

INTISARI

Kegagalan baut nap roda belakang *dump truck* Isuzu Elf NMR 71 HD akibat *overloading* (11,97 ton) kerap diatasi mekanik melalui modifikasi destruktif perbesaran lubang ke baut M12. Penelitian ini bertujuan mengevaluasi keandalan baut standar M10 dan menganalisis optimasi peningkatan spesifikasi material maupun dimensinya guna mendapatkan solusi teknis yang paling aman dan andal.

Metode yang digunakan mencakup pengujian *optical emission spectrometry* (OES) untuk mengidentifikasi material baut eksisting. Evaluasi kekuatan dan keandalan baut terhadap beban aktual dianalisis melalui perhitungan tegangan *Von Mises*, *Mean Time Between Failure* (MTBF), serta pemenuhan *safety factor* (SF) menuju target batas aman dinamis $n \geq 3,0$.

Hasil uji menunjukkan baut M10 eksisting adalah *property class* 4.6 dengan SF kritis 1,13 dan umur pakai (MTBF) hanya 76,87 jam. Untuk mengatasi kegagalan tersebut, direkomendasikan dua opsi solusi akhir berdasarkan prioritas operasional: pertama, mempertahankan dimensi standar dengan menggunakan baut M10 *property class* 9.8 (dengan syarat penyesuaian muatan untuk mencapai target SF 3,0); atau kedua, melakukan modifikasi perbesaran lubang hub untuk baut M12 *Property Class* 8.8 yang terbukti menghasilkan ketahanan paling optimal terhadap beban penuh 11,97 ton dengan capaian *safety factor* sebesar 3,66.

Kata Kunci: *Stud Axle Shaft*, *Overloading*, *Safety Factor*, *OES*, *Von Mises*

ABSTRACT

Failure of the rear wheel hub bolts on the Isuzu Elf NMR 71 HD dump truck due to overloading (11.97 metric tons) is often addressed by mechanics through a destructive modification involving enlarging the bolt holes to accommodate M12 bolts. This study aims to evaluate the reliability of standard M10 bolts and analyze the optimization of material specifications and dimensions to identify the safest and most reliable technical solution.

The methods used included optical emission spectrometry (OES) testing to identify the material of the existing bolts. The evaluation of the bolts' strength and reliability under actual loads was analyzed through Von Mises stress calculations, Mean Time Between Failure (MTBF), and compliance with the safety factor (SF) to meet the target dynamic safety limit of $n \geq 3.0$.

Test results showed that the existing M10 bolts are property class 4.6 with a critical SF of 1.13 and a service life (MTBF) of only 76.87 hours. To address this failure, two final solution options are recommended based on operational priority: first, maintaining standard dimensions by using M10 bolts of property class 9.8 (provided that the load is adjusted to achieve the target SF of 3.0); or second, enlarging the hub hole to accommodate M12 Property Class 8.8 bolts, which have been proven to provide the most optimal resistance to a full load of 11.97 metric tons with a safety factor of 3.66.

Keywords: Stud Axle Shaft, Overloading, Safety Factor, OES, Von Mises