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Risk Analysis of Operator Work Posture Using the Rapid Entire Body Assessment (REBA) Method in Industrial Machine Production Processes

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Abstract

In industrial manufacturing environments, non-ergonomic working postures are a major contributing factor to the development of musculoskeletal disorders (MSDs) among machine operators. In spare part production processes, operators are often required to maintain static and awkward postures for prolonged periods, which may increase biomechanical load on the body. This study aims to analyze the risk of operator working postures using the Rapid Entire Body Assessment (REBA) method in an industrial machine spare part production process. The research employed a descriptive observational approach conducted under actual working conditions without modifying existing work methods. Postural data were collected through direct observation and photographic documentation of operators at four main workstations, namely lathe, milling, cylindrical grinding, and surface grinding. Body segment angles, including the neck, trunk, legs, upper arms, lower arms, and wrists, were measured using the APECS application and evaluated using the REBA worksheet. The results indicate that operators at three out of four workstations exhibited forward-bending neck postures, resulting in relatively high neck angle deviations. All analyzed workstations were classified as having a medium level of MSD risk, with REBA scores ranging from 4 to 7. The milling workstation recorded the highest risk level with a REBA score of 7, primarily due to excessive trunk flexion, neck inclination, and prolonged static postures. These findings highlight the need for ergonomic improvements, such as adjusting machine height using platforms or height-adjustable bases, to enable operators to work in a more neutral posture and reduce musculoskeletal risk.

1. INTRODUCTION

In modern industrial environments, working conditions play a crucial role in determining workers' physical and mental well-being. The manufacturing sector, as one of the main economic drivers, frequently exposes workers to various occupational risk factors that may adversely affect their health. Employees are valuable assets in industrial operations, yet many manufacturing industries still lack standardized work procedures and ergonomic work facilities, particularly in manual production activities (Ruwana & Sigit, 2025). In addition, many industrial processes, especially in small and medium-sized enterprises (SMEs), continue to rely heavily on human labor for material handling and manufacturing processes (Pradityatama *et al*., 2024). Ergonomics is a discipline that focuses on understanding human behavior and performance in work systems and applying that understanding to interactions in real working environments (Wilson, 2000). Therefore, the concept of ergonomics places workers as the primary consideration in the planning and design of work systems (Marhaendra, 2026) to create a safe, comfortable, healthy, and efficient working environment (Zhang *et al*., 2023). Among the various ergonomic aspects, working posture is recognized as a particularly critical determinant influencing occupational safety, health, and productivity.

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Work effectiveness is closely related to working posture. Workers who adopt ergonomic postures are more likely to perform their tasks efficiently and achieve the expected outcomes, whereas non-ergonomic postures can accelerate fatigue and reduce productivity and work performance (Adistana & Tranggono, 2023). Since work productivity is an important indicator for evaluating the effectiveness of changes in working posture (Wang *et al*., 2023), posture analysis has become one of the important applications of ergonomics to reduce the risk of injury while improving work efficiency (Refaldi, 2024). Improper working posture may cause pain or injury to the body parts involved during work. When maintained over a prolonged period, these conditions can accumulate and increase the risk of developing occupational diseases, particularly musculoskeletal disorders (MSDs) (Dewantari, 2021). Therefore, posture assessment is an essential component of ergonomic evaluation in industrial settings.

One of the most prevalent occupational health problems associated with poor working posture is musculoskeletal disorders (MSDs). MSDs are injuries or disorders affecting muscles, joints, tendons, ligaments, nerves, and supporting structures of the body (Saputra & Dahda, 2022). One of the most common causes of MSDs is the accumulation of repetitive stress over time, and musculoskeletal conditions affect billions of people worldwide each year (Joshi & Deshpande, 2020). If MSDs are not properly managed, they may result in chronic pain, reduced physical function, and limitations in performing work effectively. These conditions can subsequently decrease work productivity and increase employee absenteeism (Kusumaningrum & Darnoto, 2025). From an economic perspective, MSDs impose significant costs on both workers and organizations due to medical treatment, productivity loss, and compensation expenses.

MSDs represent a major global health concern, affecting approximately 1.71 billion people worldwide and contributing substantially to physical disability (Prasetya *et al*., 2024). In Indonesia, a study involving 482 workers from 12 regencies and cities reported that approximately 16% of occupational health problems experienced by workers were related to MSDs (Candra *et al*., 2023).

In spare part manufacturing industries specifically, operators are required to perform highly repetitive tasks, maintain prolonged static postures, and operate machinery under time pressure. PT. Metal Teknologi Indonesia, a company engaged in industrial machine spare part production, employs 13 workers across four main machining workstations: lathe, milling, cylindrical grinding, and surface grinding. Preliminary observations revealed that workers at all four workstations frequently adopt forward bending and stooped postures while operating machines, which may significantly increase their risk of developing MSDs. Furthermore, the use of personal protective equipment (PPE) remains suboptimal, and workstation layouts are not fully designed according to ergonomic principles.

This study aims to analyze and assess the risk level of operator working postures at PT. Metal Teknologi Indonesia using the Rapid Entire Body Assessment (REBA) method. The findings are expected to serve as a basis for ergonomic improvement recommendations to reduce MSD risk among machine operators.

2. METHODOLOGY

This study used a descriptive observational approach with quantitative ergonomic analysis to evaluate the risk of operator working postures during spare part machine production activities at PT. Metal Teknologi Indonesia. The research was conducted under normal working conditions without modifying existing work methods or equipment.

The observation subjects consisted of machine operators at four main workstations, namely lathe, milling, cylindrical grinding, and surface grinding. All observed operators were male with varying lengths of service. Work activities observed included machine setup, workpiece installation, machining operations, and workpiece removal at each respective workstation.

The Rapid Entire Body Assessment (REBA) method was applied to identify and classify the level of musculoskeletal disorder (MSD) risk associated with actual operator postures. REBA is an observational method developed to assess unpredictable working postures and quickly evaluate postural risks affecting the entire body, particularly the upper body. The method is relatively easy to apply because posture assessment is based on angle ranges rather than precise joint angle measurements, making it suitable for workplace ergonomic evaluations that require further posture analysis (Widodo *et al*., 2020). REBA was developed through collaborative work involving ergonomists, physiotherapists, and nurses based on the analysis of approximately 600 working postures. The method simultaneously evaluates the posture of the upper limbs, trunk, neck, and lower extremities while also considering grip type and muscle activity. Furthermore, REBA classifies postural risk into five categories, ranging from negligible to very high (Hita-Gutiérrez *et al*., 2020).

The REBA method was selected because preliminary observations revealed that operators at all four workstations frequently adopted forward-bending neck postures, stooped trunk positions, and raised arm postures for prolonged periods while operating machines, conditions that are indicative of elevated MSD risk and require a comprehensive whole-body postural assessment tool.

The REBA assessment was conducted through the following steps:

1. Postural data collection: Direct observation and photographic documentation of operator postures were conducted at each workstation during normal working hours.
2. Body segment angle measurement: The angles of six body segments (neck, trunk, legs, upper arms, lower arms, and wrists) were measured using the APECS application.
3. REBA worksheet scoring: Measured angles were evaluated using the standard REBA worksheet to obtain scores for each body segment, including additional factors such as load, coupling, and activity scores.
4. Score calculation: Score A (trunk, neck, legs) and Score B (upper arms, lower arms, wrists) were calculated separately, then combined into Score C, and finally the activity score was added to obtain the final REBA score.
5. Risk level classification: The final REBA score was used to determine the MSD risk level category and corresponding action requirement at each workstation.

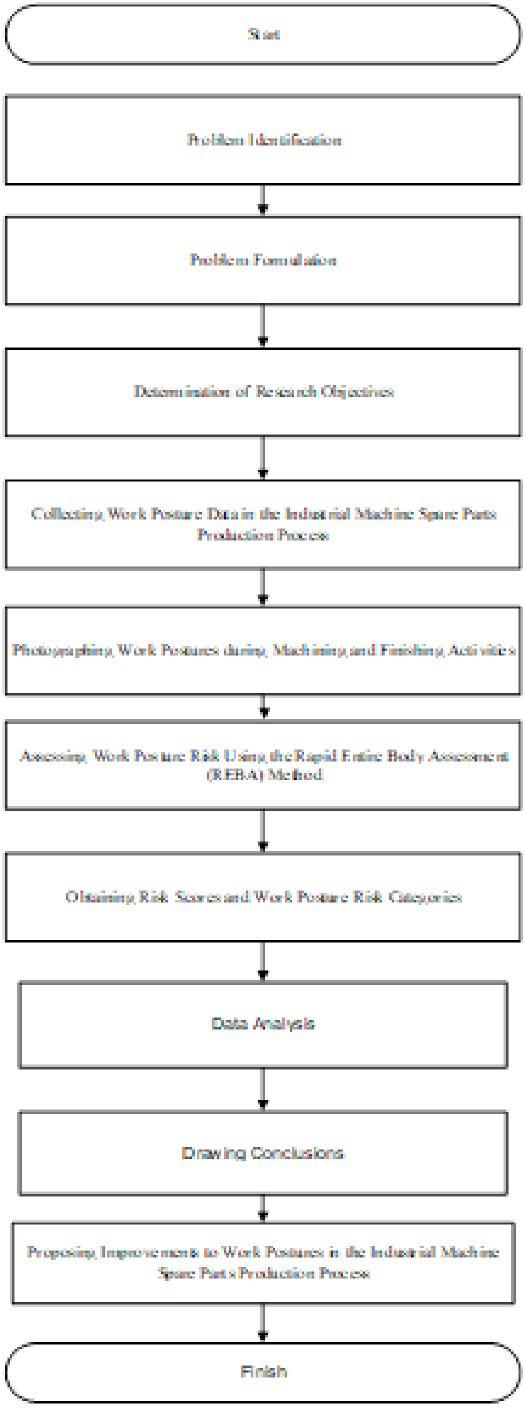

Figure 1.
Research Flowchart

3. RESULTS AND DISCUSSION

Operators work posture analysis was conducted at four main workstations in the industrial machine spare parts production process: lathes, milling, cylindrical grinding, and surface grinding. Each workstation was analyzed based on actual working conditions without any intervention or changes in work methods. This work posture assessment aims to identify the risk level of Musculoskeletal Disorders (MSDs) potentially experienced by operators due to non-ergonomic work postures during the production process.

The Rapid Entire Body Assessment (REBA) method was used as a tool because it can evaluate work posture comprehensively, encompassing all body segments involved in the operator's work activities, including the neck, trunk, legs, upper arms, lower arms, and wrists (Kurnia & Sobirin, 2020). The body segments analyzed include the neck, back or trunk, legs, upper arms, lower arms, and wrists. In addition to body posture, the REBA method also considers additional factors such as the workload handled, grip quality (coupling), and work activity characteristics, including movement frequency and duration.

The use of REBA in this study is considered relevant because the activity of operating machines in the spare part production process involves a combination of static and dynamic postures for prolonged periods, which significantly increases the biomechanical load on the body and elevates the risk of developing musculoskeletal disorders (Faudy & Sukanta, 2022; Yudiardi *et al*., 2021). The

REBA method can evaluate work posture comprehensively by encompassing all body segments involved in work activities, including the neck, trunk, legs, upper arms, lower arms, and wrists (Kurnia & Sobirin, 2020; Dewantari, 2021). The REBA worksheet used as a reference in the work posture assessment process is presented in Figure 2, while the documentation of operator work postures at each workstation is shown in Figures 3 to 7.

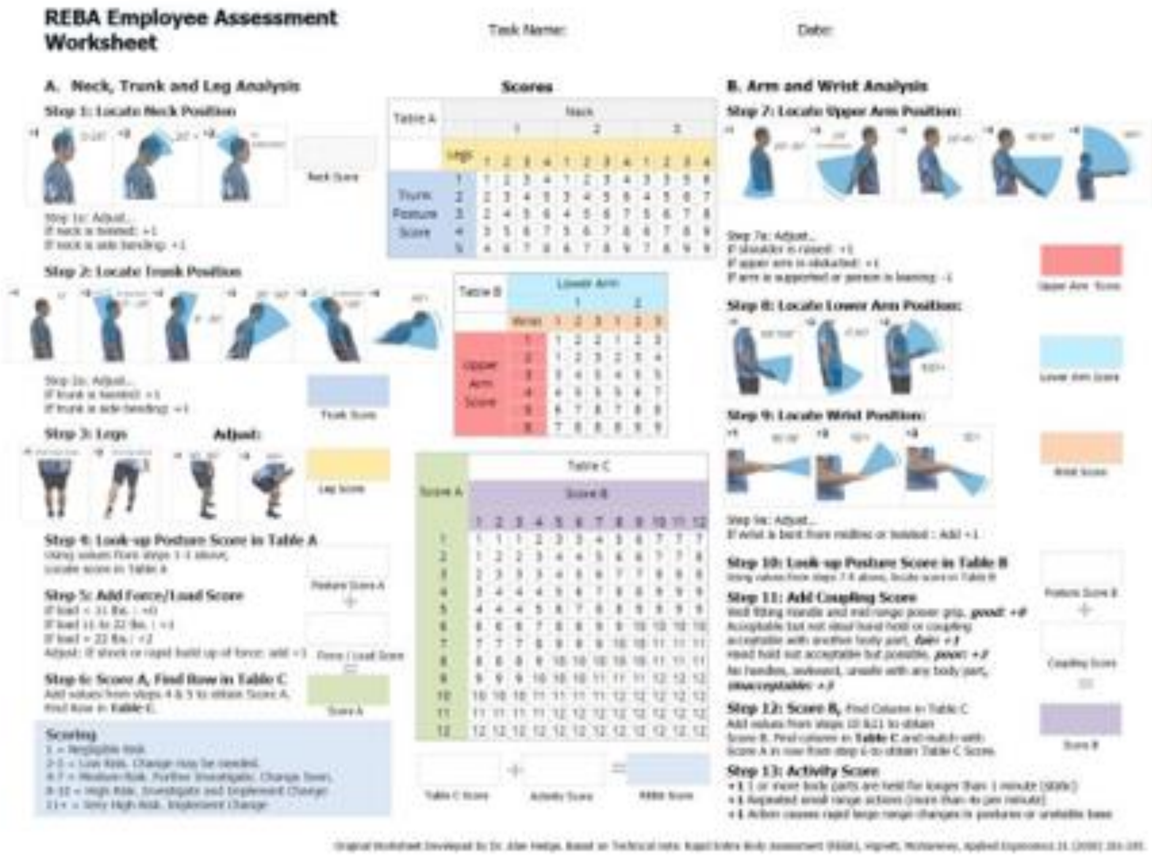

Figure 2.
Worksheet REBA

Figure 3.
Body Posture While Working

Figure 4.
Analysis of the Degree of Tilt of the Lathe Work Station

Table 1.
REBA Body Posture Score at Lathe Workstation

Skor	
Neck	2
Trunk	2
Legs	1
Upper Arms	1
Lower Arms	2
Wrist	3
Load Score	0
Coupling Score	0
Activity Score	1
Posture Score Tablel A	3
Posture Score Tablel B	3
Score A	3
Score B	3
Score C	3
REBA Score	4

A summary of the REBA scores for the lathe workstation is presented in the Lathe Workstation Body Posture Score Table. Based on the REBA score calculation, the final score was 4, which falls into the medium risk category. This condition indicates that further investigation and work posture improvements are needed soon.

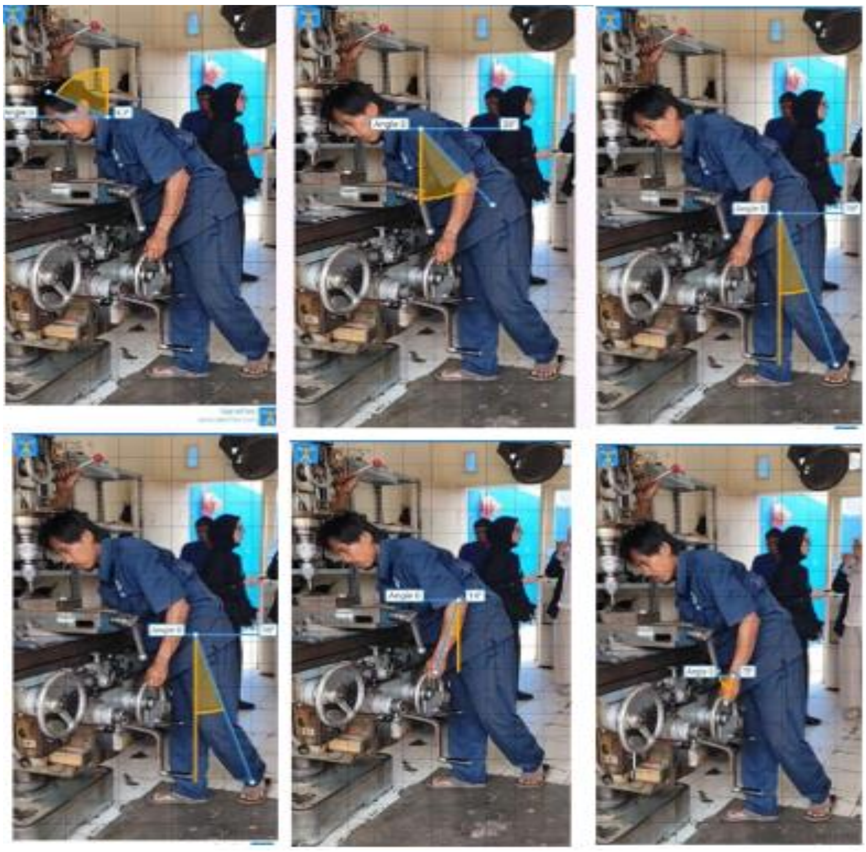

Figure 5.
Milling Workstation Inclination Degree Analysis

Based on the REBA calculation results summarized in the Milling Workstation Posture Score Table, the milling workstation has a REBA score of 7. This score falls into the moderate to high-risk category, indicating that work posture correction is necessary as soon as possible to prevent MSDs

Table 2.
REBA Body Posture Score at Milling Workstation

Skor	
Neck	2
Trunk	4
Legs	1
Upper Arms	3
Lower Arms	2
Wrist	3
Load Score	0
Coupling Score	0
Activity Score	1
Posture Score Tablel A	5
Posture Score Tablel B	5
Score A	5
Score B	5
Score C	6
REBA Score	7

Figure 6.
Analysis of the Degree of Inclination of the Cylindrical Grinding Workstatio

The analysis of the tilt of the operator's work posture at the cylindrical grinding workstation is shown in the Analysis of the Tilt of the Cylindrical Grinding Workstation. Observations indicate that the operator frequently performs activities with his upper arms raised and his neck bent for extended periods.

Table 3.
REBA Body Posture Score at Cylindrical Grinding Workstation

Skor	
Neck	3
Trunk	2
Legs	1
Upper Arms	3
Lower Arms	2
Wrist	2
Load Score	0
Coupling Score	0
Activity Score	1
Posture Score Tablel A	4
Posture Score Tablel B	5
Score A	4
Score B	5
Score C	5
REBA Score	6

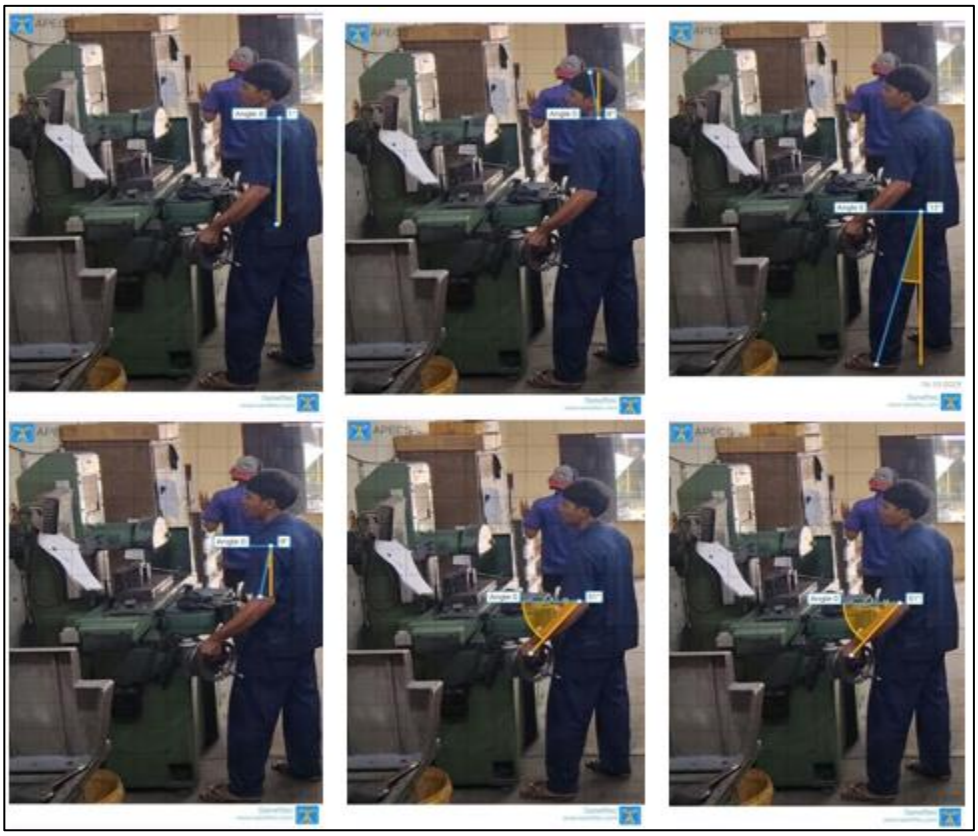

Figure 7.
Analysis of the Degree of Inclination of Surface Grinding Workstation

Table 4.
REBA Body Posture Score at Surface Grinding Workstation

Skor	
Neck	1
Trunk	2
Legs	1
Upper Arms	1
Lower Arms	2
Wrist	2
Load Score	0
Coupling Score	0
Activity Score	1
Posture Score Tablel A	2
Posture Score Tablel B	5
Score A	2
Score B	5
Score C	4
REBA Score	5

Based on the REBA calculation results presented in the Body Posture Score Table for the Surface Grinding Workstation, the REBA score is 5. This score falls into the moderate risk category, indicating that work posture improvements are still necessary, although the risk level is not as high as the milling workstation.

Table 5.
Recapitulation of REBA Scores at All Workstations

Stasiun Kerja	REBA *Score*					MSD's *Risk*
	Score A	*Score* B	*Score* C	*Activity Score*	*Total Score*	*Risk Level*
Bubut	3	3	3	1	4	*Medium Risk, Further Investigatio n, Change Soon*
Milling	5	5	6	1	7	
Cyndrical Grinding	4	5	5	1	6	
Surface Grinding	2	5	4	1	5	

The REBA score range falls into the medium risk category, meaning all workstations require further investigation and improved work posture soon. The identified MSD risks are primarily caused by hunched postures, bent neck positions, and static work activities performed for prolonged periods. Based on the risk levels identified at each workstation, ergonomic improvements are recommended to reduce MSD risk among operators. The primary recommendation is to adjust machine height by installing platforms or height-adjustable bases, enabling operators to work in a more neutral upright posture without excessive trunk or neck flexion. This intervention is particularly critical at the milling workstation, which recorded the highest REBA score of 7, primarily due to excessive trunk flexion (score 4), elevated upper arms (score 3), and extreme wrist deviation (score 3). Additional recommendations include the provision of anti-fatigue mats, periodic rest breaks, and operator training on proper ergonomic postures during machine operation.

4. CONCLUSION

Based on the results of the analysis of operator work postures using the Rapid Entire Body Assessment (REBA) method, it can be concluded that all operators at the four observed workstations exhibited non-ergonomic work postures. Operators at three of the four workstations tended to adopt forward-bending neck postures, resulting in the greatest degree of neck tilt compared to other body segments. This condition indicates a significant biomechanical load on the neck and upper back during work activities. The risk level for Musculoskeletal Disorders (MSDs) varied across workstations. The milling workstation recorded the highest REBA score of 7, followed by cylindrical grinding with a score of 6, surface grinding with a score of 5, and lathe with a score of 4. All workstations fall into the medium risk category, requiring further investigation and immediate posture improvement. These risk levels were influenced by several key factors, namely the degree of body tilt during work, workload characteristics, work duration, and the tendency for static postures to be maintained for prolonged periods. To reduce the identified MSD risks, ergonomic improvements are recommended, particularly adjusting machine height using platforms or height-adjustable bases to enable operators to work in a more neutral upright posture. This improvement is most urgently needed at the milling workstation, given its highest risk score among all observed workstations.

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