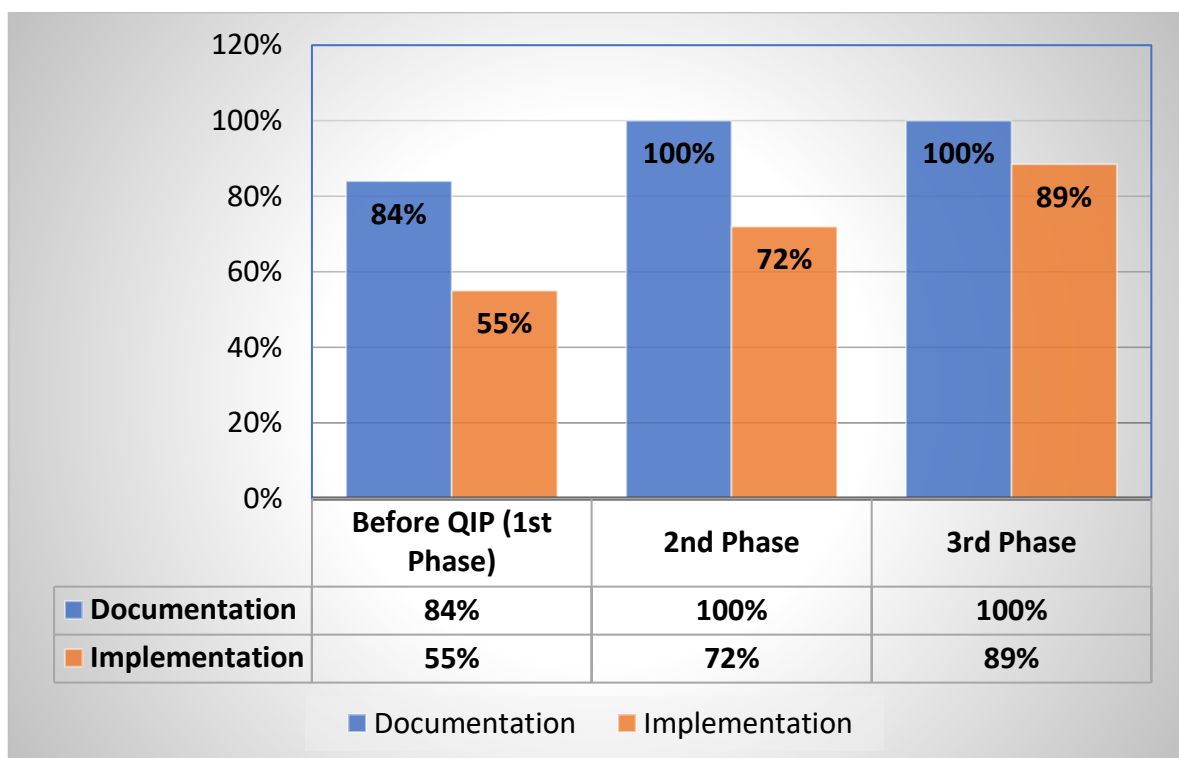


Figure 56. QIP Progress Bar Graph

## 6.2 Percentage QIP Modules Implementation Status

The graph (shown in figure 57) illustrates the percentage of completion for distinct QIP modules, giving a clear picture of how well each QIP module has been integrated into the organization's processes.

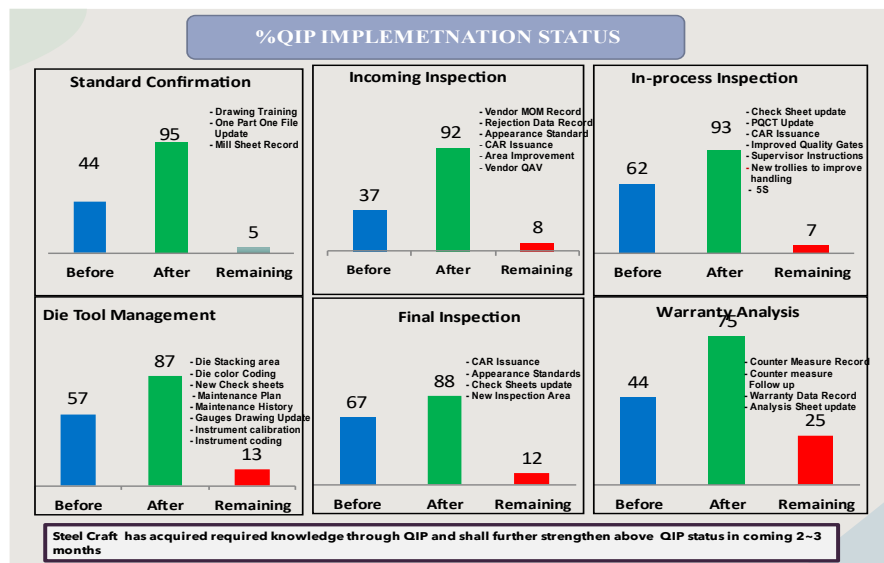


Figure 57. Percentage QIP modules implementation status

### 6.3 Major Improvements Through QIP Implementation

These major improvements were conducted sequentially during the implementation of the QIP, aligning with the QIP module's sequence, and resulting in step-by-step quality and traceability enhancement.

- Standard Operation Procedure
- PQCT and One Part One File Update for all parts
- Drawing Training for all Concern Persons
- New Incoming Check Sheets
- New Incoming Inspection Area
- Improvement of Quality Gates
- Quality Gate Plantation
- Update of Process Standard for all Processes
- 100% Color Coding & 5-S Implementation
- Corrective Action Report, SOP, and implementation for all processes
- New area for Die Stacking and maintenance.
- Creation of new documents and check sheets for jigs, fixtures & dies.
- Display of Appearance Standards

- Preparation of additional trollies to improve part handling.
- Color coded Trolleys/Bins for all processes and Quality gates

### 6.4 Monthly Customer Rejection Data Graph

The monthly production and rejection data for August 2023 are shown in Figures 58 and 59. Figure 58 illustrates the production versus rejection data, whereas Figure 59 deconstructs the rejection grounds. These graphs provide insight into manufacturing quality and show areas that may need additional attention.

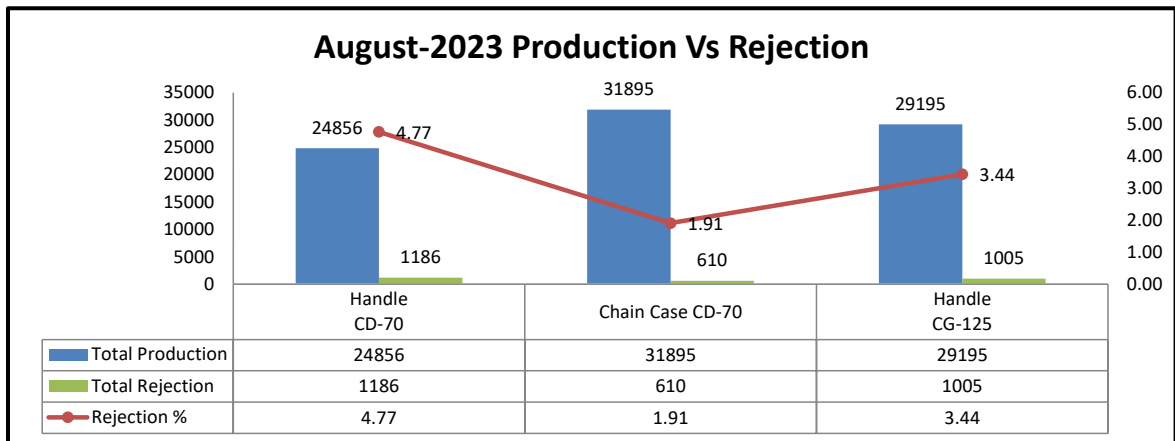


Figure 58. August-2023 Productions VS Rejection From AHL

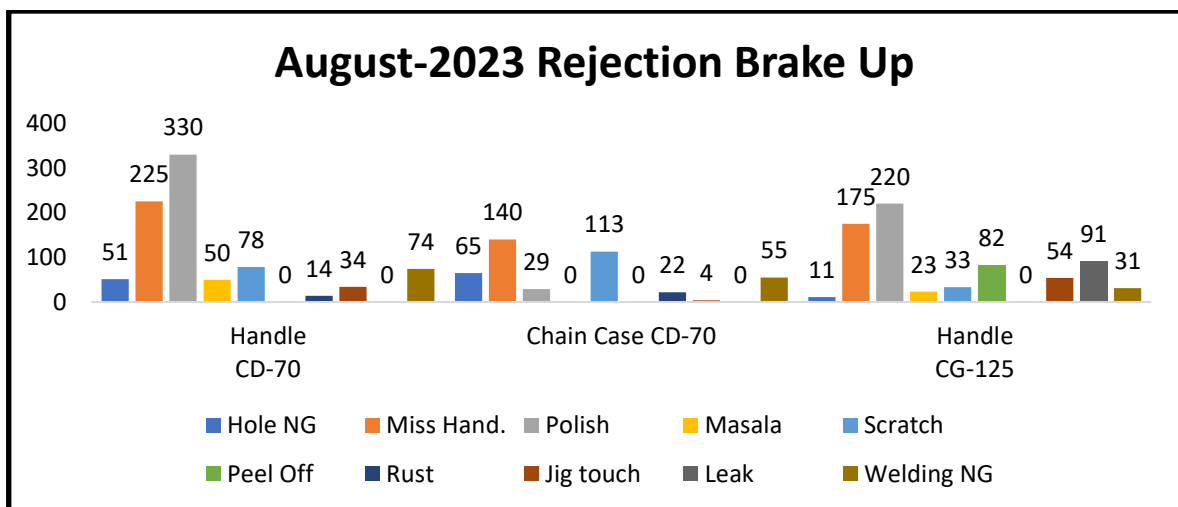


Figure 59. August-2023 Rejection Brake Up

### 6.5 Quality Audit (QA) 2023-2024 (Final Audit)

A final quality inspection was performed between the years 2023 and 2024. The audit examines (shown in figure 60) whether or not the company follows quality standards and processes, verifying for compliance while also looking for areas for continuous improvement.

QIP System & Performance Review (Audit Report)										Date: 07-Sep-2023	
Vendor: M/S Steel Craft (Pvt.) Ltd.					Final Audit FY 2023		Steel Craft Limited				
Audit Participants							CEO / Dir.		Auditor		
Vendor: Faisal Rehman, M. Irfan, M Husnain Ali							Faisal Rehman		M.Irfan M. Husnain Ali		
Sr #	Area	Description	Status		Weightage	Judgment		Remarks			
			Document	Implement		Document	Implement				
1	Drawing / Specs Control System	SOP	<input type="checkbox"/>	<input type="checkbox"/>	5%	100 @ 5%= 5%	0.95 @ 5% 4.75%	QA management aware with symbols, team training required to fully aware			
		Master Dwg File	<input type="checkbox"/>	<input type="checkbox"/>							
		Under Dev & Obsolete. Part File	<input type="checkbox"/>	<input type="checkbox"/>							
		Drawing Knowledge	<input type="checkbox"/>	<input type="checkbox"/>							
		Part Files update status	<input type="checkbox"/>	<input type="checkbox"/>							
		IPP Record (Spec Change, Quality Improvement & Self Control)	<input type="checkbox"/>	<input type="checkbox"/>							
		Deviation Record	.....	.....							
2	Incoming inspection System	SOP's	<input type="checkbox"/>	<input type="checkbox"/>	15%	100 @ 15%= 15%	0.92 @ 15% 13.75 %	No jigs/fixture usage . Only raw material (Pipes, MS sheets etc.) No need, Only Raw material received. No specific system, controlled by Lot wise and inventory control.			
		Incoming Insp Check Sheets	<input type="checkbox"/>	<input type="checkbox"/>							
		Incoming Insp Jigs/ Fixtures	<input type="checkbox"/>	<input type="checkbox"/>							
		Limit Samples	<input type="checkbox"/>	<input type="checkbox"/>							
		In coming Countermeasures	<input type="checkbox"/>	<input type="checkbox"/>							
		FIFO	<input type="checkbox"/>	<input type="checkbox"/>							
3	In process inspection System	SOP	<input type="checkbox"/>	<input type="checkbox"/>	25%	100 @ 25%= 25%	0.93 @ 25% 23.2%	Only data collection, Need data analysis towards the control of CAR system exist, Need to take root cause analysis to avoid recurrence. Machine check sheets filling done, But data need to make at actual basis. M/C NG but in Check sheet OK			
		In process Insp Check Sheets	<input type="checkbox"/>	<input type="checkbox"/>							
		In process Insp Jigs / Fixtures	<input type="checkbox"/>	<input type="checkbox"/>							
		Work Instruction + PQS	<input type="checkbox"/>	<input type="checkbox"/>							
		SOP of Machines	<input type="checkbox"/>	<input type="checkbox"/>							
		PQC I & II	<input type="checkbox"/>	<input type="checkbox"/>							
		In process Countermeasures	<input type="checkbox"/>	<input type="checkbox"/>							
		SS	<input type="checkbox"/>	<input type="checkbox"/>							
Startup Inspection System.(After die repair / New die) (Machine and Parts)	<input type="checkbox"/>	<input type="checkbox"/>									
4	Die / Tool Management & Calibration System	SOP's	<input type="checkbox"/>	<input type="checkbox"/>	25%	100 @ 25% = 25%	0.87 @ 25% 21.80 %	Instruments calibration done from outsource, Jig / Gauges calibration Preventive maintenance not done. Maintenance done on requirement Under development for some jigs in press shop No specific system, estimated by production report.			
		Die/ Tool, Jig/Gauge & Instrument Identification	<input type="checkbox"/>	<input type="checkbox"/>							
		Jig / Gauge Dwg	<input type="checkbox"/>	<input type="checkbox"/>							
		Jig/Gauge & Inst. Calibration	<input type="checkbox"/>	<input type="checkbox"/>							
		Die/ Tool Maintenance Schedule and Record	<input type="checkbox"/>	<input type="checkbox"/>							
		Back up of Die / Tool	<input type="checkbox"/>	<input type="checkbox"/>							
5	Final Inspection System	SOP	<input type="checkbox"/>	<input type="checkbox"/>	20%	100 @ 20% = 20%	0.88 @ 20% 17.50 %	Inspection reports not available, under development. Part audit done by QA staff.Action need to taken against NG dimensions.			
		Final Inspection Check Sheets	<input type="checkbox"/>	<input type="checkbox"/>							
		Final Inspection Std. sheets	<input type="checkbox"/>	<input type="checkbox"/>							
		Master Sample	<input type="checkbox"/>	<input type="checkbox"/>							
		Limit Samples	<input type="checkbox"/>	<input type="checkbox"/>							
		Part Audit Record	<input type="checkbox"/>	<input type="checkbox"/>							
6	Incoming, Line & Warranty Parts Analysis System	SOP	<input type="checkbox"/>	<input type="checkbox"/>	10%	100 @ 10% = 10%	0.75 @ 10% 7.50%	Analysis done. Problem repetition of cut marks in Handle. Done as per plan, Need to take action against low cp, cpk.			
		Parts analysis, improvement record & monitoring	<input type="checkbox"/>	<input type="checkbox"/>							
		Statistical Process Control (Control Charts and Process Capability Analysis)	<input type="checkbox"/>	<input type="checkbox"/>							
		Process FMEA	<input type="checkbox"/>	<input type="checkbox"/>							
Observed System Compliance					100%	100%	88.5%				
<b>Comments:</b> Legend <input type="checkbox"/> =100% <input type="checkbox"/> =83% <input type="checkbox"/> =75% <input type="checkbox"/> =50% <input type="checkbox"/> =25% X=0%											

Figure 60. QIP system and performance review (Final Audit Report)

## 7 Discussion

The research explores the challenges of quality improvement at STEEL CRAFT (PVT.) LTD., a well-known supplier of high-quality auto parts. The Handle CG-125 and, both handcrafted by STEEL CRAFT (PVT.) LTD., are critical to our inquiry. Because of the vital significance of these parts in the vehicle industry, an in-depth understanding of precision engineering and quality control is required. The primary purpose of this research was to understand more about the company's unique production methods, the company's commitment to high quality standards, and the elements that contribute to the superior performance and longevity of these components.

This goal necessitated a thorough and multifaceted research strategy, both of which were used in this paper. The research was based on the Quality Improvement Programme (QIP), which is a collection of modules meant to address various areas of manufacturing. These modules were methodically designed to keep rejection rates moderate, product quality high, and the organisation moving forward in a constant state of progress. The QIP modules deserve the majority of the credit for advancing the study's objectives by patiently removing barriers inherent in production operations.

Among the many important goals of the QIP modules was the promotion of continuous improvement. The development of standardised operational procedures (SOPs) and the rigorous recording of industrial processes were two of the most important components in accomplishing this goal. Because the organisation has created clear procedures that allow it to monitor and govern deviations, it is more probable that all goods will match the declared quality criteria. As a result, not only did product quality improve, but so did the number of defects and customer complaints, resulting in improved overall levels of satisfaction.

We were able to boost the percentage of high-quality output from the project to an incredible 99 percent because to the effectiveness of the QIP modules. As a result of the work, this was

a significant accomplishment. Traceability and product documentation have also increased, making it easier to pinpoint the source of any problems and make necessary adjustments. The significance of these findings cannot be overstated, since they immediately contribute to greater customer satisfaction and on-time delivery, as well as lower internal rejection rates and queue losses.

It was also critical to minimise difficulties caused by improper jig installation and irresponsible handling. This was accomplished through the development of specialised jigs and fixtures, as well as the implementation of safe warehousing and handling practises. The use of a color-coded system for inbound inspection items, in-process inspection, and final inspection aided in the acceleration of the quality control process. As a result, error rates were reduced.

The installation of the 5S Quality System considerably improved the company's overall effectiveness. The strict commitment to keeping the workplace clean, well-organized, and efficient aided in establishing consistency, accountability, and continual improvement. When taken as a whole, this has a favourable impact on the quality of the manufacturing processes.

The data obtained clearly confirmed the technology's efficiency. The QIP audit sheet and the bar graph both reflect how far the process has progressed in terms of quality improvement. The deployment of these modules has resulted in a significant rise in the percentage of modules that have been performed, indicating a significant improvement in quality.

Finally, the technique utilised in this study, which includes the Quality Improvement Programme (QIP) modules and the 5S Quality System, was shown to be highly effective in addressing issues encountered during the manufacturing process, boosting product quality, and pleasing customers. The accomplishments show the value of systematic quality improvement activities and speak to the possibility of achieving excellence in manufacturing processes for firms of all sizes. The lessons learned from this study will be beneficial to

organisations aiming to encourage continuous improvement and maintain high quality standards in their operations.

The Quality Improvement Programme (QIP) improved several manufacturing process components. The QIP Audit Sheet has helped establish the program's current state, identify areas for development, and build a framework for ongoing changes. The program's status now can be accurately assessed. The QIP Progress Bar Graph shows the program's steady growth, proving its usefulness and ability to promote continual progress. The graph "Percentage QIP Modules Implementation Status" summarises the diverse ways the organisation has successfully implemented QIP modules. Standardised operation methods, quality gate adjustments, and color-coded trolleys for part handling have all reduced rejection rates and increased product traceability under the QIP. Furthermore, the Monthly Customer Rejection Data Graphs have indicated manufacturing quality issues and areas that need attention. Finally, the Quality Audit (QA) report showed that the company is devoted to quality standards and that continuous development is necessary for manufacturing success.

## 8 Conclusion and Future work

### 8.1 Conclusion

In conclusion, the implementation of quality improvement program at STEEL CRAFT (PVT. LTD. has resulted in major improvements in the manufacturing processes, most notably with regard to the Handle CG-125. With the assistance of the research that centred on the Quality Improvement Programme (QIP) modules, we were able to successfully accomplish the objectives that had been outlined at the start of the research. The organization has established a culture of continuous development by dramatically reducing the number of products that are rejected and significantly enhancing the overall quality of their offerings. This illustrates the organization's commitment to obtaining the mandated rejection rate of 0.3%, which was achieved by drastically reducing rejection rates and significantly enhancing product quality. Moreover, the company was successful in reaching this goal. Not only has the implementation of standard operating procedures (SOPs) and careful documentation helped to streamline production procedures, but it has also contributed to an incredible 99% improvement in the overall quality of the products that have been produced. This has ultimately contributed to an increase in the level of satisfaction experienced by customers and has insured that deliveries will be completed on time. As a result of the Quality Improvement Programme's successful mitigation of concerns such as hole quality, porosity, jig fitting, and maltreatment, the number of product rejections has significantly decreased, which is evidence that the programme is effective. The findings of the study illustrate the benefits of a systematic approach to quality improvement, giving helpful insights for long-term performance and market leadership. The study was conducted by. This is especially true in regard to the industrial sector and the goal of obtaining the predetermined rejection rate.

The research approach that was taken in this investigation was one that turned out to be very productive. The research was based on a program called the Quality Improvement Programme (QIP), which consisted of a number of modules, each of which was aimed to improve a different part of the manufacturing process. The modules were designed to

increase the quality of the product. All of this can be attributed to the QIP modules, which led to a decrease in rejection rates, an improvement in product quality, and the establishment of a culture of continuous development. The organization was able to make substantial headway in the direction of quality improvement as a result of the implementation of standard operating procedures (SOPs) as well as the full documentation of production processes.

It was one of the key goals in establishing the QIP modules to create a culture of continuous improvement, and this purpose has been largely realized as a result of the QIP modules. SOPs were implemented, and production procedures were scrupulously recorded; this gave the organization a formal structure that could be used to monitor and regulate violations. This assisted in ensuring that each item met the predetermined quality standards that were established. The quantifiable results of this work led to increased levels of customer satisfaction, as measured by higher product quality, decreased rates of product failure, and fewer customer complaints.

This project has an incredible 99% rate of high-quality product output, demonstrating the effectiveness of the QIP modules. This is a significant accomplishment for the project. The improved product traceability and documentation also made it easier to identify the root causes of problems before deploying remedies. These outcomes have increased customer satisfaction and on-time delivery, which has strengthened the company's reputation as a reliable supplier while decreasing internal rejection rates and queuing losses.

The system successfully solved concerns such as hole quality, jig fitting, and abuse. Specialised jigs and fittings, as well as specific handling and storage practises, have considerably decreased jig fitment and incorrect handling difficulties.

After implementing the 5S Quality System, the company's overall efficiency increased significantly. The organisation was able to develop consistency, responsibility, and a culture

of continuous improvement because of the clean, well-organized, and efficient workplace. As a result, overall production quality has improved.

The QIP audit sheet and progress bar graph, which illustrate the study's results regarding the significant increases in quality, are evidence of the project's effectiveness. The increased deployment of QIP modules is a significant step towards improved quality.

Finally, the findings of this study emphasise the importance of implementing a systematic quality improvement plan. As a result, businesses now have a better understanding of what it will take to improve their manufacturing procedures, maintain constant high quality, and satisfy their customers. The study's findings provide critical counsel that can assist firms on a road of continual improvement, laying the groundwork for long-term success and market supremacy.

## 8.2 Future Work

As a direct result of the work done for this investigation, several interesting new paths of research have developed. By performing in-depth study on the sustainability and regular use of the Quality Improvement Programme (QIP), STEEL CRAFT (PVT) LTD can gain fresh ideas. An assessment of the company's ability to sustain the attained quality standards over time, as well as the requirement for incremental adjustments to the QIP modules to meet increasing industry expectations, would be beneficial.

A second viable method would be to study the feasibility of incorporating cutting-edge technologies such as data analytics and automation into existing manufacturing processes. Intelligent manufacturing technologies and real-time data analysis may improve quality control, reduce errors, and increase production efficiency.

Furthermore, learning from other manufacturing groups, both within and outside the automotive industry, would provide a broader view of best practises for quality improvement. These organisations could be found in the motor sector or elsewhere. Examining how other businesses have dealt with and overcome comparable challenges may serve to acquire relevant benchmarking data.

Given the global shift towards sustainability and environmental stewardship, future research might look into how STEEL CRAFT (PVT) LTD. could apply more ecologically responsible production practises. This could pave the way for creative techniques of boosting quality while lowering environmental effect, in accordance with the growing demand for eco-friendly and sustainable autos. These probable future study areas have the potential to significantly increase manufacturing quality, efficiency, and sustainability.

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