	Technical Specification for Verification and Inspection of Radar Speedometers	S/N	CNMV 91															
		Rev.	2															
<p>1. These Technical Specifications are developed pursuant to Paragraph 2, Articles 14 and 16 of the Weights and Measures Act.</p> <p>2. The date of promulgation, document number, date of enforcement and content of amendment are listed as follows:</p> <table><tr><th>Rev.</th><th>Date of Promulgation</th><th>Document No. (Ching-Piao-Szu-Tsu)</th><th>Date of Enforcement</th><th>Content of Amendment</th></tr><tr><td>1</td><td>13.06.2003</td><td>No.09240005540</td><td>01.07.2003</td><td></td></tr><tr><td>2</td><td>24.12.2009</td><td>No.09840006640</td><td>01.01.2011</td><td>1.Clearly define the proper range of applications for radar speedometers for official inspection, as well as the categories 2.Amend the general requirements to radar speedometers to meet its intend used. 3.Add the measurement of speed detecting at the two points of 50 km/h and 110 km/h for each type of radar speedometers applying for the first time for the initial verification to confirm the speed value consistency of the main part and the image recording device 4. The maximum permissible errors are stipulated for the width of the parallel beam of the antenna on radar speedometers with and without photo-taking device respectively 5. The maximum permissible errors of verification are the same as those of inspection</td></tr></table>				Rev.	Date of Promulgation	Document No. (Ching-Piao-Szu-Tsu)	Date of Enforcement	Content of Amendment	1	13.06.2003	No.09240005540	01.07.2003		2	24.12.2009	No.09840006640	01.01.2011	1.Clearly define the proper range of applications for radar speedometers for official inspection, as well as the categories 2.Amend the general requirements to radar speedometers to meet its intend used. 3.Add the measurement of speed detecting at the two points of 50 km/h and 110 km/h for each type of radar speedometers applying for the first time for the initial verification to confirm the speed value consistency of the main part and the image recording device 4. The maximum permissible errors are stipulated for the width of the parallel beam of the antenna on radar speedometers with and without photo-taking device respectively 5. The maximum permissible errors of verification are the same as those of inspection
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<p>3. Reference standards:</p> <p>OIML R91 Radar equipment for the measurement of the speed of vehicles</p> <p>DOT HS 810 845 Speed-Measuring Device Performance Specifications: Across-the-Road Radar Module</p>																		
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1. Scope:

1.1 This specification applies to radar speedometers with and without photo-taking device (hereafter “radar speedometer”) subject to verification and inspection for law-enforcement applications. A radar speedometer means a device that detects vehicle speeds by using the frequency of Doppler signal.

1.2 Radar speedometers installed on roadside transmit an unmodulated continuous microwave beam (CW) across the roadway, monitor the signals reflected from moving vehicles crossing the microwave beam for the vehicle speeds and display vehicles’ speed. When a vehicle’s speed exceeds the preset speed, the radar speedometer display the vehicle’s speed and preserves the displayed vehicle speed’ readings until manual actuation or records the image of the vehicle automatically.

1.3 This specification is not apply to:

- (1) Photo-taking device equipped radar speedometers with the axis of the main radiation beam of the transmitting antenna are parallel to the direction of the vehicle’s movement.
- (2) Modulated radar speedometers.
- (3) Radar speedometers detecting vehicles’ speed when the radar speedometer equipped on a moving patrol car.

2. Terms and definitions

2.1 Main beam of antenna radiation

The beam of the antenna has the peak power value in far-field radiation patterns.

2.2 Horizontal beam width of the antenna:

The total included acute angle, in the horizontal plane, of the main lobe between the half-power points of the radar antenna far- field radiation patterns.

2.3 Doppler signal

The magnitude of the frequency change of the radar return signal received when the radar’s reflecting target is in motion.

2.4 Cosine Effect:

The effect due to the moving direction of vehicles and the signal of the radar speedometer do not in parallel.

2.5 Density of power:

The magnitude of uniform microwave passes through a unit plane perpendicular to the direction of microwave.

2.6 Side lobes:

Radar beams from the antenna which are not part of the primary radar beam, but which may appear as shoulders on the main radar beam.

2.7 Function of irregular signal identification:

When two vehicles with different speeds pass simultaneously through the microwave beams, the detecting shall be invalid.

3. General requirements:

3.1 When each type is sent for initial verification for the first time, the following documents shall be provided:

3.1.1 documents to identify the radar speedometer under test is for specific used.

3.1.2 a temperature-resistant test reports issued by an impartial domestic third-party; the test procedure shall be as follows:

Put the radar speedometer under test with power off into a thermostated container. The temperature shall be increased to a constant 70°C with the temperature change not exceeding 1°C/min and holds at 70°C for two hours. Then, cool down the temperature of the thermostated container with the temperature change not exceeding 1°C/min. Take the radar speedometer under test out when the temperature of the thermostated container less than 60°C, and implement the verification of speed detection accuracy described in paragraph 6.5. The results of accuracy of speed detection shall be the same as those of the maximum permissible errors on verification.

3.1.3 user manuals and product specifications (including operation instructions, electrical specifications of the radar speedometer, with or without photo-taking device, measurement method, error range, complete assembly drawing, versions of software, related technique data, etc.)

3.1.3.1 for radar speedometers without photo-taking device with the axis of the main beam of the antenna radiation is parallel to the direction of the vehicle's movement, it shall include:

If a DC power supply is used, a low-voltage indication function shall be built-in.

3.1.3.2 for radar speedometers without photo-taking device with the axis of the main beam of the antenna radiation is not parallel to the direction of the vehicle's movement, it shall include:

(1) The descriptions of sensitivity setting, Cosine Effect, speed measurement, the layout of installation locations, etc.

(2) Having the function of direction discrimination, the function of the certainty of vehicle identification.

(3) If a DC power supply used, a low-voltage indication function shall be equipped.

(4) The angle of incidence formed by the axis of the main beam of the antenna radiation and the road shall be between 15° ~30°.

- (5) Describing the proper relation between the targeting direction of the camera and the direction of the radiation beam of the radar speedometer and the assembly drawing or the picture of the camera and the radar of speedometer showed in the user's manual.
 - (6) A photo showing the serial number of the speedometer, the direction of the target vehicle, the plate number, time (including year, month, day, hour and minute), speed, and location, etc.
- 3.2 The model of radar speedometer and the angle of incidence shall be installed and used correctly, according to its original factory's manual. Under no circumstance can the speedometer be modified, replaced or adjusted.
- 3.3 Under no circumstance can a radar speedometer whose axis of the main beam of the transmitting antenna radiation is parallel to the direction of the vehicle's movement be equipped a photo-taking device to the radar speedometer whose axis of the main beam of the transmitting antenna radiation is not parallel to the direction of the vehicle's movement.
- 3.4 After a radar speedometer passes verification, no any software or hardware can be used to switch to the detection model and affect its accuracy.
4. Verification and Inspection Equipment:
- 4.1 The evaluation of the uncertainty to the verification and inspection equipment: shall be down before the verification and inspection equipment can be used and the verification and inspection equipment shall be traceable to national standards. The requirements for the equipment shall include:
 - (1) The equipment for the antenna, spectrum analyzer and electromagnetic field strength meter: the frequency range shall cover the frequency bands of X, Ku, K, and Ka.
 - (2) The equipment for a low-frequency signal transmitter: the frequency range shall at least cover from 100 Hz to 100 kHz.
5. Structure
- 5.1 On the main part of the radar speedometer shall bear the following information:
 - (1) Name or trademark of the manufacturer.
 - (2) Model number and the serial number.If the antenna and the main part are separable, the aforementioned information shall be marked on the antenna and the main part respectively.
 - 5.2 The main part of the radar speedometers shall bear the specification of power supply.
 - 5.3 When a radar speedometer is sent for initial verification, it shall conform to the contents of the operating Instructions, and its entire system shall be sent for verification. When for re-verified, the main part of a radar speedometer and its

aerial and accessories shall be sent to for verification with its power cord and signal connection line for testing.

5.4 All the switches, buttons, and knobs of the main part of the radar speedometer and its accessories shall be function smoothly and reliably. There shall be no mal-contact, loosening or malfunction which will interrupt the operation.

5.5 The speed indication of a radar speedometer shall be displayed in digital.

5.6 The value indicating speed on a radar speedometer shall be displayed simultaneously, clearly and unambiguously.

5.7 The speed indication of a radar speedometer shall be expressed as kilometers per hour (km/h).

5.8 The resolution of the speed indication of a radar speedometer shall be ≤ 1 km/h.

5.9 The speed detection range of a radar speedometer shall at least cover the range from 25 km/h to 199 km/h.

6. Verification and inspection procedure:

6.1 The structure and specifications of radar speedometers shall be verified and inspected in accordance with the following items and order:

- (1) Structure,
- (2) Microwave transmitter frequency,
- (3) Radiation field type of transmitting antenna,
- (4) Density of microwave radiation power,
- (5) Speed detection accuracy.

6.2 The method of testing the microwave transmitter frequency is as follows:

- (1) Put the radar speedometer under tested 2 meters away from the front of the receiving antenna. Both shall be on the same axis and face to face, as shown in Figure 1.
- (2) Connect the output of the horn antenna to a spectrum analyzer.
- (3) After the radar speedometers under tested and the spectrum analyzer have switched on for 30 minutes, read the data from the spectrum analyzer which receives the signal frequency transmitted from radar speedometer under tested.

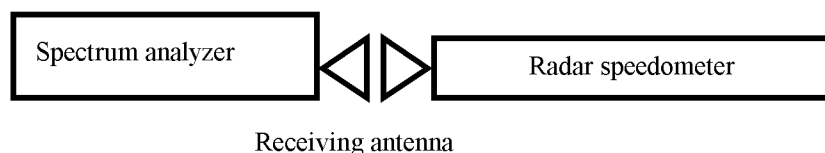


Figure. 1: Equipment installation for the verification of transmitting frequency

6.3 The testing for the radiation field type of the transmitting antenna is to verify the half power of the beam width (HPBW) of radiation field type of a radar speedometer and the corresponding relationship of the main beam and side lobes.

Testing procedures are as follows:

- (1) This test shall be performed in a full electric wave darkroom, as shown in Figure 2.
- (2) In the darkroom, put the speedometer under tested on a rotation table. The receiving antenna is installed 2 meters away from the speedometer on the other side of the room.
- (3) The output of the receiving antenna is connected to a spectrum analyzer and a recorder outside of the darkroom.
- (4) After the radar speedometer under tested and the spectrum analyzer have switched on for 30 minutes, have the radar speed detector under tested make a 360° rotation and transmit signals.
- (5) Use a spectrum analyzer to measure the strength of the microwave signal transmitted by the antenna of the radar speedometer in different angles and produce the radiation field type figure of the antenna of radar speedometer via the recorder.
- (6) Derive the width of the horizontal beam of the antenna of the radar speedometer, the corresponding size of the main beam and side lobes from the radiation field type

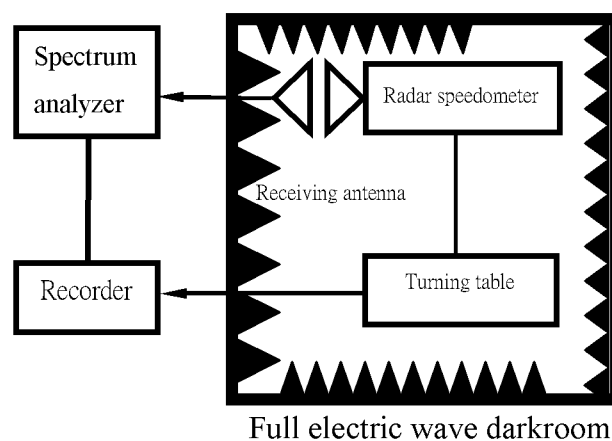


Fig. 2: Equipment installation for detecting accuracy

6.4 The testing procedures to verify the density of the microwave radiation power are as follows:

- (1) Put the radar speedometer under tested in a full electric wave darkroom and have the radar speedometer transmit microwaves, as shown in Figure 3.
- (2) Use an electromagnetic field meter to measure the electromagnetic field's strength of the antenna of the radar speedometer. The probe shall be about 5 cm away from the instrument and the measurement shall be taken around the instrument. Record the maximum electromagnetic field strength.

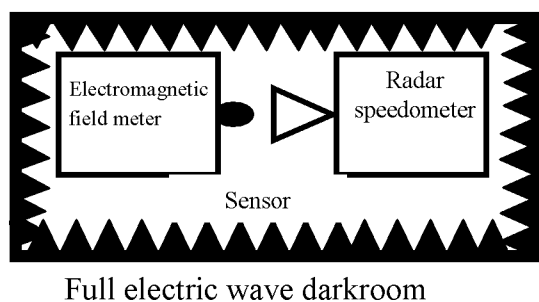


Figure. 3: Equipment installation for the verification of the density of microwave radiation power

6.5 The verification of speed detection accuracy uses a low-frequency signal transmitter and mixer to simulate Doppler signals. The verification procedures are as follows:

- (1) In a full electric wave darkroom, the radar speedometer under tested is placed at one end of the darkroom. Two horn antennas are installed 2 meters away from the instrument at the other end of the darkroom, transmitting and receiving microwave respectively, as shown in Figure 4.
- (2) After the radar speedometer and low frequency signal transmitter have switched on for 30 minutes, the verification procedure can be started. .
- (3) Make one of the input of the mixer receive the signal emitted by the radar speedometer while a low frequency signal transmitter connects to the other input of the mixer and inputs input corresponding Doppler signal.
- (4) Make the antenna of the radar speedometer receive the signal emitted by the mixer after the mixer produces the corresponding signal. The radar speedometer shall display the corresponding speed simultaneously.
- (5) When the axis of the main beam of the antenna radiation is parallel to the direction of the vehicle's movement, the formula shall be used:

$$V_d = 0.5 \times f_d \times \lambda$$

Where V_d : corresponding speed (m/s)

f_d : Doppler frequency (Hz)

λ : wavelength of the signal transmitted by the radar speed detector being tested (m)

- (6) When the axis of main beam of the antenna radiation is not parallel to the direction of the vehicle's movement, the formula shall be used:

$$V_d = 0.5 \times f_d \times \lambda / \cos \alpha$$

Where α : Average effective angle of incidence

- (7) When verification of speed accuracy being implemented, following speed shall at least be tested: 25, 50, 60, 70, 90, 100, 110, 150 and 199 km/h.

- (8) When each type of a radar speedometer with photo-taking device is sent for initial verification for the first time, the two points of 50 km/h and 110 km/h shall be measured with photos being taken, so as to confirm the consistency of speed value of the main part and the image record device.

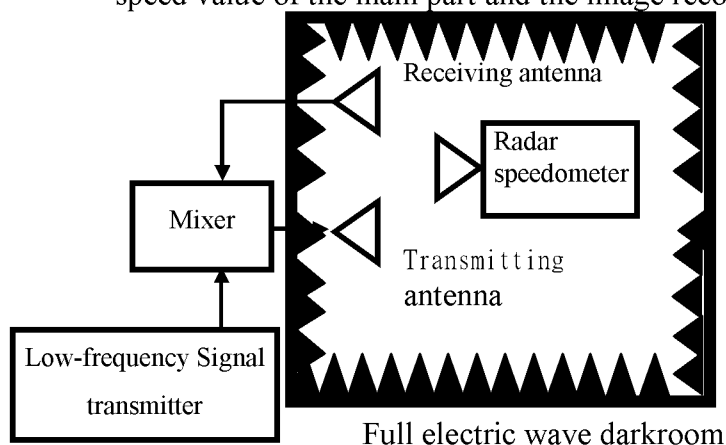


Figure. 4: Equipment installation for detecting accuracy

7. Maximum permissible errors for verification and inspection

7.1 The maximum permissible errors regarding verification for a radar speedometer are as follows:

- (1) Microwave transmitting frequency: $\pm 0.2\%$ of working frequency.
- (2) When the axis of the main beam of the transmitting antenna radiation is not parallel to the direction of the vehicle's movement, the width of the parallel beam of the antenna: less than 6 degree at -3 dB the place (half power points), or less than 12 degree at the place of -10 dB.
- (3) When the axis of the main beam of the transmitting antenna radiation is parallel to the direction of the vehicle's movement, the width of the parallel beam of the antenna: less than 24 degrees at -3 dB the place (half power points).
- (4) The difference between the main beam and side lobes of the transmitting antenna: larger than 15 dB.
- (5) Microwave radiation power strength: less than 5 mW/cm², at a distance of 5cm.
- (6) Accuracy of speed detection: not larger than 1km/h when the speed is less than 150 km/h, or not larger than 2km/m when speed is not less than 150km/h

7.2 The verification report of the radar speedometer shall record the serial number of the radar speedometer under tested. If the antenna and the main part are separable, the report shall record the serial numbers of the antenna and the main part respectively.

7.3 The maximum permissible errors for inspection is the same as the those of for verification.

7.4 The period of validity of verification is 1 year, commencing from the day that a verification compliance mark is affixed to the speedometer and expiring on the first day of the following month of the next 12 months.

8. The verification compliance marks

8.1 The placement of verification compliance tag of radar speedometer shall be obvious, and stuck on the cover of the main part. If the antenna and the main part are separable, the verification compliance tag shall be stuck on the antenna and the main part respectively.

8.2 After the speedometer passes verification, a verification compliance certificate shall be granted.

9. Date of Enforcement

9.1 This version goes into force on Jan. 1, 2011. However, for radar speedometers that have passed the initial verification before the revision of this specification goes into force, they shall be applied to the revision of this specification since Dec. 31, 2012.