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NATIONAL ECOLOGICAL ENVIRONMENT STANDARD
OF THE PEOPLE'S REPUBLIC OF CHINA

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**Technical specification for emission remote supervision
system of non-road mobile machinery**
非道路移动机械排放远程监控技术规范

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Table of Contents

Foreword	3
1 Scope	4
2 Normative references	4
3 Terms and definitions	5
4 General requirements	7
5 On-board terminals	9
6 Enterprise platform	17
7 Test methods	19
8 Standard Implementation	19
Annex A (normative) Test methods for on-board terminals.....	20
Annex B (informative) Static data stored on the enterprise platform.....	30
Annex C (normative) On-board terminal communication protocol and data format..	32
Annex CA (informative) Data format and definition of on-board terminal removal alarm	45
Annex D (normative) Enterprise platform communication protocol and data format	46
Annex E (informative) Self-assessment report of the enterprise platform.....	52

Technical specification for emission remote supervision system of non-road mobile machinery

1 Scope

This Standard specifies the general requirements for emission remote supervision system of non-road mobile machinery, the functions, performance and safety requirements of on-board terminals and enterprise platforms, as well as test methods and communication protocols and data formats for data transmission.

This Standard applies to remote online monitoring and networking of non-road diesel mobile machinery with a rated net power of 37 kW and above that meets the fourth stage of HJ 1014-2020.

2 Normative references

This Standard refers to the following documents or clauses therein. For any dated referenced document, only the dated version applies to this Standard. For any undated referenced document, the latest version (including all amendments) applies to this Standard.

GB 17691-2018, *Limits and measurement methods for emissions from diesel fueled heavy-duty vehicles (CHINA VI)*

GB 18030, *Information technology -- Chinese coded character set*

GB 20891-2014, *Limits and measurement methods for exhaust pollutants from diesel engines of non-road mobile machinery (CHINA III, IV)*

GB/T 1988, *Information technology -- 7-bit Coded character set for information interchange*

GB/T 2423.18, *Environmental testing -- Part 2: Test methods -- Test Kb: Salt mist, cyclic (sodium chloride solution)*

GB/T 4208, *Degrees of protection provided by enclosure (IP code)*

GB/T 22239, *Information security technology -- Baseline for classified protection of cybersecurity*

GB/T 28046.1, *Road vehicles -- Environmental conditions and testing for electrical and electronic equipment -- Part 1: General*

factory in accordance with the provisions of HJ 1014-2020. Machinery manufacturers shall take necessary technical measures. During the operation of the machinery throughout its life cycle, it shall be able to accurately locate it through the on-board positioning terminal and transmit data in accordance with the requirements of this Standard.

4.2 Engineering machinery equipped with diesel engines with a rated net power of 37 kW or above [if equipped with a selective catalytic reduction (SCR) after-treatment system, at least an SCR downlink NO_x sensor] shall be equipped with an on-board emission terminal that meets the requirements of Chapter 5 before leaving the factory in accordance with the provisions of HJ 1014-2020. Machinery manufacturers shall take necessary technical measures to transmit data in accordance with the requirements of this standard during the operation of the machinery throughout its life cycle.

4.3 The on-board terminal shall comply with the requirements specified in Chapter 5. The machinery manufacturer or on-board terminal manufacturer shall conduct functional and performance tests on the on-board terminal. The test method shall comply with the provisions of Annex A. The machinery manufacturer shall ensure that the on-board terminal works normally throughout the life of the machinery.

4.4 For special-purpose machinery such as underground operation machinery and offshore platform machinery, machinery manufacturers shall report to the ecological and environmental authorities and can be exempted from installing on-board terminals and remote online networking. Submitted materials include (but not limited to): machinery model, machinery environmental protection code, machinery type, usage scenario, exemption reasons, etc. For the second diesel engine, type inspection shall be carried out according to HJ 1014-2020, and installation of on-board terminals and remote online networking can be exempted.

4.5 The positioning, data collection and transmission of on-board terminals, enterprise platform server settings, network data storage and applications, etc., shall comply with the relevant laws and regulations of the relevant management departments.

4.6 The on-board terminal shall be activated according to the requirements of 5.2.2 and receive the result feedback from the national platform. After successful activation, data collection shall be carried out and transmitted to the enterprise platform according to the specified communication protocol. The enterprise platform shall transmit the received data to the national platform in real time according to the specified communication protocol. The enterprise platform shall comply with the requirements specified in Chapter 6. The enterprise platform shall have the storage and transmission functions of static data specified in Annex B.

4.7 The national platform sends a response message to the enterprise platform regarding the received data. The data flow framework is shown in Figure 1.

interface.

5.1.3 Machinery manufacturers shall install warning light related indicators (including signal lights, display screens or sounds) in a position visible to the machine operator. When the on-board terminal fails, the network status is abnormal, or the on-board terminal is removed, the machine operator shall be notified by the warning light related indicators.

5.1.4 Machinery manufacturers shall provide warranty services for on-board terminals in accordance with the warranty period requirements specified in 5.8 of HJ 1014-2020.

5.2 Functional requirements

5.2.1 Power-on self-test

The on-board terminal shall indicate the current main status through the warning light and related indicators when it is powered on and starts working. The main status includes: whether the network communication is normal, whether the function is normal (last at least 10 s; if all functions are normal, it can be automatically extinguished afterwards).

5.2.2 Activation

5.2.2.1 Before leaving the factory, the on-board emission terminal of construction machinery shall be activated according to the procedure specified in Figure 2. The activation information includes the security chip identification ID (referred to as chip ID), the public key stored in the security chip and the mechanical environmental protection code (MEIN). MEIN shall be written into the on-board emission terminal or electronic control unit [including mechanical electronic control unit (MCU) and engine electronic control unit (ECU)]. The activation information of the on-board emission terminal shall be transmitted to the national platform after adding a data signature through the private key stored in the security chip.

5.2.2.2 Before non-road mobile machinery other than construction machinery leaves the factory, the on-board positioning terminal shall be activated according to the procedure specified in Figure 3. The activation information is MEIN. MEIN shall be written into the on-board positioning terminal or electronic control unit.

5.2.2.3 The on-board emission terminal and on-board positioning terminal shall receive the activation results fed back by the national platform in accordance with the protocol specified in Annex C.

working hours) before the communication is restored.

5.2.7 Removal of alarms

Machinery manufacturers shall have technical measures to prevent on-board terminals from being dismantled. Without the authorization of the machinery manufacturer, it shall be ensured as much as possible that the on-board terminal cannot be dismantled. When the on-board terminal is dismantled, the machine shall activate an alarm. If the technology allows, the dismantling alarm information can be transmitted according to the communication protocol specified in Annex C. The alarm information includes the dismantling time and location information.

5.3 Performance requirements

5.3.1 Adaptability

The electrical adaptability and environmental adaptability of the on-board terminal shall comply with the requirements of 4.3.1 and 4.3.2 of GB/T 32960.2-2016. The protection of the shell shall meet the requirements of 5.3.2.2.

5.3.2 Protection

5.3.2.1 Salt spray protection

The on-board terminal shall be tested according to the Test Method 4 specified in GB/T 2423.18. The on-board terminal installed in an exposed manner shall be tested according to the Test Method 5 specified in GB/T 2423.18. After the test, the sealing shall remain unchanged, the signs and labels shall be clearly visible, and the functional status shall reach Class C defined in GB/T 28046.1.

5.3.2.2 Enclosure protection

The on-board terminal shall at least meet the protection level of IP53 specified in GB/T 4208. For exposed on-board terminals, at least the protection level of IP65 specified in GB/T 4208 shall be met. After the housing protection test is performed according to A.4.2 in Appendix A, all functions of the on-board terminal shall be at Class A as defined in GB/T 28046.1.

5.3.3 Durability

The service life of the on-board terminal shall be no less than 7 years.

5.3.4 Positioning performance

The positioning performance of the on-board terminal shall meet the following requirements:

- a) Horizontal positioning accuracy is no more than 10 m;

- b) Minimum position update frequency is 1 Hz;
- c) Positioning time:
 - 1) Cold start: The time from system power-on to capture is no more than 120 s;
 - 2) Hot start: The time to capture is less than 10 s.

5.3.5 Electromagnetic compatibility performance

The electromagnetic compatibility performance of the on-board terminal shall comply with the requirements of 4.3.3 of GB/T 32960.2-2016. The requirement for the on-board terminal to the transient conduction immunity test pulse 1 along the power line is Class C.

5.4 Data security requirements

5.4.1 Security chip

On-board emission terminals shall be equipped with security chips. Security chip manufacturers shall have a complete quality assurance system and pass ISO 9001 quality management system and ISO 14001 environmental management system certification. Security chips shall meet the following requirements:

- a) Have a unique chip ID. The chip ID consists of a 4-digit chip model identifier and a maximum of 12 characters customized by the on-board emission terminal manufacturer;
- b) The chip ID and key are stored, and the key is registered by the security chip manufacturer. The chip ID and public key can be read, but the private key cannot be read or modified;
- c) The security level shall meet the GM/T 0008 security level 2 requirements or the product security assurance level shall not be lower than EAL4+ requirements, and have a commercial cryptographic product certification
- d) The secret key strength shall be 256 bits;
- e) The digital signature speed shall be no less than 50 times/s.

5.4.2 Security policy

The on-board terminal shall provide a technically feasible security strategy to ensure that the product's various performance and functions are within the safety range. The security strategy shall include the following:

- a) The data stored and transmitted by the on-board terminal shall be complete. The on-board emission terminal shall be signed using an asymmetric encryption algorithm. The national SM2 algorithm can be used, and the private key shall be

6.1.4 When the data received by the enterprise platform does not meet the requirements of this standard, the enterprise shall immediately investigate and repair it within 30 days.

6.2 Functional requirements

6.2.1 The enterprise platform shall have the function of receiving emission remote monitoring data from the on-board terminal.

6.2.2 The enterprise platform shall ensure data security. It is advisable to use encryption to receive and store data from the on-board terminal. The enterprise platform shall ensure that the data has not been modified in any way.

6.2.3 The enterprise platform shall transmit the received data to the national platform in real time according to the communication protocol specified in Annex D. The national platform shall send a response message to the enterprise platform regarding the data reception status.

6.2.4 The enterprise platform shall have the storage and transmission functions of static data specified in Annex B.

6.2.5 The enterprise platform shall have the function of storing data transmitted during the entire life cycle of the machine. Among them, data within at least 5 years shall be stored as hot data. Data older than 5 years can be stored as cold backup data. The hot data query response time of a single machine shall not exceed 5 seconds. The enterprise platform shall have sufficient storage space to receive real-time data from the machine.

6.2.6 When the data communication link is abnormal, the enterprise platform shall retransmit the data after the data communication link returns to normal.

6.2.7 The enterprise platform shall have self-checking and early warning functions in accordance with the relevant technical requirements in Chapter 6.

6.2.8 If an activated on-board terminal needs to be replaced due to damage, etc., the enterprise platform shall record and transmit the mechanical static data to the national platform.

6.3 Performance requirements

6.3.1 The enterprise platform shall have authentication functions to prevent malicious access and attacks. It shall have permission management for data types and data entities, such as the management of different users' access rights to different machine data.

6.3.2 The enterprise platform shall have a high availability mechanism that can prevent task failure and data loss caused by faults.

6.3.3 The enterprise platform shall meet the requirements of GB/T 22239 security level protection level 2 and above.

Annex A

(normative)

Test methods for on-board terminals

A.1 Overview

This appendix specifies the test methods for the functions and performance of the on-board terminal for remote monitoring of emissions of non-road mobile machinery.

A.2 Test preparation

At least 5 sets of on-board terminals, corresponding wiring harnesses and matching connectors shall be prepared. Samples are randomly selected for testing.

A.3 Functional testing

A.3.1 Power-on self-test and activation test

After the on-board terminal is connected to the power supply, the activation operation is performed on the test platform (referring to the test platform used by the test organization when testing the on-board terminal) according to the process in Figure 2 or Figure 3. The activation function of the on-board terminal must meet the requirements of 5.2.2. Check whether the on-board terminal works normally according to the product manual provided by the on-board terminal manufacturer. The power-on self-test function of the on-board terminal shall meet the requirements of 5.2.1. Then check whether the on-board terminal can be connected to the test platform normally, and there is data transmitted to the test platform.

A.3.2 Time and date check

Read the data transmitted from the on-board terminal to the test platform. Check the time format in the data. Record the error between the standard time 24 h corresponding to the on-board terminal and the transmission time. The time and date provided by the on-board terminal must meet the requirements of 5.2.3.4.

A.3.3 Data collection check

Read the data transmitted from the on-board terminal to the testing platform. Check whether the data collection frequency and data content meet the requirements of 5.2.3.1 and 5.2.3.2.

A.3.4 Data storage check

Check the data storage function of the on-board emission terminal according to the

manufacturer's instructions. Calculate the internal storage medium capacity of the on-board emission terminal based on the amount of data transmitted continuously for 10 min. Check whether the storage requirements of 5.2.4 are met.

A.3.5 Data retransmission check

Artificially create abnormal communication failure of the on-board emission terminal, and then restore communication. Check whether there is supplementary data through the detection platform and whether it meets the requirements of 5.2.6.

A.4 Performance test

A.4.1 Adaptability test

The electrical adaptability test and environmental adaptability test of the on-board terminal shall be carried out in accordance with the relevant requirements of GB/T 32960.2-2016.

A.4.2 Protection test

The salt spray protection of on-board terminals shall be tested according to the test method specified in GB/T 2423.18

The protection of the on-board terminal casing shall be tested according to the test method of the corresponding protection level specified in GB/T 4208.

A.4.3 Durability test

The service life of the on-board terminal shall not be less than 7 years. The durability test method adopts the temperature alternating durability life test method in Annex A of GB/T 32960.2-2016.

A.4.4 Satellite navigation positioning performance test

A.4.4.1 Test equipment

The simulation test uses a Global Navigation Satellite System (GNSS) simulator. The simulator shall be able to simulate and generate at least 24 satellite dynamic signals at the same time and support simulated path planning. In order to be close to the number of satellites in the real environment, 7~8 satellites with a constant carrier-to-noise ratio (42~44) quality are simulated. The test sample can use an on-board GNSS complete machine (on-board terminal) or an on-board GNSS module. In order to test the stability of the performance, a conduction test (the GNSS simulator is connected to the test sample by wire, see Figure A.1) or an air interface test (the test sample is placed in a microwave darkroom, and the GNSS simulator is connected to the test sample wirelessly, see Figure A.2) is used for testing.

A.5.1.3 The test sample can implement the SM2 encryption algorithm.

A.5.2 Penetration test method

A.5.2.1 Test equipment

The equipment for penetration test is as follows:

- a) Abnormal command sending device;
- b) Signal connection device;
- c) Test control computer.

A.5.2.2 Test methods

A.5.2.2.1 Based on the normal requirements for obtaining emissions and related data, the on-board terminal needs to process the normal operation instruction set from the enterprise platform, as well as the abnormal instruction set of no less than 100 samples. At least the typical network attack methods specified in 6.2 of GB/T 37027-2018 shall be included. Check whether the on-board terminal has the ability to detect more than 95% of the abnormal instructions, and the false alarm rate can be less than 1%, and can detect and start protection measures within 10 seconds after the attack begins.

A.5.2.2.2 Scan the on-board terminal system for vulnerabilities. Check whether the system has vulnerabilities that have been published for 6 months or more in the authoritative vulnerability database specified by the relevant departments. The vulnerabilities shall come from the authoritative vulnerability database or sharing platform in China. The verified vulnerabilities and test cases shall obtain the public vulnerability numbers granted by the vulnerability database or sharing platform, and the vulnerability types shall include general vulnerabilities and event-type vulnerabilities.

A.5.2.2.3 Data integrity test for storage and transmission by the on-board terminal. Send the designated source data to the on-board terminal, and the on-board terminal transmits it to the testing platform. Parse the data stored in the on-board terminal. Compare it with the designated source data to confirm the integrity of the stored data. Parse the data transmitted from the on-board terminal to the testing platform. Compare it with the designated source data to confirm the integrity of the transmitted data.

A.5.2.2.4 The on-board terminal is connected to the enterprise platform. Use the test platform to simulate non-enterprise operation instructions and send them to the on-board terminal. Test whether the on-board terminal accepts and executes the instructions.

A.5.3 Evaluation indicators

A.5.3.1 Response time: If the sample under test outputs the first detected abnormal

instruction within 10 s (including 10 s) after the attack starts, the test passes; if it is greater than 10 s or no abnormal instruction is detected, the test fails.

A.5.3.2 The sample under test outputs all detected abnormal instructions. If the proportion of detected abnormal instructions is greater than (including) 95%, the test passes, otherwise the test fails.

A.5.3.3 When A.5.3.2 of this annex is met, compare the test results with the corresponding abnormal instructions. If the accuracy is greater than (including) 99%, the test passes, otherwise the test fails.

A.5.3.4 If the on-board terminal system does not have vulnerabilities that are published by the authoritative vulnerability database for 6 months or more, the test will pass, otherwise the test will fail.

A.5.3.5 The data stored and transmitted by the on-board terminal shall be complete.

A.5.3.6 The on-board terminal shall not execute instructions issued by non-enterprise platforms.

A.6 Cryptographic algorithm implementation security test method

A.6.1 Test equipment

The cryptographic algorithm security test equipment is as follows:

- a) Side channel signal acquisition and analysis system;
- b) Oscilloscope;
- c) Electromagnetic acquisition probe;
- d) Fault signal injection system;
- e) Electromagnetic radiation generator;
- f) Test result recording computer.

A.6.2 Test methods

A.6.2.1 The on-board terminal manufacturer shall provide design and instruction documents or relevant national encryption certification certificates.

A.6.2.2 The on-board emission terminal operates normally and obtains the data signed by the on-board emission terminal. Use the cryptographic algorithm declared by the manufacturer to verify the signature of at least 100 pieces of information. Verify the correctness of the use of the national secret algorithm SM2 through interface testing. The test sample delivery personnel provide the public key, the ID used for the signature, and the signed data.

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