U.S. ENVIRONMENTAL PROTECTION AGENCY

OFFICE OF INSPECTOR GENERAL

Improving air quality
Compliance with the law

EPA Demonstrates Effective Controls for Its On-Road Heavy-Duty Vehicle Compliance Program; Further Improvements Could Be Made

Report No. 19-P-0168 **June 3, 2019**

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Abbreviations

AECD	Auxiliary Emission Control Device
CD	Compliance Division
CFR	Code of Federal Regulations
CI	Compression-Ignition
COC	Certificate of Conformity
EPA	U.S. Environmental Protection Agency
EV-CIS	Engine and Vehicle Compliance Information System
GAO	U.S. Government Accountability Office
HD	Heavy-Duty
IEC	International Electrotechnical Commission
ISO	International Organization for Standardization
LD	Light-Duty
NOx	Nitrogen Oxides
NTE	Not-to-Exceed
NVFEL	National Vehicle and Fuel Emissions Laboratory
OECA	Office of Enforcement and Compliance Assurance
OIG	Office of Inspector General
OTAQ	Office of Transportation and Air Quality
PEMS	Portable Emissions Measurement System
SI	Spark-Ignition
TATD	Testing and Advanced Technology Division
U.S.C.	United States Code

Cover Photos: Various types of heavy-duty vehicles. (EPA OIG photos)

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U.S. Environmental Protection Agency
Office of Inspector General

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At a Glance

Why We Did This Project

The Office of Inspector General (OIG) conducted this audit to determine whether the U.S. Environmental Protection Agency's (EPA's) existing internal controls effectively detect and prevent on-road heavy-duty (HD) vehicle emissions fraud. Effective internal controls provide reasonable—though not absolute—assurance that the potential for fraud is minimized.

In May 2018, we issued a companion audit report that focused on the EPA's light-duty vehicle compliance program: OIG Report No. 18-P-0181, *EPA Did Not Identify Volkswagen Emissions Cheating; Enhanced Controls Now Provide Reasonable Assurance of Fraud Detection*.

This report addresses the following:

- *Improving air quality.*
- *Compliance with the law.*

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List of OIG reports.

EPA Demonstrates Effective Controls for Its On-Road Heavy-Duty Vehicle Compliance Program; Further Improvements Could Be Made

What We Found

The EPA's HD vehicle compliance program currently has controls to effectively detect and prevent noncompliance—a precursor to potential fraud.

The EPA demonstrated that its current internal controls are effective at detecting and preventing noncompliance in the on-road HD vehicle sector. Past instances of noncompliance have resulted in excess emissions of pollutants, which have significant and quantifiable negative impacts on human health and the environment.

The on-road HD sector is the fastest growing transportation sector in the United States based on fuel use and is a significant source of air pollution. Despite having fewer on-road vehicles than the light-duty sector, the HD sector accounted for 35 percent more fine particulate matter emissions in calendar year 2014 than the light-duty sector. Furthermore, the majority of emissions from the on-road HD sector come from diesel engines, which—unlike gasoline engines—typically operate more efficiently under conditions that produce higher emission levels of regulated pollutants like nitrogen oxides and carbon monoxide. Manufacturers may therefore be inclined to configure their diesel engines to operate at higher emission levels. In the 1990s, the EPA discovered that multiple HD manufacturers illegally used electronic engine controls to increase fuel efficiency at the expense of pollution control. This discovery highlighted the importance of compliance oversight and emission control in the HD sector, and the EPA made major changes to the HD vehicle compliance program, including adding regulatory tests to more accurately measure on-road emissions under real-world operating conditions. These changes were fully implemented in 2007.

Although we found that the agency demonstrated that its existing internal controls are effective, we identified specific risks to the EPA's goal of achieving public health and environmental benefits through its HD vehicle compliance program. We also identified areas where existing controls could be strengthened. These improvements will help the EPA better address risks, assure compliance with mobile source regulations, and protect human health and the environment.

Recommendations and Agency Planned Corrective Actions

We made eight recommendations to the Assistant Administrator for Air and Radiation, including defining measures to assess program performance; conducting a formal risk assessment that addresses specific risks; evaluating whether specific programmatic or regulatory changes are necessary; assessing whether the development of data analysis tools is feasible; evaluating opportunities for targeted testing; tracking compliance issues in a standardized manner; and developing procedures and criteria for referring compliance issues to the Office of Enforcement and Compliance Assurance. The EPA agreed with all recommendations. Two recommendations have been completed, and the others are resolved with corrective actions pending.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
INSPECTOR GENERAL

June 3, 2019

MEMORANDUM

SUBJECT: EPA Demonstrates Effective Controls for Its On-Road Heavy-Duty Vehicle Compliance Program; Further Improvements Could Be Made
Report No. 19-P-0168

FROM: Charles J. Sheehan, Deputy Inspector General

TO: William L. Wehrum, Assistant Administrator
Office of Air and Radiation

This is our report on the subject audit conducted by the Office of Inspector General (OIG) of the U.S. Environmental Protection Agency (EPA). The project number for this audit was OPE-FY17-0026. This report contains findings that describe the problems the OIG has identified and corrective actions the OIG recommends. This report represents the opinion of the OIG and does not necessarily represent the final EPA position. Final determinations on matters in this report will be made by EPA managers in accordance with established audit resolution procedures.

The Office of Air and Radiation's Office of Transportation and Air Quality has primary responsibility for the subjects covered in this audit.

In accordance with EPA Manual 2750, your office provided acceptable corrective actions and milestone dates in response to OIG recommendations. All recommendations are resolved and no final response to this report is required. However, if you submit a response, it will be posted on the OIG's website, along with our memorandum commenting on your response. Your response should be provided as an Adobe PDF file that complies with the accessibility requirements of Section 508 of the Rehabilitation Act of 1973, as amended. The final response should not contain data that you do not want to be released to the public; if your response contains such data, you should identify the data for redaction or removal along with corresponding justification.

We will post this report to our website at www.epa.gov/oig.

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Chapter 1
Introduction

Purpose

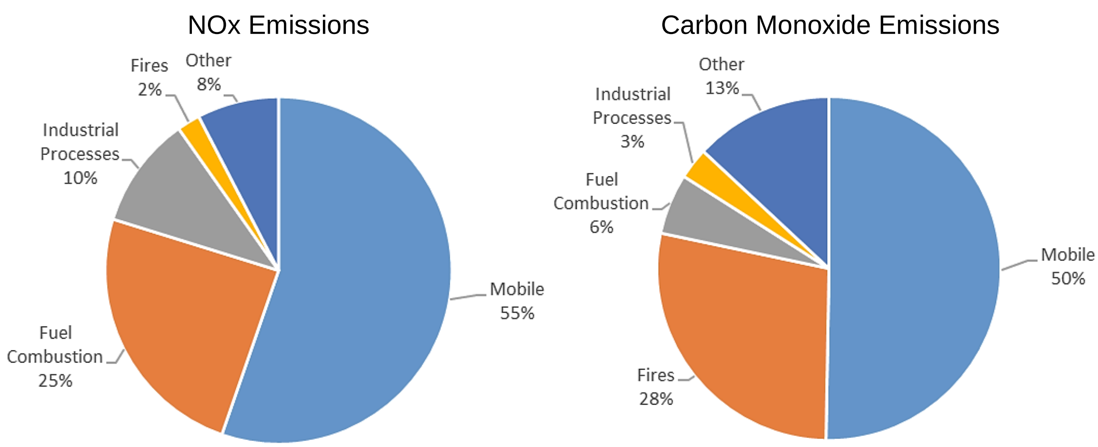
The objective of this audit is to determine whether the U.S. Environmental Protection Agency's (EPA's) existing internal controls are effective at detecting and preventing on-road heavy-duty (HD) vehicle emissions fraud. Effective internal controls provide reasonable—though not absolute—assurance that the potential for fraud is minimized.

Background

Air Pollution from Mobile Sources

Mobile sources include aircraft, commercial marine vessels, non-road vehicles and equipment, including construction equipment and generators, on-road light-duty (LD) vehicles such as passenger cars and smaller pickup trucks, and on-road HD vehicles such as larger pick-up trucks, tractor-trailers and buses. Mobile sources are one of the major contributors to air pollution in the United States. For example, mobile sources accounted for 55 percent of the total nitrogen oxides (NOx) emissions and 50 percent of the total carbon monoxide emissions in calendar year 2014 (Figure 1). The pollution from mobile sources is generated primarily by internal combustion engines that burn gasoline, diesel and other types of fuels; the combustion byproducts create pollution.

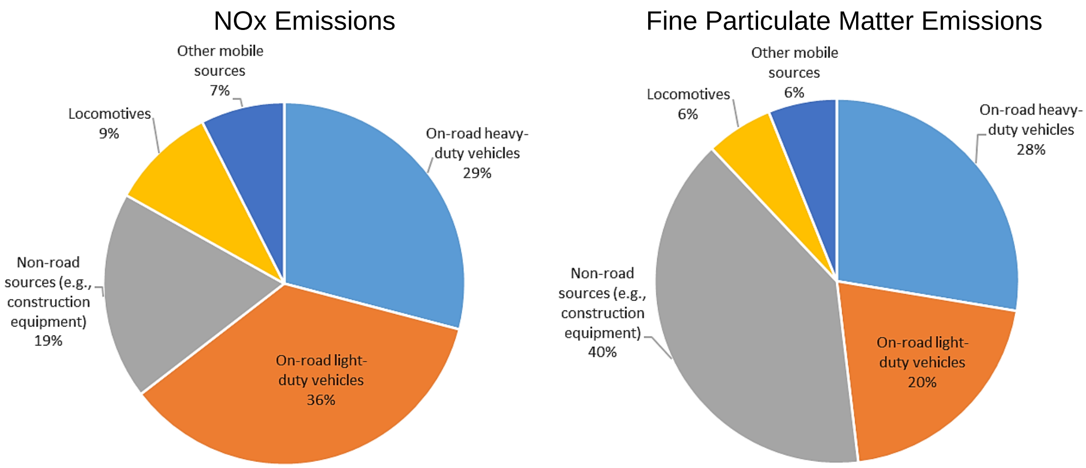
Figure 1: 2014 U.S. NOx and carbon monoxide emissions from <u>all</u> sources



Source: Office of Inspector General (OIG) analysis of the 2014 EPA National Emissions Inventory. (Note: As of April 2019, this was the latest inventory available.)

The EPA is responsible for regulating air pollution from the mobile source sector. This report focuses on the EPA's mobile source compliance program for on-road HD vehicles and engines, which comprise the fastest growing transportation sector in the United States based on fuel use. The on-road HD sector (also referred to as the "HD highway sector") includes vehicles weighing more than 8,500 pounds—such as commercial trucks, tractor-trailers and buses—and the engines that propel those vehicles.[1] As shown in Figure 2, the on-road HD sector accounted for 29 percent of NOx emissions and 28 percent of fine particulate matter emissions from mobile sources in calendar year 2014.

Figure 2: 2014 U.S. NOx and fine particulate matter emissions from mobile sources



Source: OIG analysis of the 2014 EPA National Emissions Inventory. (Note: As of April 2019, this was the latest inventory available.)

Statutory Authority and Regulations Relevant to Mobile Sources

The EPA's on-road HD vehicle compliance program implements statutory mandates in the Clean Air Act (42 U.S.C. Chapter 85) designed to improve air quality. These mandates include developing domestic emission standards, as well as requirements for testing, certification and in-use compliance.[2]

The EPA develops regulations and guidance to implement the statutory mandates for the on-road HD sector. For practical and historical reasons, the regulations controlling pollutants such as particulate matter and NOx typically apply to HD

[1] Some HD vehicles that weigh between 8,500 and 14,000 pounds, such as large pickup trucks and cargo vans, are regulated by the LD vehicle compliance program because their technical and operating characteristics are similar to LD vehicles.
[2] *In-use compliance* refers to compliance after the vehicle or engine enters commerce and is explained in the "In-Use Testing" subsection of this report.

engines rather than vehicles.[3] The HD vehicle and engine program applies to all on-road HD vehicles, but the EPA designed separate regulatory provisions for spark-ignition (SI) engines, which are typically gasoline- or gaseous-fueled, and for compression-ignition (CI) engines, which are typically diesel-fueled, because of their different technical characteristics.[4] In 2011, the EPA promulgated the first greenhouse gas standards for HD highway vehicles. These standards took effect starting in the 2014 model year and were the first HD standards to apply to the full vehicle.[5]

Table 1 describes the tests (which are detailed in EPA regulations) that HD manufacturers must complete for each model year engine to demonstrate compliance with the exhaust emission standards.[6] These required test cycles, which together are designed to simulate real-world exhaust emissions under various operating conditions, are often referred to as "standard test cycles."

Table 1: EPA-required standard test cycles

Standard test cycle	Purpose
Federal Test Procedure	Simulates transient operation; includes engine startups (cold and hot).
Supplemental Emissions Test *	Simulates steady-state (e.g., highway) driving under various engine speeds and loads (i.e., torque).
Not-to-Exceed (NTE) Demonstration *	Demonstrates emissions performance when the engine is operating at steady-state within a prescribed range of engine speed and load. This range is known as the "NTE zone."

Source: EPA regulations, 40 CFR Part 86.

* Applicable to the HD CI sector only.

The EPA conducts vehicle and engine testing at its National Vehicle and Fuel Emissions Laboratory (NVFEL) located in Ann Arbor, Michigan. It also conducts testing at contract laboratories. The standard engine tests are performed using an engine dynamometer, which is an electric motor that simulates operating conditions and allows testing to be reproducible in a laboratory environment. Engines are connected to the dynamometer and are operated at specified speeds and loads for prescribed amounts of time and in accordance with other strict parameters defined in EPA regulations for each standard test cycle. Exhaust is captured from the test engine and sent to a gas analyzer to accurately measure pollutant levels in the exhaust (Figure 3).

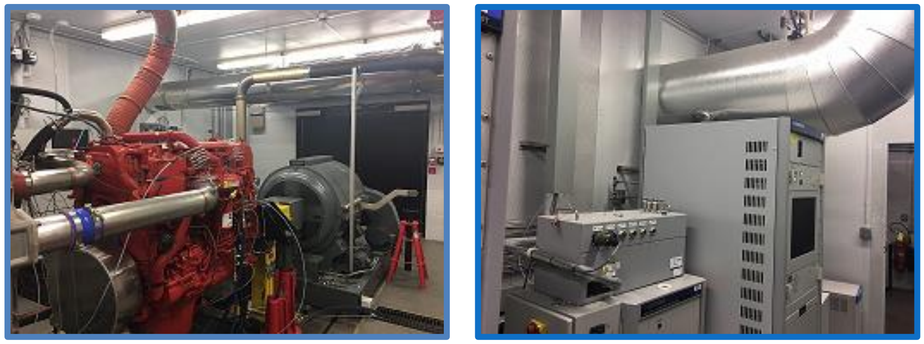
[3] In contrast, LD emission standards generally apply to the vehicle. Vehicle design impacts engine performance due to factors like aerodynamics. According to the EPA, it is typical in the LD sector for the same manufacturer to build both the engine and the vehicle, while HD engines and vehicles are often produced by different manufacturers. It is also common for the same HD engine to be used by multiple vehicle manufacturers. In addition, the technology needed to test HD vehicles in a laboratory did not exist until relatively recently, whereas it has been widely available for HD engines.

[4] The majority of HD highway vehicles are powered by CI engines.

[5] The EPA applied the new greenhouse gas standards to *vehicles* rather than *engines* because aerodynamics is a major factor impacting fuel economy, which is directly related to greenhouse gas emissions.

[6] Compliance with both HD engine and vehicle standards is measured using engine tests. Greenhouse gas emissions are measured by applying modeling that captures the vehicle's aerodynamic features to the results of the engine test.

Figure 3: Dynamometer testing process



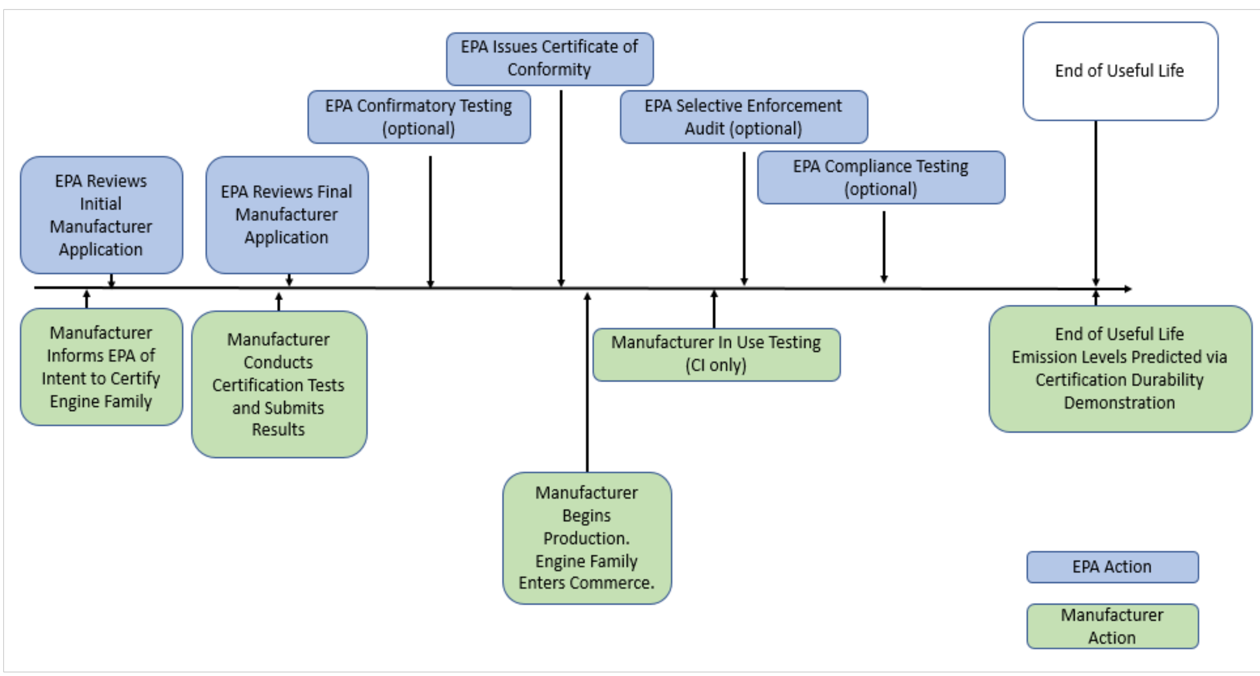
Source: EPA OIG photos.

Note: In the picture on the left, the red engine is in the foreground; the grey dynamometer is in the background. Exhaust gas from the engine is sent through the silver pipes to the gas analyzer (shown in the picture on the right), which is located in the adjacent room.

Components of EPA's On-Road HD Vehicle Compliance Program

As illustrated in Figure 4, the components of the EPA's on-road HD vehicle compliance program are designed to verify compliance with regulatory requirements throughout the useful life of the engine. "Useful life" is defined in regulations and varies by engine category (Table 2).

Figure 4: On-road HD vehicle compliance life cycle



Source: EPA.

Table 2: EPA-regulated useful life for exhaust standards

Engine category	Useful life *(miles/years, whichever comes first)*
HD SI	110,000/10
Light HD CI *	110,000/10
Medium HD CI *	185,000/10
Heavy HD CI *	435,000/10 or 22,000 hours in some cases

Source: OIG analysis of EPA table.

* Within the overall category of CI engines, engines are further classified as light, medium and heavy based on weight.

Certificate of Conformity

An ***AECD*** is any part of the vehicle design that can identify changes to a parameter (e.g., temperature, vehicle speed and transmission gear) for the purpose of modifying the emission control system. Legitimate AECDs may be used to detect and respond to unusual operating conditions, which may cause damage to the engine.

*A **defeat device*** is an AECD that reduces the effectiveness of the emission control system under conditions that may reasonably be expected during normal vehicle operation and use.

As indicated in Figure 4, the HD compliance life cycle begins with the manufacturer submitting a Certificate of Conformity (COC) application for a specific "engine family" (i.e., a group of engines that share certain emission control system and design features) to the EPA for review. The COC application includes manufacturer-conducted *certification testing* data that demonstrate the engine family's compliance with emission standards over all of the standard test cycles (previously outlined in Table 1), as well as disclosures of any auxiliary emission control devices (AECDs). AECDs are permitted in vehicles if they are disclosed in the COC application and meet one of the following four legal exceptions; otherwise, the AECDs are considered illegal "defeat devices":[7]

1. Driving conditions when the AECD is operating are substantially reflected in standard test cycles.
2. The need for the AECD is justified in terms of protecting the vehicle against damage or accident.
3. The AECD only operates during engine starting.
4. The AECD applies only for emergency vehicles and the need is justified.

The EPA reviews each COC application. To verify the accuracy of the testing data submitted by the manufacturer, the EPA may then select certain engines for *EPA confirmatory testing* based on the following criteria:[8] random

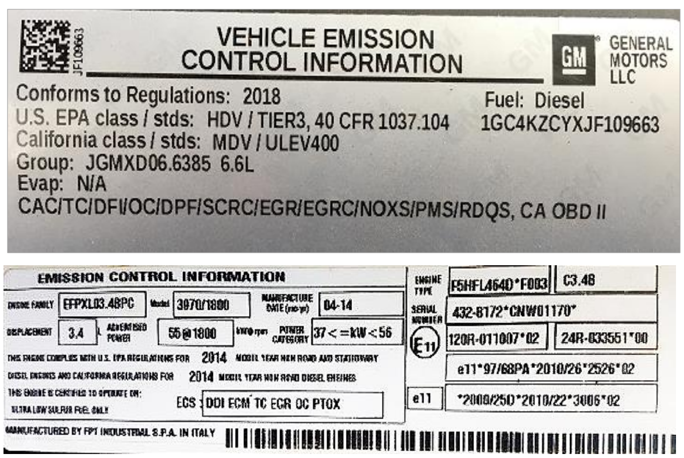
[7] According to the EPA, the presence of an illegal defeat device does not always imply a deliberate attempt to deceive or cheat (i.e., fraud). Defeat devices may exist for various reasons, such as poor design decisions or a failure to fully understand technical interactions within the engine and emission control system. These reasons are why the EPA requires manufacturers to disclose all AECDs in their COC applications.

[8] Due to capacity and/or facility limitations, the EPA may conduct engine testing in the NVFEL or at a contract laboratory. For example, the NVFEL currently does not have HD SI engine testing capabilities.

selection; low compliance margins (i.e., the difference between actual emission levels and the emission standard); testing history; new technology; or if there is a reason to believe a problem may exist with the particular engine or manufacturer.[9]

As part of the COC application process, manufacturers are also required to provide durability data, which demonstrate that the emission control system will meet emission standards throughout the useful life of the vehicle/engine. *Durability testing* is an important component of the HD engine COC process, given the long life of HD engines. The EPA must approve the design of the manufacturer-conducted durability testing, which includes a combination of standard test cycles (previously described in Table 1) and EPA-approved "ageing-cycles" that reflect the projected engine operating conditions unique to a particular engine family.

After reviewing the final application, test data from the manufacturer and any confirmatory test data from the EPA, the agency will determine if the COC application is approved or denied. If approved, the EPA will issue a COC to the manufacturer, permitting the vehicle/engine to be sold in the United States.



Labels affixed to a vehicle (top) and engine (bottom) specify the vehicle/engine family, compliance with EPA regulations and other information. (EPA OIG and EPA photos, respectively)

After COC approval and once the manufacturer begins mass production of a particular engine family, the EPA may conduct *selective enforcement audits*, which consist of strategically selecting and testing production-line engines to determine whether the engines continue to meet emission standards and are consistent with the information in the COC. These audits can be performed at the manufacturer's facilities, which enables the EPA to inspect the production and testing procedures along with the engine emissions performance.

In-Use Testing

Also after COC approval, manufacturers of HD CI engines are required to conduct in-use tests on privately owned vehicles at different stages of engine life.[10] *In-use testing* measures on-road emission levels under real-world operating conditions via a Portable Emissions Measurement Systems (PEMS) to determine engine durability and compliance with on-road emission

[9] The EPA uses these criteria to select engines for testing at other points in the compliance life cycle as well.
[10] As of April 2019, the EPA has not developed in-use testing regulations for HD SI engines.

standards. These in-use, on-road standards—known as "NTE standards"—establish the maximum level of emissions allowed as long as the vehicle's operating condition falls within the prescribed NTE zone.[11] NTE standards do not involve a specific driving or operating cycle; instead, they apply to any type of driving that can occur within the NTE zone. While the NTE zone for each engine family may be unique, certain criteria apply to all engine families. For example, an engine must be operating within the NTE zone for at least 30 seconds for emissions to be regulated under NTE standards. In addition, there are numerous exclusions that disqualify an NTE point, such as when the ambient temperature or altitude falls outside of a specified range.

> ***NTE standards*** prescribe the maximum pollutant emission limits for on-road, in-use operating conditions that fall within the NTE zone.

For every model year, the EPA selects engine families for in-use testing based on relevant information, including but not limited to an engine family's standard cycle test results, production volume, certification or compliance history, and after-treatment system characteristics. Manufacturers install PEMS units into privately owned vehicles featuring engines from the selected families; these vehicles are then operated as normal for the duration of the in-use tests. All in-use test data must be reported to the EPA within 7 days after completion of the test. If a manufacturer voids a test for any reason (e.g., when deficiencies are identified, such as if established processes were not followed or testing conditions were not met), it must provide an explanation to the EPA, and the agency will determine whether voiding the test was appropriate. As resources allow, the EPA also conducts its own in-use *compliance testing* using both PEMS units for on-road testing and engine dynamometers for laboratory testing to complement the manufacturer in-use testing.

If testing reveals any failures to meet regulatory standards, the manufacturer is required to highlight these failures to the EPA. The EPA may then require manufacturers to conduct additional testing to determine whether the failure is widespread or limited in scope. If further testing demonstrates widespread failure, it can lead to recalls or vehicle modifications. Manufacturers must report all emission-related defects to the EPA and are required to take remedial actions. The EPA has the ability to withhold, deny, revoke or suspend a COC if a manufacturer knowingly (1) submits false or inaccurate information, (2) renders inaccurate or invalid test data, or (3) commits any other fraudulent acts.

[11] The NTE zone is previously defined in Table 1. In Table 1, however, the term is applied to the "NTE Demonstration" standard test cycle, which is conducted at the beginning of the COC application process to show how the engines/vehicles operate in *simulated* driving conditions. Here, the term applies to the on-road, *in-use* testing conducted after the COC has been approved.

History of Fraud Involving Defeat Devices

The on-road HD sector was involved in a defeat device case in the late 1990s.[12] Major HD CI engine manufacturers sought to achieve fuel efficiency goals by using electronic engine controls that allowed NOx emissions to exceed standards at highway speeds. The EPA considered this engine control strategy to constitute an illegal defeat device. At the request of the EPA, the U.S. Department of Justice brought a federal lawsuit against seven manufacturers, which resulted in a settlement requiring these companies to pay over $1 billion to resolve claims that they installed computer devices in HD diesel engines, which resulted in illegal amounts of air pollution emissions.[13]

The case brought regulatory changes to the HD CI compliance program, including the development of the NTE standard for on-road emissions and the implementation of the supplemental emissions standard test cycle for engine dynamometer testing. These changes were fully implemented in 2007. The EPA developed the NTE standards in collaboration with both its co-regulator—the California Air Resources Board—and manufacturers to more accurately reflect on-road emissions under real-world operating conditions.

HD Vehicle Compliance Program Organization and Coordination

The EPA's on-road HD vehicle compliance program is located within the Office of Transportation and Air Quality (OTAQ). OTAQ's Assessment and Standards Division is responsible for developing mobile source emission control regulations and policies. OTAQ's Compliance Division (CD) is responsible for implementing the EPA's mobile source regulatory program. OTAQ's Testing and Advanced Technology Division (TATD) is responsible for operating the laboratory at the NVFEL in Ann Arbor. Depending on the test program, TATD provides compliance and enforcement data to CD, the EPA's Office of Enforcement and Compliance Assurance (OECA), and the Department of Justice.

CD's Diesel Engine Compliance Center and Gasoline Engine Compliance Center are responsible for selecting the vehicles and engines for testing and for interpreting the test results to determine whether a vehicle or engine is meeting the regulatory standards.[14] These centers also conduct the selective enforcement audits that are part of the HD engine compliance life cycle (illustrated in

[12] The federal defeat device case filed against Volkswagen in 2015 was related to LD vehicles.
[13] The following seven manufacturers were named in the EPA's proposed consent decrees of October 1998, which were approved by the U.S. District Court for the District of Columbia in July 1999: Caterpillar Inc., Cummins Engine Company Inc., Detroit Diesel Corp., Mack Trucks Inc., Navistar International Transportation Corp., Renault Vehicles Industrials SA and Volvo Truck Corp.
[14] In addition to on-road HD vehicles and engines, the Diesel Engine Compliance Center is responsible for implementing the mobile source compliance program for various other sectors, including non-road vehicles and equipment, such as construction and agricultural equipment, commercial marine vessels, and locomotives. The Gasoline Engine Compliance Center is also responsible for other sectors, including motorcycles, all-terrain vehicles, gasoline boats and personal watercraft, forklifts, generators, and compressors.

Figure 4). TATD is responsible for conducting laboratory testing and on-road testing using PEMSs, as well as producing test results. CD resolves most issues involving noncompliance under its own administrative authority and coordinates with OECA to address compliance issues that CD determines may merit enforcement action. OECA attorneys handle administrative enforcement actions and, in coordination with the Department of Justice, help develop and prosecute civil and criminal enforcement cases.

Internal Control Standards

The U.S. Government Accountability Office (GAO) defines "internal control" in the following manner:

> [A] process effected by an entity's oversight body, management, and other personnel that provides reasonable assurance that the objectives of an entity will be achieved. … Internal control comprises the plans, methods, policies, and procedures used to fulfill the mission, strategic plan, goals, and objectives of the entity.[15]

An "internal control system" is defined as follows:

> An internal control system is a continuous built-in component of operations, effected by people, that provides reasonable assurance, not absolute assurance, that an entity's objectives will be achieved. … Internal control is not one event, but a series of actions that occur throughout an entity's operations. … Management is responsible for an effective internal control system. As part of this responsibility, management sets the entity's objectives, implements controls, and evaluates the internal control system.[16]

According to the GAO, internal control has five components:

1. **Control Environment.** The foundation for an internal control system. The control environment provides the discipline and structure to help an entity achieve its objectives.

2. **Risk Assessment.** Assessment of the risks facing the entity as it seeks to achieve its objectives. This assessment provides the basis for developing appropriate risk responses.

3. **Control Activities.** Actions that management establishes through policies and procedures to achieve objectives and respond to risks in the internal control system, which includes the entity's information system.

[15] GAO, *Standards for Internal Control in the Federal Government*, GAO-14-704G, September 2014.
[16] *Ibid.*

4. **Information and Communication.** Quality information that management and personnel communicate and use to support the internal control system.

5. **Monitoring.** Activities that management establishes and operates to assess the quality of performance over time and to promptly resolve audit findings and other reviews.

The GAO notes that "17 principles support the effective design, implementation, and operation of the associated components and represent [the] requirements necessary to establish an effective internal control system." These principles are described in Chapter 2 of this report in the context of our assessment of each control component.

Office of Management and Budget Circular A-123, *Management's Responsibility for Enterprise Risk Management and Internal Control*, issued July 2016, defines obligations for risk management and internal control in federal agencies. EPA Order 1000.24 (CHG 2), *Management's Responsibility for Internal Control*, requires all EPA organizations to establish and maintain internal controls to achieve effective and efficient program operations, including evaluating internal controls on an ongoing basis and taking prompt actions to correct any vulnerabilities identified.

Responsible Office

OTAQ, within the EPA's Office of Air and Radiation, implements the emissions testing and compliance program for mobile sources, including on-road HD vehicles and engines.

Scope and Methodology

We conducted our performance audit from March 2017 to January 2019 in accordance with generally accepted government auditing standards.[17] Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our objective. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objective.

To answer our objective, we examined mobile source requirements for on-road HD vehicles and engines, including emissions testing requirements and protocols as described in statute, regulations and relevant guidance documents. We determined the roles and responsibilities for emissions testing and compliance, including for EPA staff and offices that implement and oversee the program. We

[17] The project was suspended from July 2018 to December 2018 to conduct work on a related congressionally requested audit.

reviewed the extent to which the EPA relies on contractors. We examined the process that the EPA uses to issue COCs and any auditing that the EPA performs on manufacturer-submitted data. We reviewed the processes that the EPA uses to audit new and in-use vehicles and engines via standard test cycles in its NVFEL, as well as to measure on-road emissions using PEMS units. We traveled to the NVFEL and observed firsthand TATD's testing of vehicles and engines. Our work focused on the divisions in OTAQ supporting the on-road HD vehicle and engine compliance program, including CD and TATD. We also met with OECA and the Office of Research and Development to determine how these offices support the emissions testing and compliance program.

We interviewed multiple technical experts, management and staff from a variety of external organizations, including other regulatory agencies, nongovernmental organizations, academia and industry.

We conducted this audit to determine whether the EPA's existing internal controls are effective at detecting and preventing on-road HD vehicle and engine emissions fraud. By its nature, fraud begins with noncompliance. Thus, this audit focuses on whether OTAQ's internal control system provides reasonable assurance that noncompliance with mobile source emission standards is detected and prevented—one of the office's primary objectives. As noted in the GAO's *Standards for Internal Control in the Federal Government* and in Office of Management and Budget Circular A-123, absolute assurance is not attainable, as factors outside the control or influence of management can affect the entity's ability to achieve all of its objectives. All OIG findings in this report are specific to OTAQ's on-road HD vehicle and engine compliance program and the divisions and centers within OTAQ that support the program.

Prior Report

We completed a companion audit that focused on the EPA's LD vehicle compliance program; the associated audit report, OIG Report No. 18-P-0181, *EPA Did Not Identify Volkswagen Emissions Cheating; Enhanced Controls Now Provide Reasonable Assurance of Fraud Detection,* was issued on May 15, 2018. The OIG made seven recommendations to improve the internal controls of the LD vehicle compliance program. The EPA provided acceptable corrective actions, three of which are completed as of May 2019.

Chapter 2
EPA's Current Internal Controls Provide Reasonable Assurance that Fraud Will Be Detected and Prevented; Further Improvements Could Be Made

The EPA's on-road HD vehicle and engine compliance program has demonstrated that its current internal controls are effective at detecting and preventing noncompliance—a precursor to potential fraud.[18] However, there are opportunities for improvement. The OIG evaluated the EPA's controls based on the five components defined in the GAO's governmentwide internal control standards: control environment, risk assessment, control activities, information and communication, and monitoring. Effective internal controls are important for OTAQ to achieve its goal of ensuring compliance and detecting noncompliance with mobile source emission regulations. Noncompliance can and has caused excess emissions of pollutants, which have significant, quantifiable negative impacts on human health and the environment.

Control Environment

Control environment is the foundation for an internal control system. This component requires that management and employees establish and maintain an environment throughout the organization that sets a positive and supportive attitude toward internal control and conscientious management. The key principles that affect the accomplishment of this goal are described in Table 3.

Table 3: Control environment principles

	Principle
1.	The oversight body and management should demonstrate a commitment to integrity and ethical values.
2.	The oversight body should oversee the entity's internal control system.
3.	Management should establish an organizational structure, assign responsibilities and delegate authority to achieve the entity's objectives.
4.	Management should demonstrate a commitment to recruit, develop and retain competent individuals.
5.	Management should evaluate performance and hold individuals accountable for their internal control responsibilities.

Source: OIG analysis of GAO internal control standards.

[18] Per the GAO's *Standards for Internal Control in the Federal Government* (GAO-14-704G), effective internal controls provide reasonable—though not absolute—assurance that the potential for fraud is minimized.

The factors that support the OIG's evaluation of this component include:

- OTAQ has protocols (e.g., for potential conflicts of interest) and conditions (e.g., low staff turnover) in place to prevent inappropriate knowledge transfer to private industry.

- OTAQ management has created an organizational culture of integrity and ethical values by establishing policies and principles for staff to follow.

- All OTAQ staff interviewed indicated that they feel comfortable reporting compliance issues to management. We found no instances of interviewed staff being pressured to inappropriately approve or expedite COC applications from industry.

- OTAQ has procedures and systems in place to oversee its internal control system. For example, OTAQ developed and maintains the Engine and Vehicle Compliance Information System (EV-CIS), which is the official database for compliance purposes and is used to oversee the compliance program and support enforcement cases.

- Our analysis confirmed that EV-CIS acts as a management and workflow tool designed to track the compliance process and select vehicles and engines for testing. EV-CIS also controls system access based on user role and tracks testing, certification and compliance decisions.

- OTAQ's quality assurance and control documents provide structured roles and responsibilities. For example, to achieve its objectives, OTAQ divides the workload for the HD sector into centers based on engine type.

- TATD has established, implements and maintains a quality management system, which operates according to the International Organization for Standardization (ISO)/International Electrotechnical Commission (IEC) 17025 standard.[19]

- OTAQ demonstrates an ability to recruit competent staff (e.g., engineers and scientists) and retain staff (e.g., a low turnover rate).

- Management has a system in place to report, document and follow up on laboratory concerns, audit findings and corrective actions (such as issues with nonconforming work).

[19] The EPA's NVFEL is accredited in accordance with the recognized ISO/IEC 17025:2005 certification. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory's quality management system. For more information on the scope of this accreditation, visit the EPA's *Vehicle and Fuel Emissions Testing* website.

- TATD has laboratory performance metrics that track laboratory use, as well as quality metrics that track the number of audits conducted. TATD also tracks any nonconforming work that it finds during audits, along with opportunities for improvement that it identifies as a result of the audits.

- TATD has procedures in place to verify that completed work conforms to the scope of its responsibility.

- OTAQ tracks basic metrics, such as type and quantity of testing. Workflow is tracked via EV-CIS. In addition, for CI engines, the Diesel Engine Compliance Center uses data reported through manufacturer in-use testing to track compliance. However, there are no comprehensive performance metrics to measure or define the success of the EPA's on-road HD vehicle and engine compliance program.

Control Environment Conclusion

OTAQ's on-road HD vehicle and engine compliance program demonstrated effective current controls addressing the five control environment principles outlined in Table 3. However, we found that CD does not have specific performance metrics to help it measure success. Performance metrics or indicators enable management to measure and demonstrate that the program is successful. Metrics can also incentivize certain activities that would contribute to OTAQ's goal of ensuring compliance, such as helping to increase attention on in-use compliance.

Control Environment Recommendation

We recommend that the Assistant Administrator for Air and Radiation:

1. Define performance measures to assess the performance of the EPA's on-road heavy-duty vehicle and engine compliance program.

Risk Assessment

As described in the GAO's *Internal Control Management and Evaluation Tool*, a precondition to risk assessment is the establishment of clear, consistent goals and objectives. Once the objectives have been set, the agency needs to identify the risks that could impede the efficient and effective achievement of those objectives. Per the GAO, "Internal control should provide for an assessment of the risks that the agency faces from both internal and external sources. Once risks have been identified, they should be analyzed for their possible effect." Management then should formulate an approach for risk management and decide upon the internal control activities required to mitigate those risks, including during times of change. Table 4 highlights the principles under this component.

Table 4: Risk assessment principles

	Principle
1.	Management should define objectives clearly to enable the identification of risks and define risk tolerances.
2.	Management should identify, analyze and respond to risks related to achieving the defined objectives.
3.	Management should consider the potential for fraud when identifying, analyzing and responding to risks.
4.	Management should identify, analyze and respond to significant changes that could impact the internal control system.

Source: OIG analysis of GAO internal control standards.

The factors that support the OIG's evaluation of this component include:

- OTAQ's stated goal for its compliance programs is to achieve environmental and public health benefits by "implementing emission standards covering every vehicle, engine, and gallon of fuel sold … and ensuring that these standards are met over the life of the product."[20] In addition, CD has its own goals of implementing OTAQ's regulatory program by making determinations on certification and registration, ensuring compliance, and using compliance data.

- CD has performed informal (i.e., not documented or systematic) risk assessments on an ongoing basis based on professional judgment. For example, there are weekly meetings to assess and prioritize risk. In addition, during our audit, staff demonstrated how they identify and analyze risks faced by the program and how testing plans are fluid to respond to changing risk. CD also provided the OIG with documentation illustrating how, over the last year, it implemented a more systematic approach to risk assessment. Furthermore, the EPA piloted a systematic method to identify and quantify risks, and the agency committed resources to explore the top priority in each of the centers.

- According to OTAQ, the Assessment and Standards Division continually gathers information about vehicle, engine and equipment emissions and activity from a variety of sources, including data that CD collects through its compliance program oversight. OTAQ also said that the Assessment and Standards Division uses this information to update its emissions models and to establish rulemaking priorities.

- TATD develops annual laboratory plans based on resource assumptions and input from CD on testing priorities.

[20] EPA, *2007 Progress Report: Vehicle and Engine Compliance Activities*, EPA-420-R-08-011, October 2008.

- CD has responded to past experiences with noncompliance and other external conditions, such as changes to engine technology, by modifying its program and clarifying or changing its policies. For example, CD has responded to past experiences with defeat devices in the HD sector by clarifying its policy regarding AECDs and developing a formal process to help manufacturers and others determine whether an AECD is a defeat device. Noncompliance with NOx emission standards by HD CI engine manufacturers in the late 1990s led to the development of NTE standards and the supplemental emissions test standards to measure and therefore control emissions during real-world operating conditions.

- OTAQ has responded to risks by incorporating new technological advancements into its compliance program, such as an HD chassis dynamometer (Figure 5), which has helped to inform the EPA's compliance and policy decisions.[21]

Figure 5: EPA's HD chassis dynamometer

Source: EPA OIG.

Note: The picture on the left shows the front of the HD chassis dynamometer, while the picture on the right shows the back.

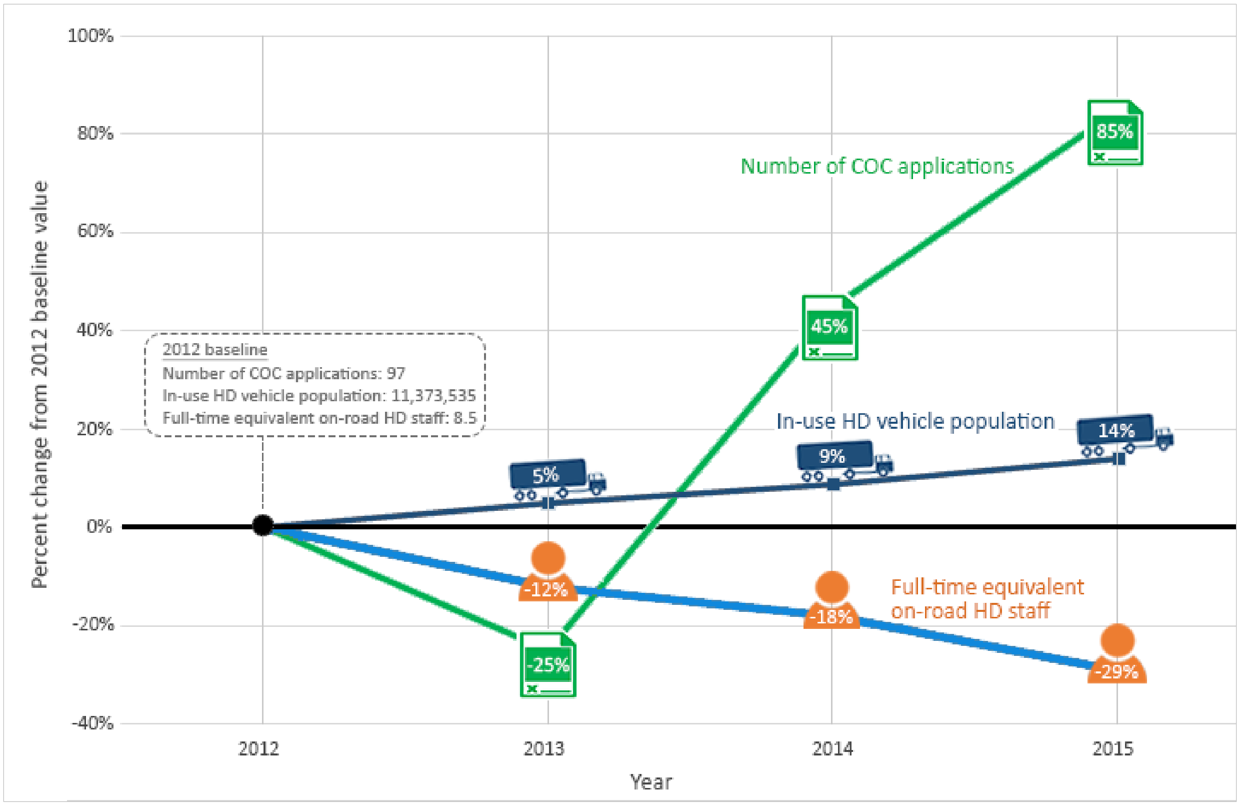
- CD created a *Compliance Vision* document that contains a compliance risk framework and highlights that risk assessment is fundamental to CD's planning and daily work. It also describes risk assessment cycles.

- One aspect of risk assessment is for management to identify the resources needed to meet program objectives. The EPA noted that its resources have been declining, while its regulatory oversight responsibilities have

[21] For example, in November 2017, the EPA proposed repealing the emissions requirements for "glider" vehicles and engines (i.e., old engines that have been refurbished and put into new truck bodies) (*Repeal of Emission Requirements for Glider Vehicles, Glider Engines, and Glider Kits*, 82 Federal Register 53442, proposed November 16, 2017). Subsequently, OTAQ published results from HD chassis dynamometer testing to show that glider vehicles and engines emit many times the level of pollutants over the standards for new HD engines (*Chassis Dynamometer Testing of Two Recent Model Year Heavy-Duty On-Highway Diesel Glider Vehicles*, EPA-HQ-OAR-2014-0827-2417, November 20, 2017). As of April 2019, the proposed rule has not been finalized.

increased. The data show that although COC applications and the on-road HD in-use population have increased from a 2012 baseline (which means the workload for OTAQ staff has also increased), OTAQ staffing levels have declined significantly (Figure 6).

Figure 6: On-road HD staff levels versus COC applications and in-use vehicle population



Source: OIG analysis and image.

Note: Staff levels are measured in fiscal years and include staff in both TATD and CD responsible for implementing on-road HD regulations. In-use vehicle population is measured in model years and includes all on-road HD vehicles. Starting in model year 2014, the EPA fully implemented greenhouse gas standards for HD vehicles and began requiring certifications for *vehicle* configurations in addition to *engine* configurations, hence the spike in 2014 COC applications.

- As part of our audit, we identified specific risks to OTAQ's goal of achieving public health and environmental benefits through its mobile source emission control programs, which we outline in Table 5. While OTAQ has identified many of these risks, its analysis of these areas has not been documented in a formal risk assessment. According to OTAQ, its ongoing but informal risk assessments have concluded that these areas present less risk and therefore merit less investment, given resource realities.

Table 5: Risks to achieving OTAQ's environmental goals

Condition	Cause	Effect
New emission control technologies to reduce criteria pollutants could potentially have a side effect of increasing the risk from non-criteria (i.e., unregulated) pollutant emissions. The EPA does not routinely measure non-criteria pollutants. The EPA does have emission-level guidance for some non-criteria pollutants, such as ammonia.	Non-criteria pollutants are not regulated by the EPA, except insofar as the Clean Air Act states that controlling regulated pollutants cannot result in increased emissions of non-criteria pollutants that would impact public health. *Note:* Per the Clean Air Act, "no emission control device, system, or element of design shall be used in a new motor vehicle or new motor vehicle engine … if such device, system, or element of design *will cause or contribute to an unreasonable risk to public health, welfare, or safety* in its operation or function. … In determining whether an unreasonable risk exists…the *Administrator shall consider*…whether and to what extent the use of any device, system, or element of design causes, increases, reduces, or eliminates *emissions of any unregulated pollutants*." (42 U.S.C. § 7521(a)(4)(A)–(B)(i)) (*emphases added*).	By not measuring emissions for non-criteria pollutants such as ammonia, which may be increasing due to new treatment technologies, the EPA may be substituting one risk for another. The EPA may also be unable to fulfill its requirement under the Clean Air Act to determine the risk from increased emissions from any non-criteria pollutants that are caused by controlling criteria pollutants.
From 2012–2016, the EPA conducted limited HD confirmatory and compliance testing. In this time period, EPA laboratory resources were devoted to LD diesel vehicle testing in response to the Volkswagen emissions cheating case described in our companion report (Report No. 18-P-0181). Given the fixed number of PEMS units and staff, this focus on LD testing comes at the expense of other testing, such as HD in-use testing.	According to the EPA, limited HD testing is due to the realities of resource constraints. OTAQ's ongoing and real-time risk assessments concluded that testing capacity and management attention needed to focus on LD diesels in the wake of the Volkswagen emissions cheating case.	Limited HD testing increases the probability that noncompliance will go undetected. In the limited HD testing conducted by the EPA, compliance issues have been found. While the on-road HD sector has fewer manufacturers and in-use vehicle populations than the LD sector, it is the fastest growing transportation sector in the United States and is responsible for a higher percentage of some criteria pollutant emissions (e.g., fine particulate matter) than any other mobile source sector.
For regulatory compliance purposes, there is ambiguity in the marketplace differentiating remanufactured engines from rebuilt engines. Per the EPA's *How to Maintain or Rebuild Engines Certified to EPA Standards*, EPA-420-F12-052, issued August 2012, the EPA does have general principles describing its expectations for maintaining or rebuilding HD engines. *Note:* A remanufactured engine is remanufactured to the original specifications and is tested to original equipment standards. In contrast, rebuilt engines are repaired, typically up to the level of failure or if visible wear is identified.	According to the EPA, there are clear regulatory emission requirements in place that cover remanufactured and rebuilt on-road HD engines. However, according to the EPA, market participants may be using the term "remanufacturing" colloquially to refer to specific processes engaged in and applied to existing engines, while regulatory provisions (such as 40 CFR § 86.004-40 and 40 CFR § 1068.120) make it clear that such market participants are using the term "remanufacturing" to also describe the "rebuilding" process. Any ambiguity or lack of clarity is more likely due to the misnomer used in the marketplace ("remanufacturing") than due to lack of clarity in the regulatory provisions. Additionally, EPA on-road HD emission standards apply to new engines. There are no requirements for engine emission controls to be upgraded or even maintained once they are sold, though the EPA does have this kind of requirement for locomotives and marine diesel engines.	Real or perceived ambiguity over when an engine is considered rebuilt versus remanufactured increases the potential for engines to operate beyond their useful life without adhering to emission standards.

Condition	Cause	Effect
Technical differences between SI and CI engines create technical challenges and tradeoffs in controlling emissions that may impact compliance. For HD CI engines, some emission controls may reduce engine performance, engine life or fuel economy. The impact on HD SI engines is different because cleaner operation is generally the most efficient operational mode for SI engines, while CI engines may operate more efficiently at higher emission levels. Additionally, greenhouse gas standards make it more difficult for HD CI engines to meet criteria pollutant standards, since HD CI engines may be more efficient when emission controls are tuned to result in higher criteria pollutant emissions.	Inherent technical differences exist between CI and SI engine designs and their respective fuels.	Explicitly accounting for the conflicting incentives would enable the EPA to better target testing and identify technical aspects of emission control systems that are most susceptible to noncompliance.
The EPA does not have the ability to conduct in-house HD SI engine confirmatory or compliance testing at its NVFEL because the agency does not have a test cell designed for HD SI engine testing.	The EPA's engine testing cells are only for HD CI engines and, as of April 2019, cannot be used for SI engine testing due to particulate matter buildup on tunnel walls from diesel combustion. According to the EPA, it is working with analytical equipment manufacturers to determine whether technology advances have addressed the contamination issue, allowing a single test site to be used for both types of engines. The EPA said that it has weighed the benefits of investing in lab capability for this sector against the benefits of building lab capacity to address risks in other sectors. Investment in an HD SI engine site has been deemed lower priority because the NVFEL can and does test HD SI vehicles, which represent more than 90% of the highway HD SI production and because the HD SI sector is a smaller contributor to overall pollution than the HD CI sector. Additionally, the EPA says it can use other compliance testing tools, such as PEMS screening, and contract laboratories to conduct compliance testing of HD SI engines.	The EPA's lack of in-house SI engine dynamometer compliance testing capacity may decrease the likelihood of detecting noncompliance in the HD SI sector. While HD CI engines comprise the majority of HD production volume and emissions, some external experts expect to see an increase in HD SI production volumes to comply with tighter NOx standards. Additionally, because there are no in-use testing requirements for the HD SI sector, EPA testing is the only avenue for the EPA to verify emission levels.

Source: OIG analysis and conclusions.

- During our audit, we also identified other issues that may require regulatory or other program changes beyond the implementation and oversight of existing regulations (Table 6). OTAQ is already aware of many of these issues. While we recognize that these changes involve substantial resource investment and management or political support, they could improve the overall efficacy of OTAQ's HD emission control program and help achieve the EPA's broader goal of protecting human health and the environment.

Table 6: Issues that may require regulatory changes

Condition	Cause	Effect
The average lifetime for HD CI engines operating in California is 800,000 miles. Actual useful life of on-road HD CI engines can be greater than 2 million miles; however, EPA regulations define HD CI engine useful life as up to 435,000 miles. Emission control after-treatment systems can deteriorate after regulatory useful life. Additionally, the Clean Air Act does not require HD sector state inspection/maintenance programs, which are required in the LD sector, that can help identify problems when vehicles operate past their regulatory useful life.	According to the EPA, the regulatory definition of "useful life" was determined based on discussions with industry and other stakeholders during the rulemaking process.	There is no incentive for users to maintain the emission control system since it diminishes CI engine performance. Additionally, the secondary user is not required to maintain the emission control system. The result is increased emissions from HD CI engines operating beyond their regulatory useful life.
The EPA's NTE standard for HD engines may not represent real-world operating conditions. According to the external experts we interviewed, manufacturers can program engine operations around NTE zone conditions. Furthermore, manufacturers can pass the NTE standards but still have high emissions in the non-NTE zone, which is where most operation occurs. According to the external experts, California Air Resources Board and EPA staff we interviewed, a "work-based window" standard (akin to the current European Union standard) would better reflect real-world operating conditions. Unlike the current NTE standard, which is based on the length of time driving, this method is based on the amount of work performed by the engine. Since 2004, the EPA has recognized the limitations of the NTE standard and has considered revising the NTE standard so that it captures more transient operating conditions.	The original NTE standard was developed in 2000. It improved laboratory testing by expanding the range of operating conditions tested via on-road PEMS testing. It was tailored to the measuring capabilities of the PEMS units available at the time the standard was developed. Some technical adjustments were made to the NTE standard in 2010 (*Revisions to In-Use Testing for Heavy-Duty Diesel Engines and Vehicles; Emissions Measurement and Instrumentation; Not-to-Exceed Emission Standards; and Technical Amendments for Off-Highway Engines*, 75 Federal Register 68448, November 8, 2010). During our audit, the EPA expressed concerns that there are still technical limitations with the work-based window approach.	Outdated definitions (e.g., useful life) or standards (e.g., NTE) may increase the likelihood that real-world conditions are not adequately accounted for in the regulations, thus increasing the gap between actual operating conditions and regulatory test emissions. This gap is likely to grow wider as manufacturers optimize vehicle/engine performance under regulatory test conditions. Studies—such as the International Council on Clean Transportation's "Impacts and mitigation of excess diesel-related NOx emissions in 11 major vehicle markets" published in *Nature* in May 2017—show that real-world HD emissions exceed regulatory limits.
For the HD SI sector, there is no manufacturer in-use testing requirement (i.e., NTE standard). This element of the compliance program is only available for the HD CI sector. Defect and recall reporting requirements still pertain to the HD SI sector.	According to the EPA staff we interviewed, the HD SI sector does not have in-use testing requirements because the sector was not prioritized, given that it has a smaller in-use population and is a smaller contributor to air pollution than the HD CI sector.	The EPA's lack of in-house HD SI confirmatory testing capacity (see risk described above in Table 5) and the lack of an HD SI manufacturer in-use testing requirement decrease the likelihood of detecting noncompliance. While HD CI engines comprise the majority of HD production volume and emissions, some external experts expect to see an increase in HD SI production volumes to comply with tighter NOx standards, which may provide more justification for developing HD SI testing capacity and in-use requirements.

Condition	Cause	Effect
Unlike other regulatory bodies such as the European Union, the EPA currently uses a mass-based standard for regulating particulate matter via its mobile source emission standards. External experts we interviewed believe a particle number standard is superior to a particle mass standard. According to the EPA's Office of Air Quality Planning and Standards (the office that establishes national ambient air quality standards), particle number is most highly concentrated in the ultrafine size range, but mass is most concentrated in the larger size ranges. Particle number takes into account particle size; characterizing particle size is important because different size particles penetrate to different regions of the human respiratory tract.	Mass-based particulate matter standards have been the norm for regulatory bodies because measuring techniques were designed for measuring mass rather than particle number. Advances in measurement techniques allow particulate matter to be measured via particle number with greater accuracy. However, the EPA said that measurement limitations still exist that prevent particle count methods from being used for compliance purposes. Furthermore, the EPA noted that currently available evidence is still too limited to provide support for consideration of a national ambient air quality standard that is based on particle number as distinct from particle mass. The EPA will reevaluate the evidence during its review of the air quality standard-setting process.	As measurement technology advances, a particle number standard could enable the EPA to regulate particulate matter more accurately based on health impacts. According to the EPA, while evidence "suggests that the ability of particles to enhance allergic sensitization is associated more strongly with particle number and surface area than with particle mass," the association is still too limited to support a particle number standard (*Policy Assessment for the Review of the Particulate Matter National Ambient Air Quality Standards*, EPA 452/R-11-003, issued April 2011). Particle number emissions from motor vehicles are predominantly in the ultrafine size range.

Source: OIG analysis and conclusions.

Risk Assessment Conclusion

OTAQ's on-road HD vehicle and engine compliance program demonstrated effective controls related to the four risk assessment principles outlined in Table 4. The EPA has demonstrated a history of responding to significant issues that could impact its internal control system. We did find that the EPA lacks a formalized risk assessment (i.e., one that is documented, systematic, and updated on a scheduled and periodic basis). Per the GAO's internal control standards, risk assessment provides the basis for developing appropriate risk responses. A formal risk assessment would help the EPA be more proactive in responding to risks and increase the probability that OTAQ will address broader strategic risks.

We also identified several specific risks for OTAQ to evaluate as part of its risk assessment (Table 5), as well as issues that would require regulatory or program changes but should still be evaluated in the context of a risk assessment (Table 6). The EPA is aware of and has informally analyzed many of the risks and issues we identified; however, we included them in this report (a) because we have independently confirmed that they exist and (b) to highlight that they should be evaluated as part of a formal, documented risk assessment and the EPA's annual regulatory agenda development process.

Risk Assessment Recommendations

We recommend that the Assistant Administrator for Air and Radiation:

2. Conduct and document a risk assessment for the on-road heavy-duty vehicle and engine compliance program that prioritizes risk and links specific

control activities to specific risks. Update the risk assessment on a scheduled and periodic basis.

3. Address the following risks as part of the on-road heavy-duty vehicle and engine compliance program risk assessment, in addition to other risks that the EPA identifies:

    a. Non-criteria pollutants not being measured.
    b. Level of heavy-duty sector testing throughout the compliance life cycle.
    c. Marketplace ambiguity over regulatory treatment of rebuilt versus remanufactured engines.
    d. Different compliance challenges for heavy-duty compression-ignition and spark-ignition engines.
    e. Lack of laboratory test cell and in-house testing capacity for heavy-duty spark-ignition engines.

4. Evaluate the following issues, which may require regulatory or programmatic action, as part of (1) the on-road heavy-duty vehicle and engine emission control program risk assessment and (2) the EPA's annual regulatory agenda development process:

    a. Regulatory definition of on-road heavy-duty engine useful life may not reflect actual useful life.
    b. Not-to-Exceed standard may not reflect real-world operating conditions, especially for certain applications.
    c. In-use testing requirements for heavy-duty spark-ignition engines may be needed.
    d. A particle number standard may more accurately control particulate matter emissions that impact human health.

Control Activities

Internal control activities are the policies, procedures, techniques and mechanisms that help mitigate risks identified during the risk assessment process. They are essential to facilitate proper stewardship of and accountability for government resources and to achieve effective, efficient program results. Table 7 highlights the principles under this component.

Table 7: Control activities principles

	Principle
1.	Management should design control activities to achieve objectives and respond to risks.
2.	Management should design the entity's information system and related control activities to achieve objectives and respond to risks.
3.	Management should implement control activities through policies.

Source: OIG analysis of GAO internal control standards.

The factors that support the OIG's evaluation of this component include:

- OTAQ has control activities designed to achieve objectives and respond to risks, including policies and procedures that detail testing methodologies and audits to assess the control system. For example, OTAQ has control activities that address risks such as measurement uncertainty, nonconforming work, inefficient use of lab resources, poor quality test data and deviations to test processes.

- To maintain its ISO/IEC 17025:2005 certification, the EPA must follow strict processes and procedures. OTAQ has a Quality Services Team focused on quality control to confirm that these processes and procedures are followed. The team also helps the EPA achieve regulatory compliance, performs quality assurance project plan scope reviews, and performs quality process reviews for ISO considerations.

- EV-CIS collects data to allow analysis and management of the certification process and in-use compliance through documentation, tracking and reports.

- OTAQ designed its information system and related control activities to achieve its objectives of detecting noncompliance and responding to risks. For example, our analysis of EV-CIS confirmed that system access is controlled, workflow is managed and delegated based on user role, testing and compliance/certification decisions are tracked, and risk is factored into the EPA's decision-making.

- OTAQ sufficiently implements control activities through policies. For example, TATD's detailed quality management system sets forth the quality control policy and structure, which demonstrates OTAQ's policy to improve the effectiveness of technical operations.

- We did not identify any automated tools or reports that exist for the on-road HD sector. However, according to the EPA, the HD CI sector module in EV-CIS has more robust business rules than the modules for the other mobile source sectors because it was developed more recently. The EPA said these business rules, which govern how manufacturers enter data into EV-CIS, serve a similar purpose as automated tools or reports.

Control Activities Conclusion

OTAQ's on-road HD vehicle and engine compliance program demonstrated effective controls related to the three control activities principles outlined in

Table 7. However, we identified two ways that OTAQ's controls can be improved for this component:

- **Data analysis tools.** While the HD CI module in EV-CIS uses complex business rules, additional development of automated tools or reports may allow the on-road HD vehicle and engine compliance program to more fully use EV-CIS. Automated tools that have been developed for other sectors have saved the EPA time in reviewing COC applications. Using EV-CIS to better analyze and automate data reviews allows the EPA to more efficiently use resources and detect potential problems with COC applications or in-use compliance issues.

- **Targeted testing.** The test procedures for the manufacturer in-use program are prescribed in regulation. However, EPA regulations allow the agency to seek targeted information from manufacturers on a case-by-case basis, as well as encourage manufacturers to conduct testing beyond the prescribed in-use testing. This combination of potential discretion and targeted, nonstandard manufacturer-conducted testing may present an opportunity to reduce manufacturer burden while also identifying compliance issues currently undetected by existing testing methods.

Control Activities Recommendations

We recommend that the Assistant Administrator for Air and Radiation:

5. Conduct and document an assessment of the feasibility of developing data analysis tools specifically designed for on-road heavy-duty vehicle and engine regulations to better use data collected through the EPA's Engine and Vehicle Compliance Information System and to improve identification of potential compliance issues.

6. Conduct and document an evaluation of opportunities to reassess the manufacturer in-use testing program, including the use of targeted, nonstandard testing in areas of concern.

Information and Communication

For an agency to execute and control its operations, it must have relevant, reliable information relating to external and internal events. The information should be recorded and communicated to management and other agency stakeholders in a form and within a time frame that enables them to carry out their internal control and operational responsibilities. Table 8 highlights the principles under this component.

Table 8: Information and communication principles

	Principle
1.	Management should use quality information to achieve the entity's objectives.
2.	Management should internally communicate the necessary quality information to achieve the entity's objectives.
3.	Management should externally communicate the necessary quality information to achieve the entity's objectives.

Source: OIG analysis of GAO internal control standards.

The factors that support the OIG's evaluation of this component include:

- TATD has policies, procedures and a quality management system in place to provide quality information to CD and other stakeholders for use in compliance determinations, enforcement and other regulatory purposes. The NVFEL holds an ISO/IEC 17025:2005 certification, providing third-party confirmation that TATD's quality management system is effective.

- TATD tracks laboratory activity metrics, including types of testing and quality metrics. Quality metrics track the number of audits conducted, as well as nonconforming work and opportunities for improvement that were found by the audits. In fiscal year 2017, approximately 10 percent of all HD engine tests were audited.

- EV-CIS collects key compliance data and workflow information that enable management to oversee the certification process and analyze in-use compliance data.

- OTAQ internally communicates the quality information needed to achieve objectives, including management reports, audit reports, tracking spreadsheets and summary information.

- Our analysis of CD's compliance issue referrals to OECA demonstrated communication across the two offices.

- The EPA provides guidance to manufacturers on how to comply with its regulations, policies and procedures. As conditions and regulations change, the EPA develops guidance and advisory circulars to assist the regulated community. Manufacturers that we interviewed were generally satisfied with the EPA's responsiveness to their questions and concerns.

- OTAQ has various channels to receive external communications and feedback, including public email addresses listed on OTAQ's website.

- When we first began this audit in 2017, the HD compliance program's level of coordination with OECA varied. However, this condition has improved during the course of our audit. For example, the HD SI group has weekly meetings with OECA, and the HD CI group has a monthly meeting with OECA, as well as a staff member who directly supports OECA investigations.

- According to the EPA, while data from portable activity measurement systems,[22] remote sensing and other sources are sometimes used to inform EPA testing, significant resources are required to evaluate the data's quality and suitability to identify high-emitting vehicles. Therefore, OTAQ's use of this information is mostly ad hoc. HD diesel vehicles have more sensors than LD gasoline vehicles, enabling more data to be collected from onboard vehicle computers. As of March 2019, OTAQ has implemented regular and documented information sharing protocols so that all data available from external sources are routinely shared and discussed. In addition, OTAQ provided us with documentation showing that it regularly holds meetings to share and discuss external data, with the goal of using these data in both risk assessment and ongoing compliance oversight. Detailed agendas for the first four meetings—which included both HD and LD vehicle and non-road emission data sources and activities—were also provided to us.

- At the certification stage, the EPA and California Air Resources Board discuss HD test orders sent to manufacturers. The EPA provided documentation of regular collaboration between the two agencies regarding broader HD compliance issues and in-use testing.

- OTAQ tracks compliance issues, such as certification and in-use issues, as well as referrals to OECA; however, tracking is done ad hoc through meetings, notes and emails. In some cases, OTAQ requests that manufacturers self-report to OECA the certification or other issues identified by OTAQ. If a manufacturer does not self-report, OTAQ said that this omission will be discovered when it meets with the manufacturer to review the new certification application. During the course of our audit, OTAQ took steps to improve its tracking process. In May 2018, OTAQ provided us with evidence of more standardized tracking of compliance issues in the HD SI sector.

- OTAQ does not have standard procedures in place to transfer compliance issues to OECA; rather, staff and managers make a judgment call regarding what constitutes a reportable compliance issue to OECA. According to some staff we interviewed, it is not always clear what should be reported.

[22] Portable activity measurement systems are small data loggers that interface with onboard vehicle computers to gather detailed activity and engine parameters during real-world operations.

Information and Communication Conclusion

OTAQ's on-road HD vehicle and engine compliance program demonstrated effective controls related to the three information and communication principles outlined in Table 8. We identified two ways that OTAQ's information and communication controls could be improved to enhance effectiveness:

- **Tracking of compliance issues.** OTAQ may not be tracking compliance issues and referrals to OECA in a standardized way because some mobile source sectors have very few compliance issues or referrals to OECA, which can be easily tracked informally. However, standardized tracking would (1) provide OTAQ knowledge about whether and how compliance issues are resolved; (2) make it easier to rank the relative impact of compliance issues, which would help OTAQ and OECA decide how to prioritize issues; (3) document successful methods for detecting potential noncompliance; and (4) make it easier to detect trends. *Note:* In May 2018, OTAQ provided us with evidence of more standardized tracking of compliance issues in the HD SI sector.

- **Triggers for reporting compliance issues to OECA.** According to the EPA staff we interviewed, there are no formal procedures to transfer information about compliance issues and potential enforcement cases to OECA. The EPA said that OTAQ and OECA share this information through regular meetings and emails, and they examine the case-specific facts of any given situation to determine whether enforcement action is appropriate. According to the EPA, it is difficult to craft guidelines on what to report because (1) the merits of addressing a concern through administrative authority versus enforcement authority are not always clear and (2) the information needed to build a case most often emerges over time. Based on our interviews, we also concluded that OTAQ has more incentive to work with manufacturers to expeditiously correct issues rather than report issues to OECA, where enforcement actions may take longer to resolve given OECA's workload and the administrative burden of pursuing enforcement actions. Procedures for transmitting potential compliance issues to OECA could help assure that compliance issues are being consistently reported and appropriately transmitted to OECA for follow-up and tracking.

Information and Communication Recommendations

We recommend that the Assistant Administrator for Air and Radiation:

7. Track and document in a standardized manner on-road heavy-duty vehicle and engine compliance issues, as well as referrals to the EPA's Office of Enforcement and Compliance Assurance, including how issues were

identified, the current status of these issues and any enforcement actions taken.

8. Develop and implement procedures for communicating potential compliance issues to the EPA's Office of Enforcement and Compliance Assurance.

    a. Establish clear criteria for when compliance issues should be referred to the EPA's Office of Enforcement and Compliance Assurance.

Monitoring

Internal control monitoring should assess the quality of performance over time and promptly resolve findings of audits and other reviews. Table 9 highlights the principles under this component.

Table 9: Monitoring principles

	Principle
1.	Management should establish and operate monitoring activities to monitor the internal control system and evaluate the results.
2.	Management should remediate identified internal control deficiencies on a timely basis.

Source: OIG analysis of GAO internal control standards.

The factors that support the OIG's evaluation of this component include:

- OTAQ internal control monitoring activities include the use of management reports; internal and external audits; and policies and procedures that guide management review, quality assurance and control processes.

- OTAQ has controls in place to identify internal control deficiencies on a timely basis, including processes for identifying and tracking audit findings, customer service feedback, and opportunities for improvement and preventive actions.

- Internal and external audit reports identify strengths, opportunities, weaknesses and threats/risks. The audit reports are used to monitor the NVFEL's internal controls and evaluate the results. To maintain ISO/IEC certification, OTAQ's Quality Services Team focuses on quality control and enhancing the overall quality of laboratory testing, which includes managing a Concern Identification and Resolution Database comprising issues identified by staff or through audits.

- OTAQ's policies on concern identification and resolution are being implemented via a database. The Concern Identification and Resolution

Database tracks relevant information such as concern description, root cause analysis for corrective actions, action or correction taken, Quality Service Team follow-up and/or verification performed, and status update information. Concerns and audit findings are identified, and resolution is tracked.

- To monitor compliance testing quality, TATD has quality metrics for HD vehicle and engine testing that track the number of audits conducted, as well as any nonconforming work and opportunities for improvement that were found as a result of the audits.

- Staff interviewed feel comfortable reporting compliance issues and internal control deficiencies to management.

Monitoring Conclusion

OTAQ's on-road HD vehicle and engine compliance program demonstrated effective controls related to the two monitoring component principles outlined in Table 9. We do not have any recommendations related to the monitoring control component.

Overall Conclusion

OTAQ demonstrated that the existing controls for its on-road HD vehicle and engine compliance program are effective and operate in an integrated manner to detect and prevent noncompliance—a precursor to potential fraud. While the EPA demonstrated effective internal controls, we identified areas where controls can be improved. These improvements will help the EPA better address risks, assure compliance with mobile source regulations, and achieve its broader goal of protecting human health and the environment.

Agency Response and OIG Evaluation

The agency concurred with all recommendations and provided acceptable planned corrective actions.

Six recommendations (1, 2, 3, 4, 6 and 8) are considered resolved with corrective actions pending. The agency suggested some modifications to improve the clarity of Recommendation 6, which we accepted.

Two recommendations are completed. In April 2019, the agency completed the corrective actions for Recommendations 5 and 7. For Recommendation 5, the EPA provided us with documentation that it conducted a feasibility assessment for developing automated data analysis tools for on-road HD vehicle and engine regulations. The EPA noted that EV-CIS is a workflow system with hundreds of business rules and, therefore, is an automated tool. The agency's assessment concluded that additional automated tools are not needed. The EPA also noted that the Diesel and Gasoline Engine Compliance centers continually work with CD's Data, Analysis, and Information Center. For Recommendation 7, the EPA provided us with documentation of the tools it is using to track and document in a standardized manner on-road HD vehicle and engine compliance issues.

Appendix A provides the Office of Air and Radiation's response to the draft report. In addition, the Office of Air and Radiation provided specific suggestions for our consideration, and we applied edits as appropriate.

Status of Recommendations and Potential Monetary Benefits

RECOMMENDATIONS

Rec. No.	Page No.	Subject	Status[1]	Action Official	Planned Completion Date	Potential Monetary Benefits (in $000s)
1	14	Define performance measures to assess the performance of the EPA's on-road heavy-duty vehicle and engine compliance program.	R	Assistant Administrator for Air and Radiation	9/30/22	
2	21	Conduct and document a risk assessment for the on-road heavy-duty vehicle and engine compliance program that prioritizes risk and links specific control activities to specific risks. Update the risk assessment on a scheduled and periodic basis.	R	Assistant Administrator for Air and Radiation	6/30/21	
3	22	Address the following risks as part of the on-road heavy-duty vehicle and engine compliance program risk assessment, in addition to other risks that the EPA identifies: a. Non-criteria pollutants not being measured. b. Level of heavy-duty sector testing throughout the compliance life cycle. c. Marketplace ambiguity over regulatory treatment of rebuilt versus remanufactured engines. d. Different compliance challenges for heavy-duty compression-ignition and spark-ignition engines. e. Lack of laboratory test cell and in-house testing capacity for heavy-duty spark-ignition engines.	R	Assistant Administrator for Air and Radiation	9/30/21	
4	22	Evaluate the following issues, which may require regulatory or programmatic action, as part of (1) the on-road heavy-duty vehicle and engine emission control program risk assessment and (2) the EPA's annual regulatory agenda development process: a. Regulatory definition of on-road heavy-duty engine useful life may not reflect actual useful life. b. Not-to-Exceed standard may not reflect real-world operating conditions, especially for certain applications. c. In-use testing requirements for heavy-duty spark-ignition engines may be needed. d. A particle number standard may more accurately control particulate matter emissions that impact human health.	R	Assistant Administrator for Air and Radiation	9/30/22	
5	24	Conduct and document an assessment of the feasibility of developing data analysis tools specifically designed for on-road heavy-duty vehicle and engine regulations to better use data collected through the EPA's Engine and Vehicle Compliance Information System and to improve identification of potential compliance issues.	C	Assistant Administrator for Air and Radiation	4/11/19	
6	24	Conduct and document an evaluation of opportunities to reassess the manufacturer in-use testing program, including the use of targeted, nonstandard testing in areas of concern.	R	Assistant Administrator for Air and Radiation	9/30/20	

RECOMMENDATIONS

Rec. No.	Page No.	Subject	Status[1]	Action Official	Planned Completion Date	Potential Monetary Benefits (in $000s)
7	27	Track and document in a standardized manner on-road heavy-duty vehicle and engine compliance issues, as well as referrals to the EPA's Office of Enforcement and Compliance Assurance, including how issues were identified, the current status of these issues and any enforcement actions taken.	C	Assistant Administrator for Air and Radiation	4/10/19	
8	28	Develop and implement procedures for communicating potential compliance issues to the EPA's Office of Enforcement and Compliance Assurance. a. Establish clear criteria for when compliance issues should be referred to the EPA's Office of Enforcement and Compliance Assurance.	R	Assistant Administrator for Air and Radiation	9/30/20	

[1] C = Corrective action completed.
R = Recommendation resolved with corrective action pending.
U = Recommendation unresolved with resolution efforts in progress.

Appendix A

Agency Response to Draft Report

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

MAR 2 2 2019

OFFICE OF
AIR AND RADIATION

MEMORANDUM

SUBJECT: Agency's Final Response to Office of Inspector General's report, *EPA Demonstrates Effective Controls for its On-Road Heavy-Duty Vehicle Compliance Program; Further Improvements Could Be Made (OPE-FY17-0026)*

FROM: William L. Wehrum
Assistant Administrator
Office of Air and Radiation

TO: Kevin Christensen
Assistant Inspector General
Office of Audit and Evaluation
Office of Inspector General

The EPA's Office of Air and Radiation (OAR) welcomes the opportunity to review and comment on the Office of Inspector General's (OIG) report titled *EPA Demonstrates Effective Controls for its On-Road Heavy-Duty Vehicle Compliance Program; Further Improvements Could Be Made* (Draft Report).

We were impressed with the OIG audit team's comprehensive investigation and are pleased that OIG has concluded that our current internal controls are effective at detecting and preventing noncompliance in the on-road heavy-duty vehicle sector. We were especially gratified by OIG's findings regarding "an organizational culture of integrity and ethical values" and "staff feel comfortable reporting compliance issues and internal control deficiencies to management." These are critical to enabling and enhancing program effectiveness. But we also firmly believe that the ability to improve and change is key to our continued efficacy. To that end we appreciate the recommendations for improvement OIG has offered and will work toward implementing all of them.

The Clean Air Act requires the U.S. Environmental Protection Agency (EPA) to establish and implement regulations to protect human health and the environment, including regulations to control emissions from cars, trucks, and other mobile sources of air pollution. EPA's Office of Transportation and Air Quality (OTAQ) within the OAR fulfills this responsibility for EPA by setting motor vehicle emission standards and by monitoring compliance with the requirements. OTAQ collaborates with EPA's Office of Enforcement and Compliance Assurance (OECA) in cases that involve potential violations of the law and OECA exercises enforcement authority on behalf of the Agency.

OTAQ evaluates compliance through oversight activity at all stages of the vehicle and engine lifecycle; that is, before, during, and after production. Before entering any vehicle or engine into commerce, manufacturers must obtain a certificate of conformity from EPA. The certificate documents are the Agency's determination that the vehicle/engine design is sufficiently robust to satisfy emission standards throughout its useful life. OTAQ checks compliance during production through audits and other measures to confirm that production vehicles and engines match the specifications set forth in the manufacturer's application for certification. OTAQ continues to monitor compliance years after vehicles and engines have entered service by testing privately-owned vehicles and by reviewing manufacturer reports and emissions test results. As the Draft Report explains, OTAQ designed and implements this comprehensive approach to achieve two primary objectives: to minimize pollution from heavy-duty vehicles and engines, and to ensure environmental standards are applied fairly across all manufacturers.

EPA heavy-duty (HD) highway sector emissions regulations cover both compression ignition (CI) and spark-ignition (SI) technology vehicles greater than 8,500 pounds Gross Vehicle Weight, and the engines that power those vehicles. These range from pick-up type trucks to urban buses to 18-wheelers. Since EPA began regulating heavy-duty vehicle emissions, OTAQ and OECA have developed strong and effective programs to detect and prevent noncompliance. Most often noncompliance by vehicle and engine manufacturers results from technical design flaws or misinterpretation of regulations. However, noncompliance can also be the result of purposeful manufacturer decisions. Notable noncompliance problems in the heavy-duty highway sector include a major defeat device case in the late 1990s, in which manufacturers designed electronic controls to maximize fuel economy at highways speeds, at the cost of allowing excessive nitrogen oxide emissions. A federal lawsuit resulted in a settlement with seven major manufacturers, who were ordered to pay more than $1 billion in penalties. More recently, EPA last year announced the largest-ever recall in the sector to correct a faulty emissions control system component in more than 500,000 trucks equipped with Cummins, Inc. engines.

One factor contributing to the efficacy of EPA's vehicle and engine emissions oversight is that OTAQ routinely updates and adapts its program to respond to new information, technology, and circumstances. It is necessary for the program to continuously evolve as new information becomes available. EPA updated its evaluation methods as new technical details emerged in the Cummins case, for example. As noted in the Draft Report, OTAQ updated its test procedures following the 1990s defeat device case to better represent real-world emissions. But emissions control technology and heavy-duty use patterns have changed since then, so OTAQ will again revisit these issues through a public process as part of EPA's Cleaner Truck Initiative (CTI) rulemaking that OTAQ is currently leading.

Consistent with our interest in continuously improving our program, OAR welcomes the observations and recommendations the OIG has provided in the Draft Report. OAR's responses to OIG's specific recommendations follow.

Recommendation 1: Define performance measures to assess the performance of the EPA's heavy-duty vehicle compliance program.

Response 1: OAR agrees with this recommendation. OAR currently uses in-use vehicle emissions testing data to track heavy-duty emissions compliance over time. OAR will develop additional performance measures to better monitor emissions compliance and program success.

Planned Completion Date: OAR will implement this recommendation in four phases over three years: 1) develop the performance measures by end of Q4, FY2020; 2) implement, gather data, and evaluate by the end of Q4, FY2021; 3) revise measures as informed by evaluation, then fully implement measures by the end of Q4, FY2022; and 4) use those measures to inform program management moving forward, ongoing.

Recommendation 2: Conduct and document a formal risk assessment for the EPA's heavy-duty vehicle compliance program that prioritizes risk and links specific control activities to specific risks. Update the risk assessment on a scheduled and periodic basis.

Response 2: OAR agrees with this recommendation. OAR currently conducts an informal risk assessment of its heavy-duty vehicle compliance program and started implementing and documenting a formal process for both light-and heavy-duty sectors in 2018 in response to OIG's recommendation for the light-duty program. OAR will continue to expand and formalize this process and will develop protocols for its implementation and documentation.

Planned Completion Date: OAR will complete this recommendation by the end of Q3, FY2021.

Recommendation 3: Address the following risks as part of the on-road heavy duty vehicle and engine compliance program risk assessment, in addition to other risks that the EPA identifies:

- Non-criteria pollutants not being measured.
- Level of heavy-duty sector testing throughout the compliance life cycle.
- Marketplace ambiguity over regulatory treatment of rebuilt versus remanufactured engines.
- Different compliance incentives for heavy-duty compression-ignition and spark-ignition engines.
- Lack of laboratory test cell and in-house testing capacity for heavy-duty spark-ignition engines.

Response 3: OAR agrees with this recommendation and will address each of these areas:

- *Non-criteria pollutants not being measured*

Response: Under the Clean Air Act, manufacturers are responsible for measuring and reporting emissions of nonregulated pollutants. OTAQ does not routinely measure non-criteria pollutants, but we will work to enhance manufacturer reporting by establishing a new document type in our Engine and Vehicle Compliance Information System (EV-CIS) to collect the manufacturer reports; updating our guidance to announce the new EV-CIS capacity and to remind manufacturers of their reporting obligation; and then reviewing and considering the reported information as part of our ongoing risk assessment process.
Planned Completion Date: End of Q4 2021.

- *Level of heavy-duty sector testing throughout the compliance life cycle*
  Response: OTAQ will continue to prioritize testing for all vehicle and engine sectors, including the HD highway sector, as resources allow. We will formally document and periodically reassess the level of testing as part of our periodic risk assessment.
  Planned Completion Date: End of Q3 2021.

- *Marketplace ambiguity over regulatory treatment of rebuilt versus remanufactured engines*
  Response: OTAQ believes the regulations are clear on this issue so we will engage stakeholders to improve understanding of nomenclature and expectations, and we will work to educate manufacturers about ambiguity resulting from their inappropriate use of terminology.
  Planned Completion Date: End of Q1 2021.

- *Different compliance challenges for heavy-duty compression-ignition and spark-ignition engines* **Response:** This recommendation concerns the technical differences between SI and CI engines, and the resulting different challenges and tradeoffs in controlling emissions for the two types of technology. We will formally document and periodically reassess concerns about different compliance incentives as part of our periodic risk assessment.
  Planned Completion Date: End of Q3 2021.

- *Lack of laboratory test cell and in-house testing capacity for heavy-duty spark-ignition engines* **Response:** Heavy-duty spark-ignition (HDSI) engines represent less than 4% of heavy-duty highway production. NVFEL is able to test all the other sectors and can use contract laboratories or portable emissions measurement systems to test HDSI engines if necessary. Therefore, investment in HDSI testing capacity has not been a priority to date. Going forward, we will formally document and periodically reassess decisions about investments in laboratory capacity as part of a periodic risk assessment.
  Planned Completion Date: End of Q3 2021.

Recommendation 4: Evaluate the following issues, which may require regulatory or programmatic action, as part of 1) the on-road heavy-duty vehicle and engines emissions control program risk assessment and 2) the EPA's annual regulatory agenda and development process:

- Regulatory definition of on-road heavy-duty engine useful life may not reflect actual useful life.
- Not-to-exceed standard may not reflect real-world operating conditions, especially for certain applications.

- In-use testing requirements for heavy-duty spark ignition engines may be needed.
- A particle number standard may more accurately control particulate matter emissions that impact human health.

Response 4: OAR agrees with this recommendation. We will consider the first three issues as part of the CTI rulemaking process. We will also commit to considering approaches to best control particulate matter emissions that affect public health and will continue to work toward improving ultrafine particulate matter measurement techniques.

Planned Completion Date: OAR will issue Notice of Proposed Rulemaking that addresses the first three components by the end of Q4 2020. The particulate matter measurement assessment work is ongoing, but OAR will collaborate with the Office of Research and Development to address this issue as one of the research priorities listed for assessment by the end of Q4 2022.

Recommendation 5: Conduct and document an assessment of the feasibility of developing data analysis tools specifically designed for on-road heavy-duty vehicle and engine regulations to better use data collected through EV-CIS and to improve identification of potential compliance issues.

Response 5: OAR agrees with this recommendation. OTAQ designed the heavy-duty modules in EV-CIS with sophisticated business rules and other features to streamline processing of HD highway certification and compliance information. OTAQ's assessment concluded that automated tools are not needed for this sector at this time.

Planned Completion Date: Complete. OAR will continue to evaluate opportunities for new data tools that improve EV-CIS functionality.

Recommendation 6: Conduct and document an evaluation of opportunities to engage manufacturers in performing more targeted, nonstandard testing in areas of concern.

Response 6: OAR agrees with this recommendation. OTAQ will address this issue through the CTI rulemaking process.

Planned Completion Date: OAR will issue a Notice of Proposed Rulemaking that addresses this issue by end of Q4 2020.

Recommendation 7: Track and document in a standardized manner on-road heavy-duty vehicle and engine compliance issues, as well as referrals to OECA, including how issues were identified, the current status of these issues and any enforcement actions taken.

Response 7: OAR agrees with this recommendation and implemented a tracking and documentation system in response to a similar recommendation for the light-duty program.

Planned Completion Date: Complete.

Recommendation 8: Develop and implement procedures for communicating potential compliance issues to OECA. Establish clear criteria for when compliance issues should be referred to OECA.

Response 8: OAR agrees with this recommendation and already does this informally. We will coordinate with OECA to formalize and better document the process.

Planned Completion Date: End of Q4 2020.

*   *   *

Again, we appreciate the thoroughness of the OIG review of the Heavy-Duty Vehicle Compliance program, and the recommendations to continuously improve our efforts in this important part of our clean air program.

If you have any questions regarding this response, please contact Byron Bunker, Director, Compliance Division, Office of Transportation and Air Quality, at (734) 214-4155.

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