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POLICY UPDATE

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# REMOTE-SENSING REGULATION FOR MEASURING EXHAUST POLLUTANTS FROM IN-USE DIESEL VEHICLES IN CHINA

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

On July 27, 2017, China's Ministry of Environmental Protection (MEP) released details of a national regulation for measuring pollutants in exhaust from in-use diesel vehicles using remote-sensing equipment.[1] China is the first country in the world to implement such on a national level. The regulation took effect immediately and replaces all local standards related to monitoring diesel vehicle exhaust emissions with remote sensing. It does not mandate remote-sensing programs at the local level, but rather defines a uniform protocol for local agencies to follow if they currently have or decide to implement a remote-sensing program. The goal of the regulation is to eliminate the top 5% of high-emitting vehicles, and it applies to both light-duty and heavy-duty diesel vehicles.

## BACKGROUND

Remote sensing can be used to measure exhaust emissions from on-road vehicles without interrupting traffic, by using roadside equipment (see Figure 1). Compared with laboratory testing, remote sensing can collect emissions data from a large sample of vehicles in a short period of time. It can be used to cross-check vehicles' real-world performance with inspection and maintenance (I/M) test results, screen for high-emitting vehicles, screen for clean vehicles, and monitor the in-use fleet emissions level. In many cases, remote sensing incorporates cameras that record vehicle license plate information, which is linked to vehicle registration information. Remote sensing can also measure vehicle speed and acceleration to provide additional criteria against which to judge the test's validity.

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1 在用柴油车排气污染物测量方法及技术要求（遥感检测法）("Measurement methods and specifications for exhaust pollutants from in-use diesel vehicles (remote sensing method)") Retrieved from http://www.zhb.gov.cn/gkml/hbb/bgg/201708/t20170802_419057.htm

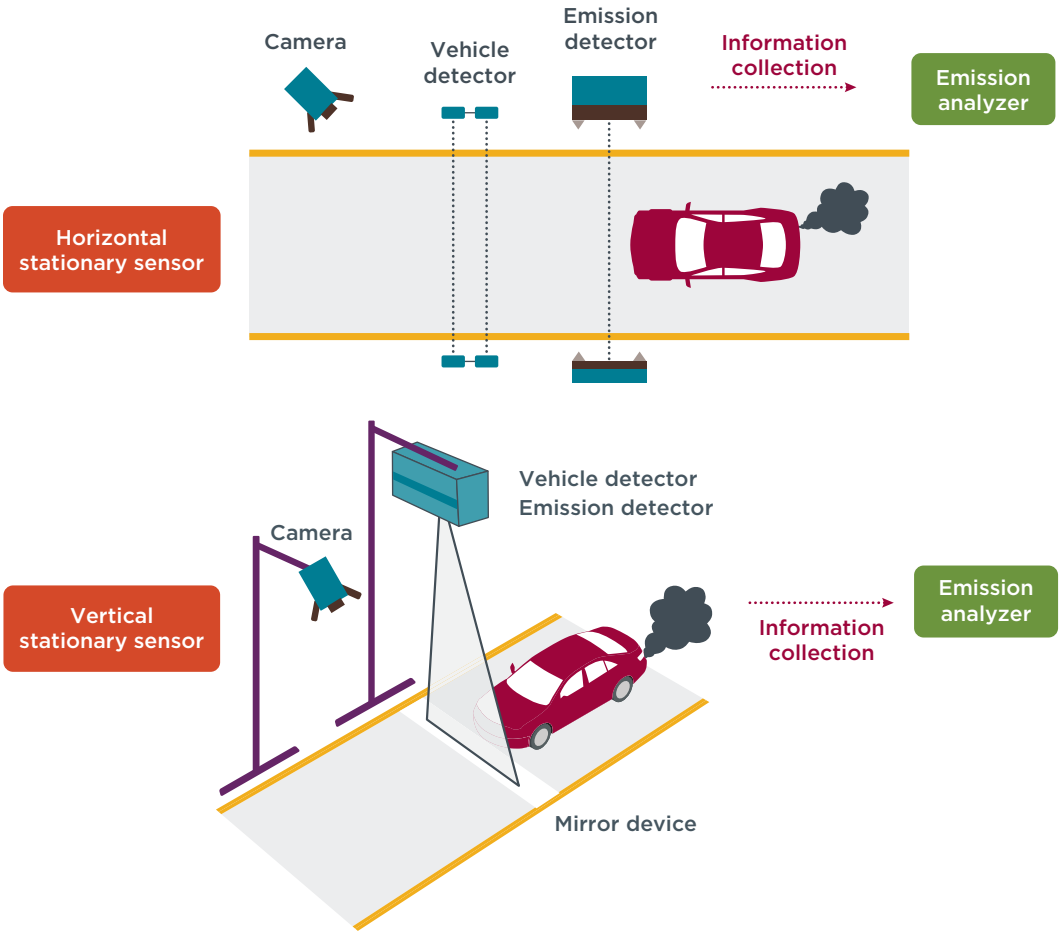


**Figure 1.** Illustration of horizontal and vertical remote sensing

In China, remote sensing has been used by local agencies since 2005 as part of vehicle emissions-management programs. China's Air Pollution Prevention and Control Law, which took effect on January 1, 2016, clarified the legal foundation, empowering regulatory agencies at the city level to monitor and test on-road vehicle emissions with remote-sensing instruments and to take action against noncompliant in-use vehicles. By the end of 2016, around 70 cities in seven provinces[2] and two municipalities (Beijing and Tianjin) in China had established remote-sensing programs to screen on-road vehicle emissions. To support the programs, the regulatory agencies of these provinces and municipalities issued local remote-sensing regulations to define procedures for testing emission exhaust and identifying high-emitting vehicles. The parts related to diesel vehicle testing in these regulations are now superseded by the national regulation issued as of July 2017.

## REMOTE-SENSING EQUIPMENT REQUIREMENTS

The new national regulation defines specific measurement methods for stationary remote-sensing equipment, which is set at fixed locations, and mobile remote-sensing equipment.

2 The seven provinces are Guangdong, Anhui, Shandong, Liaoning, Jiangsu, Hebei, and Shaanxi.

For vertical remote sensing, the regulation requires equipment to be installed on a gantry no lower than 5 m above ground level. For horizontal remote sensing, the regulation requires that the test light path be positioned 20 cm to 40 cm above the road surface. Mobile remote-sensing equipment must include a global positioning system to collect location information.

For all equipment, the regulation requires an opacity test to use a green light-emitting diode (LED) with a wavelength of 550–570 nm or equivalent light source. The response time of the test-analysis system must be less than or equal to 1 second. Table 1 defines the test concentration range requirement and absolute error or relative error that test equipment must meet. In addition, for each pollutant, repetitive testing results must meet half of the error requirement and continuous testing results for 1 hour must meet the error requirement. Testing equipment must also meet certain requirements, as shown in Table 2.

**Table 1.** Acceptable error for test results of main pollutants

| Pollutant | Test concentration range | Absolute error | Relative error |
|---|---|---|---|
| **$CO_2$** | (0–16) x $10^{-2}$ | ± 0.25% | ± 10% |
| **NO** | (0–5,000) x $10^{-6}$ | ± 20 x $10^{-6}$ | ± 10% |
| **Opacity** | (0–100)% | ± 2% | ± 5% |

*Note: Test equipment is only required to meet the absolute error or relative error requirement*

**Table 2.** Requirements for testing equipment and sensors

| Test element | Requirement |
|---|---|
| **Camera and plate reading** | Vehicle picture capture rate: ≥98%<br>Vehicle plate capture rate: ≥95% |
| **Ambient weather and site condition testing** | Temperature range: –40° to 50° (error: ± 0.5°)<br>Relative humidity: 5–95% (error: full range ± 3%)<br>Wind speed: 0–20 m/s (error: ± 10%)<br>Pressure: 70–102.4 kPa (error: ± 5%)<br>Slope angle: –15 to +15 degrees (error: ± 0.1 degree) |

The regulation also establishes a calibration requirement and requires that remote-sensing equipment self-calibrate automatically at least every 3 hours during consistent testing.

## TESTING LOCATION AND ENVIRONMENT REQUIREMENTS

For stationary testing, the testing location is required be on a long, uphill road with a smoothly paved surface. The interval between vehicles must be greater than or equal to 1 second. A vehicle exhaust measurement is invalid if the intervals between it and the two vehicles in front of and behind it are shorter than 1 second.

The test data are valid only if collected under certain atmospheric conditions:

- No rain, fog, or snow; no obvious dust
- Wind speed: ≤ 5 m/s
- Environment temperature: –20° to 45°
- Relative humidity: ≤ 85%
- Pressure: 70 kPa–106 kPa

## TEST RESULTS

A vehicle is determined to be a noncompliant if it exceeds the remote-sensing emission limits in Table 3 for the same pollutant in two or more consecutive remote-sensing tests in 6 months. The nitrogen oxide (NO) limit is only used for screening high-emitting vehicles. *High-emitting vehicle* typically refers to a vehicle that is forbidden from entering a city or a low-emission zone set by the local government.

**Table 3.** Emission limits for compression ignition engine

| Pollutant | Limits |
|---|---|
| **Opacity** | 30% |
| **Ringelmann blackness[a]** | Level I (20%) |
| **NO[b]** | 1,500 x $10^{-6}$ |

*Notes:*
*[a]Ringelmann blackness is an indicator of smoke density that compares the darkness of smoke with the Ringelmann scale. It has five levels of density inferred from a grid of black lines on a white surface that, if viewed from a distance, merge into known shades of grey. Smoke Level 0 is represented by white, and Level 5 is represented by all black. Levels 1 (20%) to 4 (80%) are represented by 10-mm square grids drawn with 1-mm, 2.3-mm, 3.7-mm, and 5.5-mm-wide lines. Vehicle smoke is videotaped to determine its Ringelmann blackness density.*
*[b]NO limit is only used for screening high-emitting vehicles.*

The regulation does not specify follow-up enforcement actions for vehicles identified as noncompliant or high emitting. As currently implemented by cities, vehicles that fail remote-sensing testing are sometimes required to be sent for I/M testing to verify noncompliance or are directly mandated to be sent for repair until they pass I/M testing. Some cities only notify vehicle owners of noncompliant or high-emitting vehicles after they are detected, without enforcing a penalty or requiring a repair.

## NEXT STEPS

The regulation will strongly support expanding the remote-sensing program at the local level and will reinforce in-use diesel vehicle emission management. For example, according to the 2017 Jing-jin-ji Air Pollution Prevention and Control Plan, 28 cities in the Jing-jin-ji area are required to establish remote-sensing programs with at least 10 pieces of horizontal stationary remote-sensing equipment and two mobile pieces of remote-sensing equipment. These cities and any other cities that carry out remote-sensing programs will refer to the new national regulation to screen for and take actions against noncompliance and high-emitting in-use diesel vehicles. The standardized remote-sensing data can also be used for purposes that are not covered in the regulation, such as fleet screening, evaluating the in-use vehicle emission level, and identifying high-emitting models that may have manufacturing defects. It is not clear if there will be another national remote-sensing regulation for gasoline and alternative fuel vehicles.