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Health Protection Index
Vehicle Electromagnetic Radiation Testing and Evaluation Protocol

(Version 2023)

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Vehicle Electromagnetic Radiation Testing and Evaluation Protocol

1 Scope

This document is applicable to M and N vehicles, including those powered by internal combustion engines, electricity, and hybrid.

This document specifies the test and evaluation methods for EMR levels of the vehicle, including test cycles, test frequency bands, test areas and test points, as well as scoring criteria and release method of evaluation results according to the test results.

2 Normative References

The following references are indispensable for the application of this document. For dated references, only the dated edition applies to this document. For undated references, the latest edition (including all amendments) applies to this document.

GB /T 3730.1-2001 Motor Vehicles and Trailers - Types - Terms and Definitions

GB /T 19596-2004 Terminology of Electric Vehicles

GB /T 29259-2012 Road Vehicle - Electromagnetic Compatibility Terminology

GB 8702-2014 Controlling Limits for Electromagnetic Environment

GB /T 12534-90 Motor Vehicles—General Rules of Road Test Method

HJ/T 10.2-1996 Guideline on Management of Radioactive Environmental Protection Electromagnetic Radiation Monitoring Instruments and Methods

3 Terms and Definitions

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

3.1 electric field

a component of the electromagnetic field characterized by electric field strength and electric flux density

3.2 magnetic field

a component of the electromagnetic field characterized by the magnetic field strength and magnetic induction

3.3 electromagnetic field

a field characterized by four interrelated vectors, namely, electric field strength, electric flux density, magnetic field strength, and magnetic induction, which is used together with current density and volume charge density to characterize the electric and magnetic states in a medium or vacuum

3.4 electric field strength

a vector field quantity, E, whose force acting on a charged particle at rest is equal to the product of E and the charge of the particle in volts per meter (V/m)

3.5 magnetic field strength

a vector field quantity, H, which, at a given point, is equal to the magnetic induction divided by the magnetic permeability and then minus the magnetization strength in amperes per meter (A/m)

3.6 magnetic induction

a vector field quantity, B, whose force on a charged particle with a certain velocity is equal to the product of the velocity and the vector B, multiplied by the charge of the particle, in Tesla (T) or microtesla (μT) In air, the magnetic induction is equal to the magnetic field strength multiplied by the magnetic permeability μ0, i.e. B = μ0H.

3.7 electromagnetic radiation (EMR)

electromagnetic environment formed at where the drivers and passengers are located in or around the vehicle through the radiation generated by the operating electrical equipment of the vehicle or related accessories such as the wiring harness and the interaction of the radiation with the inherent structure of the vehicle such as the body sheet metal, which may affect the health of the drivers and passengers, including electric field and magnetic field environments

3.8 anechoic chamber

a shielded enclosure with absorber inside generally, in particular in this standard, a semi-anechoic chamber equipped with the 4WD drum for vehicle testing

4 General Requirements

4.1 Measurement conditions

4.1.1 Test field

The constant-speed-running test cycle and communication test cycle shall be carried out in the anechoic chamber.

The accelerating and decelerating test cycles shall be carried out outdoors on a clean, dry, flat, and straight road paved with asphalt or concrete, with a width of not less than 8 m and a longitudinal gradient of 0.1% or less.

If the measurement is carried out on a dynamometer, the road load shall be set according to the curb weight of the vehicle.

4.1.2 Measurement environment

The background noise in the test field environment shall be less than 10% of the limit value in Annex A.1. The outdoor road test environment shall be favorable, without rainfall, snowfall, hail and other inclement weather, and the horizontal visibility shall be not less than 500 m.

4.2 Measuring instrument

The measuring instrument shall be capable of measuring magnetic fields in the frequency range of 10 Hz ~ 30 MHz and electric fields in the range of 30 MHz ~ 3 GHz. The measuring probe shall be isotropic. When the terminal connected to the measuring probe functions, the electromagnetic field of the frequency band of concern in this standard measured by the probe connected to the terminal more than 1 m away shall be lower than 10% of the limit value of Annex A.1, and the requirements for frequency-selective radiation measuring instruments in HJ/T10.2-1996 *Guideline on Management of Radioactive Environmental Protection Electromagnetic Radiation Monitoring Instruments and Methods* shall be met.

The measuring instrument shall be able to calculate the root mean square value of the electric field and magnetic field over 20 s. See Table 1 for the minimum requirements for frequency resolution of data acquisition of the measuring instrument.

Table 1 Minimum Requirements for Frequency Resolution of Measuring Instrument

Frequency Range	Frequency Resolution
10 Hz~500 Hz	≤1.25 Hz
500 Hz~10 kHz	≤25 Hz
10 kHz~400 kHz	≤1 kHz
400 kHz~30 MHz	≤75 kHz
30 MHz～3 GHz	≤500 kHz

After the standard antenna for test under the communication test cycle is connected with the signal source, it shall be able to effectively simulate the test cycle under which the mobile phone transmits at the maximum radiated power of GSM according to the requirements of the radio administration authority, and its equivalent isotropically radiated power (EIRP) shall reach +33 dBm.

5 Test Process

5.1 Description of vehicle test cycles

The vehicle test cycles include the running test cycles, the communication test cycle and the charging test cycle (for NEVs only). The running test cycles are subdivided into constant-speed-running test cycle, accelerating test cycle and decelerating test cycle. See Table 2 for details of the test cycles:

Table 2 Overview of Test Cycles

Test Cycle		Description of Test Cycle
Running test cycles	Constant-speed-running test cycle	The vehicle shall be running at a constant speed of 40 km/h; All lights shall be turned on (including hazard warning light); The A/C shall be set to maximum airflow for refrigeration; Wiper shall be at the maximum setting; Seat heating and ventilation shall be at the maximum setting (if available); All interior display screens shall be turned on; The IVI system shall play standard video.
	Accelerating test cycle	With the accelerator fully open, the vehicle under test (VUT) shall be accelerated from a standstill until 90 km/h or the maximum speed (for a VUT with a maximum speed of less than 90 km/h); All electrical appliances not related to driving shall be turned off.
	Decelerating test cycle	With a deceleration greater than 2.5 m/s2, the VUT shall be decelerated from 90 km/h or its maximum speed (for a VUT with a maximum speed of less than 90 km/h) until it comes to a standstill; All electrical appliances not related to driving shall be turned off.
Communication test cycle		The vehicle shall be stationary in the KeyOn state; When the vehicle is equipped with mobile communication equipment, the on-board T-BOX (or equivalent on-board mobile communication equipment) shall be connected to the base station simulator and transmit at the maximum power; otherwise, the signal source shall be connected to the standard antenna, the antenna shall transmit at a specified position in the vehicle, and its equivalent isotropically radiated power (EIRP) shall reach +33 dBm.
Charging test cycle		When the vehicle is stationary in the Off state, the battery SOC is greater than 20% but less than 80% during charging. (DC fast charging mode shall prevail)

Taking into account the fact that different vehicles have different driving modes and operating modes, the test shall be conducted as follows:

1. When the vehicle has different driving modes such as economic mode, standard mode and

sport mode, the sport mode shall prevail as the vehicle driving mode during the test;

2. When the vehicle is a hybrid and has operation modes such as battery electric drive mode and fuel mode, the battery electric mode shall prevail as the vehicle operating mode during the test;
3. When the vehicle has a 4WD function, the 4WD mode shall be turned on as the vehicle operating mode during the test;
4. When the vehicle has an energy recovery function, the energy recovery gear shall be turned to the maximum;
5. Under the charging test cycle, DC fast charging mode shall prevail. The state of charge (SOC) of the battery electric vehicle and hybrid electric vehicle under running test cycles shall be 20% ~ 80%.

5.2 Test frequency bands

See Table 3 for the test frequency bands under different test cycles:

Table 3 Test Frequency Bands

Test Cycle	Test Site	Test frequency bands
Running test cycles	magnetic field	10Hz-30MHz
Communication test cycle	electric field	30MHz-3GHz
Charging test cycle	magnetic field	10Hz-30MHz

5.3 Test layout

5.3.1 Running test cycles

5.3.1.1 Constant-speed-running test cycle

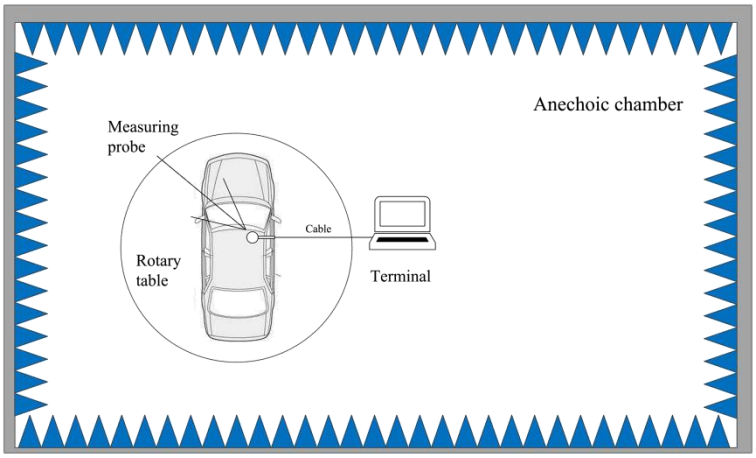


Fig. 1 Layout of Constant-speed-running Test Cycle

See Fig. 1 for the layout of the constant-speed-running test cycle. The vehicle shall be fixed to the dynamometer in an anechoic chamber and operate under the specified test cycle, and the terminal connected to the measuring probe shall be arranged outside the anechoic chamber or more than 3 m away from the vehicle inside the anechoic chamber.

5.3.1.2 Accelerating test cycle

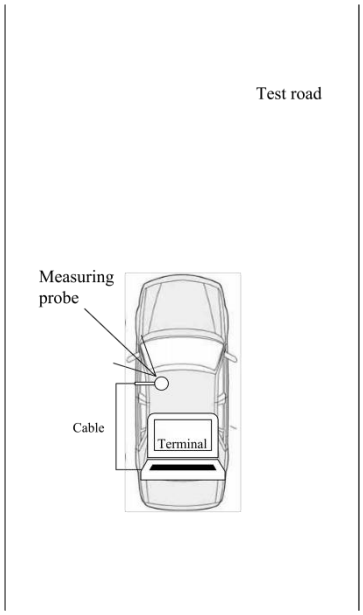


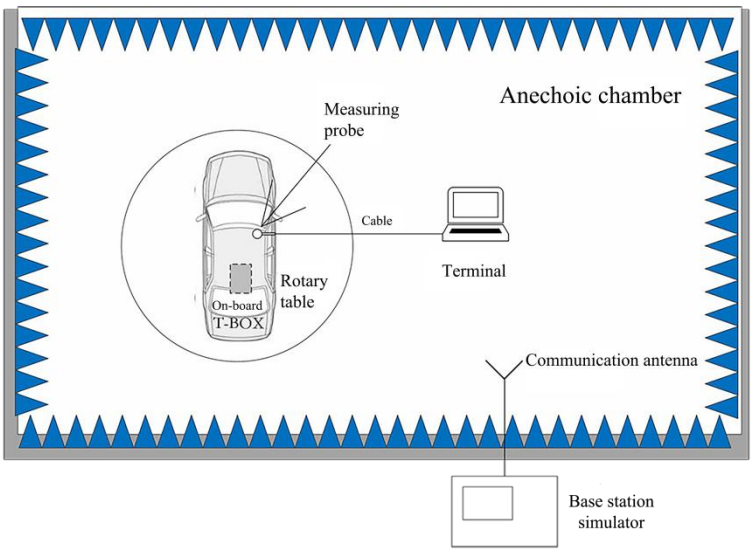
Fig. 2 Layout of Accelerating and Decelerating Test Cycles

See Fig. 2 for the layout of the accelerating test cycle. The vehicle shall operate under a specified test cycle on an outdoor road that meets the conditions, and the terminal connected to the measuring probe shall be arranged more than 1 m away from the vehicle test point.

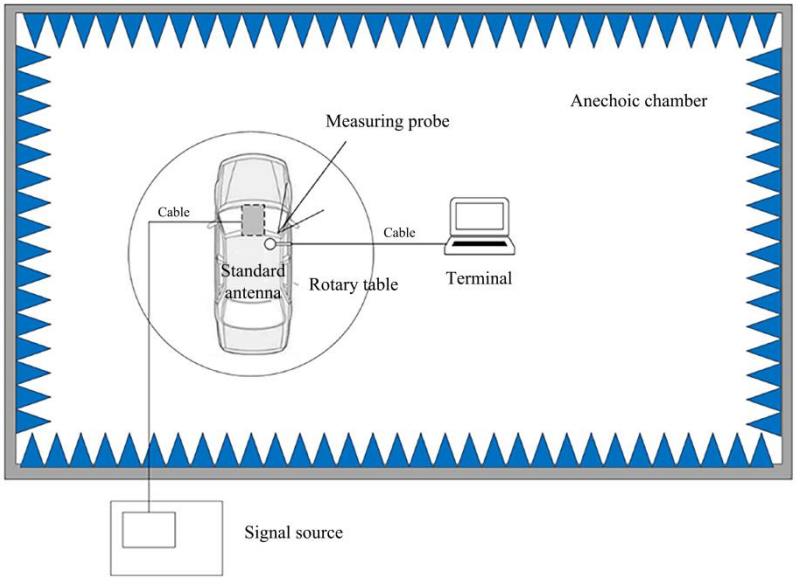
5.3.1.3 Decelerating test cycle

Same as the accelerating test cycle.

5.3.2 Communication test cycle



(a) Base Station Simulator + On-board T-BOX



(b) Signal Source + Standard Antenna

Fig. 3 Layout of Communication Test Cycle

See Fig. 3 for the layout of the communication test cycle. When the VUT is equipped with an on-board T-BOX, a base station simulator shall be connected to the on-board T-BOX (Fig. 3-a), and the on-board T-BOX shall transmit at the maximum power; when the VUT is not equipped with an on-board T-BOX, a signal source shall be connected to the standard antenna (Fig. 3-a) to simulate the test cycle under which the mobile phone transmits at the maximum radiated power of GSM according to the requirements of the radio administration authority, and the equivalent isotropically radiated power (EIRP) of the antenna shall reach +33 dBm. The signal source shall be arranged outside the anechoic chamber or more than 3 m away from the vehicle inside the anechoic chamber;

When the VUT has a special mobile phone slot, the standard antenna shall be placed in the mobile phone slot first; otherwise, it shall be placed inside the cup holder as follows:

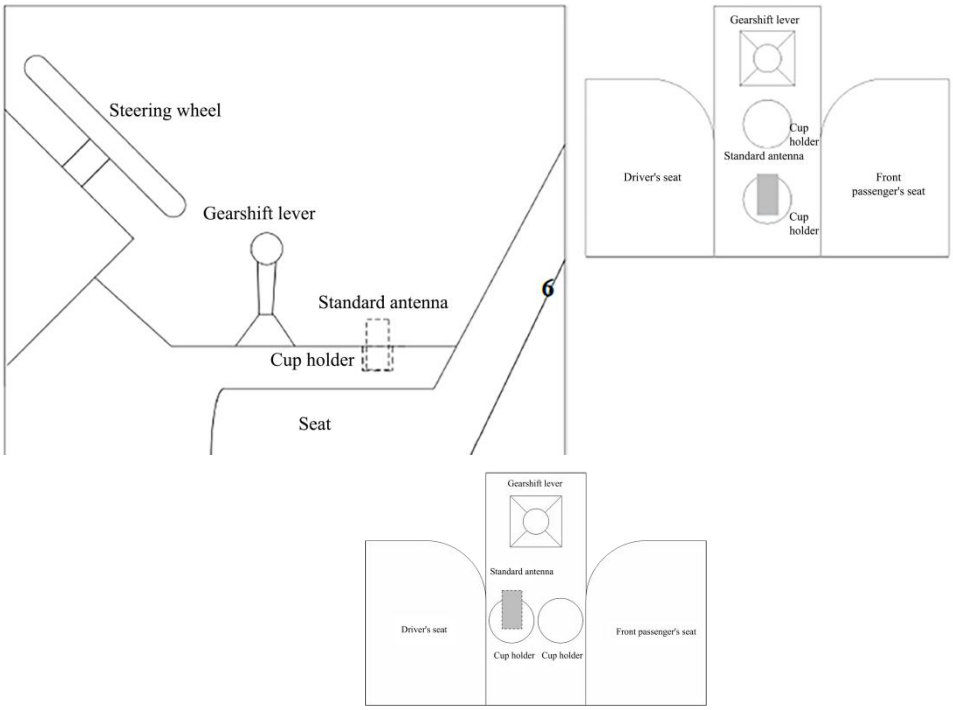


Fig. 4 Placement at Mobile Phone and Cup Holder

5.3.3 Charging test cycle

Refer to the layout of the constant-speed-running test cycle.

5.4 Test areas and test points

5.4.1 Test areas

For a 2-seat vehicle, the test area covers the driver's seat and the front passenger's seat, as shown in Fig. 5.

For a vehicle with 4 seats or more, the test area covers the driver's seat, the front passenger's seat, the left passenger's seat and the right passenger's seat, as shown in Fig. 6.

The driver's seat is the leftmost seat in the front row, the front passenger's seat is the rightmost seat in the front row, the left passenger's seat is the leftmost seat in the rear row, and the right passenger's seat is the rightmost seat in the rear row.

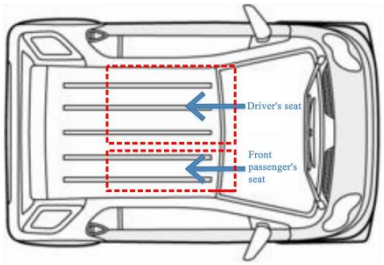


Fig. 5 Test Area for 2-seat Vehicle

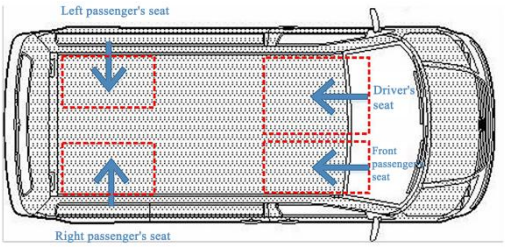


Fig. 6 Test Area for Vehicles with 4 Seats or More

The driver's seat includes the seat area and central control area, while the front passenger's seat and left and right passenger's seats only include the seat area.

Under the constant-speed-running test cycle, the driver's seat, front passenger's seat and all other passenger's seats shall be tested. Under the accelerating and decelerating test cycles and the communication test cycle, only the driver's seat and front passenger's seat shall be tested. Under the charging test cycle, only the charging area shall be tested. See the table below for the correspondence between the test cycles and the test areas.

Table 4 Correspondence between Test Cycles and Test Areas

Test Cycles	Test areas				
	Driver's seat	Front passenger's seat	Left passenger's seat	Right passenger's seat	Charging area
Constant-speed-running	●	●	●	●	×
Accelerating	●	●	×	×	×
Decelerating	●	●	×	×	×
Communication	●	●	×	×	×
Charging	×	×	×	×	●

5.4.2 Test points

5.4.2.1 Test points in seat area

See Fig. 7 for the test points in the seat (including driver's seat, front passenger's seat, left passenger's seat and right passenger's seat) area. Before the test, the seat, if adjustable, shall be adjusted as follows

1. If the seat is adjustable forward and backward, it shall be adjusted to the middle of the travel;

2. If the seat is adjustable up and down, it shall be adjusted to the lowest position of the travel;

3. If the seat backrest can be tilted, it shall be adjusted at an angle of 15° from the plumb line;

4. The probe center shall be 7.5 cm away from the seat surface. See Fig. 7 for the layout position of the probe center at each test point;

5. At points 1, 2 and 3, the probe center shall be located on the central axis of the seat;

6. At points 4 and 5, the probe center shall be located 10 cm in front of the projection of the foot floor area on the front edge of the seat, and the probe is located at the left and right most edges of the foot floor area.

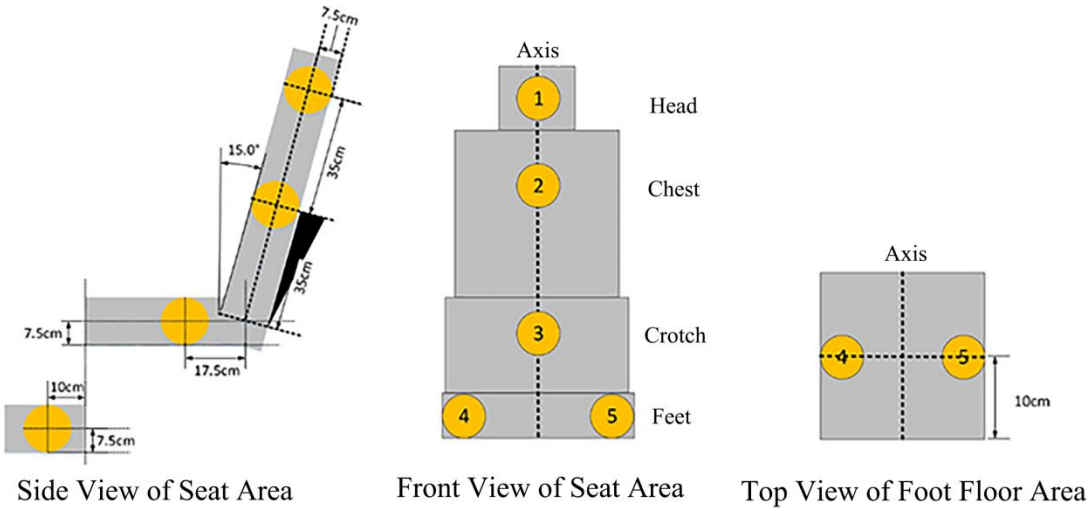


Fig. 7 Test Points in Seat Area

5.4.2.2 Test points in central control area

The test points in the central control area are at the center of the central control panel area, the gearshift lever position and the front edge of the armrest. The probe center at point 6 shall be located at the center of the central control screen (or the center of the central control button area if there is no central control screen). The probe centers at points 7 and 8 shall be located on the central

axis of the vehicle, with the probe at point 7 located at the root of the rear of the gearshift lever (or gearshift knob or button), and the probe center at point 8 located at the front edge of the armrest, as shown in Fig. 8.

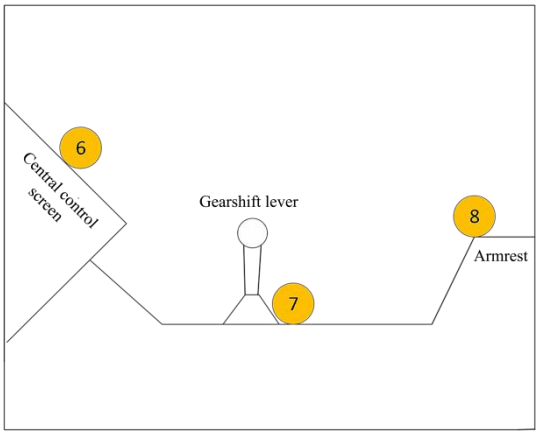


Fig. 8 Test Points in Central Control Area

5.4.2.3 Test points in charging area

The test points in the charging area are as follows: The measuring probe shall be closely attached to four points (9, 10, 11 and 12) at the upper, lower, left and right of the charging plug on the central horizontal and vertical lines of the charging port and the charging cable at point 13 shall be 0.5 m away from the charging port with vertical suspension part 100 mm ~ 300 mm away from the vehicle body.

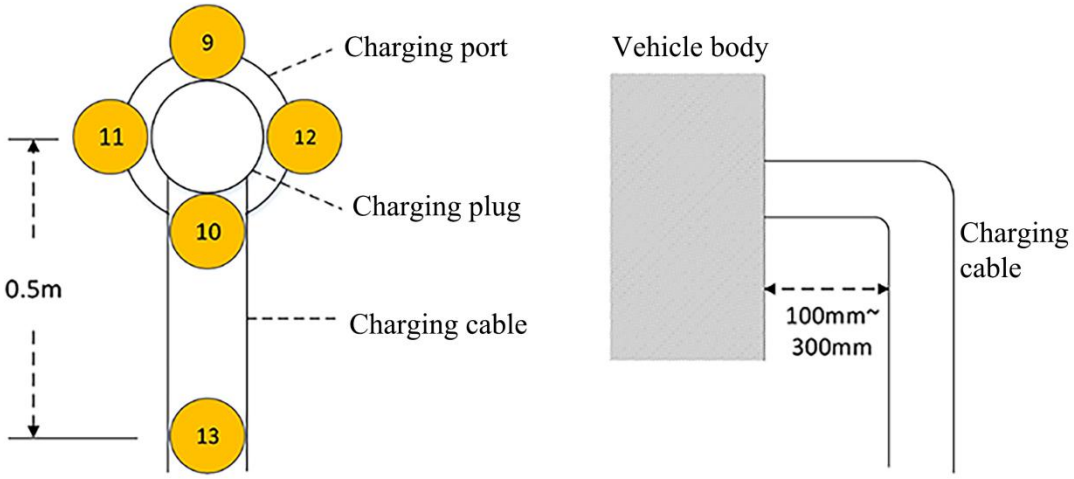


Fig. 9 Test Points in Charging Area

5.4.2.4 Corresponding test points in each test area

See the table below for corresponding test points in each test area.

Table 5 Correspondence between Test Areas and Test Points

Test areas	Test points												
	1	2	3	4	5	6	7	8	9	10	11	12	13
Driver's seat	●	●	●	●	●	●	●	●	×	×	×	×	×
Front passenger's seat	●	●	●	●	●	×	×	×	×	×	×	×	×
Left passenger's seat	●	●	●	●	●	×	×	×	×	×	×	×	×
Right passenger's seat	●	●	●	●	●	×	×	×	×	×	×	×	×
Charging area	×	×	×	×	×	×	×	×	●	●	●	●	●

5.5 Test process

Prepare the vehicle and test instruments.

Confirm the vehicle appearance and performance, and fill in the vehicle information in the sample vehicle verification table of Annex II.

Close the doors and lower the windows.

Determine the test position and set up the test cycle. The following are examples of NEVs with 4 seats or more.

The points of concern in the area of concern shall be tested under the running test cycles, communication test cycle and charging test cycle, respectively. Under the constant-speed-running test cycle, 4 areas shall be concerned, i.e. the driver's seat, front passenger's seat, left passenger's seat and right passenger's seat; under the accelerating and decelerating test cycles, 2 areas shall be concerned, i.e. the driver's seat and the front passenger's seat, and the same is true under the communication test cycle; under the charging test cycle, only the charging area shall be concerned.

For the 3 areas, i.e. the front passenger's seat and left and right passenger's seats, point 1 (head), point 2 (chest), point 3 (crotch position) and points 4 and 5 (feet) in the seat area shall be tested; for the driver's seat, in addition to points 1-5 of the seat area, the electric field and magnetic field corresponding to points 6, 7 and 8 in the central control area shall also be tested and the test data shall be saved. The value of each measuring point shall be the root mean square value in the frequency domain. The duration of each measuring point under the constant-speed-running test cycle, communication test cycle and charging test cycle shall be 20 s, while that under the accelerating or decelerating test cycle shall be the whole accelerating or decelerating process.

If the tester is in doubt about the test result, retests shall be conducted at two-minute intervals. If the result is not reproduced in two retests, the first result shall be judged to be abnormal, the last test shall be final and the result shall be recorded; otherwise, the first test result shall prevail.

The constant-speed-running, accelerating, decelerating, communication and charging test cycles have different test processes. In the test processes under running and charging test cycles, the extremely-low frequency, low frequency and high frequency bands are covered, which is a difficult job to accomplish with one test probe. Therefore, the test can be carried out in sections according to the equipment situation. The following test processes are sectioned by 400 kHz as the dividing line, i.e., the magnetic field tests are conducted under the running test cycles of 10 Hz ~ 400 kHz and 400 kHz ~ 30 MHz respectively to cover the frequency band of 10 Hz ~ 30 MHz.

5.5.1 Running test cycles

5.5.1.1 Test process under constant-speed-running test cycle

The corresponding process of the constant-speed-running test cycle is as follows:

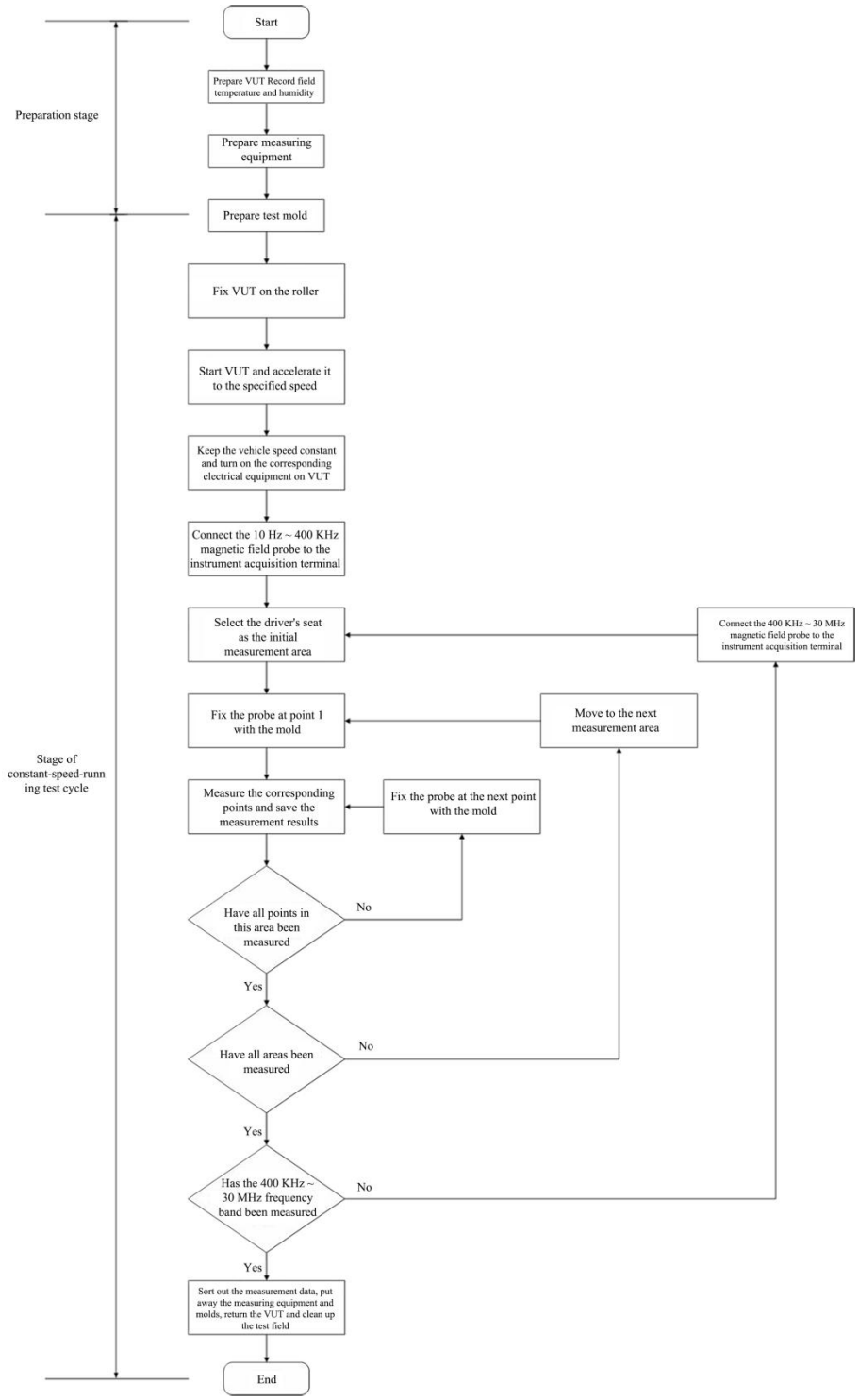


Fig. 10 Test Process under Constant-speed-running Test Cycle

5.5.1.2 Test process under accelerating and decelerating test cycles

The corresponding test process under the accelerating and decelerating test cycles is as follows:

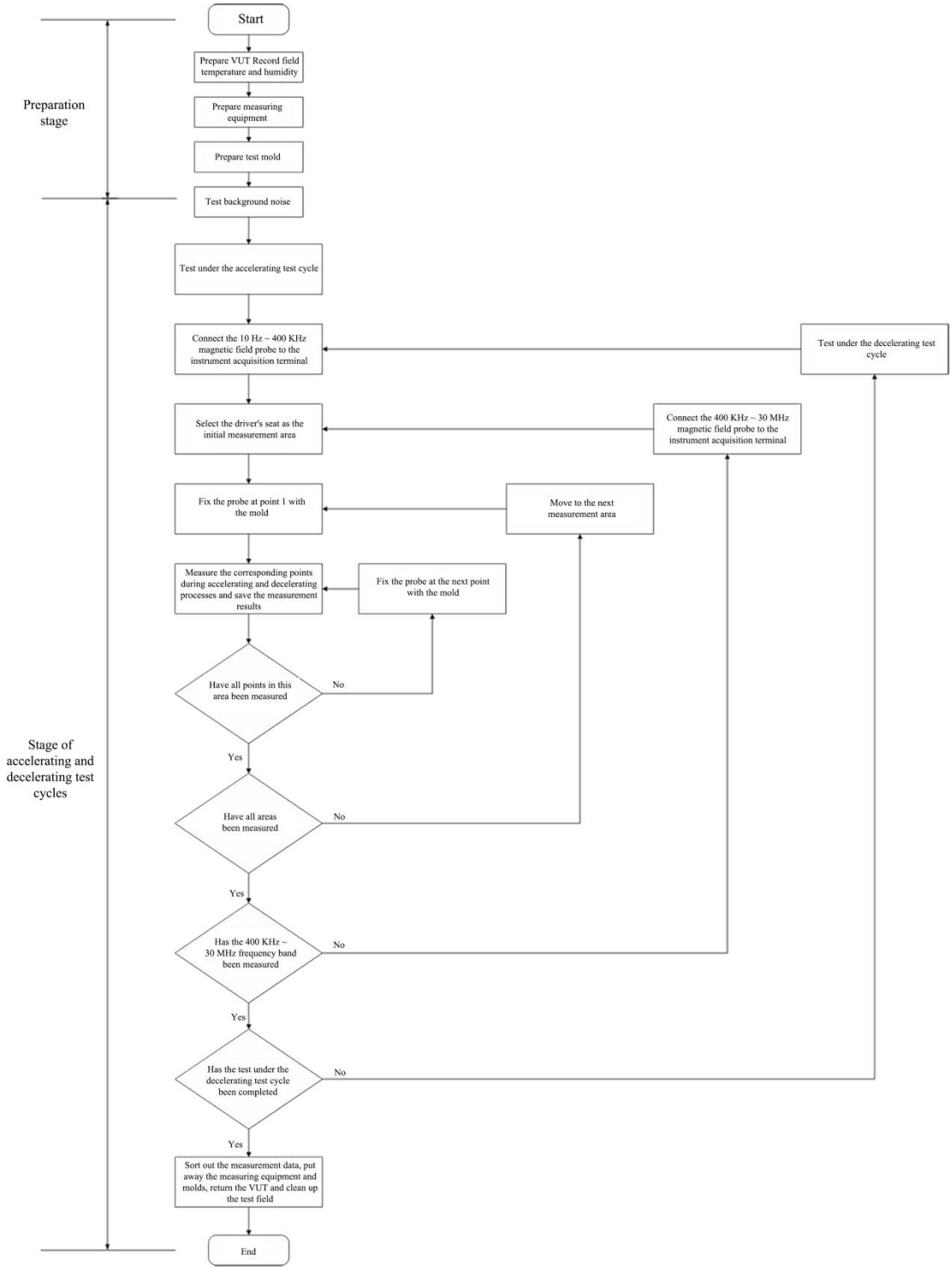


Fig. 11 Test Process under Accelerating and Decelerating Test Cycles

5.5.2 Communication test cycle

The corresponding test process under the communication test cycle is as follows:

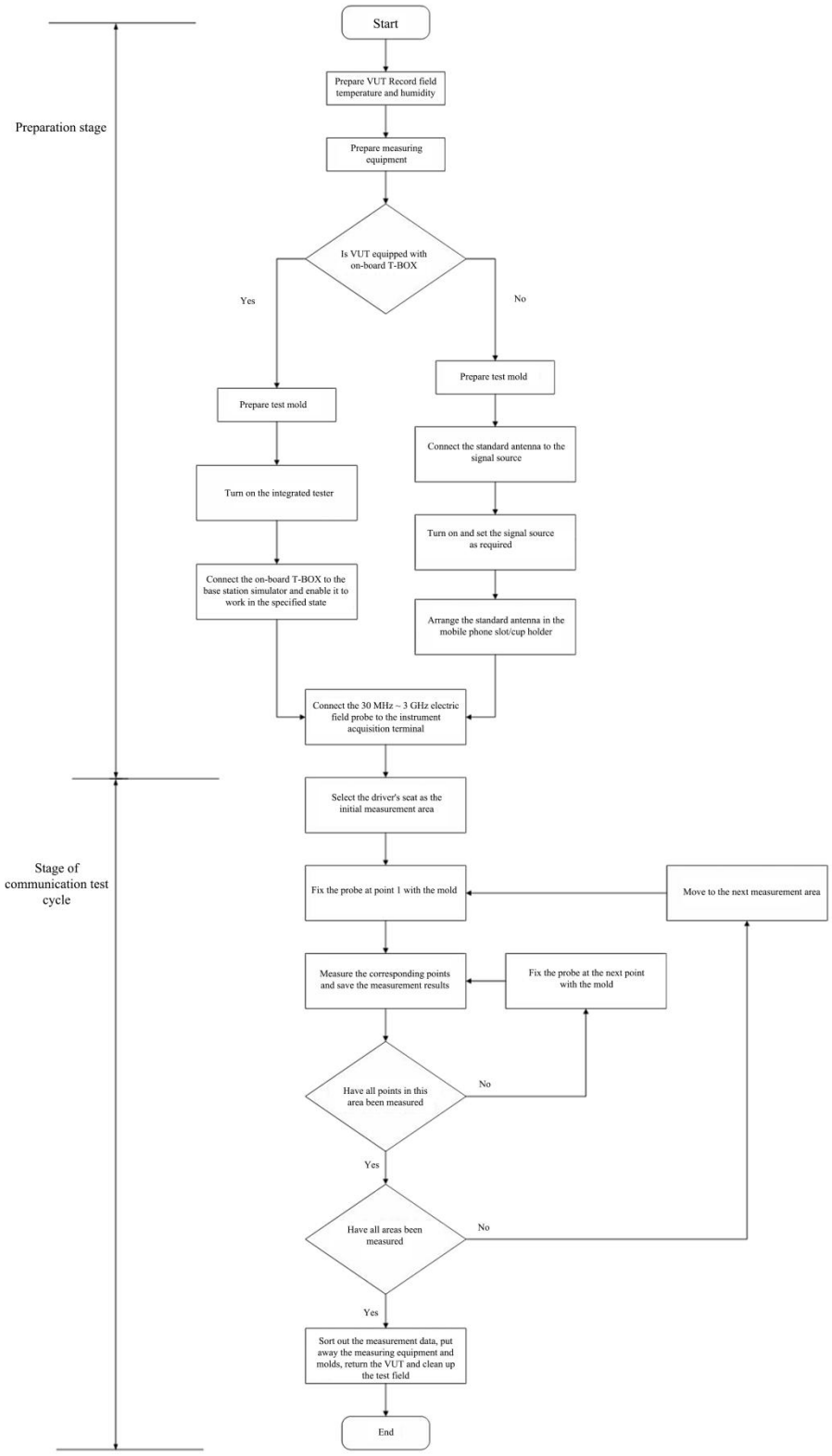


Fig. 12 Test Process under Communication Test Cycle

5.5.3 Charging test cycle

The corresponding test process under the charging test cycle is as follows:

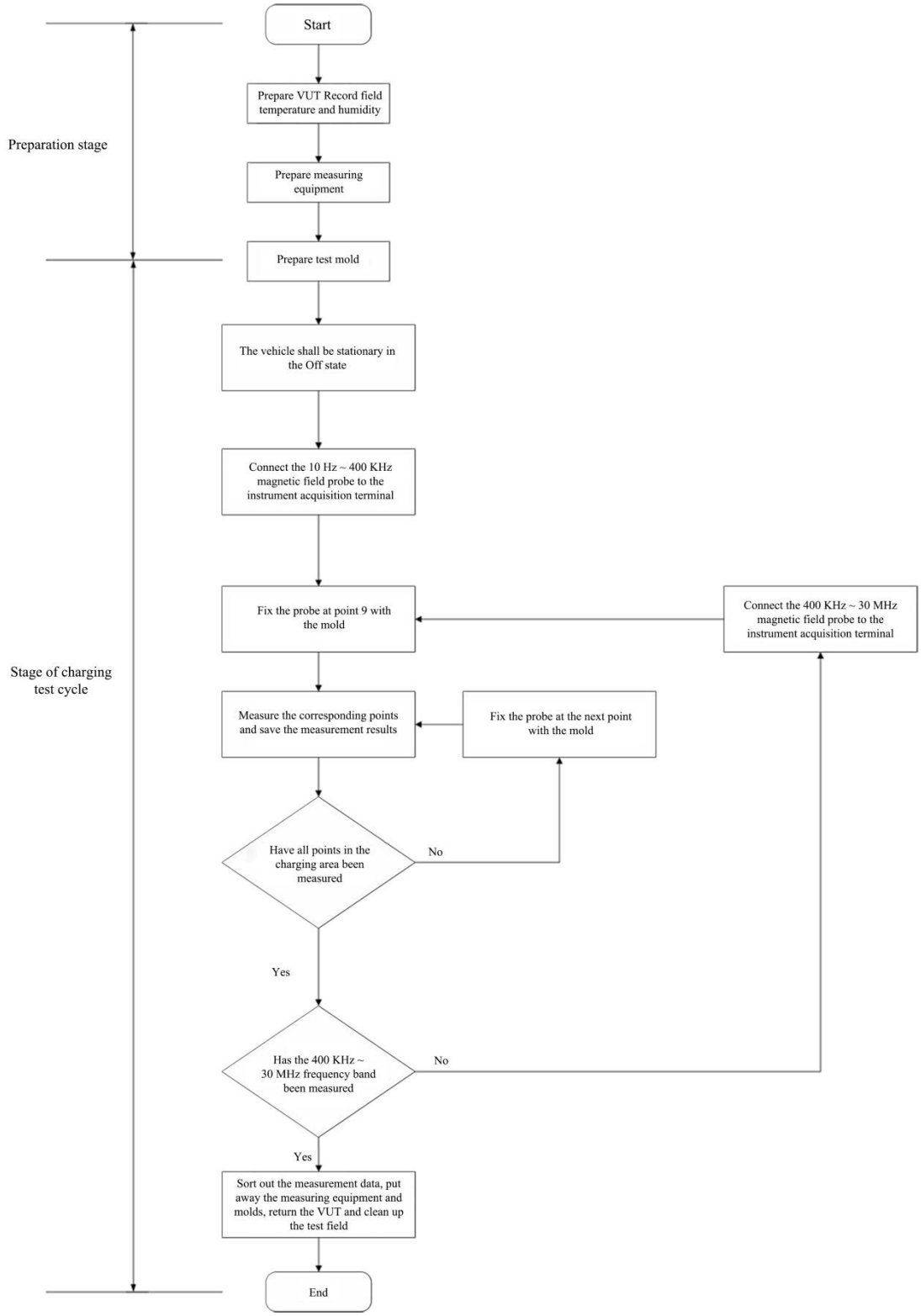


Fig. 13 Test Process under Charging Test Cycle

6 Evaluation of Test Results

6.1 Evaluation principle

In order to ensure that the evaluation results can truly reflect the EMR level of vehicles, instruct consumers concerned about EMR to choose and use vehicles, and guide automobile enterprises to optimize the design of EMR, the test result evaluation of EMR for "China-Automobile Health Index" shall be based on the following principles:

1. Focuses

The primary group served by the China-Automobile Health Index is consumers. Therefore, in terms of frequency bands, the EMR sector shall focus on the frequency bands that have been clearly identified in medical research as having an impact on human health; in terms of test cycles, it shall focus on the test cycles that are of particular concern to consumers; and in terms of test areas, it shall focus on the areas and points where the key organs of drivers and passengers are situated for a long period of time. The test results of these key frequency bands, key test cycles and key areas and points shall be fully reflected in the final comprehensive evaluation.

2. Objectivity

Evaluation indexes, evaluation methods and evaluation modes shall objectively and adequately reflect EMR levels under various test cycles of concern, avoiding the subjective influence of test and evaluation personnel on the evaluation results, thus ensuring objective and fair evaluation results.

3. Comprehensiveness

Today, with the rapid development of NEVs and intelligent and connected vehicles, the continuous introduction of new technologies has led to a more complex electromagnetic environment for vehicles, and consumers are skeptical about the EMR brought about by various technologies. Therefore, the test cycles and working frequency bands of various vehicle electrical systems shall be comprehensively evaluated, and the indexes shall refer to, but not be limited to, the requirements of current international and domestic standards.

4. Operability

The test duration for measuring the evaluation indexes shall be reasonable. The requirements for the test and evaluation environment and equipment shall not go beyond the current industry level. The test results shall be representative, the evaluation mode shall be concise and reasonable, and the evaluation indexes shall have clear layers.

6.2 Evaluation index

For the China-Automobile Health Index, the sector of electromagnetic radiation (EMR) has a full score of 100 points, consisting of constant-speed-running magnetic-field radiation index (CMRI), accelerating magnetic-field radiation index (AMRI), decelerating magnetic-field radiation index (DMRI), communicating electric-field radiation index (CERI) and charging magnetic-field radiation index (GMRI), which correspond to their respective test cycles, with corresponding full scores of 65, 10, 5, 20 and 5 points, respectively, where the 5 points for GMRI are a penalty item.

6.3 Evaluation layers

Each evaluation index is divided into three evaluation layers when the score is calculated: The first layer is the evaluation of the test results of a single test point in a specific area under specific test cycle ("single-point layer"); the second layer is the comprehensive evaluation of the test results of all test points in a single area ("area layer"); and the third layer is the comprehensive evaluation of the test results of different areas of the vehicle under the same test cycle ("test cycle layer").

6.3.1 Single-point layer

For China-Automobile Health Index, the smallest test unit of the sector of EMR is the test result of each test point. This test result must be obtained under the specified test cycle and specified frequency band. See 6.4.4 herein for its evaluation method.

6.3.2 Area layer

Within the second evaluation layer (area layer), the test results of all test points in a single area shall be focused on, and different weights shall be assigned to various test points by focusing on the

points where the vital organs of the human body are located.

For 5-point seat areas such as the front passenger's seat, rear left passenger's seat and rear right passenger's seat, EMR has a great impact on the nervous system and reproductive system, so 30% weight shall be assigned to the corresponding points (points 1 and 3) of head and crotch respectively; considering that EMR can affect the operation of implantable electronic devices such as the cardiac pacemaker, 30% weight shall be also assigned to the corresponding point (point 2) on the chest; although the corresponding points of the left and right feet (points 4 and 5) are often exposed to the strong electromagnetic field of the vehicle, there are no important organs or nervous systems in the legs and feet. Therefore, only 5% weight shall be assigned to each of the two points.

The 3 points of the central control area shall be counted within the driver's seat for scoring, so there are 8 points (head, chest, crotch, left foot, right foot, central control 6, central control 7 and central control 8) in the driver's seat. In particular, 25% weight shall be assigned to the corresponding points (points 1, 2 and 3) at the head, chest and crotch respectively, 5% weight shall be assigned to the corresponding points (points 4 and 5) at the left and right feet respectively, and 5% weight shall also be assigned to each of the 3 points in the central control area.

20% weight shall be assigned to each of the five test points in the charging area.

See Table 6 for the weight assignment of this part.

6.3.3 Test cycle layer

For each test cycle, the weights shall be evenly assigned to each test area.

See the table below for specific scoring criteria, layers and weight assignment of EMR in China-Automobile Health Index.

Table 6 Scoring Layers and Weight Assignment

<table>
<tr><th>Index</th><th>Full Score Score</th><th>Assignment to Test Cycle Layer</th><th colspan="2">Assignment to Area Layer</th><th>Scoring Criteria for Single-point Layer</th></tr>
<tr><td rowspan="2">Constant-speed-running magnetic-field radiation index</td><td rowspan="2">65 points</td><td rowspan="6">The weights shall be evenly assigned to each test area.</td><td>Driver's seat</td><td>Front passenger's seat and left and right passenger's seats</td><td rowspan="6">Reference value based on GB 8702-2014
-100 points when value ≥ 200% of reference value;
0 points when 200% of reference value > value ≥ 100% of reference value;
20 points when 100% of reference value > value ≥ 50% of reference value;
50 points when 50% of reference value > value ≥ 10% of reference value;
100 points when 10% of reference value > value</td></tr>
<tr><td>25% for head, chest and crotch respectively
5% for each point at the foot and in the central control area</td><td>30% for head, chest and crotch respectively
5% for each point at the foot</td></tr>
<tr><td>Accelerating magnetic-field radiation index</td><td>10 points</td></tr>
<tr><td>Decelerating magnetic-field radiation index</td><td>5 points</td></tr>
<tr><td>Communicating electric-field radiation index</td><td>20 points</td></tr>
<tr><td>Charging magnetic-field radiation index</td><td>5 points (penalty item)</td><td colspan="2">20% for each of the 5 test points in the charging area</td></tr>
</table>

6.4 Evaluation of results

6.4.1 Calculation of total score

The total score (S) of "China-Automobile Health Index - EMR" shall be calculated by subtracting the deducted points for charging magnetic-field radiation index (GMRI) from the sum of the scores of constant-speed-running magnetic-field radiation index (CMRI), accelerating magnetic-field radiation index (AMRI), decelerating magnetic-field radiation index (DMRI) and communicating electric-field radiation index (CERI), as shown in Formula 1:

$$S = S_{CMRI} + S_{AMRI} + S_{DMRI} + S_{CERI} + S_{GMRI} - 5 \quad \text{(Formula 1)}$$

6.4.2 Calculation of single-index scores - test cycle layer

6.4.2.1 Calculation of CMRI score

In Formula 1, the score is calculated from the sum of the products of the score of the driver's seat (S_{CMRI-1}), the score of the front passenger's seat (S_{CMRI-2}), the score of the left passenger's seat (S_{CMRI-3}), and the score of the right passenger's seat (S_{CMRI-4}) of S_{CMRI} and their corresponding weights, respectively, multiplied by the corresponding weight of the test cycle layer, which is 0.65, as shown in Formula 2 and Formula 3.

$$S_{\mathrm{CMRI}} = \frac{0.65}{M}\sum_{m=1}^{M} S_{CMRI-m} \quad \text{(Formula 2)}$$

S_{CMRI-m}→

- S_{CMRI-1} - score of driver's seat
- S_{CMRI-2} - score of front passenger's seat
- S_{CMRI-3} - score of left passenger's seat
- S_{CMRI-4} - score of left passenger's seat

(Formula 3)

In Formula 2, M=2 for 2-seat vehicles and M=4 for 4-seat vehicles or above.

6.4.2.2 Calculation of AMRI score

$$S_{\mathrm{AMRI}} = \frac{0.1}{2}\sum_{m=1}^{2} S_{AMRI-m} \quad \text{(Formula 4)}$$

6.4.2.3 Calculation of DMRI Score

$$S_{\mathrm{DMRI}} = \frac{0.05}{2}\sum_{m=1}^{2} S_{DMRI-m} \quad \text{(Formula 5)}$$

6.4.2.4 Calculation of CERI Score

$$S_{\mathrm{CERI}} = \frac{0.2}{2}\sum_{m=1}^{2} S_{CERI-m} \quad \text{(Formula 6)}$$

6.4.2.5 Calculation of GMRI Score

$$S_{GMRI} = 0.05 S_{GMRI-5} \quad \text{(Formula 7)}$$

6.4.3 Calculation of single-area score under determined test cycle - area layer

S_{CMRI-1} in Formula 2 is calculated from the sum of the products of the score of each point and the corresponding weight, respectively, as shown in Formula 8.

$$S_{\mathrm{CMRI-1}} = 0.25\sum_{n-1}^{3} S_{CMRI-1-n} + 0.05\sum_{n-4}^{8} S_{CMRI-1-n} \quad \text{(Formula 8)}$$

In the formula, $S_{CMRI-1-1}$ represents the score of the head point of the driver's seat, $S_{CMRI-1-2}$ represents the score of the chest point of the driver's seat, $S_{CMRI-1-3}$ represents the score of the crotch point of the driver's seat, $S_{CMRI-1-4}$ represents the score of the right foot point of the driver's seat, $S_{CMRI-1-5}$ represents the score of the left foot point of the driver's seat, and $S_{CMRI-1-6}$, $S_{CMRI-1-7}$, and $S_{CMRI-1-8}$ represent the scores of the points 6, 7 and 8 in the central control area, respectively, of the driver's seat. See Formula 8 for an explanation of this part.

$S_{CMRI-1-n}$→ {
- S_{CMRI}-1-1 - score of head point of the driver's seat
- S_{CMRI}-1-2 - score of chest point of the driver's seat
- S_{CMRI}-1-3 - score of crotch point of the driver's seat
- S_{CMRI}-1-4 - score of right foot point of the driver's seat
- S_{CMRI}-1-5 - score of left foot point of the driver's seat
- S_{CMRI}-1-6 - score of point 6 in the central control area of the driver's seat
- S_{CMRI}-1-7 - score of point 7 in the central control area of the driver's seat
- S_{CMRI}-1-8 - score of point 8 in the central control area of the driver's seat

(Formula 8)

$S_{CMRI-m}|m$=2, ... and M in Formula 2 is calculated from the sum of the products of the score of each point and the corresponding weight, respectively, as shown in Formula 9.

$$S_{CMRI-m} = 0.3\sum_{n-1}^{3} S_{CMRI-m-n} + 0.05\sum_{n-4}^{5} S_{CMRI-m-n} \quad \text{(Formula 9)}$$

6.4.4 Calculation of single-point score - single-point layer

For the test results of this minimum test unit, the scoring criteria given in this standard are as follows:

Taking the GB 8702-2014 reference limit as a benchmark, the spectrum of the test result of a point under the specified test cycle, the specified frequency band and the specified area shall be compared with this benchmark.

If the test result contains data exceeding the benchmark, the ratio of the excess quantity to the benchmark shall be determined by dividing the difference value between the test result of each frequency point and the benchmark by the benchmark. The frequency point with the largest ratio shall be taken as the evaluation frequency point. If the test result of the evaluation frequency point is greater than or equal to two times the benchmark, this point shall be scored as -100; if the test result of the evaluation frequency point is greater than or equal to the benchmark, but less than two times the benchmark, this point shall be scored as 0 points.

If the test results do not contain data exceeding the benchmark, the test result of each frequency point shall be divided by the benchmark, the result of which is the ratio of the test quantity to the benchmark. The frequency point with the largest ratio shall be taken as the evaluation frequency point. If the test result of the evaluation frequency point is greater than or equal to half of the benchmark, this point shall be scored as 20; if the test result of the evaluation frequency point is greater than or equal to 10% of the benchmark, this point shall be scored as 50; otherwise, the point shall be scored as a full mark of 100.

See Table 6 for the scoring criteria of this part.

Annex A Limits of Existing International and Domestic Mainstream Standards

A.1 GB 8702-2014 *Controlling Limits for Electromagnetic Environment*

Frequency Range	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Magnetic Induction (μT)
Greater than 1 Hz and less than or equal to 8 Hz	8000	$3.2\times10^4/f^2$	$4\times10^4/f^2$
Greater than 8 Hz and less than or equal to 25 Hz	8000	$4000/f$	$5000/f$
Greater than 0.025 kHz and less than or equal to 1.2 kHz	$200/f$	$4/f$	$5/f$
Greater than 1.2 kHz and less than or equal to 2.9 kHz	$200/f$	3.3	4.1
Greater than 2.9 kHz and less than or equal to 57 kHz	70	$10/f$	$12/f$
Greater than 57 kHz and less than or equal to 100 kHz	$4000/f$	$10/f$	$12/f$
Greater than 0.1 MHz and less than or equal to 3 MHz	40	0.1	0.12
Greater than 3 MHz and less than or equal to 30 MHz	$67/f^{1/2}$	$0.17/f^{1/2}$	$0.21/f^{1/2}$
Greater than 30 MHz and less than or equal to 3000 MHz	12	0.032	0.04
Greater than 3000 MHz and less than or equal to 15000 MHz	$0.22f^{1/2}$	$0.00059f^{1/2}$	$0.00074f^{1/2}$
Greater than 15 GHz and less than or equal to 300 GHz	27	0.073	0.092
Note f is expressed in the units indicated in the frequency range column.			

A.2 ICNIRP Guidelines 1998 Public Exposure Limits

Frequency Range	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Magnetic Induction (μT)
Less than or equal to 1 Hz	—	3.2×10^4	4×10^4
Greater than 1 Hz and less than or equal to 8 Hz	10000	$3.2\times104/f^2$	$4\times104/f^2$
Greater than 8 Hz and less than or equal to 25 Hz	10000	$4000/f$	$5000/f$
Greater than 0.025 kHz and less than or equal to 0.8 kHz	$250/f$	$4/f$	$5/f$
Greater than 0.8 kHz and less than or equal to 3 kHz	$250/f$	5	6.25
Greater than 3 kHz and less than or equal to 150 kHz	87	5	6.25
Greater than 0.15 MHz and less than or equal to 1 MHz	87	$0.73/f$	$0.92/f$
Greater than 1 MHz and less than or equal to 10 MHz	$87/f1/2$	$0.73/f$	$0.92/f$
Greater than 10 MHz and less than or equal to 400 MHz	27.5	0.073	0.092
Greater than 400 MHz and less than or equal to 2000 MHz	$1.375f^{1/2}$	$0.0037f^{1/2}$	$0.0046f^{1/2}$
Greater than 2 GHz and less than or equal to 300 GHz	61	0.16	0.20
Note f is expressed in the units indicated in the frequency range column.			

A.3 ICNIRP Guidelines 2010 Public Exposure Limits

Frequency Range	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Magnetic Induction (μT)
Less than or equal to 1 Hz	—	—	—
Greater than 1 Hz and less than or equal to 8 Hz	5000	$3.2\times10^4/f^2$	$4\times10^4/f^2$
Greater than 8 Hz and less than or equal to 25 Hz	5000	$4000/f$	$5000/f$
Greater than 25 Hz and less than or equal to 50 Hz	5000	160	200
Greater than 50 Hz and less than or equal to 400 Hz	$250000/f$	160	200
Greater than 400 Hz and less than or equal to 3000 Hz	$250000/f$	$6.4\times10^4/f$	$80000/f$
Greater than 3 kHz and less than or equal to 10 MHz	83	21	27
Note f is expressed in the units indicated in the frequency range column.			

Bibliography

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[8] IEC TS 62764-1-2019 Measurement procedures of magnetic field levels generated by electronic and electrical equipment in the automotive environment with respect to human exposure