POLICY UPDATE

NOVEMBER 2017

CHINA'S FIRST NATIONAL PORTABLE EMISSIONS TESTING STANDARD FOR HEAVY-DUTY VEHICLES

ICCT **POLICY UPDATES** SUMMARIZE REGULATORY AND OTHER DEVELOPMENTS RELATED TO CLEAN TRANSPORTATION WORLDWIDE.

In September 2017, China's Ministry of Environmental Protection issued the first national standard for portable emission measurement system (PEMS) testing of heavy-duty vehicles (HDVs).[1] The regulation is a supplement to all existing requirements under the China V standard,[2] and it requires additional on-road PEMS testing for new and in-use China V HDVs. Given that the China VI HDV emission standard is not likely to be implemented nationwide until 2020,[3] the supplemental PEMS standard is designed to prevent excess nitrogen oxide (NO_x) emissions from China V HDVs. In doing so, China has become the first country in the world to attempt to solve a known deficiency in the Euro V type-approval process by requiring additional PEMS testing for newly produced vehicles and in-use compliance testing.

The PEMS testing standard took effect October 1, 2017. Type approvals of new China V heavy-duty diesel and gas fueled models after that date must comply with the standard. For China V models type-approved before October 1, 2017,[4] the standard requires in-use compliance testing and reporting of results to the regulatory agency. Relevant local standards become invalid as of the national standard's implementation date.

BACKGROUND

China's HDV emission standards follow the European Union regulatory pathway. In both Europe and China, it has been widely demonstrated that many HDVs certified with Euro IV and V standards emit significantly higher NO_x emissions during real-world use than their certified levels, especially in low-speed, urban driving.[5] In some cases,

1 The standard, HJ857-2017, is available online at http://kjs.mep.gov.cn/hjbhbz/bzwb/dqhjbh/dqydywrwpfbz/201709/t20170921_422035.shtml?from=timeline&isappinstalled=0

2 The China V standard, GB17691-2005, is available online at http://kjs.mep.gov.cn/hjbhbz/bzwb/dqhjbh/dqydywrwpfbz/200701/t20070101_67495.htm

3 The China VI proposal is available online at http://www.mep.gov.cn/gkml/hbb/bgth/201610/t20161017_365634.htm

4 China V took effect starting January 1, 2017.

5 Lowell, D. & Kamakaté, F. (2012). *Urban Off-Cycle Emissions from Euro IV/V Trucks and Buses.* Washington, DC: International Council on Clean Transportation (ICCT). Retrieved from http://www.theicct.org/urban-cycle-nox-emissions-euro-ivv-trucks-and-buses

real-world NO_x emissions from Euro IV HDVs are similar to those of Euro III HDVs.[6] As explained in previous ICCT studies,[5,7] the root cause of high off-cycle NO_x emissions from HDVs is that the type-approval protocol for Euro IV and V HDVs is insufficient for ensuring that manufacturers control NO_x in real-world driving. The deficiencies in Euro IV/V standards include an unrepresentative test cycle, lack of cold-start testing requirements, and weak in-use compliance provisions. To address this problem, the Beijing Municipal Environmental Protection Bureau issued two local standards in February 2013. They specifically introduce additional testing requirements for China IV and V HDVs registered in Beijing.[8] The first standard took effect on March 1, 2013, and requires China IV and V engines to be tested using the World Harmonized Transient Cycle (WHTC). The WHTC is considered more representative of real driving conditions as it includes a much higher percentage of low-speed and low-load conditions. The second standard, effective July 1, 2013, established additional in-use PEMS testing requirements for manufacturers to prove that real-world NO_x emissions do not exceed regulated limits. At the national level, China's Ministry of Environmental Protection (MEP) issued a supplemental standard in 2014 requiring China IV and V heavy-duty engines in urban vehicles to be tested using the WHTC.[9] This standard applies to all diesel public buses, postal trucks, and municipal sanitation vehicles over 3,500 kg. The standard took effect on January 1, 2015, for all China IV engine/vehicle sales and registrations and on January 1, 2017, for all China V engines/vehicles.[10]

In October 2016, MEP released a proposal for public comment on China VI HDV emission standards.[11] For type tests[12] under the China VI proposal, the World Harmonized Stationary Cycle (WHSC) replaces the European Stationary Cycle (ESC), and the WHTC replaces the European Transient Cycle (ETC). Moreover, the China VI proposal introduces PEMS testing requirements for type test, newly produced vehicles, and in-use compliance testing.

The China VI standard will be an important step toward reducing real-world emissions from HDVs in China. However, this standard is not likely to be implemented nationwide until 2020. As a remedial measure to prevent excess NO_x emissions from HDVs produced before 2020, MEP in September 2017 released a supplemental PEMS testing standard for new and in-use China V HDVs.

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6 Wu, Y., Zhang, S. J., Li, M. L., Ge, Y. S., Shu, J. W., Zhou, Y., ... Hao, J. M. (2012). The challenge to NOx emission control for heavy-duty diesel vehicles in China. *Atmospheric Chemistry and Physics,* 12(19), 9365–9379. Retrieved from https://doi.org/10.5194/acp-12-9365-2012

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

8 Tu J. & Wagner V. (2013). Supplemental NO_x standards for Euro IV/V HDVs in Beijing. Washington, DC: ICCT. Retrieved from http://www.theicct.org/publications/supplemental-nox-standards-euro-ivv-hdvs-beijing

9 Wagner V. (2014). Supplemental WHTC testing for Euro IV/V heavy-duty vehicles in China. Washington, DC: ICCT. Retrieved from http://www.theicct.org/supplemental-whtc-testing-hdvs-china

10 MEP announcement No.2016-4, retrieved from http://www.mep.gov.cn/gkml/hbb/bgg/201601/t20160118_326596.htm and MIIT announcement No.2014-27, retrieved from http://www.miit.gov.cn/n1146295/n1652858/n1652930/n4509607/c4512394/content.html

11 The China VI proposal is available online at http://www.mep.gov.cn/gkml/hbb/bgth/201610/t20161017_365634.htm

12 Per requirements in China's newly amended Air Pollution and Control Law, starting from the China 6/VI regulation, the regulatory agency no longer type approves new vehicle models. The Chinese MEP used to have a procedure of issuing certification to new vehicle models that are tested to comply with emission standards. This procedure was referred to as vehicle type approval. Under the new law, vehicle manufacturers self-test and self-certify their new vehicle models and need to report to the regulatory agency and publish required information to the public. MEP still establishes the test protocols and emission limits for all required tests. The set of tests are referred to as type tests.

EMISSION LIMITS AND REQUIREMENTS

The new supplemental standard requires all new and in-use heavy-duty diesel and gas fueled vehicles to be tested using PEMS and to meet the required emission limits. The standard includes two sets of emission limits for China V, i.e., brake-specific emission limits (g/kWh) and instantaneous emission limits (ppm). A vehicle fails if the emissions exceed either the brake-specific or the instantaneous emission limits.

Table 1 shows the new standard's emission limits. It should be noted that cold start is excluded from the emission value calculation. The cold-start period ends once the coolant temperature has reached 70 °C for the first time, or after the coolant temperature is stabilized within 2 °C over a period of five minutes, whichever comes first, but no later than 20 minutes after the engine starts. For the brake-specific emission limits, conformity factors (CF, defined as the ratio of measured on-road emission factors over the regulated limits on ETC or WHTC) for carbon monoxide (CO) are 1.5 and for NO_X 2.0. Total hydrocarbon (THC) emissions and particle mass (PM) are optional. For the instantaneous emission limit, only a NO_X limit of 900 ppm is required.

Table 1. Emission limits of the supplemental PEMS standard

Stage	Polllutant	CO	NO_x	THC	PM
China V	brake-specific emission limits[a]	≤6 g/kWh (CF=1.5)	≤4 g/kWh (CF=2.0)	Optional	Optional
	Instantaneous emission limits[b]	N.A.	900 ppm	N.A.	N.A.
	[a] 90% of all valid windows shall meet the limit. [b]95% of the instantaneous NO_X emission rates shall meet the limit.				

For data processing, the final brake-specific emission value is calculated based on a work-based window method, the same as is used in the Euro VI regulation.[13]

Table 2 provides a detailed comparison of emission limits and test requirements of the supplemental China V, the China VI proposal,[14] and the Euro VI PEMS standards.[15] The China VI proposed standard and the Euro VI standard both set a NO_X CF of 1.5, whereas the China V standard includes a rather loose CF of 2.0. In addition, the China VI proposal includes emission limits for particles, whereas no particle limits are required in the supplemental China V standard.

Requirements on PEMS trips also differ for the three standards. The time allocation of urban driving in the supplemental China V standard is much less than that in the China VI proposal and the Euro VI standard. The China VI proposal and the Euro VI standard allow HDVs to be tested in ambient temperatures as low as -7 °C, whereas the lowest temperature allowed in the supplemental China V standard is 2 °C. In addition, the altitude range is narrower in the supplemental China V standard. The China VI proposal and the Euro VI standard reduce the minimum power threshold to

13 Muncrief, R. (2017). *NO_x emissions from heavy-duty and light-duty diesel vehicles in the EU: Comparison of real-world performance and current type-approval requirements.* Washington DC: ICCT. Retrieved from http://www.theicct.org/nox-europe-hdv-ldv-comparison-jan2017

14 Second proposal released in April 2017, public version unavailable.

15 Euro VI amendment of September 2016, available at http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32016R1718&from=EN

10%, to better account for low-load and urban operation, whereas the threshold in the supplemental China V standard stays at 15%. To summarize, trip requirements in the supplemental China V standard are not as stringent as in the China VI proposal or the Euro VI standard.

Table 2. A comparison of supplemental China V, China VI proposal, and Euro VI PEMS standards.

		Supplemental China V	China VI proposal	EURO VI
Implementation year		2017	2020 for China VI a 2023 for China VI b*	2014
Vehicle tested		Newly produced and in-use	Type test, newly produced and in-use	Type approval and in-use
Mandated test frequency		Every two years with minimum of 10,000km	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**	4 g/kWh (CF=2.0)	0.69 g/kWh (CF=1.5)	0.69 g/kWh (CF=1.5)
	PN	No	No limit for China VI a $1.2x10^{12}$ #/kWh for China VI b (CF=2.0)	No
Cold start included		No	No	No
Driving shares (% of time duration)	**Urban**	10%-70%	20%-70%	20%-70%
	Rural	10%-30%	25%-33%	25%-33%
	Motorway	0%-80%	0%-55%	0%-55%
Test length		5x work of WHTC (for urban vehicles) 3x work of ETC (for other categories)	4x-7x work of WHTC	5x work of WHTC (4x-7x work of WHTC beginning 2018)
Payload		50%-100% for bus 75%-100% for truck	China VI a: 50%-100% China VI b: 10%-100%	50%-60% (10%-100% beginning 2018)
Ambient temperature		2 °C ~ 38 °C	-7 °C ~ 38 °C	-7 °C ~ 38 °C
Altitude		<1,000 m	<1,700 m in China VI a <2,400 m in China VI b	<1,700 m
Minimum power threshold		15%	10%	15% (10% beginning 2018)

**The China VI HDV standard is proposed to be implemented in two phases nationwide—China VI a in January 2020 and China VI b in January 2023.*

IN-USE COMPLIANCE PROGRAM

The supplemental China V standard's compliance program includes manufacturer-run and agency-run PEMS tests. Manufacturers are required to test their in-use vehicles and report results to the regulatory agency every two years. The agency has the authority to randomly test three vehicles from a vehicle family. If the first vehicle passes, the vehicle family is considered compliant. If the first vehicle fails but the second and third vehicles pass, the vehicle family is considered compliant. Otherwise, the vehicle family fails.

NEXT STEPS

The supplemental PEMS testing standard for China V HDVs is a great step forward to ensure further control of excess NO_x emissions from HDVs in China. As a next step, a more stringent China VI standard is expected to be finalized by early 2018, which we will continue to track closely.