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CHINA'S STAGE VI EMISSION STANDARD FOR HEAVY-DUTY VEHICLES (FINAL RULE)

ICCT POLICY UPDATES

SUMMARIZE
REGULATORY
AND OTHER
DEVELOPMENTS
RELATED TO CLEAN
TRANSPORTATION
WORLDWIDE.

On June 28, 2018, the Ministry of Ecology and Environment (MEE)¹ of the People's Republic of China released the final rule for the China VI emission standard for heavy-duty vehicles^{2,3} (GB17691–2018; hereafter referred to as *China VI*). The China VI standard will be implemented in two phases. China VI-a will take effect on July 1, 2019 for new gas-powered heavy-duty vehicles (HDVs), on July 1, 2020 for new urban HDVs, and July 1, 2021 for the remaining new HDVs. China VI-b will take effect on January 1, 2021 for new gas-powered HDVs, then on July 1, 2023 for all new HDVs. When fully implemented, China VI will require all new HDVs sold in China to meet the standard.

Unlike the previous standard phases, which closely followed the European emission standards, the China VI standard combines best practices from both European and U.S. regulatory requirements, in addition to creating its own. China VI-a is largely equivalent to Euro VI, and China VI-b introduces slightly more stringent testing requirements and a remote emission monitoring system. Specifically, the standard features:

- » Reductions in nitrogen oxides (NO_x) and particulate matter (PM) emission limits by around 70% from the current China V standard;
- » The introduction of particulate number (PN) limits;
- » A shift from the European Steady-state Cycle (ESC) and European Transient Cycle (ETC) to the more representative and dynamic World Harmonized Stationary Cycle (WHSC) and World Harmonized Transient Cycle (WHTC);
- » Inclusion of new World Harmonized Not-to-Exceed (WNTE) test;
- » Extended durability requirements;

¹ Formerly the Ministry of Environmental Protection

² Limits and measurement methods for emissions from diesel-fueled heavy-duty vehicles (China VI), Ministry of Ecology and Environment, June 28, 2018. http://kjs.mep.gov.cn/hjbhbz/bzwb/dqhbz/dqydyrrwpfbz/201807/t20180703_445995.shtml

³ The standard applies to diesel and gas fueled (natural gas and liquefied petroleum gas) engines and vehicles of M1 vehicles with a gross vehicle weight above 3,500 kg and all M2, M3, N1, N2 and N3 vehicles.
M1: passenger vehicles, no more than eight seats in addition to the driver's seat.

M2: passenger vehicles, more than eight seats in addition to the driver's seat, GVW not exceeding 5,000 kg.

M3: passenger vehicles, more than eight seats in addition to the driver's seat, GVW exceeding 5,000 kg.

N1: Vehicles for the carriage of goods, GVW≤3,500 kg.

N2: Vehicles for the carriage of goods, 3,500 kg<GVW≤12,000 kg.

N3: Vehicles for the carriage of goods, GVW>12,000 kg.

- » Adoption of full vehicle Portable Emission Measurement System (PEMS) testing and requirements based on the European PEMS regulation, with modifications that address the unique driving conditions in China for type test, new production and in-service conformity testing;
- » Improved on-board diagnostic (OBD) system and anti-tampering provisions based on U.S. OBD requirements;
- » A requirement for vehicles to be equipped with a remote emission monitoring on-board terminal (remote OBD), a first in vehicle regulation across the globe;
- » A multi-component compliance program involving agency- and manufacturer-run emission tests during pre-production, production, and in-use stages;
- » China's first emission warranty program for HDVs, in which manufacturers are required to guarantee emission-control parts for a minimum distance travelled or service time.
- » The final rule-making includes one statement that indicates future possible requirement on CO₂ emission from HDVs.

This policy update provides further details about some of these features, a comparison with emission regulations in the other major markets, and a summary of the impact of this rule.

POLICY BACKGROUND

Diesel vehicles represent only 9.4% of the on-road fleet in China but are estimated to be the largest on-road source of NO_x and PM emissions. Specifically, diesel vehicles were responsible for nearly 70% and more than 90% of on-road NO_x and PM emissions in China in 2017.⁴

China has historically implemented standards equivalent to those in effect in the European Union, with implementation dates of the China HDV standards generally lagging behind the equivalent EU standard by 8-10 years.

Several studies have shown that Euro IV and Euro V HDVs produce substantially higher NO_x emissions during real-driving conditions than of the type-approval test cycles.^{5,6} This is mainly due to the fact that the current HDV type-approval procedures do not sufficiently reflect real-world driving situations, particularly under low-speed and low-temperature conditions.⁷ As a remedial measure to prevent excess NO_x emissions from HDVs, MEP in September 2017 released a supplemental PEMS testing standard for new and in-use China V standard certified HDVs.⁸

4 Ministry of Ecology and Environment, *China Vehicle Emission Control Annual Report 2018*, June 1, 2018. http://www.zhb.gov.cn/gkml/stbjbgw/qt/201806/t20180601_442293.htm

5 Dana Lowell, Fanta Kamakate, *Urban off-cycle NO_x emissions from Euro IV/V trucks and buses: Problems and solutions for Europe and developing countries*, (ICCT: Washington, DC, 2012). <https://www.theicct.org/publications/urban-cycle-nox-emissions-euro-ivv-trucks-and-buses>

6 Qiang Zhang, et al., *Investigation of Diesel Emissions in China*, (ICCT: Washington, DC, 2013). <https://www.theicct.org/publications/investigation-diesel-emissions-china>

7 Rachel Muncrief, *Comparison of real-world off-cycle NO_x emissions control in Euro IV, V, and VI*, (ICCT: Washington, DC, 2015). <https://www.theicct.org/publications/comparing-real-world-cycle-nox-emissions-control-euro-iv-v-and-vi>

8 Luhanzhi Yang, *China's first national portable emissions testing standard for heavy-duty vehicles*, (ICCT: Washington, DC, 2017). <https://www.theicct.org/publications/china-1st-national-HDV-PEMS-testing-standard>

CHINA VI STANDARD EMISSIONS LIMITS AND REQUIREMENTS

The China VI HDV standard includes two phases, China VI-a and China VI-b. China VI-a is largely equivalent to the Euro VI standard, which includes a PN limit of $6 \times 10^{11} \text{#/kWh}$ that can only be met by non-diesel engines or by installing a diesel particulate filter (DPF) on a diesel engine. China VI-b adds PN limits of $1.2 \times 10^{12} \text{#/kWh}$ for full-vehicle PEMS tests and introduces remote emission monitoring system to ensure the real-world performance of aftertreatment systems.

TYPE TEST

The vehicle type test includes eight test items (see Table 1). For standard cycle engine tests, the China VI standard replaces the ETC and ESC with the more representative WHTC and WHSC. The standard also substantially tightens the emission limits for NO_x and particulates.

Table 1 Type test items

Test items			Diesel engine	Mono-fuel gas engine	Bi-fuel engine		
Standard cycle	WHSC	Gaseous pollutants	YES	—	YES		
		PM/PN					
		CO ₂ and fuel consumption					
	WHTC	Gaseous pollutants	YES	YES	YES		
		PM/PN					
		CO ₂ and fuel consumption					
Off-cycle	Off-cycle laboratory testing (WNTE)	Gaseous pollutants	YES	—	YES		
		PM					
	Full vehicle PEMS testing		YES	YES	YES		
Crankcase			YES	YES	YES		
Durability			YES	YES	YES		
OBD system			YES	YES	YES		
NO _x control			YES	—	YES		

The emission limits in China VI are identical to those in Euro VI (see Table 2).

Compared with China V, the NO_x and PM emission limits are reduced by 77% and 67%, respectively, as measured on transient cycles. In addition, China VI-a includes a PN limit for HDVs— $8.0 \times 10^{11} \text{#/kWh}$ for steady-state cycle and $6.0 \times 10^{11} \text{#/kWh}$ for transient cycle testing. The PN limits will require a DPF system to be incorporated into all new diesel HDVs sold in China.

Table 2 Emission limits for WHSC and WHTC test

Testing cycle	CO (mg/kWh)	THC (mg/kWh)	NMHC (mg/kWh)	CH ₄ (mg/kWh)	NO _x (mg/kWh)	NH ₃ (ppm)	PM (mg/kWh)	PN (#/kWh)
WHSC (CI)	1500	130	—	—	400	10	10	8.0×10 ¹¹
WHTC (CI)	4000	160	—	—	460	10	10	6.0×10 ¹¹
WHTC (PI)	4000	—	160	500	460	10	10	6.0×10 ¹¹

CI= compression ignition

PI= positive ignition

In addition to more realistic test cycles and more stringent emission limits, the China VI standard introduces additional off-cycle test requirements, including the World Harmonized Not-to-Exceed (WNTE) test⁹ and a full-vehicle PEMS test. The test requirements and emissions limits of the WNTE test in China VI are the same as in the Euro VI standard (see Table 3).

Table 3 Emission limits for WNTE test

Test	CO (mg/kWh)	THC (mg/kWh)	NO _x (mg/kWh)	PM (mg/kWh)
WNTE	2000	220	600	16

PEMS TESTING REQUIREMENTS

China VI introduces PEMS testing for type tests, new production tests, and in-service conformity tests. The China VI PEMS testing requirements and emission limits primarily follow the Euro VI PEMS standard, with a few enhancements and modifications for the Chinese context. Table 4 provides a detailed comparison of PEMS emission limits and test requirements of China VI and Euro VI standards. China VI and Euro VI both set a NOx CF of 1.5. China VI also introduces PN limits for full-vehicle PEMS tests starting from the China VI-b stage, whereas no particle limits are required in the Euro VI PEMS regulation. The standard also extends the maximum altitude boundary to 2,400 m in the China VI-b stage, while the maximum altitude allowed in Euro VI is 1,700 m. For data evaluation, only one calculation method—the work-based window method—is applied. A vehicle is considered a pass only if 90% or more of the valid windows meet the emission limits (see Table 4). In addition, the provision includes an innovative transient NOx concentration limit of 500 ppm and requires at least 95% of the data points obtained from the PEMS testing not to exceed this limit. This additional NOx limit offers the potential for correlating the vehicle emissions remote sensing tests with PEMS tests to provide dual support to in-use emission compliance and enforcement. Finally, though not directly integrated in the PEMS testing, the same section of the rule requires no visible smoke during real-world driving.

9 United Nations Economic Commission for Europe (UNECE), Global Technical Regulation No. 10 Off-cycle emissions (OCE), 2009. https://www.unece.org/trans/main/wp29/wp29wgs/wp29gen/wp29glob_registry.html

Table 4 A comparison of China VI and Euro VI PEMS standards.

		China VI	Euro VI
Implementation year		2020 for China VI-a 2023 for China VI-b	2014
Vehicle tested		Type test, new production and in-use	Type approval and in-use
Mandated test frequency		18 months with minimum of 10,000km and then every two years	18 months with minimum of 25,000km and then every two years
Emission limits for diesel	NO_x	0.69 g/kWh (CF=1.5)	0.69 g/kWh (CF=1.5)
	PN	No limit for China VI-a $1.2 \times 10^{12} \text{#/kWh}$ for China VI-b (CF=2.0)	No
	CO	6 g/kWh (CF=1.5)	6 g/kWh (CF=1.5)
Cold start included		No	No
Driving shares (% of time duration)	Urban	20%-70%	20%-70%
	Rural	25%-33%	25%-33%
	Motorway	0%-55%	0%-55%
Test length		4x-7x work of WHTC	5x work of WHTC (4x-7x work of WHTC beginning 2018)
Payload		China VI-a: 50%-100% China VI-b: 10%-100%	50%-100% (10%-100% beginning 2018)
Ambient temperature		-7 °C ~ 38 °C	-7 °C ~ 38 °C
Altitude		<1,700 m in China VI-a <2,400 m in China VI-b	<1,700 m
Minimum power threshold		10%	15% (10% beginning 2018)
Data evaluation method		Work-based window method	Work-based window method or CO ₂ -based window method

EXTENDED DURABILITY REQUIREMENTS

What is considered a vehicle's useful life in the China VI HDV standard is slightly more stringent than the Euro VI requirements, as shown in Table 5. Compared with China V, it requires longer distance durability for all vehicle categories, but allows the same service time requirements.

Table 5 Durability Requirements

Vehicle category	Useful life ⁽¹⁾	
	Distance travelled (km)	Service time (years)
M1, N1, M2	200,000	5
N2, N3 (GVW≤18 tonne) M3 Class I, Class II, Class A M3 Class B (GVW≤7.5 tonne)	300,000	6
N3 (GVW>18 tonne) M3 Class III M3 Class B (GVW>7.5 tonne)	700,000	7

(1) Distance travelled or service time, whichever is sooner

EMISSION WARRANTY

Similar to the China 6 LDV standard, the China VI HDV standard also introduces an emission warranty requirement. Manufacturers are required to guarantee a number of emission-control parts in their new vehicles for a minimum distance or time. If the emission control equipment and related components malfunction during the warranty period, the manufacturers are responsible for repairing the part and paying the relevant expenses. In addition, manufacturers are required to publish the list of the emission control equipment and related components and their corresponding warranty period. The minimum warranty period is shown in Table 6. Beyond providing the parts warranty, it is also manufacturers' responsibility to inform end-users to properly use the diesel exhaust fluid required for the SCR system.

Table 6 Minimum warranty period

Vehicle category	Minimum warranty period ⁽¹⁾	
	Distance travelled (km)	Service time (years)
M1, M2, N1	80,000	5
M3, N2, N3	160,000	5

(1) Distance travelled or service time, whichever is sooner

IMPROVED OBD SYSTEM REQUIREMENTS

China VI requires that a full OBD system be installed on all new engines and vehicles to identify, record and communicate types of malfunctions. China VI OBD requirements mainly follow the Euro VI OBD program, with some additional requirements similar to those in U.S. regulations, such as anti-tampering and anti-fraud provisions. When the emissions exceed the OBD threshold limits (see Table 7) or an emission-related malfunction is detected, the malfunction indicator should alert the operator. If emissions exceed the OBD threshold limits and the vehicle is not fixed in a certain amount of time, a permanent code will be stored in the computer. In addition, an operator inducement system will be activated, and the vehicle can only be driven with

a 25% reduction in torque or at maximum speed of 20 km/h. The permanent codes cannot be cleared by any scan tool until the computer knows that the problem is fixed.

Table 7 OBD threshold limits

Engine type	NO _x (mg/kWh)	PM (mg/kWh)	CO (mg/kWh)
Compression ignition	1200	25	-
Gas-fueled positive ignition	1200	-	7500

For the first time in any heavy-duty vehicle regulation, the China VI standard will require HDVs to be equipped with an on-board remote emissions monitoring system (Remote OBD). Real-time engine data from the ECU, NO_x sensor, DPF and other emission-related data are required to be reported remotely to the monitoring center of the regulatory agency. Table A1 in the Appendix presents a list of data items that are required to be reported through the remote OBD system. Remote OBD provisions are valuable for improving in-use compliance and improving the effectiveness of future inspection and maintenance programs.

NO_x CONTROL SYSTEM REQUIREMENTS

A vehicle's NO_x control system is required to work effectively at ambient temperatures from -7°C to 35°C, at altitudes below 2,500 km, and with an engine coolant temperature above 70°C¹⁰. Vehicles are required to be equipped with an operator warning and operator inducement system. When low reagent level, low reagent consumption, or other malfunctions are detected, a visual warning is given to the operator. If the malfunctions are not fixed in time, the operator inducement system will be activated (see Table A2 in the Appendix).

OVERVIEW OF COMPLIANCE TESTS

The China VI regulation requires a number of agency- and manufacturer-run regulatory tests that apply to vehicle prototypes and throughout a vehicle's useful life (see Figure 1). These are described in more detail below.

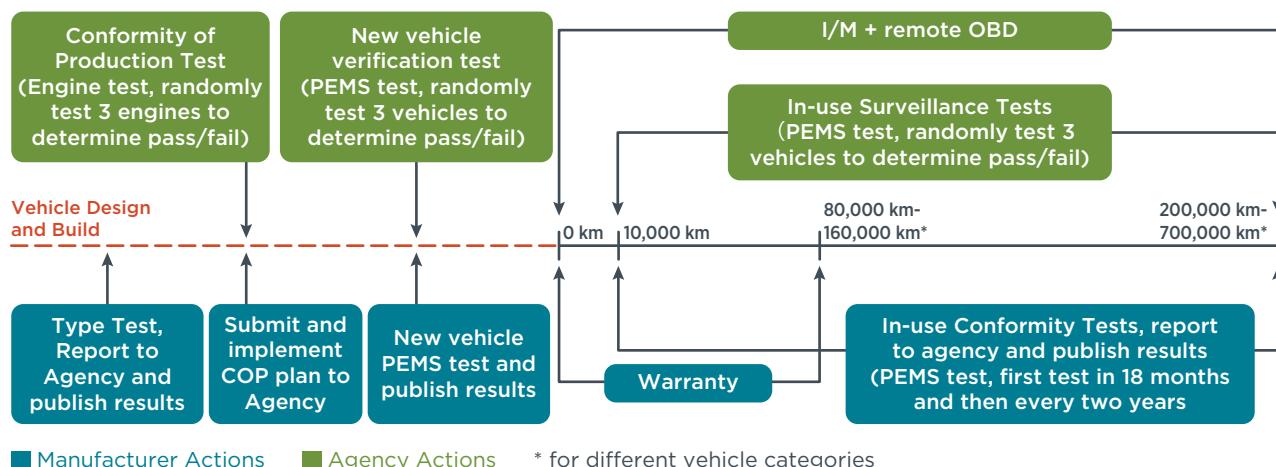


Figure 1 China VI compliance program

¹⁰ This provision does not apply in the case of monitoring for reagent level in the storage tank, where monitoring will be conducted under all conditions where measurement is technically feasible including all conditions when a liquid reagent is not frozen.

A. Manufacturer-run tests

Manufacturer-performed tests mandated by the China VI standards include four stages of testing: type test, conformity of production test, new vehicle test, and in-use conformity test. These are described in more detail below.

A.1. TYPE TEST REPLACEMENT OF TYPE APPROVAL

Compared with previous standards in China, one of the major changes of China VI is that “Type approval” is replaced with a “Type test”. The Chinese MEE previously issued certification to new vehicle models that had been tested by certified laboratories and complied with emission standards. This procedure was referred to as vehicle type approval.

Per requirements in China’s newly amended Air Pollution and Control Law that was implemented in 2016, starting from the China 6/VI regulation, the regulatory agency no longer type-approves new vehicle models. Under the new law, MEE will establish the test protocols and emission limits for all required type tests, but they will focus their limited resources on performing verification tests, including conformity of production, new vehicle inspection and in-service compliance inspection.

Under the China VI standards, vehicle manufacturers will self-test and self-certify their new vehicle models. The manufacturer must report test results and emission-related information to the regulatory agency and make this available to the public.

A.2. CONFORMITY OF PRODUCTION (COP) TEST

Engine and vehicle manufacturers are required to guarantee their products exactly match the specifications and performance outlined in the type test documentation submitted. Manufacturers are required to publish their COP guarantee plan prior to mass-producing engine and vehicle products, including for example: details of which tests they perform, testing results, and the measures to be taken if engines or vehicles fail the test.

A.3. NEW VEHICLE INSPECTION

Vehicle manufacturers also need to perform on-road emissions test on a representative sample of newly produced vehicle models right off the production line with PEMS testing. Manufacturers determine their own sampling methods and ratio and are required to publish the test results.

A.4. IN-SERVICE TESTING

The last required manufacturer-run emission test is in-service PEMS testing performed on in-use vehicles by both engine and vehicle manufacturers. In-service PEMS testing is to be performed based on engine family and vehicle family. For each engine family, engine manufacturers sample vehicles from different vehicle manufacturers and perform in-service testing. For each vehicle family, vehicle manufacturers sample different vehicle models from the same vehicle family and perform in-service testing. For both engine and vehicle manufacturers, the minimum sample size is 3, and the maximum sample size is 10. The first in-use PEMS test will be performed in the first 18 months after the vehicle is registered. Manufacturers are required to perform in-use testing every two years for each engine family and vehicle family. Test results are required to be reported to the agency and published by manufacturers.

B. Agency-run tests and inspections

For all the four manufacturer-run tests, the regulatory agency has the authority to conduct verification tests of the manufacturer tests described above. These are outlined in more detail below.

B.1 COP TEST

To verify COP compliance, the MEE performs similar tests on three test engines from each engine family. The agency has the authority to perform all or partial engine tests (WHSC, WHTC, and WNTE), ECU checks and OBD checks on three random selected engines. If one of the three engines exceed any emission limit by 1.1 times, the average emissions of three engines exceeds the limit, or one of the three engines fails the ECU or OBD check, the engine family fails the COP test.

B.2 NEW VEHICLE VERIFICATION TEST

The agency has the authority to perform verification tests on newly produced vehicles, which are classified as those with mileage under 10,000km. The new vehicle verification test includes visual inspection of emission control systems, PEMS tests, OBD and NOx control strategy checks, remote OBD checks, and new engine checks.

For new vehicle PEMS tests, the regulatory agency randomly selects three newly produced vehicles for each vehicle family and performs PEMS test. A vehicle family is considered as passing the test only if all of the following requirements are met:

- » 80% or more of the valid windows of each test vehicle meet the emission limits, and the average percentage of valid windows that meet the emission limits of three test vehicles exceeds 90%;
- » At least two test vehicles pass the transient NO_x concentration limit of 500 ppm, and at most one test vehicle exceeds the limit of 500 ppm but does not exceed 550 ppm;
- » Visible smoke is not seen from any of the test vehicles;
- » All three test vehicles pass the ECU and OBD checks.

B.3 IN-USE SURVEILLANCE TEST

For in-service vehicles with mileage above 10,000km, the agency has the authority to randomly select three vehicles from each vehicle family and perform an in-use surveillance test. The in-use test may include a PEMS test plus an OBD and NOx control strategy check. The same pass/fail determination method in Section B.2 applies to in-use surveillance test. For non-compliant vehicles, the manufacturer is required to submit a corrective action plan to the agency and implement the action plan after the agency's approval.

INTERNATIONAL CONTEXT

The China VI standard is one of the most stringent HDV emission standards adopted to date. The emission limits and test procedures are similar to Euro VI, but the PEMS testing requirements, in-use compliance program and OBD requirements are slightly more stringent than those under Euro VI. Full implementation of the China VI HDV standard will bring China in line with standards in the US, Canada, Japan, and EU (see

Figure 2). Table 8 summarizes the difference between China V/Euro V, Euro VI, and China VI HDV standards.

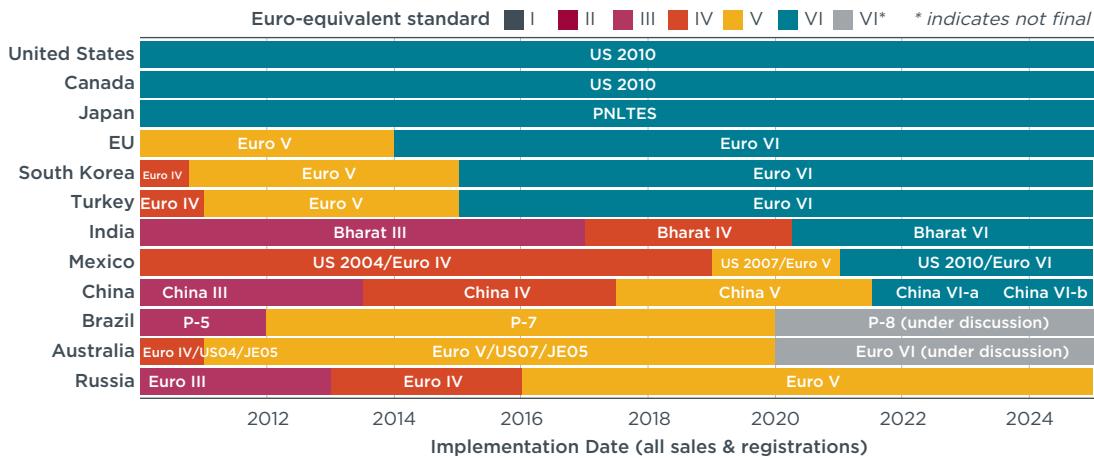


Figure 2 Implementation timeline of heavy-duty emissions standards in major vehicle markets

Table 8 Comparison of China V/Euro V, Euro VI, China VI-a and China VI-b HDV standards.

		China V/Euro V	Euro VI		China VI-a	China VI-b		
Engine test cycle		ESC, ETC	WHSC, WHTC, WNTE					
Emission limits on transient cycle	NO_x (g/kWh)	2	0.46					
	PM (g/kWh)	0.03	0.01					
	PN (#/kWh)	No limit	6E+11					
PEMS test		No	Yes					
Emission limits for PEMS test	NO_x (g/kWh)	N.A.	0.69 (CF=1.5)					
	PN (#/kWh)	N.A.	No limit	No limit	1.2E+12 (CF=2.0)			
Altitude boundary for PEMS test		N.A.	<1,700 m	<1,700 m	<2,400 m			
Pay load for PEMS test		N.A.	50%-100% (Euro VI-c and before) 10%-100% (Euro VI-d)	50%-100%	10%-100%			
OBD requirements		Euro V OBD	Euro VI OBD	Euro VI OBD + US anti-tampering provisions				
Remote OBD data reporting		No	No	No	Yes			
Emission durability periods for different vehicle categories		100,000 km/5 years 200,000 km/6 years 500,000 km/7 years	160,000 km/5 years 300,000 km/6 years 700,000 km/7 years	200,000 km/5 years 300,000 km/6 years 700,000 km/7 years				
Emission warranty program		No	No	Yes				

NEXT STEPS

The implementation of the China VI emission standard for heavy-duty vehicles is a critical measure to clean up diesel emissions and a key step on the path to winning the “war against air pollution” in China. Regions struggling with severe air quality or cleaner regions with an ambition to achieve world-class air quality levels have taken actions to move faster on controlling emissions from on-road vehicles. For example, the city of Shenzhen recently announced a plan to implement the China 6 standard for light-duty vehicles nearly 5 years ahead of the national timeline.¹¹ It is expected that once this rulemaking for heavy-duty vehicles is finalized, it will be adopted on an accelerated schedule in select subnational jurisdictions.

The successful implementation of the rulemaking will depend on a few crucial factors, such as the compliance of diesel fuel with existing ultralow-sulfur fuel standards, and the effective introduction of requirements for OBD systems that ensure appropriate use of diesel exhaust fluid for reducing NOx emissions. This will require robust fuel and vehicle compliance activities such as those described in this update. The upcoming years will be an important transition period to monitor the introduction of China VI emissions control technologies in conjunction with enhanced government actions to improve in-use compliance.

¹¹ Notice Regarding Implementing the Six Stage of Emission Standard for New Light-duty Vehicles, Human Settlements and Environment Commission of Shenzhen Municipality, 2018. http://www.szhec.gov.cn/hdjl/myzj/myzj/201803/t20180329_11649707.htm

APPENDIX

Once the on-board terminal is connected with the central management platform, the following required data must be reported at least every 10 second.

Table A1 Required data items for remote emission monitoring on-board terminal

Required data item
Velocity
Barometric pressure
Engine max reference torque*
Engine percent torque or actual percent torque
Friction torque
Engine speed
Engine fuel rate
NO _x sensor output
SCR inlet temperature (if applicable)
SCR outlet temperature (if applicable)
DPF differential pressure
Air flow rate
Diesel exhaust fluid level
Fuel level in fuel tank
Engine coolant temperature
Longitude and latitude

*** Engine max reference torque is a constant value to be reported when the on-board terminal is first registered and connected with the central management platform*

Table A2 Operator inducement activation requirements for NO_x emissions control.

Monitoring item	Low level inducement (25% reduction in torque)	Severe inducement (maximum speed is 20 km/h)
Reagent level	<2.5% of its nominally full capacity	The reagent tank is empty
Reagent quality	Not rectified within a maximum of 10 engine operating hours after the activation of the operator warning system	Not rectified within a maximum of 20 engine operating hours after the activation of the operator warning system
Reagent dosing activity	Not rectified within a maximum of 10 engine operating hours after the activation of the operator warning system	Not rectified within a maximum of 20 engine operating hours after the activation of the operator warning system
EGR valve counter	Not rectified within a maximum of 36 engine operating hours after the activation of the operator warning system	Not rectified within a maximum of 100 engine operating hours after the activation of the operator warning system
NO_x Control Diagnostic System counter	Not rectified within a maximum of 36 engine operating hours after the activation of the operator warning system	Not rectified within a maximum of 100 engine operating hours after the activation of the operator warning system
Reagent freeze protection	/	No reagent dosing occurs within a maximum of 40 minutes after engine start at an ambient temperature ≤ 266 K (- 7 °C).