Transmitted by the expert from
the People's Republic of China

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Exchange of information on national and international requirements

Note: The text reproduced below has been prepared by the experts from the People's Republic of China in order to seeking comments on draft Chinese National Standard on TPMS.

REQUEST FOR COMMENTS ON DRAFT STANDARD FOR TPMS

A draft standard on TPMS is under development in the People's Republic of China, which will be enforced as the voluntary one at the first stage and may be mandatory in future.

The draft Standard is developed with reference to related provisions set out in FMVSS 138 "Tyre Pressure Monitoring System", ISO21750: 2006 "Road Vehicles--Safety Enhancement in Conjunction with Tyre Pressure Monitoring System", and SAE J 2657: 2004 "Tyre Pressure Monitoring Systems for Light Duty Highway Vehicles".

The draft Standard sets out the performance requirements and test methods for tyre pressure monitoring systems (TPMS) for motor vehicles.

The draft Standard applies to the TPMS installed onto motor vehicles and it may be taken as reference for implementation by TPMS installed on other vehicle categories.

The draft standard and its Compilation Explanation are attached as Annex 1 and Annex 2 to this document.

Any comment or opinion would be appreciated.

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ANNEX I

ICS 43.040.10
T35

National Standard of the People's Republic of China

GB/T XXXX－XXXX

Tire Pressure Monitoring Systems for Motor Vehicles

(Draft for Comments)

Issued on 20XX-XX-XX

Effective from 20XX-XX-XX

Promulgated by
State General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China
And
Standardization Administration of the People's Republic of China

Foreword

This Standard is developed with reference to related provisions set out in FMVSS138 “Tyre Pressure Monitoring System”, ISO21750: 2006 “Road Vehicles--Safety Enhancement in Conjunction with Tyre Pressure Monitoring System”, and SAEJ2657: 2004 “Tyre Pressure Monitoring Systems for Light Duty Highway Vehicles”.

This is the first release of this Standard.

This standard was proposed by National Development and Reform Commission.

This Standard is under the jurisdiction of National Automotive Standardization Technical Committee.

This Standard was drafted by: China Automotive Technology and Research Center etc.

The institutes take part in the draft of this Standard:

This Standard was mainly drafted by:

Tire Pressure Monitoring Systems for Motor Vehicles

1 Scope

This Standard sets out the performance requirements and test methods for tyre pressure monitoring systems (TPMS) for motor vehicles.

This Standard applies to the TPMS installed onto motor vehicles; it may be taken as reference for implementation by TPMS installed on other vehicle categories.

2 Normative reference documents

The following documents contain provisions which, through reference in this text, constitute requirements of this Standard. For dated reference, subsequent amendments (exclusive of the content of corrigenda) to, or revisions of, these publications do not apply. However, parties to agreements based on this Standard are encouraged to investigate the possibility of applying the latest editions of the documents indicated below. For undated references, the latest edition of the normative documents shall apply.

GB/T 2423.17-93	Basic environmental testing procedures for electric and electronic products--Test Ka: Salt mist
GB/T 2423.22-2002	Environmental testing for electric and electronic products--Part 2: Test method--Test N: Change of temperature
GB/T 4942.2-93	Degrees of protection provided by enclosures for low-voltage apparatus
GB14023-2006	Vehicles, boats and internal combustion engine driven devices--Radio disturbance characteristics--Limits and methods of measurement
GB/T 17619-1998	Limits and methods of testing for immunity of electrical and electronic sub-assemblies in vehicles to electromagnetic radiation
GB 18655-2002	Limits and measurement methods--Radio disturbance characteristics for protection of receiver used on board vehicle

GB/T 19951-2005	Road Vehicles--Test methods for electrical disturbance from electrostatic discharge
GB/T 21437.2-2008	Road Vehicles--Electrical disturbances from conduction and coupling--Part 2: Electrical transient conduction along supply lines only (ISO 7637-2: 2004, IDT)
GB/T 21437.3-XXXX	Road Vehicles--Electrical disturbances from conduction and coupling--Part 3: Electrical transient transmission by capacitive and inductive coupling via lines other than supply lines (ISO/DIS 7637-3, IDT)
GB/T XXXX.3	Road Vehicles--Environmental conditions and testing for electrical and electronic equipment--Part 3: Mechanical loads (ISO16750-3, IDT)
GB/T XXXX.4	Road Vehicles--Environmental conditions and testing for electrical and electronic equipment--Part 4: Climate loads (ISO16750-4, IDT)
QC/T 413-2002	Basic specifications for electrical equipment of motor vehicles
	Radio Management department of China [2005] 423 Technical Specifications for Micro-power (short-distance) Radio Equipment "(No. eleven) Radio Control
ISO 20653: 2006	Devices for Various Types of Civilian Equipment"
	Road Vehicles--Protection degrees (IP code) Protection of electrical and electronic equipment against foreign matters, water and contact

3 Terms and definitions

The following terms and definitions shall apply to this Standard.

3.1 Tire Pressure Monitoring Systems (TPMS)

Means an auxiliary system fitted onto a vehicle which could monitor, in a real-time pattern, parameters including tyre pressure, in addition to displaying and giving an alarm by visible signals (and audio signals, if any), so as to enhance the driving safety of vehicles while reducing any accelerated tyre wear and escalated fuel consumption resulted from under-inflated tyres.

3.1.1 TPM Sensor

Means the assemblage of elements installed inside the tyre or on the surface of wheel, intended for measuring tyre pressure, etc. and conducting information transmission. It comprises sensor, transmitter and so on.

3.1.2 Receiver

Means a component intended for receiving, processing the information from the TPM module and transmitting visual signals to the display module. In some cases, it also includes the display module.

3.1.3 Display Module

Means a device intended for displaying the alarm pictograph, information of pressure value (temperature value being optional), and literal prompts; it comprises the human-machine interface for the selection and setting of system functions.

3.2 Cold Tyre Inflation Pressure (P_{rec})

Means the pressure value recommended, through considering the pre-established operating conditions of the vehicle type concerned, by the vehicle manufacturer for tyres at each position.

4 Requirements

4.1 General requirements for system

4.1.1 The outer surface of each system component shall be clean, smooth and leveled, without any such defect as indent, scratch, crack, or deformation.

4.1.2 Each component shall be made of such material that the TPMS could have a sufficient mechanical strength and lifespan.

4.1.3 The system shall merely receive and process the information transmitted by each TPM sensor installed on the vehicle concerned.

4.1.4 The system shall preclude any possibility of any erroneous alarm.

4.1.5 Operating temperature range of system

The system shall function normally in the ambient temperature of -40ºC~55ºC. As for the working and preservation temperatures of each system component, see Table 1.

Table 1 Temperature range

Unit: ºC

	Lower limit working temperature	Lower limit storage temperature	Upper limit working temperature	Upper limit storage temperature
TPM sensor	-40	-40	105	125
Receiver	-40 (Display module: -20)	-40	85 (Display module: 70)	95

4.2 Basic functions of system

4.2.1 when TPMS is turned ON, the self-diagnosis shall start immediately; meanwhile, the fault alarm indicator shall be lighted up; the system self-diagnosis shall end within 6s. The fault alarm indicator shall go out unless a malfunction exists with the system; in case of a system malfunction, a fault alarm shall be given.

4.2.2 one or more tyres falls below the under-inflation value pres-set by the manufacturer (i.e., 75% of P_{rec} indicated by manufacturer), TPMS, when under the operation mode, shall give the under-inflation alarm signal within 6s, in addition to locating the tyre(s) concerned.

4.2.3 one or more tyres decreases at a rate more than 30kPa/min, TPMS, when under the operation mode, shall give the rapid leak alarm signal within 1 minute, in addition to locating the tyre(s) concerned.

4.2.4 malfunction occurs with the system itself, TPMS, when under the operation mode, shall give the alarm signal within 10 minutes.

4.2.5 The system shall have the display function of current tyre pressure values. TPMS, when under the operation mode, shall be capable of accessing, in a real-tie manner, to the pressure value information of each tyre.

4.2.6 Display and alarming mode of system information

4.2.6.1 pictographs, numerals, etc.) shall be definite and easily readable.

4.2.6.2 In case of under-inflation alarming, a yellow indicator (refer to Figure 1 for an example) shall be lighted up, and maintained until the elimination of such a under-inflation state; meanwhile, the concerned tyre shall be correctly located by means of pictograph or literal description; in case of a four-wheel vehicle, it is recommended to adopt the pictograph as shown in Figure 2, in addition to marking the under-inflated tyre.

4.2.6.3 In case of rapid leak alarming, a yellow indicator (refer to Figure 1 for an example) shall be lighted up in the blinking mode, and maintained in such a way until the elimination of the rapid leak state; meanwhile, the concerned tyre shall be correctly located by means of pictograph or literal description; in case of a four-wheel vehicle, it is recommended to adopt the pictograph as shown in Figure 2, in addition to marking the rapid leak tyre.

4.2.6.4 In case of the system malfunction alarm, the display may adopt either of the following modes:

a) In case the malfunction alarming uses the same indicator as intended for the under-inflation alarming and rapid leak alarming, the yellow indicator (refer to Figure 1 for an example) shall be lighted up and maintained.

b) In case the malfunction alarming uses an indicator other than that intended for the under-inflation alarming and rapid leak alarming, the yellow dedicated malfunction alarming indicator (refer to Figure 3 for an example) shall be lighted up and maintained, until the malfunction is eliminated.

4.2.6.5 The yellow indicator and the yellow dedicated malfunction alarming indicator shall be installed, in front of the driver's seat, inside the passenger compartment, which shall be clearly visible.

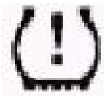

Figure 1

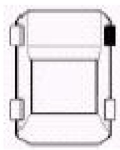

Figure 2

Figure 3

4.3 Signal receiving performance after installation onto vehicle

4.3.1 Signal receiving performance in standstill

When the vehicle is in standstill, the system could, while in the operation mode, stably receive the signals from TPM sensors, irrespective of the orientation of the wheel for test.

4.3.2 Signal receiving performance when in motion

When the vehicle is in motion, the system could stably receive the signals from TPM sensors.

4.4 Pressure measurement errors of system

The pressure measurement errors of system shall meet the requirements of Table 2. The error between the displayed pressure of any tyre and the inflation pressure for test shall not exceed the numeral given in Table 2; as for all the tyres of complete vehicles, provided the same test pressure is inflated under the same temperature, the difference of displayed tyre pressure values between any two tyres shall not exceed the numeral (absolute) given in Table 2.

Table 2 Pressure measurement errors of system **Unit: kPa**

	Applicable tyre pressure range	Temperature range	
		-20~70ºC	-40~125ºC (Excluding -20ºC~70ºC)
Error	100~450 ±8		±14
	100~700 ±12		±21
	100~1,400 ±24		±42

4.5 Radio communication transmitting characteristics of system

The system shall comply with the requirements of "Radio management department of China No. [2005] 423 Technical Specifications for Micro-power (short-distance) Radio Equipment '(No. eleven) Radio Control Devices for Various Types of Civil Equipment' ". Specifically, after each TPM sensor is installed inside the wheel hub/tyre assembly, the transmitting power, when modulated at the logic 0-1 interval, shall not exceed -20dBm (e.r.p effective value detector), or the maximum transmitting field intensity at the XYZ direction shall not exceed 70dBμV/m (maximum polarization direction, 3m peak detector, resolution bandwidth 9KHz). The frame length of high-frequency information shall not exceed 10ms, and the cumulative transmitting time of high-frequency signals within any 4s monitoring duration shall not exceed 40 ms. In case of a system using the low-frequency signals (≤125kHz), the transmitting field intensity of each low-frequency transmitter, when modulated at the logic 0-1 interval, shall not exceed 50dBμA/m (maximum polarization direction, 1m quasi-peak detector, resolution bandwidth 200Hz); the frame length of low-frequency information shall not exceed 20ms, and the cumulative transmitting time of low-frequency signals within any 4s monitoring duration shall not exceed 2s.

4.6 Electromagnetic compatibility (EMC)

4.6.1 Electromagnetic disturbance characteristics

Provided that the system operation is tested on a complete vehicle, the test results shall comply with the limit values for complete vehicles; provided that the test is conducted individually with the sub-systems, the test result shall meet the Class 1 requirements shown in Table 11 "Limits of narrowband disturbance radiated by components (Narrowband Electromagnetic disturbance + peak detector)" of GB 18655-2002.

4.6.2 Immunity to electromagnetic disturbance

The system operation shall be tested as per GB/T 17619-1998. In the process of the test, the functional states of the system shall attain Class A on all the frequency points except for those intentionally emitted.

4.6.3 Immunity to electrical transient conduction

Any receiver which is energized by the on board power supply shall be tested according to GB/T 21437.2-2008. Pulse interferences are applied during the system operation, and the system shall meet the requirements below:

-- For pulses 1 and 4, the functional state shall attain Class C, and the memory shall attain Class A state.

-- For pulses 2a, 2b, 3a, 3b, 5a and 5b, the functional state shall attain Class A.

4.6.4 Resistance to electrostatic discharge

The system or component shall be tested according to GB/T 19951-2006. After the test, the system functions shall attain Class A state.

4.7 Resistance of receiver to abnormal voltage of power supply

4.7.1 Resistance to polarity reversal of power supply

The receiver shall be capable of withstanding the 1-minute test of polarity reversal of power supply, without presenting any damage. Voltage for the test: 14±0.2V in case of a 12V electric system; 28V±0.2V in case of a 24V electric system. After the test, there shall be no electric malfunction, except for the fuse. The system shall comply with the provisions of Paragraph 4.2.

4.7.2 **Resistance to overvoltage of power supply**

The receiver shall be capable of withstanding the test of a certain value overvoltage; in case of a 12V electric system, refer to Table 3 for the test parameters. In case of a 24V electric system, it shall be determined through the joint consultations between vehicle manufacturer and supplier. After the test, various system functions shall be satisfactorily maintained. The system shall meet the provisions of Paragraph 4.2.

Table 3 Resistance to overvoltage of power supply

	Test voltage	Test time
Long-time overvoltage	$17V_{-0.2V}$	1h
Short-time overvoltage	$26V_{-0.2V}$	1min

4.8 **Climatic environment adaptability**

At the end of each climatic environment test, TPMS shall present no electric malfunction; the plug-in of each component shall be free of any noticeable distortion; and its basic functions shall be maintained in a satisfactory state. After the test, the pressure measurement error of TPMS shall comply with the requirements of Paragraph 4.4.

4.9 **Mechanical environment adaptability**

At the end of each mechanical environment test, TPMS shall be free of any permanent structural distortion; each component shall be free of any damage or electric malfunction; any fastened component shall be free of any sign of loosening; the plug-ins (plug, communication interface, etc) shall be free of either disengagement or bad contact, with the basic functions maintained in a satisfactory state. After the test, the pressure measurement error of TPMS shall comply with the requirements of Paragraph 4.4.

4.10 **Protection performance of system**

The protection degree of both the receiver and display module of TPMS shall attain IP5K3 as specified in ISO 20653 (Protection degrees of road vehicles (IP code) Protection of electrical and electronic equipment against foreign matters, water and contact); that of TPM sensor mounted inside tyre shall attain IP6K4; and that of TPM sensor mounted outside tyre shall attain IP6K6. After each component undergoes the dust-proof and water-proof tests, the system shall maintain its basic functions, with the pressure measurement error complying with the requirements of Paragraph 4.4.

4.11 Lifespan of TPM sensor

Unless it is not energized by cells, the TPM sensor shall have a lifecycle longer than 6 years or 100,000km after installation onto a matchable vehicle type.

5 Test method

5.1 General requirements

5.1.1 Test conditions

Unless otherwise specified, all tests shall be conducted under the conditions below:

a) Environmental temperature: Indoors 18ºC~28ºC; outdoors 0ºC~40ºC;

b) Ambient relative humidity: 45%~75%;

c) Atmospheric pressure: 86kPa~106kPa;

d) The rated voltage of power supply shall be used for the tests, i.e., 14V±0.1V in case of a 12V electric system, and 28V±0.2V in case of a 24V electric system;

e) Power supply for the tests: automotive batteries or a rectified constant-voltage power supply with the ripple coefficient not exceeding 0.1%.

5.1.2 Measurement instrumentation

a) Pressure gauges and pressure transducers: the digital type shall be used, with the measurement range adaptive to the working pressure of the tested samples, precision no lower than ±0.5% of the full scale, and the minimum scale division being 1kPa.

b) Precision timers: The precision is no lower than 0.1s, with the minimum scale division being 0.01s.

c) Tyre turning angle meters in compliance with the testing requirements of Paragraph 5.4.1, with the minimum scale division being 1º.

d) In-motion deflation devices complying with the deflation rate specified in Paragraph 5.4.2; if mounted onto the test vehicle, the in-motion deflation device shall not bring any noticeable impacts to TPMS.

e) Velocity measuring devices, with the precision no lower than 1%.

5.2 **Appearance inspections**

Visually check the appearance and construction of each component of TPMS, and the provisions of Paragraph 4.1.1 shall be met.

5.3 **Testing of basic system functions**

The tests of basic functions can be conducted either on a complete vehicle or on a test bench capable of simulating the normal installation and operating states of the system.

5.3.1 **Test of self-diagnostic function of system**

Inflate all the tyres up to the P_{rec} as marked on the vehicle (or marked on the tyre inflation pressure label). Turn the ignition switch from the “OFF” position to the “ON” position, and TPMS shall execute the system self-diagnosis according to Paragraph 4.2.1.

5.3.2 **Test of under-inflation alarming**

a) Inflate all the tyres up to the P_{rec} as marked on the vehicle (or marked on the tyre inflation pressure label). With the vehicle being in standstill and the ignition switch at the “OFF” position, adjust the tyre pressure so that the pressure of one or more tyres is 7kPa lower than 75% P_{rec} value as specified by the manufacturer.

b) Turn the ignition switch from the “OFF” position to the “ON” position, and record the duration from the moment when the ignition switch is turned to the “ON” position up to the moment when the under-inflation alarm indicator begins continuous light-up, which shall meet the provisions of Paragraph 4.2.2.

c) Visually check whether the under-inflation tyre located by the indicator is correct.

d) Turn the ignition switch to the “OFF” position.

e) Inflate all the tyres up to the P_{rec} as marked on the vehicle (or marked on the tyre inflation pressure label). Turn the ignition switch from the “OFF” position to the “ON” position, and verify that the under-inflation alarm indicator goes off.

5.3.3 **Test of rapid leak alarming function**

a) Inflate all the tyres up to the P_{rec} as marked on the vehicle (or marked on the tyre inflation pressure label). With the vehicle being in standstill and the TPMS being in operation, continuously deflate, for 1 minute, one or more tyres at the rate of 30~35kPa/min.

b) Record the duration from the moment when the deflation commences up to the moment when the rapid leak alarming indicator starts lighting up in the blinking mode, which shall meet the provisions of Paragraph 4.2.3.

c) Visually check whether the under-inflation tyre located by the indicator is correct.

d) After the deflation stops, the rapid leak alarming indicator shall go off within 1 minute.

5.3.4 Test of malfunction alarming

a) Inflate all the tyres up to the P_{rec} as marked on the vehicle (or marked on the tyre inflation pressure label).

b) With the TPMS in operation, simulate the failed state of TPMS, e.g., by cutting off power supply of some TPMS elements, or cutting off the electrical connection among some TPMS elements, or installing a tyre running contradiction with the TPMS. During the simulation of a TPMS malfunction, the electrical connection of the malfunction alarming indicator shall not be cut off.

c) Record the duration from the moment when a malfunction occurs up to the moment when the TPMS malfunction alarming indicator starts lighting up, which shall meet the provisions of Paragraph 4.2.4.

d) Turn the ignition switch to the “OFF” position; after 1 minute, turn it to the “ON” position again, and the system shall give a malfunction alarm within 6s.

e) Restore TPMS to the normal state, and verify that the malfunction alarming indicator goes off.

5.3.5 Test of display of tyre pressure value

With the TPMS being in operation, visually check whether the requirements of Paragraph 4.2.5 are met.

5.3.6 Check of information display mode and alarming mode

During the basic functional test of system, visually check whether the display mode and the alarming mode of the system comply with the prescriptions of Paragraph 4.2.6.

5.4 Test of signal receiving performance when mounted onto vehicle

5.4.1 Test of signal receiving performance in standstill

a) After the system is mounted onto vehicle, inflate all the tyres up to the P_{rec} as marked on the vehicle (or marked on the tyre inflation pressure label). With the vehicle being in standstill and the ignition switch at the "OFF" position, adjust the tyre pressure so that the pressure of one or more tyres is 7kPa lower than 75% P_{rec} value as specified by the manufacturer.

b) Turn the ignition switch from the "OFF" position to the "ON" position, and record the duration from the moment when the ignition switch is turned to the "ON" position up to the moment when the under-inflation alarm indicator begins continuous light-up, which shall meet the provisions of Paragraph 4.2.2.

c) Turn the ignition switch to the "OFF" position.

d) Inflate all the tyres until the pressure value specified in Paragraph 5.3.1 is reached. Turn the ignition switch from the "OFF" position to the "ON" position, and verify that the under-inflation alarm indicator goes off.

e) Each tyre shall be tested for 36 times according to the test process described in Items a)~d), Paragraph 5.4.1; at the end of each test, clockwise rotate the tyre under test for 10º, and proceed with the next test.

f) All the tyres shall respectively undergo the test described in Items a)~e), Paragraph 5.4.1.

5.4.2 Test of signal receiving performance in motion

a) After the system is mounted onto vehicle, inflate all the tyres up to the P_{rec} as marked on the vehicle (or marked on the tyre inflation pressure label); and, in particular, the tyre under test shall be inflated to a level 40kPa higher than the P_{rec} value as marked on the vehicle (or marked on the tyre inflation pressure label).

b) Steadily accelerate the vehicle to 120km/h or 80% maximum velocity (velocity error range: ±10km/h); then, while maintaining such a velocity, continuously deflate the tyre under test for 1 minute at the rate of 30~35kPa/min.

c) Record the duration from the moment when the deflation commences up to the moment when the rapid leak alarming indicator starts lighting up in the blinking mode, which shall meet the provisions of Paragraph 4.2.3.

d) Decelerate the vehicle.

e) Each tyre shall be tested for 10 times according to the test process described in Items a)~d), Paragraph 5.4.2.

f) All the tyres shall respectively undergo the test described in Items a)~e), Paragraph 5.4.2.

5.5 Test of system pressure measurement error

Set up the TPMS in a manner similar to the way in which it is mounted on the vehicle, and arrange the electrical connections properly. Place the TPM sensor under test in the pressure environment, and test the pressure measurement errors of TPMS under the pressure and temperature conditions specified in Paragraph 4.4.

5.6 Test of radio communication transmitting characteristics of system

Place the radio transmitter under the continuous transmitting state at the logic 0-1 interval, scan, by a disturbance receiver or frequency spectrograph, to measure the transmitting characteristics of TPMS from a prescribed distance in the screened room (3m for the high-frequency measurements, and 1m for the low-frequency one), and the provisions of Paragraph 4.5 shall be met. Moreover, the occupation bandwidth and stray emission characteristics shall meet the requirements of “XIN BU WU No. [2005] 423 Technical Specifications for Micro-power (short-distance) Radio Equipment ‘(XI) Radio Control Devices for Various Types of Civilian Equipment’ ”.

5.7 EMC test

5.7.1 Test of electromagnetic disturbance characteristics

With the system being in operation, carry out the electromagnetic disturbance emission test (narrowband detector) on a complete vehicle according to the test procedures specified in GB 14023-2006 or GB 18655-2002; provided that the test is conducted with the system only, the antenna method specified in GB 18655-2002 shall be followed. The disturbance emissions of the system shall meet the requirements of Paragraph 4.6.1.

5.7.2 Test of immunity to electromagnetic disturbance

With the system being in operation, carry out, in a screened room, the test of immunity to radiations with the immunity level specified in Table 1 (immunity limits) according to the test procedures specified in GB/T 17619-1998. The functional state of the system shall meet the requirements of Paragraph 4.6.2.

5.7.3 Test of immunity to electrical transient conduction

The receiver energized by on board power supply shall be tested according to the test procedures specified in GB/T 21437.2-2008, with the system being in operation. The functional state of the system shall meet the requirements of Paragraph 4.6.3.

5.7.4 Test of resistance to electrostatic discharge

The system or its components shall be tested through the component power-on method as specified in GB/T 19951-2006. The TPM sensor shall be subject to the air discharge test procedure (Max±15kV), and the receiver and other modules subject to the contact discharge procedure (Max±6KV). At the end of the test, the system shall be energized, and its functional state shall meet the requirement of Paragraph 4.6.4.

5.8 Test of resistance of receiver to abnormal voltage of power supply

5.8.1 Test of resistance to polarity reversal of power supply

Under the non-working status, reverse the polarity of power supply for 1 minute. After the test, the requirements of Paragraph 4.7 shall be met.

5.8.2 Test of resistance to overvoltage of power supply

Apply the test voltage onto the voltage input end, with both the test voltage and test duration subject to Table 3 of Paragraph 4.7.2. After the test, the requirements of Paragraph 4.7 shall be met.

5.9 Test of adaptability to climatic environment

5.9.1 Resistance to temperature

5.9.1.1 Resistance to low temperature

Subject the system to 8h low-temperature test according to the lower threshold of storage temperature specified in Table 1; after restoration to normal temperature, the system shall meet the requirements of Paragraph 4.8.

5.9.1.2 Resistance to high temperature

Subject the system to 8h high-temperature test according to the upper threshold of storage temperature specified in Table 1; after restoration to normal temperature, the system shall meet the requirements of Paragraph 4.8.

5.9.2 Resistance to temperature shock

Subject the system components (barring LCD) to the temperature shock tests according to the lower and upper thresholds of working temperature specified in Table 1; in total 100 runs are necessary. At the end of the test, place the system in the room temperature for 8h, and test the system functions, which shall meet the requirements of Paragraph 4.8.

The process of one test run shall be as follows (with the test commencing at the room temperature):

a) Attaining the upper threshold of working temperature within 10s.

b) Maintain the upper threshold of working temperature for 30 minutes.

c) Attaining the lower threshold of working temperature within 10s.

d) Maintain the lower threshold of working temperature for 45 minutes.

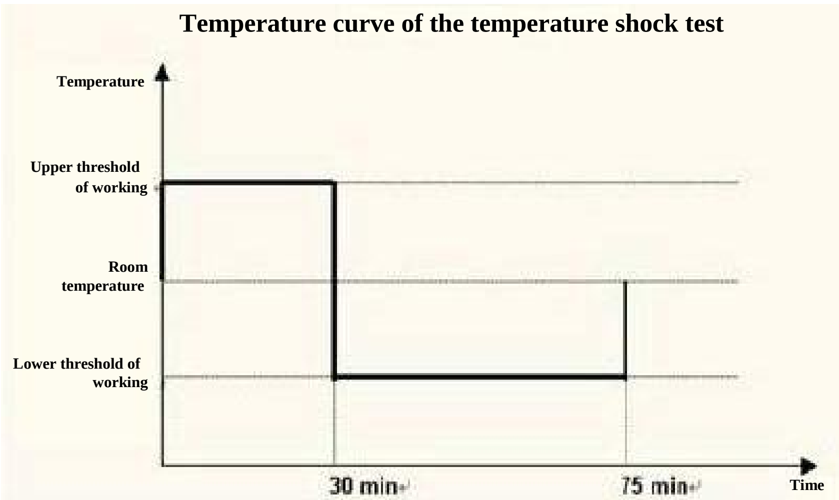

Figure 4 Temperature curve of the temperature shock test

5.9.3 Resistance to cyclic temperature and humidity variation

Test the receiver according to Paragraph 4.11 in QC/T 413, and test the TPM sensor according to Paragraph 5.6.2 in GB/T XXXX.4. At the end of the test, place the system in normal temperature for 2h, and it shall meet the requirements of Paragraph 4.8.

5.9.4 Resistance to salt fog

Subject the receiver to 48h and the TPM sensor to 96h salt fog test according to GB/T 2423.17. At the end of test, wash off deposits in clean water; there shall be no sign of corrosion on the surface of components, and the system shall meet the requirements of Paragraph 4.8.

5.9.5 Test of resistance to frost

Place the TPM sensor at -40ºC for 8h; then, relocate it, within 1 minute, into a humidity chamber (relative humidity: 90%, and temperature: 10ºC), and retain 15 minutes. After the test, the requirements of Paragraph 4.8 shall be met.

5.10 Test of adaptability to mechanical environment

5.10.1 Test of resistance to vibration

Properly install the test sample onto a vibration platform; conduct the random vibration test to the receiver according to Paragraph 4.1.2.4.2 of GB/T XXXX.3 and to the TPM sensor according to Paragraph 4.1.2.5.2 of GB/T XXXX.3; in case of a commercial vehicle, the TPM sensor shall be subject to the random vibration test according to Paragraph 4.1.2.9.2 of GB/T XXXX.3. At the end of test, check whether the components of each sub-assembly is loosened or damaged; and the system shall meet the requirements of Paragraph 4.9.

5.10.2 Test of resistance to mechanical shock

Conduct the mechanical shock test according to Paragraph 4.2.2.2 of GB/T XXXX.3; in terms of the TPM sensor, the shock acceleration shall be 1,000m/s^2. After the test, the system shall meet the requirements of Paragraph 4.9.

5.10.3 Test of resistance to free fall

The TPM sensor shall be tested according to Paragraph 4.3.2 of GB/T XXXX.3. After the test, the appearance shall present no sign of distortion, and the system shall meet the requirements of Paragraph 4.9.

5.10.4 Test of resistance of TPM sensor to over pressure

Place the sensor in a pressurized environment, and increase the pressure up to the inflation pressure as recommended by Table 4; take it out after having been maintained for 1 minute; the requirements of Paragraph 4.9 shall be met.

Table 4 Overpressure values applied to TPM sensor for each pressure measurement range Unit: kPa

Applicable tyre pressure range	Max. pressure resistance value
100~450 1,000	
100~700 1,000	
100~1,400 1,800	

5.10.5 Test of resistance of TPM sensor to rotary acceleration

Fix the TPM sensor onto the rotary test device in a manner similar to the way in which it is mounted on the vehicle (the installation orientation of the sensor shall be consistent with the rotary direction marked on the tyre), and set the acceleration grade and retention time according to Figure 5. That is one run of the test. In total 30 runs are necessary. After the test, check the TPM sensor, which shall meet the requirements of Paragraph 4.9.

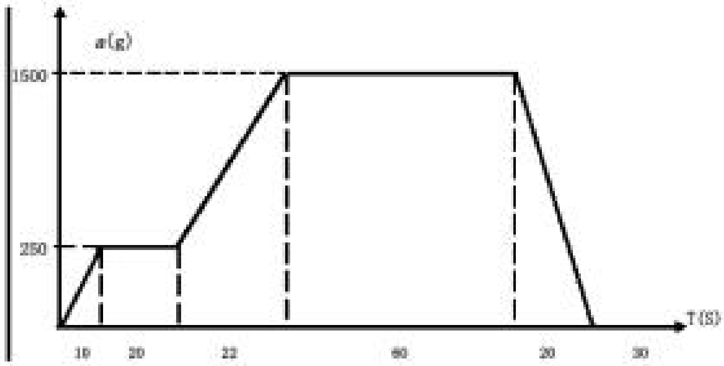

Figure 5 Test cycle of resistance to rotary acceleration

5.11 Test of protection performance of system

5.11.1 Dust-proof test

Carry out the IP5KX, IP5KX and IP6KX dust-proof tests to the receiver, display module and TPM sensor, respectively, of TPMS according to the test procedures specified in ISO 20653 (Protection degrees of road vehicles (IP code) Protection of electrical and electronic equipment against foreign matters, water and contact); after each component has undergone the dust-proof test, the basic functions of the system shall remain in the normal state, with the pressure measurement error of system being in compliance with Paragraph 4.4.

5.11.2 Water-proof test

IPX3 water-proof test shall be conducted to the receiver and display module of the system according to the test procedures specified in ISO 20653 (Protection degrees of road vehicles (IP code) Protection of electrical and electronic equipment against foreign matters, water and contact); IPX4 water-proof test shall be conducted to the TPM sensor installed inside the tyre, while IPX6 test to the TPM sensor installed outside the tyre. After the sensor has undergone the water-proof test, the basic functions of the system shall remain in the normal state, with the pressure measurement error of system being in compliance with Paragraph 4.4.

5.12 Durability test method of TPM sensor

5.12.1 Test condition

5.12.1.1 Environmental temperature

Environmental temperature shall fall within 10ºC~25ºC.

5.12.1.2 Test equipment

The test site shall be provided with the electrostatic proof measures; for the test, the receiving and display devices appropriate for the TPM sensor shall be made available.

5.12.1.3 Testing of TPM sensor state

a) At normal pressure (i.e., the standard atmospheric pressure)
   The module to be tested is under the dormant state, without emitting any signal.

b) Atmospheric pressure > 100kPa
   The module to be tested is in the ambient with a pressure ≥100kpa; the TPM sensor measures the pressure for 12 times every 3 seconds; at the end of the 12 measurements, it emits signals once.

c) Pressure ambient
   The pressure ambient for the test shall be capable of attaining the condition of 100kPa relative pressure.

5.12.2 Test procedures

5.12.2.1 Determine the state of the to-be-tested TPM sensor at normal pressure

Place the TPM sensor at the normal pressure, turn on the receiving and displaying devices, and verify that no signal is received.

5.12.2.2 Testing at about 100kPa

Place the TPM sensor in an ambient with a pressure exceeding 100kPa, and verify that the data on the receiving and display devices would be refreshed every 3 seconds.

5.12.2.3 Durability test

a) Place the TPM sensor in an ambient with a pressure exceeding 100kPa.

b) Record the data shown on the display module every 2h, and verify that the data are refreshed every 3 seconds.

c) Continue the test for 30 days (720h)

d) At the end of test, the TPM sensor shall meet the requirements of Paragraphs 4.2 and 4.4.

Annex II

National Standard "Tire Pressure Monitoring Systems for Motor Vehicles"
(Draft for Comments) Compilation Explanation

I. Source of Task

"Tyre Pressure Monitoring Systems for Motor Vehicles" is a voluntary national standard, for which the development program was released by Standardization Administration of China (SAC), with the assigned project number being 20067134-T-303. It was mainly drafted by China Automotive Technology and Research Center (CATARC), which specifically established the drafting work group.

II. Purpose and Necessity

Tyre pressure constitutes one important factor affecting not only the driveability but also the safety performance of motor vehicles. A too high pressure would quicken the wear paces of tyres, inclining to cause bursting of tyre crown, in addition to the negative effect on braking performance due to the diminished ground friction; while a too low pressure or leak would accelerate tyre wear due to doubled (and redoubled) ground friction, besides the escalation of fuel consumption. Whereas the side wall is the weak location on a tyre, in case of a too low pressure, the incessant intrusion and stretching would incline to result in fatigue failure, eventually leading to tyre blow-out. Consequently, real-time monitoring on tyre pressure is one key means for assuring the safety of tyres.

In specific consideration of such a demand, tyre pressure monitoring system (TPMS) has been developed and designed; aimed at enhancing the automotive safety, such a new technology capitalizes on the automotive electronic, sensor and wireless communication techniques, so as to monitor, in a real-time manner, the pressure of all tyres during the running of the wheels, and give an alarm in case of leak or low pressure. In one word, TPMS has made great contributions to the improvement of automotive safety and economy.

The first-generation TPMS products were developed by the other countries early in 2002. Thanks to the technological development in recent several years, TPMS products have undergone a self-perfection, self-growth period. Recently, the number of local TPMS manufacturers has been on a steady rise; however, the products are quite different in view of variety, type, technical level and quality, with some being high-quality ones featured by high technical content, while some being of outdated technical solutions. In such a context, it is necessary to develop a national standard for normalizing and guiding the healthy development of the TPMS industry. Whereas TPMS is of a relatively new technology, it has been decided to firstly present a voluntary national standard for the purposes of encouraging the application of leading technologies; once the technologies and products are further mature, it would consider the issuance of a compulsory national standard.

III. Status of foreign standards and regulations

By now, the United States has been the first and the only country that has developed and put into compulsory implementation of the TPMS regulation. National Highway Traffic Safety Administration (NTHTSA) drafted the regulation FMVSS138, in which it is required that, from September 2007, all the four-wheel passenger cars and commercial vehicles with the GVW not exceeding 4,536kg sold within the territory of the United States should be fitted with TPMS. Driven by both the federal law and the profit-making opportunity, all the major manufacturers of automotive electronics have been extremely active in the related R&D, in addition to the entry of lots of well-known chip vendors; as a result, the TPMS has been updated quickly, featuring increasingly smaller size, lower weight, more reliable performance and longer lifespan. Now, TPMS is quite popular throughout the United States. Plus, International Organization for Standardization (ISO) released ISO 21750: 2006 relating to TPMS in March 2006. Also, Society of Automotive Engineers (SAE) developed the TPMS related standard -- SAE J 2657 for light-duty vehicles in December 2004.

For the reference purpose, the following international automotive regulations and standards are available:

-- FMVSS 138 Tyre Pressure Monitoring Systems;

-- SAE J 2657: 2004 Tyre Pressure Monitoring Systems for Light Duty Highway Vehicles;

-- ISO 21750: 2006 Road Vehicles – Safety Enhancement in Conjunction with Tyre Inflation Pressure Monitoring Systems

The aforesaid three standards put forward requirements for TPMS from different aspects, which shall be consulted and assimilated in drafting of the TPMS national standard of China. Moreover, Japanese Automotive Standards Organization (JASO) has developed a technical document concerning the testing methods of TPMS when mounted onto vehicle, putting forward more detailed specifications on the basis of FMVSS 138. GRRF (Working

Party on Brakes and Running Gear), affiliated to UN/WP29 ("World Forum for Harmonization of Vehicle Regulations") responsible for developing European and global technical regulations, resolved to, on its 62nd meeting in September 2007, set up an informal TPMS work group, in which Germany assumes the chairmanship for pushing forward such a work; besides, the informal work group meetings were held in November 2007 and February 2008, respectively, probing into the feasibility in developing a TPMS related ECE regulation. As indicated by the deliberation results of several meetings, the difficulty of such an activity is much higher than the anticipated; so the progress is not smooth.

With distinct objectives and considerations, the TPMS standards developed by various nations and standardization organizations are largely different from each other, bearing respective strong and weak points.

1 Overview of FMVSS 138

Featuring a compulsory safety standard, FMVSS 138 merely sets out the most elementary functional requirements, i.e., TPMS shall, within 20 minutes, give a visible warning signal for under-inflation in case the tyre pressure falls below the stipulated value; as for such a visible warning signal, related prescriptions are specified. Also, the provisions are available for testing conditions, testing procedures, and detailed transitional period. Specifically, FMVSS 138 puts forward the following concrete requirements in view of TPMS performance:

a) TPMS shall start to operate upon ignition of the engine, and give an alarm once the tyre pressure decreases by 25%.

b) In case of any failure, TPMS shall give an alarm to the driver.

c) The alarm indicator of TPMS shall keep ON until the tyre pressure is inflated to the normal value or the system failure is eliminated.

d) Upon ignition of the engine, the alarm indicator on the instrumental panel shal undergo one self-diagnostic cycle.

e) In the user's manual provided to the vehicle owner, it shall be indicated that the TPMS may not match with any replaced tyre.

f) Each vehicle manufacturer shall progressively increase the market penetration rate of TPMS; and, from September 2007, all the four-wheel passenger cars and commercial vehicles with the GVW not exceeding 4,536kg sold within the territory of the United States should be fitted with TPMS.

g) For the tests conducted on vehicle, the vehicle velocity shall fall within 50~100km/h.

Due to technical restrictions at that time, this regulation merely concerns the most elementary under-inflation alarming function, and covers the indirect (i.e., measuring tyre under-inflation indirectly by means of wheel speed sensor) TPMS. Because of the intrinsic defect of the indirect type of TPMS (e.g., impossible to monitor when the vehicle is in standstill, a too long cycle (about 20 minutes to decide the existence of under-inflation), too many erroneous alarms, impossible to detect under-inflation in certain particular situations, impossible to display the pressure value, etc.), the products would be not certainly safe, reliable, even if they could meet this regulation.

2 Overview of SAE J 2657: 2004

This standard sets out the test methods and performance requirements for tyre pressure monitoring systems (TPMS) intended for tubeless tyres. Primarily speaking, concrete test methods are specified for the temperature resistance of TPM sensor, thermal cycle, thermal shock, resistance to ultimate temperatures, resistance to dampness, frosting, resistance to pressure, rapid leak, resistance to altitude, resistance to dirt, resistance to salt fog corrosion, resistance to fall-off, resistance to mechanical shock, and electromagnetic compatibility (EMC); moreover, concrete requirements are provided for the display mode of alarm signals, operating conditions of the system, and the most elementary performance. In this standard, it is stipulated that the tyre pressure should be monitored within the vehicle speed range of 24km/h ~ max. velocity.

Nevertheless, this standard neither requires the precision of measurements, nor limits the lifespan of products. The response time of under-inflation alarming is too long (within 10 minutes); the functions are basically similar to those of FMVSS 138.

3 Overview of ISO 21750: 2006

Applicable to the TPMS for tubeless tyres, this standard asks for monitoring all the tyres used, and providing information to the driver. All-round performance specifications are available for both the system and its components. According to this standard, tyre pressure shall be monitored when the vehicle velocity exceeds 25km/h. The system is divided into several levels in the following, and qualitative requirements are put forward for each level thereof.

-- Tyre pressure alarming system (TPAS)

Means a system which measures the tyre inflation pressure and inner temperature or the pressure-corresponding parameter, and gives information to remind the driver that the tyre pressure limit has been reached and measures are needed.

-- Tyre pressure warning system (TPWS)

Means the system which could provide the driver with useful information, including, to the minimum, the actual pressure state of each tyre, and give a warning signal once corrective measures are needed for the tyres.

-- Tyre leak alarming system (TLAS)

Means a system which could detect any noticeable pressure change of a tyre as compared with the other tyres or its original state, and give an alarm for taking necessary measures.

This standard sets out some limit values for the performance of tyre modules:

a) Life cycle: at least 6 years or 100,000km after mounted on a matchable vehicle type.

b) Precision of measurements: the measurements of absolute pressure shall, to the minimum, meet the following requirements:

  - ±2% of the full scale within the temperature range of 0ºC~70ºC, not exceeding ±10kPa to the maximum;
  - ±5% of the full scale outside the above temperature range, not exceeding ±25kPa to the maximum;

As for the TPM sensor mounted inside the wheel, the resistance to environmental effects and the concrete testing methods are set out. Detailed human-machine interface requirements are put forward for the display module.

The scope of this standard is broader than that of either FMVSS 138 or SAE J 2657. Nevertheless, it doesn’t require the TPMS to operate when the vehicle is in standstill, except for the requirements that an under-inflation alarm shall be given within 3 minutes and a failure alarm be given within 10 minutes once the vehicle speed exceeds 25km/h. These three standards put forward TPMS requirements from different aspects, which are worthy of consultation and assimilation during the drafting of the national standard of China. To present a standard for the comprehensive appraisal of the system safety and reliability, however, certain insufficiency exists with the performance requirements, e.g., how to embody and assure the reliability and stability of signal transmission of the system, how to embody and assure that the system has a lifespan longer than 6 years, etc.; being representative of the challenges and key technologies in the design of TPMS, they are also the hard nuts to crack in the drafting course of the national standard.

IV. Development process of the standard

The Chinese R&D of TPMS is later than in the United States and EU. On the local market, TPMS products were firstly seen in 2002, which are imported or imitated products, featuring small market penetration and low technical content. In 2003, Shanghai VW kicked off its R&D plan for TPMS, indicating that TPMS R&D began to seek cooperation with complete vehicle manufacturers. After a period of independent R&D and innovations, a number of local independent TPMS products arrived at the world leading level in view of functions, meeting the requirements of “reliable receiving, instantaneous response, low power consumption, and long lifecycle”. The Chinese TPMS industry has entered the independent R&D stage. The development of a TPMS national standard with leading technical indices, rational performance requirements and stringent test methods would normalize and guide the healthy evolution of such an industry; as a result, the end-users could be satisfied with the superior performance and high quality of the products, eliminating the situation that the market is full of outdated, low-technology products, and the leading standard could direct the manufacturers in uplifting its R&D capability, evading any price competition on low-level products.

In order that the anticipated TPMS national standard could give sufficient considerations to the technical development level and industrial status both in and outside China, the drafting unit of the standard – CATARC – held the “Workshop on the TPMS Technical Standard” in Shanghai on April 21st 2007, which attracted more than 160 attendees from related authorities, complete vehicle manufacturers, local and foreign TPMS integrators and chip vendors; on the meeting, all-round technical exchanges were conducted, and suggestions were put forward as to the development of the TPMS national standard.

On July 31st 2007, the “Establishment and First Meeting of the Drafting Work Group on the TPMS Standard” was convened; with CATARC taking the lead, the work group comprises 18 entities, including complete vehicle manufacturers, testing and research institutes, TPMS manufacturers, sensor and chip vendors, etc.; the drafting of the standard commended after the meeting. Specifically, the members of the work group are: China Automotive Technology and Research Center, The Quality Supervision and Test Center for Traffic Safety Products of Ministry of Public Security, Changsha Institute of Automotive Electrical Appliances, Tianjin Auto Test Center, Shanghai Volkswagen Co., Ltd., Shanghai Taihao Electronic Technology Co., Ltd., Shanghai Baolong Automotive Technologies Co., Ltd., Suzhou Shiante Automotive Electronics Co., Ltd., Shanghai

Hangsheng Industries Co., Ltd., He'nan Xuecheng Technology Co., Ltd., Cixi Fuerda Industries Co., Ltd., Chongqing Hanbang Network Technology Co., Ltd., Mobiletron Electronics (Ningbo) Co., Ltd., Toyota Motor Technology Center (China) Co., Ltd., Infineon Technologies (China) Co., Ltd., GE Sensing Apparatus (Shanghai) Co., Ltd., Simens VDO Automotive Electronics (Changchun) Co., Ltd. Shanghai Branch, and Free Scale Semiconductors (China) Co., Ltd. Three discussion meetings have been held thereafter (September 27th 2007, January 21st 2008, and March 25th 2008, respectively); through multiple rounds of deliberations and amendments by the work group experts, the draft standard for comment was delivered in May 2008.

This standard has been drafted according to the rules in GB/T1.1-2000.

V. Notes to the text of the standard

Now that TMPS is a new technology, there are not many standards and regulations for reference yet. Though the aforesaid standards (i.e., FMVSS138, ISO21750: 2006 and SAE J2657: 2004) present their respective strong points, the restrictions are apparent, and many provisions therein are not adaptive to the Chinese situations. Through sufficient analysis and researches on these standards and in combination with the current development status of TPMS, the work group assimilates the advantages of the foreign leading standards, and puts forward more rational, feasible requirements with respect to a cluster of technical indices, functional requirements and test methods. The main content and development scheme are introduced as follows:

1 Name of the standard

In the development program submitted to SAC, this standard was titled as "Tyre Pressure Monitoring Systems for Vehicles". For the conciseness and clarification, its name is finally determined as "Tyre Pressure Monitoring Systems (TPMS) for Motor Vehicles" according to the opinions of the work group experts.

2 Scope

All the three standard (FMVSS138, ISO21750: 2006 and SAE J2657: 2004) unexceptionally apply to the four-wheel light-duty vehicles adopting the tubeless tyres, which scope is narrow. In consideration that the requirements for applying TPMS on various categories of vehicles don't differ largely and there are a variety of TPMS products, this standard expands the scope to cover all types of motor vehicles and tyres (including both passenger cars and commercial vehicles, as well as both tubed and tubeless tyres), in addition to specifying that the other vehicle categories (e.g., two-wheel motorcycles and engineering machineries) may take this standard for reference.

3 Requiring a much shorter time to give the under-inflation alarm

According to this standard, TPMS shall give the under-inflation signal within 6s. Since it is much shortened as compared with FMVSS138 (20 minutes), SAE J2657: 2004 (10 minutes) and ISO21750: 2006 (3 minutes), the safety could be better assured.

4 Requiring under-inflation alarm in standstill

As specified in this standard, TPMS shall present the normal alarming function even when the vehicle is not in motion. In contrast, FMVSS138 asks for the normal operation within the vehicle velocity range of 50~100km/h, SAE J2657: 2004, when exceeding 24km/h, and ISO21750: 2006, when exceeding 25km/h. In the normal use, the tyres would occasionally be heavily under-inflated or even without any pressure after parking for one whole night (or a longer period), for which case it is necessary to give an alarm prior to the motion of the vehicle; provided an alarm is given after reaching 24km/h or 10 minutes, the under-inflated tyres would have been severely damaged, in addition to presenting a substantial danger against the safety.

5 Requiring the function of indicating the under-inflated/leaking tyre

In this standard, it is required that TPMS, while giving the alarm signals, should locate the tyre suffering under-inflation or leakage. Such a requirement is not available yet in any other foreign standard, possibly due to considerations on technology and costs; in view of the present technical level, it’s quite easy to materialize such a function. It would be imperfect for a TPMS to merely give an alarm, without locating the concerned tyre, which is unacceptable to the users.

6 Requiring rapid leak alarming

According to this standard, TPMS shall give an alarm within 1 minute provided that the tyre pressure decrease at a rate exceeding 30kPa/min (other than a blow-out), in addition to locating the leaking tyre. This new requirement is not available yet in any foreign standard. It is intended for better assuring the safety: in case of a rapid leak, the driver could be notified in advance so as to take actions earlier, thus precluding the late alarming of under-inflation.

7 The system shall be capable of indicating the current pressure value of each tyre

As specified in this standard, TPMS shall be capable of providing, when such requested, the pressure value information of each tyre, which requirement is not available in any foreign standard. In view of tyre pressure, there is a 25% difference between the normal and the under-inflation values (50~70kPa for common sedans); so, even if there is no under-inflation alarm, a relatively low pressure would intensify fuel consumption and wheel wear (according to foreign study, the fuel consumption will rise by 1.5% when the pressure is 20kPa lower than the normal one; the tyre lifecycle would be shortened by 15% when the tyre pressure is 10% lower than the normal one; according to experiences accumulated in normal use, the leak rate is tiny for a normal tyre, and the decrease would not reach 20kPa in one month; so any decrease of 20kPa in one or two days would be a certain sign that the tyre is penetrated). If the driver could always get an access to the tyre pressure information, it would be possible to make up pressure and take maintenance means, thus reducing the fuel consumption, prolonging the life cycle of tyres, and eliminating any danger against safety.

8 Specifying the signal receiving performance and test methods

The related requirements are not seen in any foreign standard. Whereas the emission and reliable receiving of wireless signals is pivotal to the engineering, safety and reliability of TPMS, this standard sets out the signal receiving performance of TPMS after its installation onto vehicle, as well as the testing methods. It is required that, when the standstill wheel for test is at different positions (one test point to be set every 10º on the 360º circumference), it is capable of receiving, in a table manner, signals transmitted by the TPM sensor. Provided any reliable receiving cannot be actualized at a standstill position, it would be needless to say the wheel in motion.

Moreover, due to the radio transmission characteristics, the receiving performance would be deteriorated upon high-speed travel, which is pivotal to the TPMS engineering. Therefore, it is required in this standard that the vehicle for test shall undergo the test of rapid leak alarm at the velocity of 120km/h or 80% of the maximum velocity, so as to verify the reliable receiving of signals.

9 Specifying the radio communication emission characteristics of the system

Such requirement is not available yet in any foreign standard. According to this standard, the transmitting frequency and stray of the system shall comply with “Radio Management of China. [2005] 423 Technical Specifications for Micro-power (short-distance) Radio Equipment ‘(No. eleven) Radio Control Devices for Various Types of Civil Equipment’ ”. Moreover, it is required that the transmitting power shall not exceed -20dBm (e.r.p effective Value detector), the frame length of high-frequency information shall not exceed 10ms, and the cumulative transmitting time of high-frequency signals within any 4s monitoring duration shall not exceed 40ms. Also, the transmitting field intensity of each low-frequency transmitter shall not exceed 50dBμA/m; the frame length of low-frequency information shall not exceed 20ms, and the cumulative transmitting time of low-frequency signals within any 4s monitoring duration shall not exceed 2s.

These requirements are put forward principally by taking into account the overall effects when a substantial quantity of TMPS products are installed onto vehicles. The simple increase of transmitting power and transmitting frequency is no good solution to the issue of receiving reliability, which would have negative effects on other systems; so, it is necessary to require that the high-frequency transmitting time within any 4s shall not exceed 40ms and the low-frequency transmitting time within any 4s shall not exceed 2s.

As indicated by present experiences, the possibility of high-frequency interference is quite high. A badly-designed TPMS would incessantly transmit thousands milliseconds of alarm information frames, which would incline to interfere with the TPMS on other vehicles, eventually leading to system mistake or erroneous alarming; now that the spatial spectral resources belong to the public, it is essential to avoid any long term " individual occupation" of such resources.

10 EMC requirements

In this standard, requirements are put forward as to the electromagnetic disturbance characteristics, immunity to electromagnetic radiation, immunity to electrical transient conduction, and resistance to electrostatic discharge.

11 Lifecycle of TPM sensor

This standard requires that the TPM sensor shall have a lifecycle longer than 6 years or 100,000km after installation onto a matchable vehicle type, for which the test methods are set out. Though the similar requirement is set out in ISO21750: 2006, no test procedures are contained therein.

Mainly speaking, the lifespan of TPMS is dependent upon the cell-supported TPM sensors. In generally circumstances, the bigger the cell capacity, the longer the cell life; however, the capacity cannot be too big since it is proportional to both the weight and costs. It shall be noted that the test is specific to the entire TPMS system, instead of the cell only. So long the circuit and energy-saving program are satisfactorily designed, a lower-capacity cell could assure the identical lifespan.

The lifetime of TPMS is tested in the accelerated mode. Except for measurements and emissions, TPMS is always in the standby state, and the power consumption is mainly attributed to emission and measurement. Assume that, during operation, the system conducts one measurement every 6s and one emission every 2 minutes; when in standstill, the system conducts one measurement every 30s and one emission every 4 minutes; and the system operates for 4h and keeps standstill for the other 20h each day. Thus, the total measurement and emission times during 1 year could be computed. Whereas the measurements and emissions of TPMS are of short-interval, pulse-type current consumption, it couldn't be simulated by a long-time incessant discharge (because the cell demands are totally different between an incessant discharge and a pulse-type discharge). Therefore, the ideal simulation should take the form of large pulse-type discharge within a short interval. In case of incessant, large-quantity, pulse-type discharge within a short interval, however, the cell would have no time to get restored; so, a restoration time must be arranged for the cell during the test. That is, at the end of each pulse-type discharge, several seconds should be set apart for the cell restoration purpose. Based on the above assumptions, the objective is to simulate 1 year by 5 days. For each day, the test duration shall be 24 hours; one run of concentrated pulse measurements and emission (i.e., 12 measurements, and 1 emission) shall be conducted every 3 seconds. Thus, the 6-year lifespan could be simulated within 30 days. TPMS shall be considered as satisfactory provided it could, at the end of the test, still normally execute measurements and emissions.