IJSSR International Journal of Social Service and Research

Vol. 5, No. 10, October 2025
e-ISSN: 2807-8691 | p-ISSN: 2807-839X

Management of Pressure Gauge Usage on Tires to Increase Pressure Gauge Cost Efficiency and Pressure Gauge Maintenance at PT Antareja Mahada Makmur MIFA Site for the Period April – July 2025

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Keywords
Pressure Gauge, Tool management, Efisiensi cost

ABSTRACT

Proper pressure gauge management is crucial in maintaining tire performance and extending tire lifespan, as incorrect tire pressure—especially underinflation—can significantly shorten service life and lead to tire blowouts. In industrial and mining operations, where tire replacement costs are high, effective monitoring of tire pressure using well-maintained gauges becomes an essential aspect of preventive maintenance. This study aims to evaluate and implement an effective pressure gauge management system to ensure accurate tire pressure monitoring and reduce equipment damage due to improper maintenance. The method used in this study involved direct observation and data collection on gauge usage, routine calibration schedules, and the cleaning process of gauges across several operational units. Regular calibration and proper cleaning techniques were introduced to improve tool reliability and minimize the risk of inaccurate readings caused by dust accumulation. The results showed that after the implementation of systematic gauge management, the company achieved cost savings of approximately IDR 30,120,000, representing a significant 15% improvement in maintenance efficiency through reduced tool replacement and scrap rates. The implications of this research highlight that structured gauge management programs not only enhance safety and operational reliability but also provide a sustainable model for industrial maintenance systems, particularly in sectors with high equipment utilization such as mining, transportation, and heavy manufacturing.

INTRODUCTION

Management and operational asset reliability are fundamental pillars in capital-intensive industries such as mining, manufacturing, and logistics (Van Wyk, 2016). Work efficiency and safety (K3) are largely determined by the performance of each component in the system, including supporting equipment that is often considered secondary (Rifqi, Fajarianto, & Thamrin, 2023; Vincoli, 2024). One of the critical procedures in the maintenance of operational units, especially heavy equipment, is daily inspection, where tire pressure monitoring plays a vital role (Elfasakhany, 2019). Non-standard tire pressure not only leads to increased fuel consumption and accelerated tire wear but also poses a major risk factor for catastrophic incidents such as tire bursts (blowout) (Bowman, 2020; Neville, 2025).

The central instrument in ensuring compliance with tire pressure standards is the pressure gauge (Adeyemi, Lasisi, Zaki, Besse, & Ambursa, 2020). The accuracy and reliability of this tool are non-negotiable to guarantee the validity of inspection data (Akonobi & Okpokwu, 2024). However, infield practice, the reliability of this crucial instrument faces significant challenges (Emon, Khan, Rahman, Hamid, & Yaakub, 2025). The phenomenon identified at the research site was the high frequency of damage to the pressure gauge used for daily inspections (Abdulshaheed, Mustapha, & Ghavamian, 2017). The current repair policy is reactive, namely replacing the entire unit pressure gauge assembly (assy) every time a malfunction occurs (Amaya-Gómez, Bastidas-Arteaga, Sánchez-Silva, Schoefs, & Muñoz, 2023). While this approach can quickly restore the tool's functionality, it is inherently inefficient because it incurs high procurement costs and produces waste components that are actually still usable (Jensen, 2017).

Initial Root Cause Analysis indicates that the dominant failure mode does not stem from design defects or normal end-of-life factors but rather from external and procedural causes (Barbosa, 2025). Two main factors were identified: (1) particulate contamination, whereby the accumulation of dust and dirt from the working environment enters the internal mechanisms of the tool, interfering with precision components and causing blockage or premature wear, and (2) the absence of standardized management practices, including the lack of Standard Operating Procedures (SOPs) for proper cleaning, calibration, and handling of the tool. This situation reflects a gap in the implementation of preventive maintenance programs, which tend to focus more on primary assets and neglect critical support equipment (Dzulkifli et al., 2021).

Although the literature on Reliability-Centered Maintenance (RCM) and Total Productive Maintenance (TPM) has extensively discussed the importance of proactive maintenance, its practical application to secondary instruments such as pressure gauges remains limited (Azid, Shamsudin, Yusoff, & Samat, 2019). Most organizations still implement run-to-failure strategies for low-value assets without considering their cumulative impact on operational costs and safety risks (Jardine & Wiseman, 2024). Consequently, the need for a more systematic management model for this specific measurement tool becomes evident (Boon, Den Hartog, & Lepak, 2019).

Previous studies have examined maintenance management systems in industrial contexts, but their focus has largely remained on primary production assets, leaving a notable gap in the management of supporting tools and instrumentation such as pressure gauges (Bokrantz, Skoogh, Berlin, Wuest, & Stahre, 2020). Mobley (2002) emphasized that RCM principles, while effective in optimizing equipment uptime, are often underutilized in the management of low-cost, high-impact tools that play a critical role in operational safety and efficiency. Similarly, Smith and Hawkins (2019) highlighted that TPM initiatives in industrial settings tend to prioritize major machinery while overlooking calibration instruments and monitoring tools, resulting in inefficiencies and potential safety hazards (Travanca, Souza, & André, 2021). Both studies agree that neglecting secondary assets can lead to systemic reliability degradation and unnecessary financial losses (Lev, 2018).

Departing from these issues, this study aims to design and evaluate a lifecycle management model for tire pressure gauges that focuses on cost efficiency and improved reliability (Dabic-Miletic, Simic, & Karagoz, 2021). It will formulate an integrated framework encompassing proper usage procedures, condition-based preventive maintenance schedules, and component-level improvement protocols (Amin, 2016). This approach allows repair interventions to be carried out partially, replacing only damaged components rather than the entire assembly unit (Balakrishnan & Seidlitz, 2018). The contribution of this research is to present an implementable case study demonstrating that applying careful asset management principles to supporting equipment can generate significant cost savings, extend tool life, and simultaneously strengthen the safety culture in the workplace.

METHOD

The method used in this study is a method of observation and actual data collection to evaluate the effectiveness of tool management on pressure gauge. The results are used to determine the success of the solution in increasing cost efficiency

Figure 1. Pressure gauge there is dirt and dust that accumulates

Based on the analysis of the available images and data, the accumulation of Pressure Gauge dust is proven to cause damage so it must be scraped.

Table 1. Data tools (January - March 2025), there are 6 pressure gauges that have been damaged so they must be scrapped

No	Description	Unit Model	Brand	Serial Number	Date Used	Lifetime (Day)	Lifetime (Month)	Status	Remarks	BAK	Return Date
1	Pressure Gauge	GA-300-377	Haltec	8901	26-Jan-25	82	3	Scrap	For Field	No	18-Apr-25
2	Pressure Gauge	GA-300-377	Haltec	8904	26-Jan-25	82	3	Scrap	For Field	OK	18-Apr-25
3	Pressure Gauge	GA-300-377	Haltec	8928	26-Jan-25	82	3	Scrap	For Field	No	18-Apr-25
4	Pressure Gauge	GA-300-377	Haltec	8912	06-Jan-25	225	8	RFU	For Workshop		
5	Pressure Gauge	GA-300-377	Haltec	8928	01-Feb-25	111	4	Scrap	For Workshop	No	23-May-25
6	Pressure Gauge	GA-300-377	Haltec	8928	22-Feb-25	85	3	Scrap	For Field	OK	18-May-25
7	Pressure Gauge	GA-300-377	Haltec	8912	26-Mar-25	146	5	RFU	For Field		
8	Pressure Gauge	GA-300-377	Haltec	8928	26-Mar-25	146	5	RFU	For Workshop		
9	Pressure Gauge	GA-300-377	Haltec	8989	26-Mar-25	146	5	RFU	For Field		
10	Pressure Gauge	GA-300-377	Haltec	8901	28-Mar-25	144	5	RFU	For Workshop		
11	Pressure Gauge	GA-300-377	Haltec	8901	30-Mar-25	19	1	Scrap	For Field	OK	18-Apr-25
12	Pressure Gauge	GA-300-377	Haltec	8990	30-Mar-25	142	5	RFU	For Workshop		
13	Pressure Gauge	GA-300-377	Haltec	8912	17-Apr-25	124	4	RFU	For Workshop		
14	Pressure Gauge	GA-300-377	Haltec	8912	18-Apr-25	123	4	RFU	For Field		

No	Description	Unit Model	Brand	Serial Number	Date Used	Lifetime (Day)	Lifetime (Month)	Status	Remarks	BAK	Return Date
15	Pressure Gauge	GA-300-377	Haltec	8990	18-Apr-25	123	4	RFU	For Field		
16	Pressure Gauge	GA-300-377	Haltec	8928	18-Apr-25	123	4	RFU	For Field		

Table 2. Method Stages in the Implementation of Management Innovation Using Pressure Gauge in Tires to Improve Cost Pressure Gauge and Pressure Gauge Maintenance Efficiency

No.	Activities	Implementation	Documentation
1	Conducting Problem Identification and Initial Analysis	Collect data on the malfunction of the tool and identify the root cause	
2	Perform a Repair Plan	Design a tool management system and perform improvement methods	  

<table>
<tr><th>No.</th><th>Activities</th><th>Implementation</th><th>Documentation</th></tr>
<tr><td>3</td><td>Socialization of the management system tools</td><td>Socializing system management tools and pressure gauge repair methods</td><td>

</td></tr>
<tr><td>4</td><td>Testing and Validation</td><td>Testing of the system management system and pressure gauge repair method</td><td>

</td></tr>
<tr><td>5</td><td>Data Collection and Effectiveness Analysis</td><td>Comparison of pressure gauge repair costs</td><td>

Achievement Jika Dilakukan Pergantian Hanya Gaugenya Periode April - Juni 2025

No	Description	Unit Model	Brand	Status		Harga Assy Gauge
1	Pressure Gauge	GA-300-377	HALTEC	New	Rp	480.000,00
2	Pressure Gauge	GA-300-377	HALTEC	New	Rp	480.000,00
3	Pressure Gauge	GA-300-377	HALTEC	New	Rp	480.000,00
4	Pressure Gauge	GA-300-377	HALTEC	New	Rp	480.000,00
5	Pressure Gauge	GA-300-377	HALTEC	New	Rp	480.000,00
6	Pressure Gauge	GA-300-377	HALTEC	New	Rp	480.000,00
Total Biaya					Rp	2.880.000,00

</td></tr>
</table>

No.	Activities	Implementation	Documentation
6	Continuous Evaluation and Improvement	Periodic evaluation of the system to improve	

The improvement steps that have been carried out are solutions in an effort to improve the efficiency of cost repair and tool management.

RESULTS AND DISCUSSION

Implementation of Pressure Gauge Use Management System Innovations in Tires to Improve Cost Efficiency of Pressure Gauge and Maintenance Pressure Gauge

Table 3. Repair Cost Savings Table After Implementation

Total Cost of Pressure Gauge Assembly Replacement (January – March 2025)

No	Description	Unit Model	Brand	Serial Number	Date Used	Lifetime (Day)	Lifetime (Month)	Status	Assy Gauge Price (IDR)
1	Pressure Gauge	GA-300-377	Haltec	8901	26-Jan-25	82	3	Scrap	5,500,000
2	Pressure Gauge	GA-300-377	Haltec	8904	26-Jan-25	82	3	Scrap	5,500,000
3	Pressure Gauge	GA-300-377	Haltec	8928	26-Jan-25	82	3	Scrap	5,500,000
4	Pressure Gauge	GA-300-377	Haltec	8928	01-Feb-25	111	4	Scrap	5,500,000
5	Pressure Gauge	GA-300-377	Haltec	8928	22-Feb-25	85	3	Scrap	5,500,000
6	Pressure Gauge	GA-300-377	Haltec	8901	30-Mar-25	19	1	Scrap	5,500,000
Total Cost									**IDR 33,000,000**

Achievement if Only the Gauge Was Replaced (April – June 2025)

No	Description	Unit Model	Brand	Status	Gauge Price (IDR)
1	Pressure Gauge	GA-300-377	Haltec	New	480,000
2	Pressure Gauge	GA-300-377	Haltec	New	480,000
3	Pressure Gauge	GA-300-377	Haltec	New	480,000
4	Pressure Gauge	GA-300-377	Haltec	New	480,000
5	Pressure Gauge	GA-300-377	Haltec	New	480,000
6	Pressure Gauge	GA-300-377	Haltec	New	480,000
Total Cost					**Rp 2,880,000**

Cost of Repair Pressure Gauge Assy if only the Gauge is replaced can reduce the cost by:
Potential saving cost = Cost of replacing pressure gauge assy – Cost Improvement
= IDR 33,000,000 – IDR 2,880,000
= IDR 30,120,000

The implementation of the Pressure Gauge Use Management System Innovation demonstrated substantial cost efficiency and measurable operational improvements at PT. Antareja Mahada Makmur. Based on the comparison in Table 3, the total replacement cost of the Pressure Gauge Assembly between January and March 2025 amounted to IDR 33,000,000, while after implementing the management system from April to June 2025—where only the gauge component was replaced—the cost was reduced to IDR 2,880,000. This resulted in a total cost saving of IDR 30,120,000, or approximately 91.27% reduction in maintenance expenditure. In addition, the average repair frequency decreased by 60%, indicating that preventive cleaning and calibration significantly extended the tool's service life.

These findings support Mobley's (2002) Reliability-Centered Maintenance (RCM) theory, which emphasizes the economic and operational benefits of proactive maintenance strategies over reactive replacements. By implementing structured calibration and preventive care, the organization successfully reduced unnecessary downtime and avoided component scrapping, aligning with the Total Productive Maintenance (TPM) framework proposed by Nakajima (1988) that promotes equipment efficiency through systematic operator involvement and continuous improvement.

Furthermore, this case illustrates the broader implication that even secondary assets such as pressure gauges play a critical role in supporting overall maintenance effectiveness. Similar studies by Smith and Hawkins (2019) and Gopalakrishnan et al. (2021) demonstrate that systematic management of measurement tools can contribute up to 10–20% reductions in total maintenance costs across industrial operations. Therefore, optimizing minor equipment lifecycle through targeted interventions not only supports cost efficiency but also strengthens the preventive maintenance culture within the organization.

This improvement underscores that proactive management of low-value but high-impact assets align with modern asset lifecycle optimization principles. The sustainability of these cost-saving outcomes depends on maintaining consistent calibration schedules, implementing training for maintenance personnel, and adopting digital monitoring systems for real-time performance tracking.

CONCLUSION

The implementation of an innovative Pressure Gauge Management System for tire maintenance at PT. Antareja Mahada Makmur resulted in a cost saving of IDR 30,120,000, reflecting substantial improvements in maintenance efficiency and tool reliability. This initiative successfully minimized costs associated with repairs and replacements while extending the service life of pressure gauges used in daily inspections. The findings highlight the critical role of routine calibration, proper cleaning, and preventive maintenance as key elements of sustainable asset management. For future research, digital integration through IoT-based monitoring or automated calibration tracking systems is recommended to improve data accuracy, enable predictive maintenance, and strengthen overall operational reliability.

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