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Quality Control Using the Quality Control Circle (QCC) Method to Reduce Product Defects on Cylinder Rotogravure at PT XYZ

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Abstract. PT XYZ manufactures rotogravure cylinders as printing masters for flexible packaging. The primary issue was the high reprocessing ratio (reprocess NG) during January–November 2024 and 2025, reaching Year-to-Date (YTD) averages of 3.89% and 2.37% respectively, both exceeding the company's 2.00% tolerance target. This study aims to identify the dominant defects, analyze their root causes, and formulate corrective actions using the Quality Control Circle (QCC) method through the PDCA (Plan-Do-Check-Action) cycle and Seven Tools. Pareto chart analysis revealed three dominant defects accounting for 82.21% of the cumulative problems: Bubble (34.62%), Pinhole (29.32%), and Corrosion (18.27%). Fishbone diagram analysis indicated root causes stemming from unstable chemical dosing flow, difficulty cleaning the copper nugget basket, lack of standardized instructions for material replenishment and oiling, and humid storage conditions. Corrective actions included replacing the dosing pump hose, modifying the copper nugget cleaning tool, establishing an enclosed storage area, and developing new Work Instructions equipped with Visual Control Checks. Implementation results for January–March 2026 demonstrated the effectiveness of the QCC method, marked by a significant reduction in defects until the defect ratio was suppressed below the company's target of 2.00%, along with cost savings of Rp30,213,408 over three months.

Keywords: *Quality Control Circle, Rotogravure Cylinder, PDCA, Seven Tools, Quality Control.*

A. INTRODUCTION

The development of the manufacturing industry in the era of globalization is taking place very rapidly, leading to increasingly fierce competition among companies, especially in the packaging manufacturing sector. This condition demands that every company continuously maintain and improve the quality of the products produced to align with consumer needs and expectations (Dale et al., 2007; Ramlawati, 2020; Tanjung et al., 2025). Integrated quality management serves as a strategic foundation in maintaining the consistency of the quality of goods and services (Aulia, 2024; Feigenbaum, 1991; Ibrahim & Rusidana, 2021; Tjiptono & Diana, 2019). Quality control is an effort to maintain the quality of the goods produced so that they conform to established specifications, while also acting as one of the main factors determining company performance and competitiveness in the market (Besterfield, 2012; Deming, 2000; Montgomery, 2019; Oakland, 2014).

PT XYZ is a manufacturing company that produces rotogravure cylinders as a core component or cylindrical rotating metal printing reference used in rotogravure printing techniques for flexible packaging needs. The cylinder is made of steel coated with copper and chromium, with designs printed through an engraving process in the form of small ink-holding cells. One of the problems that frequently arises in the production process is the Bubble defect, which a bubbling surface is caused by nickel solution levels that do not meet standards. Based on company data, the reprocessing ratio (reprocess NG) for the January–November 2024 period was recorded as quite high with a Year to Date (YTD) average of 3.89%, and although it experienced an improvement in the same period of 2025 to 2.37%, this achievement remained above the company's tolerance target (AOP) of 2.00%. Well-maintained product quality also plays a major role in broadly maintaining consumer satisfaction and purchasing decisions (Novianti, 2020), so this high defect rate has a direct impact on decreasing print quality and increasing production costs due to the repair or remake (rework) process of the cylinder.

The application of quality control methods has been extensively researched and proven effective in minimizing product damage rates across various industrial sectors (Evans & Lindsay, 2020; Juran & De Feo, 2010). Various approaches such as Statistical Quality Control (SQC) and Seven Tools have been applied in the leather processing industry (Afrizal Pradana, 2021), the tofu industry (Agustina, 2024), dowel wood production (Nurhayati & Bellanov, 2022), cake products (Marlina, 2023), up to general analysis of the Seven Tools method (Ishikawa, 1985; Umam, 2023). In addition, the Six Sigma and Lean approaches are also widely used to suppress the number of product defects in manufacturing processes (Arifin & Leonanda, 2021; Pyzdek & Keller, 2014; Womack & Jones, 2003). Research related to the application of the Quality Control Circle (QCC) method and the Plan-Do-Check-Action (PDCA) cycle shows significant results in product quality improvement (Adriantantri et al., 2023; Rusman & Prabowo, 2021), including defect suppression in glass bottle products (Kencana et al., 2024), as well as quality improvement in manufacturing processes emphasizing the role of Seven Tools systematically (Prabowo & Rusman, 2021). This systematic research approach is also supported by a deep methodological understanding regarding sampling and the types of quantitative and qualitative research (Sugiyono, 2013; Syahrizal & Jailani, 2023; Yamane, 1967). Based on this description, this study aims to identify the dominant types of defects in the rotogravure cylinder production process at PT XYZ, analyze their main causal factors, and formulate improvement proposals using the Quality Control Circle (QCC) method to suppress the product defect rate until it reaches the company's target.

B. METHOD

This research is a descriptive study utilizing both qualitative and quantitative approaches. The descriptive approach is used to systematically and factually describe and examine actual conditions in the field without intending to make broad generalizations (Sugiyono, 2013). The qualitative approach is utilized to gain an in-depth understanding of the root causes of defects through observation and interviews, while the quantitative approach is used to measure and categorize the proportions of defect types based on production data. The research focuses on the rotogravure cylinder production process in the Flexible Packaging Division of PT XYZ, with the analyzed data covering the period from January to November 2025 as well as the results of improvement implementation from January to March 2026.

Primary data were obtained through: (1) direct observation of the rotogravure cylinder production process to observe working conditions and the emergence of defects; (2) interviews with foremen, leaders, and operators to gather information regarding potential causes of defects and the control efforts that have been applied; and (3) company documentation in the form of historical data on production volume and defect counts. Secondary data were obtained from literature studies consisting of books, journals, and scientific articles related to quality control and the Quality Control Circle method as the theoretical foundation of the research.

Data analysis was conducted using the Quality Control Circle (QCC) method, which refers to the PDCA (Plan, Do, Check, Action) cycle. In the Plan stage, the improvement theme was determined using check sheets and Pareto diagrams to identify the dominant defect type, repair targets were set based on company standards, existing conditions were analyzed using the 4M+1E approach (man, machine, method, material, and environment), cause-and-effect analysis was performed using a fishbone diagram, and an improvement plan was formulated using the 5W+1H+1C approach (what, why, where, when, who, how, and cost). In the Do stage, the improvement plan was implemented on the production line. In the Check stage, the effectiveness of the improvements was evaluated by comparing defect ratios and calculating cost savings before and after implementation. In the Action stage, the proven effective improvements were standardized into Work Instruction (WI) documents and communicated to all operators to ensure quality sustainability.

C. RESULTS AND DISCUSSION

1. Identification of Defect Types and Pareto Analysis

Based on the historical production data of Rotogravure Cylinders for the period of January–November 2025, total production was recorded at 17,443 pcs with a total of 416 defective products, consisting of five types of defects: Bubble, Pinhole, Corrosive, Handling defects, and Oval. The data processing results using the Pareto diagram are presented in Table 1.

Table 1. Defect Percentage of Rotogravure Cylinders

No	Defect Types	Quantity (pcs)	Percentage (%)	Cumulative (%)
1	Bubble	144	34,62	34,62
2	Pinhole	122	29,32	63,94
3	Corrosive	76	18,27	82,21
4	Disabled	46	11,06	93,27
5	Oval	28	6,73	100,00

Source: Data Processing, 2026

By applying the 80:20 principle, three types of defects with a cumulative contribution of up to 82.21% were selected as the focus for improvement, namely Bubble (144 pcs; 34.62%), Pinhole (122 pcs; 29.32%), and Corrosive (76 pcs; 18.27%), while handling defects and oval defects were not analyzed further due to their relatively small contribution to the total problems.

2. Existing Condition and Cause-and-Effect Analysis (4M+1E)

An analysis of existing conditions was conducted on the stages of the cylinder manufacturing process, which include dechroming, turning, nickeling, coppering, CFM cutting/polish, engraving, degreasing, chroming, grinding, and proofing. Pinhole defects were found in the copper process in the form of small holes on the cylinder surface, while bubble and corrosive defects were found in the CFM cutting/polish process, causing an uneven cylinder surface. A cause-and-effect analysis using a fishbone diagram for the three dominant defect types summarizes the causal factors based on the 4M+1E approach, as presented in Table 2.

Table 2. Summary of Cause-and-Effect Analysis Based on the 4M+1E Approach

Defect Types	Factor	Potential Causes
Bubble	Machine	The chemical dosing flowrate is uncontrolled, causing the plating bath composition to deviate from standards and reducing the adhesion of the copper layer.
Bubble	Method	The cylinder cleaning process, including the edge/radius area, has not been effective in cleaning residues prior to copper plating.
Bubble	Man	Lack of operator awareness regarding critical areas of the cylinder cleaning process.
Pinhole	Machine	The lower part of the copper nugget basket is difficult to

		reach, causing residual material to be left behind and stick to the cylinder surface.
Pinhole	Method	There is no standard for adding copper nuggets and replacing diamond inserts, making the process inconsistent among operators.
Pinhole	Man	Operators have not received training regarding the latest work instructions (WI).
Corrosive	Environment	Cylinders are stored in an open, humid area without storage standards that take corrosion risks into account.
Corrosive	Method	There is no standard for post-cutting oiling and cleanliness inspection, and the drying machine temperature is less than optimal.
Corrosive	Man	Operators do not use standard hand gloves when handling materials.
Corrosive	Material	The quality of the anti-rust oil is below standard specifications (under-spec).

Source: Data Processing, 2026

Method and machine factors were the most dominant causes for all three types of defects, as they are directly related to inconsistently established work standards and suboptimal equipment conditions.

3. Cost of Non-Conformance (PONC) Analysis

The Cost of Non-Conformance (PONC) is calculated from the accumulation of defective cylinder replacement costs multiplied by the Cost of Goods Manufactured (COGM) per cylinder unit. The direct cost calculation results for the three dominant defect types are presented in Table 3.

Table 3. Direct Cost Value (Price of Non-Conformance)

No	Defect Type	Quantity (pcs)	COGM per Unit	Direct Cost
1	Bubble	144	Rp629.445	Rp90.640.080
2	Pinhole	122	Rp629.446	Rp76.792.412
3	Korosif	76	Rp629.447	Rp47.837.972

Source: Data Processing, 2026

In addition to these direct losses, product defects also cause indirect losses in the form of reduced company productivity due to unscheduled rework, disruptions to customer delivery schedules, and a decline in customer satisfaction and trust in the company.

4. Proposed Improvements and Implementation (5W+1H+1C)

Proposed improvements are formulated using the 5W+1H+1C approach (what, why, where, when, who, how, and cost) based on the root causes identified in the cause-and-effect analysis stage. A summary of the proposed improvements and their implementation for each defect type is presented in Table 4.

Table 4. Summary of Proposed Improvements and Implementation

Defect Types	Proposed Improvements	Cost
Bubble	Calibration and replacement of the dosing pump hose, accompanied by the drafting of a check sheet for regular monitoring of flowrate and chemical conditions.	IDR 50.000
Bubble	Preparation of the Work Instruction (WI) for cylinder cleaning and a Visual Control Check of the cleaning results.	IDR 0
Pinhole	Modification of the cleaning tool (a combination of	IDR 0

	demineralized water and low-pressure water sprayer) in the lower area of the copper nugget basket.	
Pinhole	Preparation of the WI for copper nugget addition standards and a schedule for diamond insert replacement every two weeks.	IDR 0
Korosif	Construction of a closed and humidity-controlled cylinder storage area.	IDR 0
Korosif	Preparation of the WI for the post-cutting cylinder oiling process and a Visual Control Check of the CFM cutting results.	IDR 0

Source: Data Processing, 2026

All of these improvements are reinforced by the application of the Poka-yoke concept through Visual Control Check media in the work area, allowing operators to visually distinguish between process results that meet standards (OK) and those that do not (NG).

5. Evaluation of Improvement Results and Cost Saving

The evaluation is carried out by comparing the defect ratio before and after the implementation of improvements over a comparable three-month period (apple to apple), namely September–November 2025 (before improvement) and January–March 2026 (after improvement). The results of the cost-saving calculation are presented in Table 5.

Table 5. Cost Saving Comparison Before and After Improvement (3 Months)

Defect Type	Before (pcs)	Loss Before	After (pcs)	Loss After
Bubble	39	IDR 24.548.394	21	IDR 13.218.366
Pinhole	23	IDR 14.477.258	15	IDR 9.441.690
Korosif	31	IDR 19.512.826	9	IDR 5.665.014
Total	**93**	**IDR 58.538.478**	**45**	**IDR 28.325.070**

Source: Data Processing, 2026

Based on Table 5, the implementation of improvements successfully reduced the number of rework occurrences significantly across all three defect types, resulting in a cost saving of IDR 30.213.408 over a three-month period. The evaluation results also showed that the overall defect ratio was successfully suppressed to below the company's standard (AOP) of <2.00%, despite some fluctuations in certain months. These findings indicate that the application of the Quality Control Circle method not only impacts the improvement of process quality but also provides economic benefits for the company. As a follow-up, all improvements proven to be effective have been standardized in the form of Work Instructions (WI) and socialized to all operators to ensure consistency and sustainability of product quality.

D. CONCLUSION

Identification of defects in the rotogravure cylinder production process at PT XYZ found five types of defects, namely Bubble, Pinhole, Corrosive, Defect, and Oval, with three dominant defect types based on Pareto analysis, namely Bubble (34.62%), Pinhole (29.32%), and Corrosive (18.27%), which cumulatively contributed 82.21% of the total problems. Cause-and-effect analysis using a fishbone diagram showed that Bubble defects were caused by instability in the dosing chemical flowrate and an inadequate cleaning process; Pinhole defects were caused by the difficulty in cleaning the copper nugget basket as well as the absence of standards for material addition and diamond insert replacement; while Corrosive defects were caused by humid storage conditions and the absence of post-cutting oiling standards. The proposed improvements formulated using the 5W+1H+1C approach, including replacing the dosing pump hose, modifying the copper nugget cleaning tool, establishing a closed storage area, and drafting a new Work Instruction accompanied by a Visual Control Check, proved effective in reducing the defect ratio to below the company target (<2.00%) during the January–March 2026 period, with cost savings of IDR 30,213,408 in three months. The implementation of this control is expected to maintain the quality consistency of rotogravure cylinder products at PT XYZ sustainably.

REFERENCES

Adriantantri, E., Indriani, S., & Saifulloh, R. (2023). Perbaikan Kualitas Produk Menggunakan Metode Quality Control Circle (QCC) dan Plan, Do, Check, Action (PDCA). *Prosiding SENIATI*, *7*(2), 225-229.

Afifa, A. (2024). Peningkatan Mutu Pendidikan Menurut Dr. W. Edward Deming. *Neraca: Jurnal Pendidikan Ekonomi*, *9*(2), 84-96.

Agustina, I. (2024). *Analisis Pengendalian Kualitas Produksi Tahu Menggunakan Metode Statistical Quality Control Dan Taguchi Pada Ud. Tahu Bang Dahri di Kabupaten Bireuen* (Doctoral dissertation, Universitas Malikussaleh).

Arifin, Z., & Leonanda, B. D. (2021). Menurunkan Jumlah Kecacatan Produk Pada Proses Produksi Dengan Menggunakan Metode Six Sigma dan Pengendalian Statistik di PT. Xyz Indonesia. *Sigma Teknika*, *4*(1), 106-114.

Besterfield, D. H. (2012). *Quality Control*. Pearson Education.

Dale, B. G., Boaden, R. J., & Lascelles, D. M. (2007). *Managing Quality*. Wiley-Blackwell.

Deming, W. E. (2000). *Out of the Crisis*. MIT Press.

Evans, J. R., & Lindsay, W. M. (2020). *Managing for Quality and Performance Excellence*. Cengage Learning.

Feigenbaum, A. V. (1991). *Total Quality Control*. McGraw-Hill.

Ibrahim, T., & Rusidana, A. (2021). *Total Quality Management*. Bandung: Yrama Widya.

Ishikawa, K. (1985). *What Is Total Quality Control? The Japanese Way*. Prentice-Hall.

Juran, J. M., & De Feo, J. A. (2010). *Juran's Quality Handbook: The Complete Guide to Performance Excellence* (6th ed.). McGraw-Hill Education.

Kencana, D. S., Chalisyah, E., & Azhari, Y. R. (2024). Analisis Pengendalian Kualitas Untuk Mengurangi Defect Pada Glass Bottle Dengan Menggunakan Metode Quality Control Circle Pt Muliaglass Container Division Cikarang Jawa Barat. *Jurnal Lentera Bisnis*, *13*(2), 1176-1198.

Marlina, W. A., Habibullah, H., & Armijal, A. (2023). Pengendalian Kualitas Cake dengan Seven Tools di Usaha Ladior, Payakumbuh. *Jurnal Optimalisasi*, *9*(2), 134-147.

Montgomery, D. C. (2019). *Introduction to Statistical Quality Control*. John Wiley & Sons.

Novianti, T. A. (2020). Pengaruh celebrity endorser dan kualitas produk terhadap keputusan pembelian kosmetik pixy. *PRAGMATIS*, *1*(1), 43-50.

Nurhayati, L., & Bellanov, A. (2022). Peningkatan Kualitas Produksi Kayu Dowel Sapu Dengan Pendekatan Metode Seven Tools dan 5W+ 1H. *Journal of Industrial and Systems Optimization*, *5*(1), 39-46.

Oakland, J. S. (2014). *Total Quality Management and Operational Excellence: Text and Cases*. Routledge.

Pradana, L. A. (2021). *Pengendalian Kualitas Dengan Menggunakan Metode SQC (Statistical Quality Qontrol) Untuk Meminimalkan Tingkat Kerusakan Produk Pada Pengrajin Kulit Sumali Keniten Ponorogo* (Doctoral dissertation, Universitas Muhammadiyah Ponorogo).

Pyzdek, T., & Keller, P. A. (2014). *The Six Sigma Handbook*. McGraw-Hill Education.

Ramlawati. (2020). *Total Quality Management*. Jakarta: Nas Medika Pustaka.

Rusman, R., & Prabowo, R. (2021, March). Penerapan Quality Control Circle dalam Memperbaiki Kualitas pada Proses Pengelasan Box Karoseri di PT. X. In *Prosiding SENASTITAN: Seminar Nasional Teknologi Industri Berkelanjutan* (Vol. 1, No. 1, pp. 495-500).

Sugiyono. (2013). *Metode Penelitian Kuantitatif, Kualitatif dan R&D*. Bandung; Alfabeta.

Syahrizal, H., & Jailani, M. S. (2023). Jenis-jenis penelitian dalam penelitian kuantitatif dan kualitatif. *QOSIM: Jurnal Pendidikan Sosial & Humaniora*, *1*(1), 13-23.

Tanjung, D. P., Zega, J. H. Y., Zai, I. I., & Harefa, D. I. P. (2025). Kualitas dalam memproduksi suatu barang dan jasa. *Jurnal Ilmu Ekonomi dan Bisnis*, *2*(1), 15-22.

Tjiptono, F., & Diana, A. (2019). *Total Quality Management (TQM)*. Yogyakarta: Andi Offset.

Umam, K. (2023). *Analisis Pengendalian Kualitas Produk Dengan Metode Seven Tools (Studi Kasus CV. SJP. INDUSTRIES)* (Doctoral Dissertation, Universitas Islam Sultan Agung).

Womack, J. P., & Jones, D. T. (2003). *Lean Thinking: Banish Waste and Create Wealth in Your Corporation*. Free Press.

Yamane, T. (1967). *Statistics: An Introductory Analysis*. Harper and Row.