

INTISARI

Air spring merupakan salah satu komponen signifikan pada sistem suspensi bus *articulated* Scania K320IA yang berfungsi menopang beban kendaraan dan menjaga kestabilan kenyamanan selama operasi. Tingginya kejadian kerusakan *air spring* pada data aktual menunjukkan perlunya analisis keandalan dan penentuan strategi *preventive maintenance* yang berdasarkan data. Penelitian ini bertujuan menganalisis *reliability* dan umur pakai *air spring* menggunakan distribusi *Weibull*, mengidentifikasi mode kegagalan serta prioritas risikonya menggunakan *Failure Mode and Effect Analysis* (FMEA), dan menyusun rekomendasi *preventive maintenance*. Data yang digunakan mencakup data aktual *failure air spring* berdasarkan jarak tempuh kendaraan, hasil observasi, wawancara, dan pengujian *surface roughness* sebagai data pendukung kondisi fisik material. Analisis *Weibull* menghasilkan nilai parameter bentuk β sebesar 6,5092 dan parameter skala η sebesar 362.142,30 km. Nilai $\beta > 1$ menunjukkan karakteristik *wear-out failure*, yaitu kecenderungan tingkat kegagalan meningkat bersamaan bertambahnya jarak tempuh. Nilai *Mean Time To Failure* (MTTF) diperoleh mencapai 337.462,39 km. Hasil FMEA menunjukkan beberapa mode kegagalan utama, yaitu bocor udara, retak karet *air spring*, dan kerusakan struktural. Retak karet memiliki nilai *Risk Priority Number* (RPN) tertinggi sebesar 336 sehingga merupakan prioritas penanganan. Temuan *surface roughness* menunjukkan nilai kekasaran pada area retak lebih tinggi dibandingkan area yang relatif utuh, sehingga mendukung indikasi degradasi material. Berdasarkan integrasi hasil FMEA dan *Weibull*, direkomendasikan *preventive replacement* dan *inspection* untuk retak karet pada interval 300.000 km, *leak test* dan *sealing inspection* pada 50.000 km, serta visual *inspection* dan *lignment check* pada 30.000 km.

Kata kunci: *Air spring*, *Reliability*, *Weibull*, FMEA, *Preventive maintenance*.

ABSTRACT

Air spring is one of the significant components in the suspension system of the Scania K320IA articulated bus, functioning to support the vehicle load and maintain stability and passenger comfort during operation. The high incidence of air spring failures in the actual data indicates the need for reliability analysis and data-based preventive maintenance planning. This study aims to analyze the reliability and lifetime of air springs using the Weibull distribution, identify failure modes and their risk priorities using Failure Mode and Effect Analysis (FMEA), and develop preventive maintenance recommendations. The data used include actual air spring failure data based on vehicle mileage, field observations, interviews, and surface roughness measurements as supporting data for evaluating the physical condition of the material. The Weibull analysis resulted in a shape parameter (β) of 6.5092 and a scale parameter (η) of 362,142.30 km. The value of $\beta > 1$ indicates a wear-out failure characteristic, in which the failure rate tends to increase as mileage increases. The Mean Time To Failure (MTTF) was calculated to be 337,462.39 km. The FMEA results identified several major failure modes, namely air leakage, rubber cracking of the air spring, and structural damage. Rubber cracking had the highest Risk Priority Number (RPN) of 336, making it the highest priority for maintenance action. The surface roughness results showed that the roughness values in the cracked area were higher than those in the relatively intact area, supporting the indication of material degradation. Based on the integration of the FMEA and Weibull results, preventive replacement and inspection for rubber cracking are recommended at an interval of 300,000 km, leak testing and sealing inspection at 50,000 km, and visual inspection and alignment checks at 30,000 km.

Keywords: Air spring, Reliability, Weibull, FMEA, Preventive maintenance