

ANNEX III

Essential requirements specific to speedometers for measuring the instant speed of road traffic vehicles from a static site or on board vehicles

1. Terminology

1.1. Optical speedometer

Optical speedometer utilizes light beams in the visible or infrared region of the electromagnetic spectrum. The speed of the vehicle may be determined either by processing the reflected energy, or by measuring the time intervals between the interruptions of beams that happen when a vehicle passes through the beam.

a) Laser barrier.- Double or triple light barrier that consists in laser emissions and other detectors. These emissions and detectors mark the moment of interruption of the light beam, or the cut-off of the dipped beam caused by the vehicle. The existing distance between light barrier, and the time between consecutive beam cut-offs, is measured.

b) Laser gun.- This speedometer operates under 'distance/time' concept. Speed is determined by measuring the flying time of a series of short light pulses generated by infrared laser diodes. When such pulses hit against an objective, the diodes reflect, filter and detect them. Time between the pulse generation and the pulse detection is measured by a microprocessor-controlled system.

1.2. Sensor speedometer

Sensor speedometer utilizes cables and other devices which are set up on the road in such a way that, when a vehicle passes on them, their physical properties suffer some changes. Generally, they include piezoelectric bands inserted on the road. When pressure is applied, such bands generate pulses for measuring cut-off time.

1.3. Doppler speedometer (Radar)

Doppler speedometer utilizes a continuous wave transceiver in the microwaves band. Such microwaves operate under Doppler's principle.

1.4. Other

Artificial vision, ultrasound and resolution speedometers, etc.

2. Components and operation

2.1. Components

Generally, a speedometer consists in the following interconnected and communicated elements:

- a) Antenna or catch sensor. – Element for measuring or detecting the vehicle to be measured. It transfers radio frequency power and, for radars, receives reflected power.
- b) Control element. – Location of the microprocessor that controls and governs the whole process and the electronic of the equipment.
- c) Photographic section. - Location of the camera and the measurement data records.
- d) Flash. - For complementing the photographic section.
- e) Other. - A speedometer may be provided with a remote and manual device that controls the most basic functions.

2.2. Signal simulator: A speedometer shall be provided with the corresponding simulators, which shall be capable of generating pulses or appropriated signals for speed simulation tests.

2.3. Doppler effect. – A speedometer that utilizes Doppler Effect is called radar. Generally, it consists in a receiving and transmitting antenna, an assessing element, and a photographic device. Such speedometers shall meet the following requirements:

- a) The peak power for the main emission lobe shall be at least 15 dB above the secondary lobe power in direct measurements; and at least 30 dB above after reflection.
- b) The width of the main lobe at 3 dB shall not exceed 7 ° in the horizontal plane; or 9 ° in the vertical plane. Mechanical axis deviation from a radiation axis shall not be more than 0.5 °.

Clauses a) and b) shall not be mandatory, provided that the instrument can unambiguously detect, control and identify the objective through the measurement process.

- c) On the basis of the frequency, f_d , of the simulated Doppler signal, the theoretical speed, v , shall be calculated with the following formula:

$$v = 0.5 \cdot f_d \cdot \lambda / \cos \alpha$$

where,

λ is the wave length of the radiation emitted by the radar; and
 α is the angle of incidence from the axis of the road.

- d) Microwave circuits shall ensure frequency stability better than 0.15 % for one year.

2.4. Sensor speedometer. – A sensor speedometer shall be designed to obtain speed measurements from signals emitted by the sensors. If more than one speed value is obtained, the resulting speed value shall be the average of partial speeds, which may not differ in more than 2 km/h.

2.5. Optical speedometer. – An optical speedometer shall be provided with means that allow checking its actual alignment with the light beam. The emission power of speedometers that utilize laser radiations shall not be harmful to human eye. Therefore, it shall not exceed Class 1, according to recommendations in Standard CEI-EN 60825-1/A1:2003, and recent editions, for security of laser products.

2.6. Other speedometers. – A speedometer that utilizes other kind of technology shall demonstrate fulfil the requirements established in this Order, and meet protection, security and stability criteria.

3. Specific requirements

a) A speedometer shall be designed in such a way, that all its elements can operate independently and can show the results to be tested separately.

b) A speedometers shall be connected to a recording device or photograph record. The correspondence between a vehicle, whose speed is measured by the speedometer, and the vehicle appearing in the recording, shall be ensured. The vehicle, whose speed is measured, shall be unambiguously identified in the recording. The indication by photograph record shall meet the requirements indicated in operation, and shall at least include the following information:

- measurement date and time;
- offender's speed;
- if both directions are measured, the direction in which the offender was driving shall be indicated;
- identification of the instrument that makes the measurement.

c) A speedometer shall indicate the speed of the vehicle being controlled. For instruments installed in vehicles in motion, the speed of the vehicle where speedometers are installed shall be indicated. In the last case, determination of the speed of both vehicles shall be simultaneously made.

d) A speedometer shall include a calibration device that allows the simulation of one or more representative speeds of those measured in practice. Such signals shall be independent of measurement circuits, and shall be able to check the functioning of all circuits that make the measurement in the speedometer.

e) A speedometer shall include a speed-selection device to identify the speeds that exceed a predetermined value.

f) The result of every measurement, equal or greater than the value predetermined by the speed-selection device, shall remain displayed either until the operator takes action; or until the following measurement. It shall not be possible to make the following measurement before a three-second period, when the result has been removed, except if it has been registered.

g) A speedometer shall not measure the speed of vehicles in both directions simultaneously, when it is not possible to ensure these measurements.

h) In order to ensure the measurement, at least two pictures taken at the offender, at different moments, shall be required for those speedometers which are installed, fixed, and designed for operating under circumstances where an operator cannot be constantly controlling the functioning specifications. One of the pictures shall show a panoramic view of the vehicle; the other, the identification plate. All these provided that the instrument is able to unambiguously detect, control and identify the objective during the measurement process.

i) The installation of a speedometer shall be carried out by means of a device that allows its adjustment in a steady manner, according to manufacturer instructions. Its contribution to relative uncertainty of the measurement system shall not be greater than 0.5 %.

j) There shall not be any speed indication when supply voltage ranges out of the limits for which the permissible errors may be exceed.

k) A speedometer shall not display the speed when two or more vehicles, with different speeds, enter the measurement field simultaneously. Except if the instrument is able to unambiguously detect, control and identify the objectives through the measurement process.

4. Maximum permissible errors (MPE)

a) Type examination:

<i>Type of installation</i>	<i>Maximum permissible errors</i>	
	For laboratory tests (by signal simulation)	For road tests (real traffic)
Fixed or static installation	± 2 km/h	± 3 km/h, to $v \leq 100$ km/h ± 3 %, to $v > 100$ km/h ± 1 km/h ¹⁾
Mobile installation		± 5 km/h, to $v \leq 100$ km/h ± 5 %, to $v > 100$ km/h

1) Average error of all the results obtained in the type approvals.

b) Product verification; verification after repair or modification:

<i>Type of installation</i>	<i>Maximum permissible errors</i>	
	For laboratory test (by signal simulation)	For road tests (real traffic)
Fixed or static installation	± 2 km/h, to $v \leq 200$ km/h	± 4 km/h, to $v \leq 100$ km/h ± 4 %, to $v > 100$ km/h

Mobile installation	± 3 km/h, to $v > 200$ km/h	± 6 km/h, to $v \leq 100$ km/h ± 6 %, to $v > 100$ km/h
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c) Periodical verification:

<i>Type of installation</i>	<i>Maximum permissible errors</i>	
	For laboratory test (by signal simulation)	For road tests (real traffic)
Fixed or static installation	± 2 km/h, to $v \leq 200$ km/h	± 5 km/h, to $v \leq 100$ km/h ± 5 %, to $v > 100$ km/h
Mobile installation	± 3 km/h, to $v > 200$ km/h	± 7 km/h, to $v \leq 100$ km/h ± 7 %, to $v > 100$ km/h

5. Other requirements

For speed simulation tests, an appropriated simulation assembly for every type of speedometer shall be provided.

- a) It shall be provided with input and output of information, such as CAN bus, RS 232 ports or similar. There shall be the possibility of transmitting information through radio to a control centre; or of verifying it for comparison.
- b) The securing possibilities available in a speedometer against fraudulent use shall be such, that it shall be possible to protect each element of the system separately.
- c) A speedometer shall be designed in such a way that it can conform the maximum permissible errors without adjustment for one year of normal use.
- d) The real-time clock shall keep track of the time of the day and the date. The following requirements apply:
 - The timekeeping accuracy shall be the 0.02 % of the time;
 - The correction possibility of the clock shall be not more than 2 minutes per week;
 - Correction for summer and winter time shall be performed automatically.

6. Protection

6.1. Communications

- a) If a speedometer is able to communicate with other external or interior devices, the interfaces required for such communications shall be secured in such a way, as to not interfere in the normal functioning of the speedometer.

b) Data transfer to a central control system shall only be possible only if the speedometer is protecting these data against any accidental or intentional interference in transmission.

c) Data transfer from a central control system shall meet the following requirements:

- All the metrologically relevant parts of this control system shall be subject to this Order.
- A speedometer shall communicate the evidence of correct data reception to the central system. This evidence shall be easily checked at anytime, in the speedometer and in the central system.

6.2.) Software

The software system including metrological relevance, programs, parameters or specific data that belong to the measurement system, shall be identified by a version number. Such number shall be adapted and modified for any software change that affects the functions and the accuracy of the speedometer.

When it is not possible to secure, by seals or other hardware security means, the access to parameters that take part in measurement results, the following shall be considered in order to ensure the protection:

- a) Authorized personnel shall only be allowed to access by means of codes, keys and passwords.
- b) At least the last intervention of an operator will be registered or memorized. The record shall at least include the date and an identification means of the authorized person making the intervention.

Software documentation submitted by manufacturer shall include:

- (a) A description of the relevant software;
- (b) A description the accuracy of measuring algorithms (e.g. rounding algorithm when calculating the speed);
- (c) A description of the user interface, menus and dialogues;
- (d) The unambiguous software identification;
- (e) A description of the software system;
- (f) Protection means for the software;
- (g) The operating manual;
- (h) Other information relevant for the software characteristics

7. Inscriptions and seals

7.1 Inscriptions

a) Mandatory inscriptions. - A speedometer or every unit composing it shall include the following indelible and readable indications:

- name or registered trademark of manufacturer or its representative;
- type name, serial number and year of manufacture;
- space for official marking.

b) Optional inscriptions. – A speedometer may bear other inscriptions approved by the competent body, providing that such inscriptions do not make difficult the reading of the indications submitted with the instrument.

7.2 Seals

The devices, which use may lead to measurement errors or to metrological security reduction, shall be sealed.

Location and nature of such seals shall be described in the technical memory presented for the type examination