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**Road vehicles — Alternators with  
regulators — Test methods and general  
requirements**

*Véhicules routiers — Alternateurs avec régulateurs — Méthodes d'essai  
et conditions générales*

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Published in Switzerland

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## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 8854 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 3, *Electrical and electronic equipment*.

This second edition cancels and replaces the first edition (ISO 8854:1988), which has been technically revised.

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# Road vehicles — Alternators with regulators — Test methods and general requirements

## 1 Scope

This International Standard specifies test methods and general requirements for the determination of the electrical characteristic data of alternators for road vehicles.

It applies to alternators, cooled according to the supplier's instructions, mounted on internal combustion engines.

## 2 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

### 2.1

#### alternator frequency

$n_G$

alternator rotational frequency in reciprocal minutes ( $\text{min}^{-1}$ )

### 2.2

#### cut-in speed

$n_A$

alternator rotational frequency, in reciprocal minutes ( $\text{min}^{-1}$ ), at which the alternator begins to supply current when speed is increased for the first time, depending on pre-exciting power (input), speed changing velocity, battery voltage, residual flux density of the rotor, and regulator characteristics

### 2.3

#### efficiency

$\eta$

alternator efficiency calculated from the measured values of voltage, current, speed and torque

### 2.4

#### minimum application speed

$n_L$

alternator rotational frequency, in reciprocal minutes ( $\text{min}^{-1}$ ), which corresponds approximately to the idling speed of the engine

### 2.5

#### minimum application current

$I_L$

current, in amperes, which is delivered by a warmed-up alternator at test voltage  $U_t$  and minimum application speed  $n_L$

### 2.6

#### rated current

$I_R$

minimum current, in amperes, which the warmed-up alternator shall supply at a speed  $n_R = 6\,000 \text{ min}^{-1}$  and at test voltage  $U_t$

NOTE The mean value minus twice the standard deviation should be stated unless the customer has requested otherwise.

### 2.7

#### rated speed

$n_R$

alternator rotational frequency, in reciprocal minutes ( $\text{min}^{-1}$ ), at which the alternator supplies its rated current,  $I_R$ , specifying the rated speed as  $n_R = 6\,000 \text{ min}^{-1}$

**2.8**  
**test voltage**

$U_t$   
specified value, in volts, at which the current measurements shall be carried out

**2.9**  
**weighted efficiency**

$\eta_W$   
speed-evaluated mean value of efficiency at different alternator speeds

**2.10**  
**zero-amp. speed**

$n_0$   
alternator rotational frequency, in reciprocal minutes ( $\text{min}^{-1}$ ), at which the alternator reaches the specified test voltage,  $U_t$ , without any current output

NOTE When plotted on a graph, this is the point at which the current/speed characteristic  $I = f(n)$  intersects the abscissa.

**3 Test conditions**

**3.1 Ambient temperature**

Tests shall be carried out at an ambient temperature of  $T_{\text{amb}} = (23 \pm 5) \text{ }^\circ\text{C}$  and may optionally also be performed at higher temperatures.

**3.2 Air pressure**

Tests shall be carried out at the standard atmospheric pressure.

Deviating conditions (e.g. measuring location, altitude, weather) shall be recorded.

**3.3 Sense of rotation**

Sense of alternator rotation shall be in accordance with the supplier's specification.

**3.4 Drive control**

The drive control shall meet the set alternator frequency values with a limit deviation of  $(n_{G \text{ set}} \pm 5) \text{ min}^{-1}$ .

**3.5 Load current control**

The load current control shall meet the requested set current values with a limit deviation of  $(I_{\text{Set}} \pm 1,0) \text{ A}$ .

**3.6 Measuring accuracy**

The test equipment shall allow measurements of all parameters to be carried out within the limit deviations specified in Table 1.

Table 1 — Accuracy of test equipment

Parameters	Limit deviation
Voltage	$\pm 0,1$ % of measured value
Current	$\pm 0,2$ % of measured value
Torque	$\pm 0,5$ % of rated value of torque sensors
Rotational frequency	$\pm 2 \text{ min}^{-1}$
Ambient temperature	$\pm 1 \text{ K}$
Air pressure	$\pm 5 \text{ hPa}$
Test period	$\pm 1 \text{ s}$

### 3.7 Measured values

All measured values shall be obtained at the end of each holding time of an operating point.

Each data record shall comprise at least the following measured values:

- $n_{\text{G actual}}$  alternator rotational frequency (actual value = measured value);
- $I_{\text{G actual}}$  alternator current (actual value = measured value);
- $U_{\text{G}}$  alternator voltage;
- $M$  alternator torque, if needed;
- $T_{\text{amb}}$  ambient temperature;
- $t_{\text{M}}$  time of acquisition of measured values from start of testing.

## 4 Test equipment

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### 4.1 Ambient air

#### 4.1.1 Flow rate

The input air flow within the alternator area shall be constant and reproducible. The maximum permissible flow rate shall be limited to 1 m/s.

#### 4.1.2 Direction of flow

The direction of the air flow within the alternator area shall be constant and reproducible. If possible, the air should flow from bottom to top.

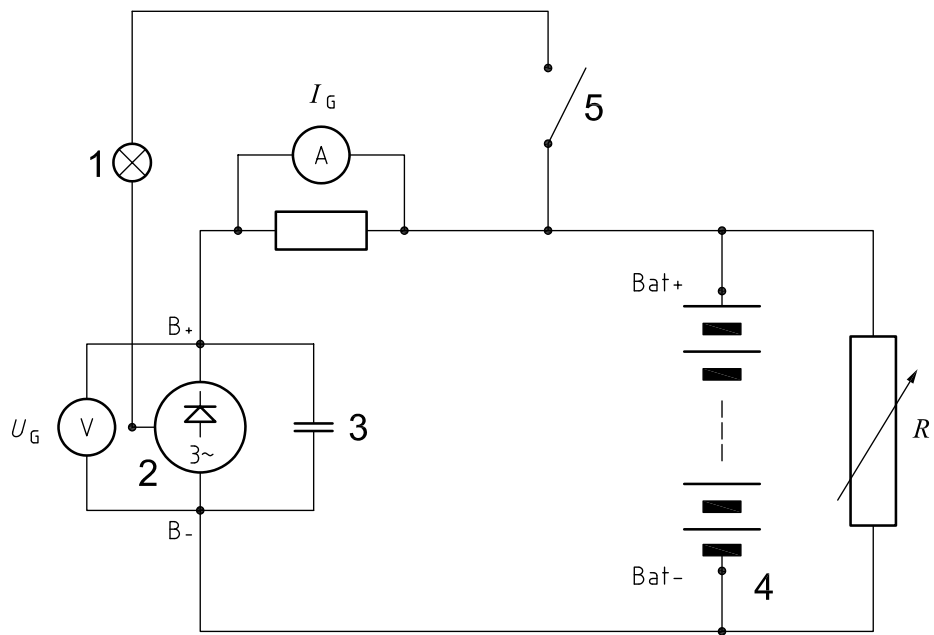
#### 4.1.3 Measurement of ambient temperature

The measuring point is located on the B side of the alternator (slip ring end, shield side) in line with the shaft and at a distance of  $(10 \pm 1)$  cm from the protective cap.

The spatial extent of the sensitive part of the temperature probe shall be limited to a cube with edges of 20 mm in length.

### 4.2 Terminal connecting plan

For the tests, connections shall be established according to Figure 1. During the tests, the ignition switch is “on”.



**Key**

- 1 load control lamp
  - 2 D+ or L- lamp connection alternator
  - 3 optional filter capacitor or test stand
  - 4 battery/storage device
  - 5 ignition lock, terminal 15
- $I_G$  alternator current  
 $R_L$  load resistor  
 $U_G$  alternator voltage

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**Figure 1 — Test circuit schematic**

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**4.2.1 Voltage measurement**

A voltmeter shall be connected directly to the output terminal(s) and/or alternator housing.

**4.2.2 Filter capacitor C (optional)**

A capacitor should be connected to the output terminals of the alternator. The connecting cable shall be as short as possible.

- Capacitor type: polarized electrolytic capacitor
- Capacity: 68 000  $\mu$ F
- Connecting cable: cross-section of at least 4 mm<sup>2</sup>, maximum cable length (2 × 1) m, copper

**4.3 Measuring system**

The measuring system shall record the parameters to be measured. Voltage, current, speed and torque shall be measured simultaneously. If parameters are recorded subsequently, there shall be no more than 1 s between the measurements of the first and last parameter.



## 5 Measurement procedure

### 5.1 Current/rotational frequency characteristic

This measurement shall be performed at full load. The alternator works at full load when the regulator duty cycle is 100 %, i.e. when the full excitation current is available.

In the measuring circuit, a battery and an adjustable resistor,  $R_L$ , shunted to the battery shall be used (see Figure 1).

The tests shall be conducted using a power-storing device (e.g. lead-acid battery, Li-ion battery or large capacitors).

The measurements shall be carried out using an integral or separate regulator.

To prevent the regulator from working, measurements shall be made at the following test voltages (for lead-acid batteries):

- (13,5 ± 0,1) V for 12 V systems;
- (27 ± 0,2) V for 24 V systems.

NOTE Measurements at other voltages are optional.

#### 5.1.1 Warm tests — Rotational frequencies and measuring points

Current measurements shall be taken at the following rotational frequencies (in  $\text{min}^{-1}$ ). At each operating point, the alternator shall reach equilibrium steady-state temperature before current values are recorded.

In order to simplify the measuring set-up, this should be ensured by specifying a set holding time for each operating point:

1 500 – 1 800 – 2 000 – 2 500 – 3 000 – 3 500 – 4 000 – 5 000 – 6 000 – 8 000 – 10 000 – 12 000 –  $n_{\text{max}}$

The power adsorbed by the alternator shall be calculated at these measuring points.

The current/rotational frequency characteristic shall be indicated by the following four points:

a) Cut-in speed,  $n_A$

Increase the alternator rotational frequency slowly ( $50 \text{ min}^{-1}/\text{s}$  to  $100 \text{ min}^{-1}/\text{s}$ ) until the charge indicator system indicates the commencement of battery charging, and record this speed.

This applies only if the regulator does not affect the timing.

b) Zero-amp. speed,  $n_0$  (indirect measurement)

Reduce the alternator rotational frequency until an alternator output current between 5 % of  $I_R$  and 2 A, but not less than 2 A, is reached. Record the speed and current. To determine the zero-amp. speed, record a second speed/current point in the linear part of the characteristic, i.e. the zero-amp. speed shall be determined by extrapolation of the current/rotational frequency characteristic until the abscissa is intersected.

c) Minimum application current,  $I_L$

Adjust the alternator rotational frequency to the idling speed of the engine (typically  $n_L = 1\,800 \text{ min}^{-1}$ ) and record the alternator output current,  $I_L$ .

d) Rated current,  $I_R$

Adjust the alternator rotational frequency to  $n_R = 6\,000 \text{ min}^{-1}$  and record the alternator output current,  $I_R$ .

## 5.1.2 Short-form tests

### 5.1.2.1 Short-form warm test

The alternator shall be warmed up until it reaches thermal equilibrium at fixed speed time and ambient temperature,  $T_{amb}$ .

The voltage shall be constant and equal to the test voltage,  $U_t$ , during the warm-up and the measuring period.

The warm-up current measurements shall then be taken at least at the following rotational frequency values in reciprocal minutes ( $\text{min}^{-1}$ ):

1 500 – 1 800 – 2 000 – 3 000 – 4 000 – 6 000 – 8 000 – 10 000 – 12 000 –  $n_{max}$

If desired, further intermediate values may be recorded and the zero-amp. speed may be determined.

The test time after warm-up shall not exceed 30 s, with constant variation of speed.

Warm-up time and speed shall be in accordance with the vehicle manufacturer's specification (typical values are 20 min to 45 min at 3 000  $\text{min}^{-1}$ , 5 000  $\text{min}^{-1}$  and 6 000  $\text{min}^{-1}$ ).

### 5.1.2.2 Short-form cold test

The whole alternator shall have an ambient temperature of  $(23 \pm 5)$  °C.

Current measurements shall be taken at ambient temperature  $T_{amb} = (23 \pm 5)$  °C at least at the following rotational frequency values in reciprocal minutes ( $\text{min}^{-1}$ ):

1 500 – 1 800 – 2 000 – 3 000 – 4 000 – 6 000 – 8 000 – 10 000 – 12 000 –  $n_{max}$

If desired, further intermediate values may be recorded and the zero-amp. speed may be determined.

The test time shall not exceed 30 s with constant variation of speed.

## 5.2 Partial load measurement

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During partial load tests, the current shall be kept constant by regulating the load  $R_L$ . The voltage shall be controlled by the regulator. The regulator duty cycle shall be less than 100 %.

## 5.3 Testing functional ability of regulator

The alternator shall be run at rated rotational frequency and rated current until the temperature of the regulator becomes stable. The load shall then be reduced slowly to 5 A and a check shall be made to ensure that the stabilized voltage does not rise above the alternator voltage specified by the supplier.

NOTE The regulator setting is specific to the vehicle manufacturer.

## 5.4 Load dump

A "load dump" is a voltage peak caused by the magnetic energy stored in the alternator and the dump of a load or an interruption of a cable. A critical load dump for the alternator and the system is a dump of a large load at high speed. The load dump time shall be measured as the time from the dump of a load until the regulator returns to the previous condition (see Figure 3). See also ISO 7637-2.