



SURFACE VEHICLE STANDARD

J3226™

JUL2026

Issued 2022-12
Reaffirmed 2026-07

Superseding J3226 DEC2022

Voltage Regulation and Limits

RATIONALE

This document was developed to address voltage regulation and limits for 12 V, 24 V, and 48 V systems.

SAE J3226 has been reaffirmed to comply with the SAE Five-Year Review policy.

A reaffirmed status is given to technical reports that have been reviewed by the technical committee and deemed to be current with no need for immediate revision. No changes have been made to this document as a result of this review.

1. SCOPE

This document defines the test procedures and performance limits of steady state and transient voltage characteristics for 12 V, 24 V, or 48 V electrical power generating systems used in commercial ground vehicles.

1.1 Purpose

The purpose of this document is to apply voltage regulation limits and test methods at various alternator speeds and electrical loads as a function of alternator rating.

2. REFERENCES

2.1 Related Publications

The following publications are provided for information purposes only and are not a required part of this SAE Technical Report.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

SAE J56	Road Vehicles-Alternators with Regulators - Test Methods and General Requirements
SAE J180	Electrical Charging Systems for Off-Road Work Machines
SAE J1455	Recommended Environmental Practices for Electronic Equipment Design in Heavy-Duty Vehicle Applications
SAE J2232	Vehicle System Voltage - Initial Recommendations
SAE J2669	Voltage Regulators for Automotive-Type Generators

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Documents



Standard, visit Sharing Hub

2.1.2 ISO Publications

Copies of these documents are available online at <https://webstore.ansi.org/>.

ISO 8854 Road vehicles - Alternators with regulators - Test methods and general requirements

2.1.3 Military Publications

MIL-STD-1275D Characteristics of 28 Volt DC Electrical Systems in Military Vehicles

3. DEFINITIONS

3.1 RATED SPEED, n_R

Alternator rotational speed, in rpm, at which it supplies its rated current, I_R . The rated speed is specified at $n_R = 6000$ rpm for the purpose of this specification.

3.2 RATED CURRENT I_R

Minimum current, in amperes, which the alternator shall supply at test voltage, V_T , and rated speed, n_R .

3.3 ALTERNATOR OUTPUT

The maximum output in amperes that an alternator produces at a fixed speed. Load % expressed at a specific speed shall be the percentage of maximum output at that speed. At $n_R = 6000$, Alternator Output is equal to Rated Current.

3.4 NOMINAL VOLTAGE

The characteristic voltage of a vehicle's electrical storage system. It is equal to the nominal voltage of the battery used (i.e., 12 V, 24 V, 48 V).

3.5 WORKING VOLTAGE

The nominal output voltage of the vehicle's alternator, under normal conditions (i.e., 14 V for a 12 V battery, 28 V for a 24 V battery, 56 V for a 48 V battery) and is the vehicle's nominal battery charging voltage.

3.6 VOLTAGE RIPPLE

Peak-to-peak alternating current voltage component of the Working Voltage.

3.7 LOAD TRANSIENT

The changing conditions of voltage due to a sudden change in load. The resulting surge in voltage may extend beyond the Steady State Voltage Limits, returning to and remaining within the Steady State Voltage Limits within a specified time.

3.8 LOAD DUMP

A sudden reduction in vehicle electrical load during alternator operation that causes a momentary increase in voltage.

3.9 LOAD SURGE

A sudden increase in vehicle electrical load during alternator operation that causes a momentary reduction in voltage.

3.10 STEADY STATE VOLTAGE LIMITS

An upper and lower limit for the electrical system voltage operating range in stabilized conditions, typically expressed in relation to the Working Voltage and may or may not include Voltage Ripple.

4. TEST CONDITIONS

- 4.1 The tests shall be carried out at an ambient temperature of $25\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$. The actual test temperature shall be recorded on all published performance reports.
- 4.2 A battery and an adjustable resistor, R, shunted to the battery, are used in the measuring circuit as shown in Figure 1. Voltage test point location shall be at the battery terminals (V_b) with respect to the battery negative.
- 4.3 The tests shall be conducted using a fully charged battery of the correct nominal voltage (drawing less than 2% of the Amp-Hour rating, expressed in Amps, at its Working Voltage). Specific battery type (i.e., lead-acid, lithium ion, etc.) to be as agreed between vehicle manufacturer and alternator manufacturer.
- 4.4 Test Equipment Connection Diagram

Connections shall be made in accordance with Figure 1. Each line voltage drop (V_1 and V_2) shall not exceed 0.25 V for a 12 V system, 0.5 V for a 24 V system, or 1.0 V for a 48 V system, for all test conditions. Excitation circuit to switch on the voltage regulator shall be active only after the alternator is rotating.

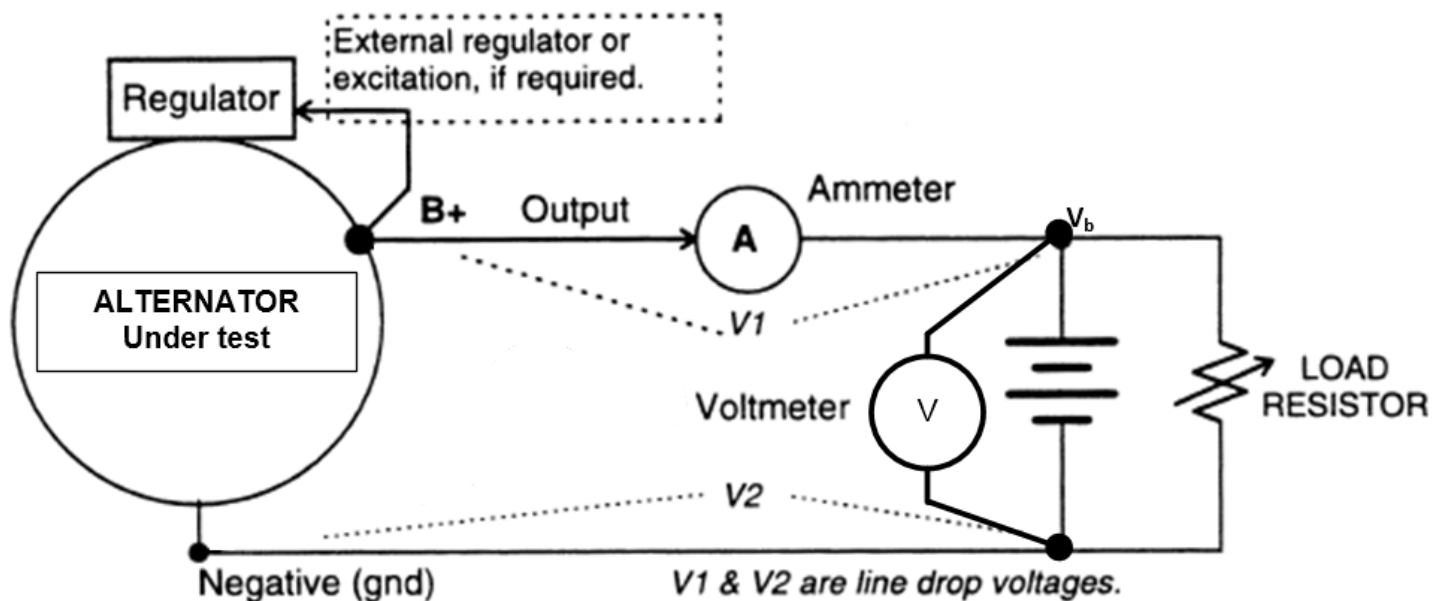


Figure 1 - Test connection diagram

4.5 Steady State Voltage Limits

Steady State Voltage Limits establishes the allowable voltage range for Voltage Ripple Testing with battery connected.

- For 12 V systems, Steady State Voltage Limits (including $\pm 2.5\text{ V}$ ripple) are 10.0 to 17.5 V (12.5 to 15 V Working Voltage).
- For 24 V systems, Steady State Voltage Limits (including $\pm 5.0\text{ V}$ ripple) are 20 to 35 V (25 to 30 V Working Voltage).
- For 48 V Systems, Steady State Voltage Limits (including $\pm 10\text{ V}$ ripple) are 40 to 70 V (50 to 60 V Working Voltage).

Note that Working Voltages remain within the $\leq 60\text{ VDC}$ limit.