ENVIRONMENTAL PROTECTION AGENCY

40 CFR Parts 86, 1036, 1037, 1039, 1065, and 1071

[EPA–HQ–OAR–2026–0728; FRL 12756–01–OAR]

RIN 2060–AW83

Amendments and Nonconformance Penalties for Model Year 2027 and Later Heavy-Duty Highway Engines and Amendments to Inducement Provisions for SCR-Equipped Diesel Engines

AGENCY: Environmental Protection Agency (EPA).

ACTION: Proposed rule.

SUMMARY: The U.S. Environmental Protection Agency (EPA) is proposing regulatory amendments to certain compliance provisions and test procedures related to model year (MY) 2027 and later heavy-duty highway engines. These amendments would include changes to the regulatory useful life periods and the emission-related warranty periods. The EPA also proposes to add clarity to certain regulatory compliance provisions and correct errors in the regulations to support the MYs 2027 and later program for heavy-duty highway engines and vehicles. This includes certain amendments related to provisions adopted in January 2023 as well as other provisions adopted in earlier rules. The EPA also proposes to make nonconformance penalties (NCPs) available to manufacturers of medium heavy-duty engines (Medium HDE) and heavy heavy-duty engines (Heavy HDE) beginning in MY 2027. In addition, the EPA proposes to amend the requirements for selective catalytic reduction (SCR) system inducement provisions for newly manufactured diesel-fueled highway engines and vehicles (*i.e.,* light- and medium-duty vehicles and heavy-duty engines) and nonroad engines and equipment. The EPA is also considering new inducement guidance for in-use highway and nonroad diesel engines, vehicles, and equipment.

DATES: Comments. Comments must be received on or before August 29, 2026. Comments on the information collection provisions submitted to the Office of Management and Budget (OMB) under the Paperwork Reduction Act (PRA) are best assured of consideration by OMB if OMB receives a copy of your comments on or before August 13, 2026.

Public hearing: The EPA will hold virtual public hearings on July 29, 2026, starting at 9:00 a.m. Eastern Time and on July 30, 2026, starting at 10:00 a.m. Eastern Time. If there is sufficient interest, an additional day of hearings will be held on the subsequent day. Please refer to the **SUPPLEMENTARY INFORMATION** section for additional information on the public hearing. Information on the status of the hearing and how to register can be found at *https://www.epa.gov/regulations-emissions-vehicles-and-engines/proposed-rule-amendments-and-nonconformance-penalties.*

ADDRESSES: You may send comments, identified by Docket ID No. EPA–HQ–OAR–2026–0728, by any of the following methods:

- *Federal eRulemaking Portal: www.regulations.gov* (our preferred method). Follow the online instructions for submitting comments.
- *Email: a-and-r-Docket@epa.gov.* Include Docket ID No. EPA–HQ–OAR–2026–0728 in the subject line of the message.
- *Mail:* U.S. Environmental Protection Agency, EPA Docket Center, OAR Docket EPA–HQ–OAR–2026–0728, Mail Code 28221T, 1200 Pennsylvania Avenue NW, Washington, DC 20460.
- *Hand Delivery or Courier:* EPA Docket Center, WJC West Building, Room 3334, 1301 Constitution Avenue NW, Washington, DC 20004. The Docket Center's hours of operation are 8:30 a.m.–4:30 p.m., Monday–Friday (except Federal holidays).

Instructions: All submissions received must include the Docket ID No. for this rulemaking. Comments received may be posted without change to *www.regulations.gov,* including personal information provided. For detailed instructions on sending comments and additional information on the rulemaking process, see the ''Public Participation'' heading of the **SUPPLEMENTARY INFORMATION** section of this document.

FOR FURTHER INFORMATION CONTACT: For information about this proposed rule, contact James Sanchez, Transportation Sector Impacts & Standards Division, Office of Transportation and Air Quality, Environmental Protection Agency, 2000 Traverwood Drive, Ann Arbor, MI 48105; telephone number: (734) 214–4439; email address: *Sanchez.James@epa.gov.*

SUPPLEMENTARY INFORMATION:

Public Participation

A. Written Comments

Submit your comments, identified by Docket ID No. EPA–HQ–OAR–2026–0728, at *www.regulations.gov* (our preferred method), or the other methods identified in the **ADDRESSES** section. Once submitted, comments cannot be edited or removed from the docket. The EPA may publish any comment received to the Agency's public docket. Do not submit to the EPA's docket at *www.regulations.gov* any information you consider to be Confidential Business Information (CBI), Proprietary Business Information (PBI), or other information the disclosure of which is restricted by statute. If you choose to submit CBI or PBI as a comment to the EPA's docket, please send those materials to the person listed in the **FOR FURTHER INFORMATION CONTACT** section. Multimedia submissions (audio, video, etc.) must be accompanied by a written comment. The written comment is considered the official comment and should include discussion of all points you wish to make. The EPA will generally not consider comments or comment contents located outside of the primary submission (*i.e.,* on the web, cloud, or other file sharing system). Please visit *www.epa.gov/dockets/commenting-epa-dockets* for additional submission methods; the full EPA public comment policy; information about CBI, PBI, or multimedia submissions; and general guidance on making effective comments.

B. Participation in Virtual Hearing

The EPA will announce detailed information about the hearing as described in **ADDRESSES**. The EPA will begin pre-registering speakers for the hearing upon publication of this document in the **Federal Register**. To register to speak at the virtual hearing, please send an email to *EPA-HD-MobileSource-Hearings@epa.gov.* If you need additional help, contact the person listed in the **FOR FURTHER INFORMATION CONTACT** section.

Registration will be open through the last day of the hearing; however, the EPA asks that you pre-register by July 22, 2026 if you intend to testify or are requesting special accommodations such as the services of an interpreter or audio description, please pre-register for the hearing and describe your needs by July 22, 2026. The EPA may not be able to arrange accommodations without advance notice.

The EPA will provide a general agenda for the hearing listing the pre-registered speakers in approximate order at *https://www.epa.gov/regulations-emissions-vehicles-and-engines/proposed-rule-amendments-and-nonconformance-penalties* before the first day of the hearing. The EPA will make every effort to follow the schedule as closely as possible on the day of the hearing; however, please plan

for the hearings to run either ahead of schedule or behind schedule. Registration will be open through the last day of the hearing and the EPA will make every effort to accommodate all speakers who join the hearing, although preferences on speaking times may not be able to be fulfilled, and special accommodations may not be available.

Each commenter will have up to three minutes to provide oral testimony, though the final time limit may change and will be provided to registered speakers before the first day of the hearing. The EPA may ask clarifying questions during the oral presentations but will not respond to the presentations at that time. Written statements and supporting information submitted during the comment period will be considered with the same weight as oral comments and supporting information presented at the public hearing.

Please note that any updates made to any aspect of the hearing are posted online at *https://www.epa.gov/regulations-emissions-vehicles-and-engines/proposed-rule-amendments-and-nonconformance-penalties.* While the EPA expects the hearing to go forward as set forth above, please monitor the Agency's website to determine if there are any updates. The EPA does not intend to publish a document in the **Federal Register** announcing updates.

C. Public Access to Voluntary Consensus Standards

Copies of ASTM standards identified in section III.E of this preamble may be obtained from ASTM International, 100 Barr Harbor Dr., P.O. Box C700, West Conshohocken, PA 19428–2959, by calling (877) 909–ASTM, or at *www.astm.org.* Copies of these standards have also been placed in the rulemaking docket for this action. For the latest status information on EPA Docket Center Reading Room services and docket access, visit *www.epa.gov/dockets/epa-docket-center-reading-room* or call (202) 566–1744. If you have a disability and the format of any of these materials interferes with your ability to access the information, please contact the EPA's Rehabilitation Act Section 508 (29 U.S.C. 794d) Program at *www.epa.gov/accessibility/forms/contact-us-about-section-508-accessibility* or via email at *section508@epa.gov.* To enable the EPA to respond in a manner most helpful to you, please indicate the nature of the accessibility issue, the web address of the requested material, your preferred format in which you want to receive the material (electronic format (ASCII, etc.), standard print, large print, etc.), and your contact information.

D. Docket

All documents in the docket are listed on the *www.regulations.gov* website. A plain language summary of the rule is also available on the *www.regulations.gov* website. Although listed in the index, some information is not publicly available, *e.g.,* CBI or other information the disclosure of which is restricted by statute. Certain other material, such as copyrighted material, is not placed on the internet and will be publicly available only in hard copy form through the EPA Docket Center at the location listed in the **ADDRESSES** section of this document.

General Information

Does this action apply to me?

This action relates to companies that manufacture, sell, or import into the United States motor vehicles, motor vehicle engines, and nonroad engines and equipment. Potentially affected categories and entities include the following:

NAICS codes [a]	Sector title
333618	Other Engine Equipment Manufacturing.
336110	Automobile and Light Duty Motor Vehicle Manufacturing.
336120	Heavy Duty Truck Manufacturing.
336310	Motor Vehicle Gasoline Engine and Engine Parts Manufacturing.
336390	Other Motor Vehicle Parts Manufacturing.
336999	All Other Transportation Equipment Manufacturing.
333111	Farm Machinery and Equipment Manufacturing.
333120	Construction Equipment Manufacturing.

[a] NAICS Association. NAICS & SIC Identification Tools. *www.naics.com/search.*

This table is not intended to be exhaustive but rather provides a guide for readers regarding entities potentially affected by this action. This table lists the types of entities that the EPA is aware could potentially be affected by this action. Other types of entities not listed in the table could also be affected. To determine whether your entity is regulated by this action, you should carefully examine the applicability criteria found in the regulation. If you have questions regarding the applicability of this action to a particular entity, consult the person listed in the **FOR FURTHER INFORMATION CONTACT** section.

What action is the Agency taking?

The EPA is proposing regulatory amendments to compliance provisions and test procedures related to the Agency's 2023 rule setting criteria pollutant emission standards for MYs 2027 and later heavy-duty highway engines. These amendments are intended to add clarity to the regulatory compliance provisions and correct errors in the regulations.

What is the Agency's authority for taking this action?

Statutory authority for this proposed action comes from the Clean Air Act (CAA) (42 U.S.C. 7401–7671q).

List of Acronyms

Acronym	Description
AAF	Annual Adjustment Factor
ABT	Averaging, Banking, and Trading
AECD	Auxiliary Emissions Control Device
ANSI	American National Standards Institute
ASTM	ASTM International
ATA	American Trucking Associations
CAA	Clean Air Act
CARB	California Air Resources Board
CCR	California Code of Regulations
CFR	Code of Federal Regulations
CNG	Compressed Natural Gas
CD	Charge Depleting
CO	Carbon Monoxide
COC	Cost of Compliance
CS	Charge Sustaining
DEF	Diesel Exhaust Fluid
DPF	Diesel Particulate Filter
DRIA	Draft Regulatory Impact Analysis
DTSD	Draft Technical Support Document
EMA	Truck & Engine Manufacturers Association
EGR	Exhaust Gas Recirculation
EPA	Environmental Protection Agency
FEL	Family Emission Limit
FR	Federal Register
FTP	Federal Test Procedure
GVWR	Gross Vehicle Weight Rating
HC	Hydrocarbons
HD	Heavy-Duty
HDE	Heavy-Duty Engine
ICP–MS	Inductively Coupled Plasma Mass Spectrometer

Acronym	Description
ISO	International Organization for Standardization
LLC	Low Load Cycle
MC	Marginal Cost
MIL	Malfunction Indicator Light
MOVES	MOtor Vehicle Emission Simulator
MY	Model Year
NCP	Nonconformance Penalty
NG	Natural Gas
NMHC	Nonmethane Hydrocarbon
NO_X	Oxides of Nitrogen
NPRM	Notice of Proposed Rulemaking
NTTAA	National Technology Transfer and Advancement Act
OBD	Onboard Diagnostics
OEM	Original Equipment Manufacturer
OMB	Office of Management and Budget
PCA	Production Compliance Audit
PM	Particulate Matter
PR	Penalty Rate
PRA	Paperwork Reduction Act
RESS	Rechargeable Energy Storage System
RFA	Regulatory Flexibility Act
RIA	Regulatory Impact Analysis
RPE	Retail Price Equivalent
SAE	SAE International
SCR	Selective Catalytic Reduction
SET	Supplemental Emission Test
SO_2	Sulfur Dioxide
SVOC	Semi-Volatile Organic Compounds
THC	Total Hydrocarbon Emissions
TSD	Technical Support Document
UL	Upper Limit
ULSD	Ultra Low Sulfur Diesel
UMRA	Unfunded Mandates Reform Act
UQS	Urea Quality Sensor
VOC	Volatile Organic Compounds

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I. Executive Summary

A. Introduction

In this action, the EPA proposes regulatory amendments to certain compliance provisions and test procedures related to MYs 2027 and later heavy-duty highway engines. These amendments would include changes to the regulatory useful life periods and the emission-related warranty periods. The EPA also proposes to add clarity to certain regulatory compliance provisions and correct errors in the regulations to support the MYs 2027 and later program for heavy-duty highway engines and vehicles. This includes certain amendments related to provisions adopted in January 2023 and other provisions adopted in earlier rules. The EPA also proposes to make NCPs available to manufacturers of Medium HDE and Heavy HDE beginning in MY 2027. In addition, the EPA proposes to amend the requirements for SCR system inducement provisions for newly manufactured diesel-fueled highway engines and vehicles and nonroad engines and equipment.[1] The EPA is also considering new inducement guidance for in-use highway and nonroad diesel engines, vehicles, and equipment.

B. Need for Regulatory Action

In January 2023, the EPA issued a final rule titled ''Control of Air Pollution from New Motor Vehicles: Heavy-Duty Engine and Vehicle Standards'' (the ''2023 Final Rule'').[2] The 2023 Final Rule included new, more stringent emission standards for oxides of nitrogen (NO_X), particulate matter (PM), hydrocarbons (HC), and carbon monoxide (CO) for MY 2027s and later heavy-duty engines.[3] The 2023 Final Rule also changed key provisions of the existing heavy-duty engine emissions control program, including test procedures, regulatory useful life, emission-related warranty, and other requirements. Additionally, the 2023 Final Rule included changes to maintenance and serviceability, including newly codified SCR inducement provisions.

Immediately upon taking office, President Trump established new Executive Branch priorities for energy, transportation, and consumer choice and committed to ensuring regulations remain within constitutional and statutory bounds. On March 12, 2025, the EPA Administrator announced that the Agency would reevaluate the 2023 Final Rule as part of the deregulatory actions the Agency would undertake.[4] Following this announcement, the EPA heard concerns from truck and engine manufacturers, the component supply industry, as well as truck users, trucking fleets, and truck dealerships, about the expected cost increases associated with the 2023 Final Rule's changes to the emission-related warranty and regulatory useful life periods (the Agency also received comments from a number of these stakeholders raising concerns with the potential high costs

[1] Throughout this preamble, the term ''inducements'' refers to SCR-related strategies to induce operators to maintain appropriate levels of high-quality DEF and not tamper with SCR systems. Engine derating and vehicle speed restrictions have historically been applied as the primary inducement for SCR systems. Engine derating is a design strategy that reduces engine power.

[2] 88 FR 4296 (Jan. 24, 2023).

[3] The EPA refers to NO_X, PM, HC, CO, volatile organic compounds (VOC), and sulfur dioxide more generally as ''criteria pollutants'' throughout this preamble.

[4] U.S. Environmental Protection Agency. (2025). ''EPA Launches Biggest Deregulatory Action in U.S. History''. *https://www.epa.gov/newsreleases/epa-launches-biggest-deregulatory-action-us-history.*

during the development of the 2023 Final Rule). In addition, several engine manufacturers have expressed concerns with the increased useful life which is set to begin in MY 2027 and the increased risk of non-compliance for in-use engines over their extended regulatory useful life. The EPA has also identified several areas where amending specific test procedures and other compliance provisions could support implementation of the MY 2027 program.

On August 12, 2025, the Administrator also stated the EPA's intention to further improve operator experience with diesel engines using SCR systems, including assessing whether engine performance derates may no longer be necessary to ensure the proper use of diesel exhaust fluid (DEF).[5] After this announcement, individual operators and States, such as Iowa, Alaska, and Nebraska, expressed concerns with inducements, and a bill was brought to Congress regarding relief for inducements in prolonged cold weather.[6] In response to feedback and concerns that the EPA continues to receive regarding the impact of inducements, the Agency is revisiting the inducement regulations finalized in the 2023 Final Rule for new heavy-duty highway engines. This includes revisiting how restrictive inducements should be to provide a reasonable basis for demonstrating that operators would continue to add quality DEF in tanks and not tamper with SCR systems. The EPA is also considering what changes could apply to in-use highway engines and vehicles and nonroad engines currently covered under existing EPA guidance.

[5] U.S. Environmental Protection Agency. (2025). ''At Iowa State Fair, EPA Administrator Zeldin Announces Diesel Exhaust Fluid (DEF) Fix.'' *https://www.epa.gov/newsreleases/iowa-state-fair-epa-administrator-zeldin-announces-diesel-exhaust-fluid-def-fix.*

[6] See, *e.g.,* Office of the Nebraska Attorney General (2026). ''Nebraska Attorney General's Office Issues Safety Alert Regarding Diesel Exhaust Fluid (DEF) System Failures Affecting Farmers, Truckers, and Motorists.'' *https://ago.nebraska.gov/nebraska-attorney-generals-office-issues-safety-alert-regarding-diesel-exhaust-fluid-def-system.*

Finally, the EPA is aware that some manufacturers' MY 2027 medium and heavy heavy-duty engine development programs have experienced technical challenges, and a few diesel engine models/families are at risk of not being completed in time for a January 2027 introduction. Consequently, these manufacturers have requested, and the EPA is proposing, NCPs under CAA section 206(g), which would allow these manufacturers to continue to sell their current products while they complete the development of engines compliant with the MY 2027 standards.

C. Summary of the Major Provisions in This Proposal

Truck and engine manufacturers as well as the component supply industry have been preparing for several years to meet the MYs 2027 and later NO_X, PM, HC, and CO standards and other requirements finalized in the 2023 Final Rule. Over the past year, most truck and engine manufacturers have communicated to the EPA that they will have a full lineup of products ready to meet the MY 2027 standards. However, some truck and engine manufacturers and the broader industry, including trucking fleets and dealers, have raised concerns with the overall costs of new vehicles resulting from the 2023 Final Rule. In light of concerns from truck and engine manufacturers, the component supply industry, and truck users, trucking fleets, and truck dealerships, the EPA is proposing targeted revisions to certain program elements that are expected to reduce the program costs, while limiting the impact on engine and vehicle manufacturers' significant investments and plans for providing compliant MY 2027 products, and retaining the majority of the projected emissions reductions from the 2023 Final Rule.

In the 2023 Final Rule, the projected costs due to the lengthened emission-related warranty periods were the largest individual contributor to the EPA's projected per-vehicle cost increases, and total program costs. As described in section III.A of this preamble, the EPA is now reconsidering whether the long-term emission reductions projected for longer emission-related warranty periods and the justifications presented in the 2023 Final Rule are reasonable. In consideration of the cost impacts, potential increased purchase price and reduced emission-related warranty coverage options for purchasers, and the associated relatively small emissions impact, the EPA proposes to retain the MY 2026 emission-related warranty periods for MYs 2027 and later heavy-duty engines.

The 2023 Final Rule also lengthened the useful life periods for all heavy-duty engine regulatory classes. The new useful life periods require manufacturers to demonstrate at the time of certification that the emission controls on their MYs 2027 and later engines are durable over the longer periods, and manufacturers are responsible for ensuring that their engines will meet the standards in-use during those useful life periods. In meetings with manufacturers over the past year about their readiness for the MY 2027 program, several manufacturers have noted they can meet the initial certification requirements but expressed concern with the uncertainty of in-use performance of their new technologies over the full useful life for the range of vehicle applications. Based on their technology development work since January 2023, these manufacturers suggest that a shorter useful life would give them more time to evaluate their new technologies in the real world and build more confidence in their ability to meet the MY 2027 standards in-use over the longer useful life periods. As described in section III.B of this preamble, the EPA proposes that the longer useful life periods would apply beginning in MY 2030. This proposed implementation delay is intended to mitigate manufacturer concerns regarding compliance uncertainties for the extended period over which manufacturers have limited data and provide manufacturers with additional lead time to refine emission control systems before the engines are subject to the longer regulatory useful life.

The EPA is also proposing to establish NCPs for certain categories of compression-ignition heavy-duty engines. Under CAA section 206(g), a manufacturer is allowed to produce engines that do not meet the applicable standards ''if such manufacturer pays a nonconformance penalty as provided under regulations promulgated by the Administrator after notice and opportunity for public hearing.'' [7] Under existing EPA regulations, the EPA would establish NCPs if three criteria are met: (1) The emission standard in question becomes more difficult to meet; (2) Substantial work must be required to meet the emission standard; and (3) the Agency finds that a manufacturer is likely to be noncomplying for technological reasons (referred to in earlier rules as a ''technological laggard''). The EPA believes these criteria have been met for the MY 2027 NO_X standards for diesel-fueled engines in the Medium HDE and Heavy HDE regulatory categories and is proposing to establish NCPs for these engine categories as described in section IV of this preamble.

Finally, in the 2023 Final Rule, the EPA codified regulatory requirements to address how manufacturers can certify engines that use DEF in SCR aftertreatment systems. The 2023 Final Rule mandated manufacturers to initiate an engine performance derate, or inducement, to address concerns with DEF quality, DEF supply, and tampering. As described in section V of this preamble, continued operator frustration has motivated the EPA to reassess the Agency's approach to certifying SCR-equipped engines. In this action, the EPA is proposing to replace engine performance derates as a part of SCR-related inducement provisions with visible and/or audible notifications. These proposed amendments for inducements would apply to newly manufactured highway engines and vehicles (*i.e.,* light- and medium-duty vehicles and heavy-duty engines) and in nonroad applications. Under CAA sections 202 and 213, the EPA sets and implements emission standards for new highway and nonroad engines and vehicles throughout their useful life; however, the EPA will be considering new inducement guidance for in-use highway and nonroad diesel engines and vehicles regarding ongoing compliance with such regulations. The EPA is considering whether such guidance might provide recommendations for engine manufacturers to get approval to modify in-use engines, consistent with any provisions the EPA adopts in this rulemaking, without violating prohibitions against tampering and defeat devices.

D. Summary of the Impacts of This Proposal

The EPA updated costs from the 2023 Final Rule Regulatory Impact Analysis (RIA) to reflect the projected change in emission-related warranty costs and operating costs associated with this proposed action. There are no changes to direct manufacturing costs between the proposed action case and the no-action case. The EPA understands that manufacturers have already solidified their technology designs for MY 2027 engines, and the Agency believes that manufacturers are likely to maintain a steady design technology for MY 2028 and 2029 and will not redesign engines in response to the proposed shorter useful life periods for those model years.

As shown in Table I–1, and in more detail in section VI of this preamble, engine manufacturers would see cost savings due to the proposed shorter emission-related warranty period per engine for MY 2027 by regulatory class and fuel type and those savings are likely to be passed on to the vehicle purchaser. See section VI of this preamble and Chapter 3 of the Draft Regulatory Impact Analysis (DRIA) for additional information on the cost impacts of this proposal.[8] The EPA expects that manufacturers will pass these savings on to purchasers. Thus, the EPA expects purchasers to save up to $37 billion in emission-related warranty savings, including up to $6,000 per diesel vehicle from the warranty savings alone (see Table I–2). Purchasers would also incur additional operating costs, but net cost savings could be as high as $12 billion.

Table I-1: Present Value and Annualized Value Emission-Related Warranty Savings, Operating Costs, and Net Savings of the Proposed Action Case Relative to the No-Action Case, Millions of 2024 Dollars*

Value Basis and Discount Rate	Emission-Related Warranty Savings	Operating Costs	Net Cost Savings
PV, 3%	$37,000	-$25,000	$12,000
PV, 7%	$24,000	-$15,000	$9,400
AV, 3%	$1,900	-$1,300	$640
AV, 7%	$2,000	-$1,200	$770

* Values show two significant figures; positive values indicate cost savings in expenditures.

[7] 42 U.S.C. 7525(g).

[8] U.S. Environmental Protection Agency. ''Amendments and Nonconformance Penalties for Model Year 2027 and Later Heavy-Duty Highway Engines and Amendments to Inducement Provisions for SCR-Equipped Diesel Engines: Draft Regulatory Impact Analysis.'' July 2026. EPA–420–D–26–002.

Table I-2 Per-Engine Cost Savings Due to Reduced Emission-Related Warranty Period for MY 2027 by Regulatory Class and Fuel Type, 2024 Dollars*

Regulatory Class	Diesel	Gasoline	Compressed Natural Gas
Light HDE	$6,152	$2,783	
Medium HDE	$4,130	$2,838	
Heavy HDE	$5,358		$6,270
Urban Bus	$6,004		$6,878

* Blank cells indicate that there are no heavy-duty engines in a specific regulatory class for that fuel type; positive values indicate cost savings in expenditures; values do not include operating costs.

In section VII of this preamble, the EPA presents the combined emissions impacts of the proposed revisions in calendar years 2030, 2040, 2045, and 2055,[9] which are summarized in Table I–3.

Table I-3 National Heavy-Duty Vehicle Emission Changes in U.S. Tons in Calendar Years 2030, 2040, 2045, and 2055 — Proposed Action Case Emissions Relative to No-Action Case

	Increase in U.S. Short Tons			
Pollutant	**2030**	**2040**	**2045**	**2055**
NO_X	30,626	39,819	37,917	36,673
VOC	84	122	118	116
Primary Total $PM_{2.5}$	29	49	47	46
CO	5,902	8,502	8,260	8,084

The EPA estimates that the 2023 Final Rule, as amended by this proposal, would continue to reduce the onroad heavy-duty NO_X inventory in 2055 by about 42 percent—over 260,000 tons of NO_X—compared to the 2055 heavy-duty NO_X inventory without the 2023 Final Rule. The proposed amendments would retain nearly 90 percent of the NO_X reductions originally projected to result from the 2023 Final Rule because the more stringent standards and more representative test cycles finalized in the 2023 Final Rule remain in place.

II. Introduction

A. Background

In January 2023, EPA adopted the 2023 Final Rule, which included new, more stringent emission standards for NO_X, PM, HC, and CO for MYs 2027 and later heavy-duty highway engines.[10] The 2023 Final Rule also changed key provisions of the existing heavy-duty emissions control program, including test procedures, regulatory useful life, emission-related warranty, and other requirements. Additionally, the 2023 Final Rule included changes to maintenance, serviceability, and certain inducement provisions.

B. Response to the 2023 Final Rule

On March 12, 2025, the EPA Administrator announced that the Agency would reevaluate the 2023 Final Rule.[11] Following this announcement, the EPA heard concerns from truck and engine manufacturers, the component supply industry, and truck users, trucking fleets, and truck dealerships, about the expected cost increases associated with the 2023 Final Rule's changes to the emission-related warranty and regulatory useful life periods (the Agency also received comments from a number of these stakeholders raising concerns with the potential high costs during the development of the 2023 Final Rule). The EPA has also identified several areas where amending specific test procedures and other compliance provisions could support the implementation of the MY 2027 program.

Since the 2023 Final Rule was finalized, truck and engine manufacturers as well as the component supply industry have been preparing to meet the MYs 2027 and later NO_X, PM, HC, and CO standards and other requirements. Over the past year, most truck and engine manufacturers have communicated to the EPA that they will have a full lineup of products ready to meet the MY 2027 standards. However, some truck and engine manufacturers and the broader industry, including trucking fleets and dealers, have raised concerns with the overall costs of new vehicles resulting from the 2023 Final Rule.

In the 2023 Final Rule, the EPA projected that up to 50 percent of the program costs can be attributed to the longer emission-related warranty periods.[12] Considering that the length of the emission-related warranty period does not factor into the stringency or feasibility of the standards and would not impact engine manufacturer's investments and production plans, the EPA considers a reduction in the emission-related warranty periods to be a straightforward cost-saving opportunity for engine manufacturers, truck dealerships, and trucking fleets regarding the potential purchase price increases due to the longer emission-related warranty periods.

[9] The 2023 Final Rule inventory analysis included calendar years up to 2045. For this proposed rule, the EPA extended analysis years to 2055 to better reflect the impact of fleet turnover further into the future.

[10] 88 FR 4296 (Jan. 24, 2023).

[11] U.S. Environmental Protection Agency. (2025). ''EPA Launches Biggest Deregulatory Action in U.S. History.'' *https://www.epa.gov/newsreleases/epa-launches-biggest-deregulatory-action-us-history.*

[12] See the indirect cost calculations presented in Chapter 7.1.2 of the 2023 Final Rule RIA. Control of Air Pollution from New Motor Vehicles: Heavy-Duty Engine and Vehicle Standards Regulatory Impact Analysis. December 2022. EPA–420–R–22–035.

In preparation for meeting the longer useful life periods promulgated under the 2023 Final Rule, most manufacturers have successfully initiated durability testing for MY 2027 certification, which is used to demonstrate that their engines maintain emission performance and meet the standards through the full useful life. However, several manufacturers have expressed concern with increased in-use compliance risk of the longer useful life periods established in the 2023 Final Rule. These manufacturers have noted that they are confident in the performance of their chosen technology pathway to meet the MY 2027 standards over the longer useful life in the laboratory, but they are less certain about how the technology will perform over the longer periods in real-world operation.

Some engine manufacturers have also expressed concerns with the MY 2027 longer useful life as it impacts the near-term use of NO_X emission credits under the EPA's averaging, banking, and trading (ABT) program. Relative to credits generated using pre-MY 2027 useful life periods, manufacturers would have to use more credits to apply them to MYs 2027 and later engines, which would accelerate depletion of their credit banks. This accelerated depletion can be especially challenging as manufacturers transition to more stringent standards under a compliance program that also includes new test procedures and other requirements.

In the 2023 Final Rule, the EPA recognized that low-volume specialized vocational vehicles, such as fire trucks, refuse trucks, concrete mixers, emergency vehicles, heavy-haul tractors, and custom-chassis motor homes, can require more extensive redesign to integrate aftertreatment systems needed to meet the MY 2027 standards. In response to concerns that manufacturers needed additional lead time for certain low-volume products, the EPA finalized an interim provision for MYs 2027 through 2029 that allows manufacturers to use NO_X emission credits generated under the existing ABT program to certify up to five percent of their production volume of Heavy HDE compliant at pre-MY 2027 requirements.[13] As manufacturers considered how to apply this five percent production volume allowance for their products, the EPA heard from some manufacturers that they have engines intended for low-volume specialty vehicles, such as refuse trucks, urban buses, motorcoaches, and fire trucks, that would qualify for this allowance, but they do not have sufficient NO_X credit balances to use the existing flexibility.

The EPA notes that most engine manufacturers are on track to meet the MY 2027 standards. The EPA acknowledges that there was substantial work required to meet these standards, including implementing new technologies and demonstrating compliance with new test procedures.[14] The technologies manufacturers have chosen for this program range from specific upgrades to the existing emissions control technologies to more comprehensive upgrades that coincide with the development and launch of entirely new engine platforms. The EPA is aware that some manufacturers' MY 2027 Medium HDE and Heavy HDE development programs have experienced technical challenges, and that some diesel engine families are at risk of not being completed in time for a January 2027 introduction (see section IV.A of this preamble). Consequently, these manufacturers have requested that the EPA establish NCPs under CAA section 206(g), which would allow them to continue to sell their current products while they complete the development of the engines compliant with the MY 2027 standards. The EPA is therefore proposing to establish NCPs for diesel-fueled Medium HDE and Heavy HDE for the MY 2027 NO_X standards.

The 2023 Final Rule mandated manufacturers to initiate an engine performance derate, or inducement, to address concerns with DEF quality, DEF supply, and tampering. On August 12, 2025, the Administrator also stated the EPA's intention to further improve operator experience with diesel engines using SCR systems, including assessing whether engine performance derates may no longer be necessary for compliance.[15] In response to the Administrator's announcement and feedback and concerns that the EPA continues to receive regarding the impact of DEF inducements, the Agency began revisiting the questions and principles discussed in the 2023 Final Rule, including how restrictive inducements should be to provide a reasonable basis for demonstrating that operators would continue to add quality DEF in tanks and not tamper with SCR systems.

In addition to the emission-related warranty, useful life, production allowance, and inducement elements from the 2023 Final Rule, the EPA, manufacturers, and other stakeholders have identified several areas where amending the specific test procedures and other compliance provisions could improve the overall accuracy, repeatability, and clarity of the regulations without changing the stringency of the standards.

C. Summary of the Proposal

As noted previously, most engine manufacturers are on track to meet the MY 2027 standards. Therefore, the EPA is not reopening the MYs 2027 and later NO_X, PM, HC, and CO standards in this rulemaking.

The EPA is proposing targeted revisions to the emission-related warranty, the regulatory useful life, and the five percent production volume allowance finalized in the 2023 Final Rule. These revisions are intended to reduce costs that could otherwise be passed on to customers as increased purchase prices. In section III.A of this preamble, the EPA describes the Agency's proposal to shorten the emission-related warranty periods for MY 2027s and later engines to the values that apply to MY 2026 and earlier engines. In section III.B of this preamble, the EPA also proposes to delay implementation of the MYs 2027 and later engines' useful life periods to instead start in MY 2030. As such, the current MY 2026 and earlier useful life periods would continue to apply through MY 2029. As described in section III.C of this preamble, the EPA is continuing the existing allowance for manufacturers to produce up to five percent of their U.S.-directed production volume of Heavy HDE that is compliant with pre-2027 requirements, but proposes to remove the requirement to use NO_X credits. These targeted revisions are expected to reduce the program costs (see section VI of this preamble), while limiting the impact on manufacturers' current production plans and retaining the majority of the projected emissions reductions from the 2023 Final Rule (see section VII.B of this preamble).

As described in section IV of this preamble, the EPA is also proposing to establish NCPs for certain categories of compression-ignition heavy-duty engines. Specifically, the EPA proposes NCPs for the Medium HDE and Heavy HDE categories.

[13] Specifically, this allowance is limited to five percent of a manufacturer's U.S.-directed production volume of Heavy HDE from MYs 2023 through 2025.

[14] The EPA is not reopening MYs 2027 and later test procedures except in the limited ways specifically proposed in section III.E of this preamble, regarding targeted technical amendments to correct or add clarification.

[15] U.S. Environmental Protection Agency. (2025). ''At Iowa State Fair, EPA Administrator Zeldin Announces Diesel Exhaust Fluid (DEF) Fix.'' *https://www.epa.gov/newsreleases/iowa-state-fair-epa-administrator-zeldin-announces-diesel-exhaust-fluid-def-fix.*

The EPA is also proposing to replace engine performance derates for SCR-related inducements with visible and/or audible notifications. These new inducement provisions would apply to new heavy-duty highway engines as well as new light-duty and medium-duty vehicles and nonroad diesel engines (see section V of this preamble).

Finally, as described in section III.E of this preamble, the EPA has also identified several additional amendments that would improve the heavy-duty engine programs.[16] The EPA is proposing specific targeted amendments to correct or add clarification to several test procedures, including the deterioration factor procedure for durability testing, the in-use moving average window procedure for off-cycle testing, the optional engine idle procedure, and the vanadium sublimation procedure for vanadium-based catalyst systems. The EPA is proposing amendments to align the heavy-duty powertrain testing and PM background correction procedures with the light-duty vehicle procedures to limit test burden for manufacturers that certify both light- and heavy-duty products. The EPA is proposing an amendment to extend an allowance for a limited number of qualifying hybrid specialty vehicles to use engines certified to alternative emission standards until MY 2030 under certain conditions. The EPA is also proposing targeted amendments to the onboard diagnostic system requirements that are intended to improve user experiences with MYs 2027 and later emission controls.

D. Legal Authority

Statutory authority for this proposed action comes from the CAA (42 U.S.C. 7401–7675). In this proposed action, the EPA is proposing to amend the emission-related warranty, regulatory useful life, and certain other provisions for MYs 2027 and later heavy-duty engines under CAA sections 202, 203, 206, 207, and 216. Unless provided otherwise by statute, an agency may revise or rescind prior actions so long as it acknowledges the change in position, provides a reasonable explanation for the new position, and considers legitimate reliance interests in the prior position.[17]

E. Reliance Interests

The EPA understands that companies have previously planned for the MY 2027 start date for the MYs 2027 and later heavy-duty engine emission standards and related program requirements.

The EPA acknowledges that this proposal would, if finalized, change the Agency's previous assessments in the 2023 Final Rule with respect to the emission-related warranty, regulatory useful life, and other program elements. The EPA notes that this proposal does not change the emission standards and related test cycles established in the 2023 Final Rule for MY 2027 and later. As explained throughout this preamble, the EPA believes this change in position is necessary. The EPA believes that the revisions proposed in this action relieve obligations in a manner that promotes compliance and cost savings without undermining existing investments in compliance. Nevertheless, the EPA requests comment on whether regulated parties have any significant reliance interests with respect to the changes in emission-related warranty, regulatory useful life, and other program elements contained in this proposal. (C–1).

The EPA further understands that other interested parties may have relied on the MY 2027 heavy-duty program for independent purposes, including compliance with relevant National Ambient Air Quality Standards (NAAQS) and related planning obligations, among others. The EPA believes that the relatively small foregone emissions reductions involved in this proposed revision, coupled with the relatively short amount of time that has passed since promulgation of the 2023 Final Rule, means that such interests do not supersede the Agency's obligation to ensure that program elements are appropriate and reflect technical and market realities. Moreover, the EPA notes that emissions from mobile sources are just one consideration among many involved in planning to attain the NAAQS and related obligations. Nevertheless, the EPA requests comment on such reliance interests and how such interests should be taken into account in any final action on this proposal. (C–2).

The EPA requests comment on the nature and extent of any other reliance interests that may arise from this proposed action and is committed to assessing any such interests, determining whether they are significant, and weighing such interests against competing rationales, as required by law. (C–3).

III. Proposed Compliance Provisions and Test Procedures

The EPA is proposing targeted revisions to the 2023 Final Rule to aid in the implementation of the MYs 2027 and later HD engine criteria pollutant emissions program, reduce the cost of the program, and improve operator experiences. The proposed changes include continuing the MY 2026 and earlier emission-related warranty periods for MYs 2027 and later engines, delaying the implementation of the MY 2027 useful life periods by three years, and targeted revisions to ABT credit flexibilities. The EPA is also proposing discrete revisions to correct and/or clarify certain identified regulatory provisions. This section III describes the proposed revisions.

A. Emission-Related Warranty

The emission-related warranty period is the period over which CAA section 207 requires an engine manufacturer to warrant to a purchaser that: (1) the engine is designed, built, and equipped so as to conform with applicable regulations under CAA section 202 and (2) is free from defects in materials or workmanship which would cause the engine not to conform with applicable regulations for the warranty period. If an emission-related component fails during the regulatory emission-related warranty period, the manufacturer is required to pay for the cost of repair or replacement. A manufacturer's general emission-related warranty responsibilities are currently set out in 40 CFR 1068.115. Note that while an emission-related warranty provides protection to the owner against emission-related repair costs during the warranty period, the owner is responsible for properly maintaining the engine (40 CFR 1068.110(e)), and the manufacturer may deny warranty claims for failures caused by the owner's or operator's improper maintenance or use (40 CFR 1068.115(a)).

In the 2023 Final Rule, the EPA finalized increases in the emission-related warranty periods for MYs 2027 and later engines, as shown in Table III–1, which relied on three primary justifications.[18] First, the EPA expected longer emission-related warranty periods would lead owners to continue to maintain their engines and vehicles over a longer period of time, which would ensure longer-term benefits of emission controls. Second, the EPA

[16] It is important to note that while this proposed rule includes a range of specific, targeted amendments to the regulations, the EPA is otherwise not reopening those provisions and is neither proposing nor seeking comment on the underlying standards or program requirements.

[17] See *FDA* v. *Wages & White Lion Invs., L.L.C.,* 604 U.S. 542 (2025); *FCC* v. *Fox Television Stations, Inc.,* 556 U.S. 502 (2009); *Motor Vehicle Mfrs. Ass'n* v. *State Farm Mut. Auto. Ins. Co.*, 463 U.S. 29 (1983); *Clean Air Council* v. *Pruitt,* 862 F.3d 1, 8 (D.C. Cir. 2017) (''Agencies obviously have broad discretion to reconsider regulations at any time'').

[18] 88 FR at 4364.

noted that manufacturers may be more incentivized to simplify complex components to reduce in-use failures if they were responsible for repairs over longer periods. Finally, the EPA projected that longer warranty periods would allow manufacturers to have access to better defect information over a period of time more consistent with engine useful life. Manufacturers are currently required to track and report defects to the EPA under the defect reporting provisions of 40 CFR part 1068. Under 40 CFR 1068.501(b), manufacturers investigate possible defects whenever a warranty claim is submitted for a component and can monitor defect information from dealers and repair shops that perform those warranty repair services. After the emission-related warranty period ends, a manufacturer would not necessarily know about these defects, since repair facilities are less likely to be in contact with the manufacturers and less likely to use original equipment manufacturer (OEM) parts.

Table III-1 2023 Final Rule Emission-Related Warranty Periods for Each Primary Intended Service Class

Primary intended service class	MYs 2026 and Earlier			MYs 2027 and Later		
	Mileage	Years	Hours	Mileage	Years	Hours
Spark-Ignition HDE	50,000	5	-	160,000	10	8,000
Light HDE	50,000	5	-	210,000	10	10,000
Medium HDE	100,000	5	-	280,000	10	14,000
Heavy HDE	100,000	5	-	450,000	10	22,000

The EPA is reconsidering the longer emission-related warranty periods in light of new information on costs and potential impact on purchase price. The EPA proposes that the relatively small long-term emission reductions projected for longer emission-related warranty periods (see section VII of this preamble) and the uncertain long-term improvements to component quality and serviceability that the Agency previously used to justify the longer warranty periods do not outweigh the costs and potential impact on purchase price.

The 2023 Final Rule estimated the increased emission-related warranty costs per year for the vehicle regulatory classes represented in EPA's Motor Vehicle Emission Simulator (MOVES) model,[19] which generally match the primary intended service classes of vehicles in EPA's regulations. The EPA also estimated the age at which the range of MOVES heavy-duty vehicle regulatory classes would reach their emission-related warranty limit based on their projected mileage accumulation.[20]

In the 2023 Final Rule, the EPA projected significant NO_X emission reductions in calendar year 2045 from vehicles subject to the MYs 2027 and later standards and other requirements.[21] The NO_X emission reductions attributable to the lengthened emission-related warranty periods were relatively small compared to the reductions due to the more stringent standards and more representative test cycles also finalized under that program. While the EPA did not separately present the contributions from each program element in the 2023 Final Rule, the Agency is updating the analysis in this proposed rule to include the contributions of the program elements we are proposing to revise (see section VII of this preamble). By removing the longer emission-related warranty periods, the EPA projects NO_X emissions would increase by approximately 36,000 tons in calendar year 2055. In the same year, the EPA estimates that the remainder of the 2023 Final Rule program is projected to reduce NO_X emissions by approximately 260,000 tons relative to the standards and requirements in place for MY 2026 and earlier engines. The proposed changes to emission-related warranty periods would reduce the NO_X emission benefits estimated in the 2023 Final Rule by 12 percent in calendar year 2055.

In response to the new emission standards for the MY 2027 program, manufacturers have added technology that qualifies as emission-related components covered under warranty. For any new emission-related components, manufacturers project purchase price adjustments to cover anticipated warranty costs, which would have resulted in a higher warranty cost pursuant to the 2023 Final Rule. By lengthening emission-related warranty periods in addition to adopting new emission standards for the MY 2027 program, the 2023 Final Rule has required manufacturers to adjust their MYs 2027 and later warranty costs to cover the new technology, as well as costs to cover the emission-related components already on their engines for longer coverage periods.

In the 2023 Final Rule, emission-related warranty costs were the largest individual contributor to the per-vehicle cost increases and the total program costs. Since the 2023 Final Rule, the EPA has met with manufacturers and has learned that the emission-related warranty costs could be significantly higher for certain applications. In the case of the Heavy HDE category, OEMs have shared that the cost increase for just the emission-related warranty could exceed $15,000 for some engines intended for use in low-mileage vocational vehicles for which the engine would be covered by warranty until the 10 year limit.[22] Commenters on the proposal to the 2023 Final Rule, including engine manufacturers, suppliers, purchasers, and industry trade associations, stated that emission-related warranty costs are generally passed on to customers in the vehicle purchase price, and they noted that such an increase could impact vehicle sales.[23]

[19] The EPA inventory analysis for this proposal was performed using a regulatory version of the Agency's MOVES model, known as MOVES5.R2, which was derived from the latest public version (MOVES5) with the updates described in Chapter 2.2 of the DRIA for this proposed rule.

[20] These costs were presented in Tables 7–14 through 7–17 of the 2023 Final Rule RIA. See Control of Air Pollution from New Motor Vehicles: Heavy-Duty Engine and Vehicle Standards, Regulatory Impact Analysis. December 2022. EPA–420–R–22–035.

[21] See Table VI–1 of the 2023 Final Rule (88 FR 4418, Jan. 24, 2023).

[22] This is consistent with the 2023 Final Rule emission-related warranty cost analysis that estimated warranty costs are approximately $1,000 per year.

[23] See sections 4 and 25 of the EPA's summary and response to comments on the proposal to the 2023 Final Rule. ''Control of Air Pollution from New Motor Vehicles: Heavy-Duty Engine and Vehicle Standards Response to Comments.'' EPA–420–R–22–036. December 2022.

Longer emission-related warranties may not align with the preferences or usage patterns of all purchasers. In comments on the proposal to the 2023 Final Rule, American Trucking Associations (ATA) noted that certain fleets purchase extended warranties based upon the unique business models and financial means of each company.[24] ATA stated that fleets with short turnover cycles for their vehicles should not be required to purchase warranties that exceed their mileage needs and that such a requirement may have the unintended consequence of some fleets retaining their current trucks longer. In response to this comment in the 2023 Final Rule, the EPA noted that, to the extent that fleets currently base their shorter turnover cycle on the EPA emission-related warranty periods, the Agency expected those fleets to consider adjusting their current business model to accommodate the longer warranties in the 2023 Final Rule.[25] In reconsidering the longer emission-related warranty periods, the EPA acknowledges that the shorter, pre-2026 warranty periods would allow these companies to continue to opt for additional warranty coverage if it meets their specific operational requirements, which would reduce the influence of the warranty as a factor a business might consider when deciding whether to purchase a new vehicle.[26]

In consideration of the cost impacts, potential increased purchase price and reduced warranty coverage options for purchasers, and the associated, relatively small emissions impact compared to the full scope of the 2023 Final Rule, the EPA proposes to retain the MY 2026 emission-related warranty periods for MYs 2027 and later. This proposal is based on the recognition that maintaining the much longer emission-related warranty for MYs 2027 and later will significantly increase the manufacturer costs and consumer prices for a relatively small emissions benefit. The EPA believes that the emission-related warranty periods in place for MY 2026 and earlier engines would continue to ensure that the regulated industry would design and warrant robust emission control technologies while allowing commercial truck purchasers to make their own decisions on the need to purchase extended warranties (which many purchasers do today).

B. Regulatory Useful Life Periods

Useful life represents the period over which emission standards apply to certified engines, and, practically, any difference between the regulatory useful life and the generally longer operational life of in-use engines represents miles and years of operation without an assurance that emission standards will continue to be met. For the EPA's heavy-duty highway engine program, useful life periods vary by engine class to reflect the different lengths of their estimated operational lives. As described in the 2023 Final Rule, the EPA considers operational life to be the average mileage at rebuild for compression-ignition engines (*i.e.,* engines typically fueled by diesel or natural gas) and the average mileage at replacement for spark-ignition engines (*i.e.,* engines typically fueled by gasoline or liquefied petroleum gas).

Table III-2 2023 Final Rule Useful Life Periods for Each Primary Intended Service Class

Primary intended service class	MYs 2026 and Earlier			MYs 2027 and Later		
	Mileage	Years	Hours	Mileage	Years	Hours
Spark-Ignition HDE	110,000	10	-	200,000	15	10,000
Light HDE	110,000	10	-	270,000	15	13,000
Medium HDE	185,000	10	-	350,000	12	17,000
Heavy HDE	435,000	10	22,000	650,000	11	32,000

The MYs 2026 and earlier useful life periods have been in place since 2004, and manufacturers have had decades to refine their durability demonstrations and understand the in-use durability of their emission controls over those periods. The new useful life periods require manufacturers to demonstrate at the time of certification that the emission controls on their MYs 2027 and later engines are durable over the longer periods. Additionally, the new emission standards, which the EPA is not reopening in this proposed rule, will apply to the applicable useful life periods, and manufacturers are responsible for ensuring that their engines will meet the standards in-use over those useful life periods.

The EPA included flexibilities in the 2023 Final Rule to limit additional certification test burden and in-use uncertainty due to the longer useful life periods. The EPA finalized a new durability test procedure that allows manufacturers to accelerate the aging of their emission controls to capture the additional time without a proportionally increased test burden. Manufacturers are actively applying the accelerated aging procedures for their MY 2027 engine certification and the EPA continues to receive data on those activities.[27] In terms of in-use uncertainty, the EPA finalized a 15 milligrams per brake horsepower-hour (mg/hp·hr) in-use compliance margin for Medium HDE and Heavy HDE for in-use testing of engines to the laboratory-based duty cycles and off-cycle test procedures,[28] and also added an accuracy margin to address uncertainty in the portable emissions measurement equipment used for onroad in-use testing.[29]

In meetings with manufacturers over the past year about their readiness for the MY 2027 program, some

[24] Comments of the American Trucking Associations: On the Control of Air Pollution from New Motor Vehicles: Heavy-Duty Engine and Vehicle Standards Proposed Rule. EPA–HQ–OAR–2019–0055–1326–A1. Pages 11–17.

[25] See section 18.3 of the EPA's summary and response to comments on the proposal to the 2023 Final Rule. ''Control of Air Pollution from New Motor Vehicles: Heavy-Duty Engine and Vehicle Standards Response to Comments.'' December 2022. EPA–420–R–22–036. p. 1147.

[26] While the required emission-related warranty period for manufacturers is proposed to be shortened, the post-warranty period for which owners would be responsible for emission-related repairs would be lengthened. The increased emission-related repair costs associated with the proposed warranty periods are reflected in the operating costs of the EPA's cost analysis. See Chapter 3 of the DRIA for this proposed rule.

[27] In section III.E.1 of this preamble, the EPA proposes clarifications and corrections resulting from EPA and manufacturer experiences in applying these new procedures.

[28] 88 FR 4334.

[29] 88 FR 4353.

manufacturers have indicated that they are on target to meet the requirements of the longer useful life periods, including in-use performance. Other manufacturers noted they can potentially meet the certification requirements but expressed concern with the uncertainty of in-use performance of their new technologies over the full useful life for the range of vehicle applications. Manufacturers suggest that a shorter useful life would give them more time to evaluate their new technologies in the real world and more confidence in the in-use durability over the longer useful life periods.

In response to industry feedback and the credible information shared about their technological readiness, the EPA proposes a three-year delay in the implementation of the increased useful life periods for heavy-duty engines shown in Table III–2. Specifically, the EPA proposes that the new useful life periods would apply beginning in MY 2030. This proposed implementation delay is intended to mitigate manufacturer concerns regarding compliance uncertainties for the extended period over which manufacturers have limited data and provide manufacturers with additional lead time to refine emission control systems before the engines are subject to the longer regulatory useful life.

Delaying the longer regulatory useful life periods would provide heavy-duty engine manufacturers with time to collect durability data on their in-use engines with the new technologies without having to manage the risks and burdens of a potential engine recall due to exceeding the emission standards during the longer useful life periods. Manufacturers have spent four or more years developing and testing engines, both in the laboratory and in vehicles with their low volume pre-production engines, to ensure that their engines will be durable and able to meet the standards for the longer useful life. However, since this development has been limited to pre-production engines, no company has real-world data on MY 2027 production hardware over the range of applications in which these engines may be used. Manufacturers have thorough development processes to test their products under conditions that reflect some of the most challenging real-world operations, and there is additional experience which will be gained with production engines in the real-world with the diversity of the engines' applications. Under the proposed delay of the longer regulatory useful life periods to MY 2030, manufacturers will be able to gain this real-world, in-use experience through three years of production engines subject to the MY 2027 standards. The proposed delay would provide additional lead time during which manufacturers can refine their engines and emission controls over the expanded operating conditions covered in the MYs 2027 and later program at the current useful life periods. This is intended to increase manufacturers' confidence that their products will comply with the standards for the duration of the longer useful life periods.

As shown in section VII of this preamble and Chapter 2 of the DRIA for this proposed rule, the EPA projects that the proposed delay in the lengthened useful life periods would have a minimal impact on the emissions inventory. To estimate the emissions inventory impacts, the EPA applied the shorter useful life periods for MY 2027 through MY 2029. The EPA believes this approach to estimating emissions impacts is conservative, because the timing of this proposed rule may limit the changes manufacturers would be willing to make to their engines prior to the start of production for MY 2027. The EPA expects most manufacturers will likely produce the same engines they have been preparing to manufacture for MY 2027; in fact, there is the potential that more new vehicles will be available for sale that would increase the probability that consumers will purchase newer vehicles that have a better emissions profile relative to their existing vehicles. In addition, because the proposal does not alter the emission standards, manufacturers will be motivated to gain as much real-world experience with the technology needed to meet the standards at the longer useful life. Therefore, the EPA does not expect engines to be less durable under this proposed change.

Based on discussions with individual engine manufacturers, the EPA expects the manufacturers that are currently prepared to certify engines meeting the longer useful life periods would equally benefit from the longer lead time to design their engines to address any uncertainties they may have regarding their in-use compliance. However, the EPA recognizes that the Agency must consider, and correspondingly propose to address, discrepancies that would result relating to durability testing that manufacturers may have already completed at the longer useful life periods. The EPA is proposing two methods under a new interim provision in 40 CFR 1036.150, which would apply to MY 2027 through MY 2029, depending on whether the manufacturer included an emissions test point at the useful life periods that apply to MYs 2026 and earlier (*e.g.,* equivalent to 435,000 miles for Heavy HDE) or if they only conducted the test to the full MYs 2027 and later useful life (*e.g.,* equivalent to 650,000 miles for Heavy HDE). If available, the EPA is proposing under this interim provision that manufacturers must use test data from the point that is equivalent to the useful life periods that apply to MYs 2026 and earlier. If manufacturers did not collect data at that point, the EPA would allow manufacturers to interpolate their data to the shorter useful life periods that apply to MYs 2026 and earlier using the data at the low-hour and longer useful life test points. The EPA requests comment on this interim provision. (C–4).

With this proposed change to useful life, there would likely be a reduction in manufacturers' costs. As stated above, the EPA does not expect manufacturers who have products ready for MY 2027 to change their emissions control technology plans for the MYs 2027 through 2029 period because of this proposed change. However, manufacturers that have not completed their durability demonstration for the longer useful life may choose to stop the demonstration at the current useful life values, which could result in a small reduction in testing costs that manufacturers could pass on to their customers. For this proposal, the EPA has taken a conservative approach to estimating the cost impacts of the proposed change to useful life by projecting no change in costs. The EPA requests comments on the cost savings from this provision. (C–5). See section VI of this preamble and Chapter 3 of the DRIA for this proposed rule for more details on the estimated cost impacts of the proposed change to useful life.

Finally, the EPA notes that useful life also plays a role in manufacturers' credit balances for those companies participating in the ABT program.[30] Useful life is a variable in the equation to calculate NO_X emission credits (see 40 CFR 1036.705(b)), and credits earned and used are proportional to useful life. For example, unless a manufacturer were to comply with the longer useful life periods early, credit, earned from a 150 mg NO_X/hp·hr Heavy HDE in MY 2022 to 2026 (*i.e.,* 50 mg/hp·hr below the standard) would be generated using a useful life of 435,000 miles, and if the credits were used to comply with an 65 mg NO_X/hp·hr Heavy HDE (*i.e.,* 30 mg/hp·hr above the standard) for MY 2027, the credits would be applied based on

[30] See Chapter 1 of the DRIA for this proposed rule.

a useful life of 650,000 miles. Therefore, for Heavy HDE, credits would be used at a 1.49 times greater rate than earned for a useful life of 650,000 miles, for the same difference in mg of NO_X per hp·hr between the Family Emission Limit (FEL) and the standard. Delaying the increase in useful life periods will positively impact the NO_X credits manufacturers have accrued from selling MY 2022 and later engines that are over compliant with the pre-MY 2027 NO_X standard. The resulting lower credit usage rate for MYs 2027 and later will allow manufacturers to extend the use of credits already earned for a longer period and/or apply those credits to a larger volume of engines during the transition to lower standards.

In summary, the proposed delay for implementing the longer useful life periods, and the associated reduction in credit usage that would result, would afford manufacturers additional time to gain experience with new technologies and test procedures that will begin to apply in MY 2027. This additional time could allow for refining designs, optimizing performance, and ensuring reliability under a wide range of in-use operational conditions. Manufacturers could leverage this extended lead time to conduct further testing and validation, ensuring that innovations are not only compliant but also robust when the useful life is increased in MY 2030 under the proposed delay. By proposing this additional time, the EPA aims to balance the objectives of stringent emission standards with pragmatic considerations of industry readiness and corresponding uncertainties.

Finally, the EPA requests comment on indefinitely keeping the MY 2026 and earlier regulatory useful life periods for MYs 2027 and later. (C–6). Chapter 2 of the DRIA for this proposed rule presents a scenario that projects the emissions impacts of never extending the useful life periods. For this scenario, the EPA has not estimated cost savings due to changes in the emissions control technology. However, as discussed in Chapter 3 of the DRIA for this proposed rule, the EPA would expect manufacturers to change the design of the emissions controls if the Agency were to finalize indefinitely keeping the MY 2026 and earlier regulatory useful life periods for MYs 2027 and later. The EPA understands stakeholders could potentially have concerns that products meeting the longer useful life periods have not yet entered the market and thus there is still some uncertainty in the feasibility of the standards through the longer useful life periods for all real-world applications.

C. Production Volume Allowance

In the 2023 Final Rule, the EPA adopted an interim production volume allowance for MYs 2027 through 2029 in 40 CFR 1036.150(k) that allows manufacturers to use NO_X emission credits to certify a limited volume of Heavy HDE compliant with pre-MY 2027 requirements.[31] To aid in implementation, the EPA chose not to limit the production volume allowance to specific applications of Heavy HDE but did limit it to no more than five percent of the average U.S.-directed production volumes of Heavy HDE over three MYs. In the 2023 Final Rule, the EPA noted that such an allowance from the MY 2027 criteria pollutant standards may be necessary to provide engine and vehicle manufacturers with additional lead time and flexibility to redesign some low-volume vehicles to accommodate the technologies needed to meet the more stringent engine emission standards.

The EPA proposes to modify 40 CFR 1036.150(k) to not require the use of NO_X credits in MYs 2027 through 2029 for engines certified under the interim production volume allowance. Under this proposal, a manufacturer certifying up to five percent of its Heavy HDE U.S.-directed production volumes under 40 CFR 1036.150(k) would not be required to use NO_X credits to offset the negative credits associated with those engines. All other conditions of 40 CFR 1036.150(k) would remain in effect and the EPA is not proposing changes to those provisions in this proposal, including the five percent cap based on the MYs 2023 through 2025 U.S.-directed production volume average, the limitation to Heavy HDE, certification to the MY 2026 requirements in 40 CFR part 86, subpart A, the carryover-family requirement, declaration of a NO_X FEL at or below the standard set out in 40 CFR 86.007–11, and applicable reporting and recordkeeping.

The EPA is proposing this change because the Agency has heard from multiple engine manufacturers that they do not have sufficient NO_X credit balances to use the existing flexibility that was designed to provide additional lead time for low-volume vehicles applications that face unique engineering and packaging constraints.[32] Specialized vocational vehicles, such as fire trucks, refuse trucks, concrete mixers, emergency vehicles, heavy-haul tractors, urban buses, and custom-chassis motor homes can require more extensive redesign to integrate aftertreatment systems needed to meet the MY 2027 standards. In the 2023 Final Rule, the EPA received comments from manufacturers and vehicle builders who indicated that, for these applications, the timing and complexity of changes, especially where aftertreatment may need to be mounted off the frame rails or where space constraints are severe, can be more challenging than for mainstream linehaul tractor configurations.

In the past year, the EPA has heard from a number of engine manufacturers and low-volume vehicle manufacturers that the challenges discussed in the 2023 Final Rule continue to exist, and additional time is needed for some specialized vocational vehicles. However, not all engine manufacturers have NO_X credits available to make use of the flexibility. Removing the requirement to use NO_X credits, within the other existing requirements including the five percent cap and limitation to Heavy HDE, would offer a practical, near-term flexibility to bridge these constraints without expanding the duration or volume of the allowance. In addition, due to the nature of the heavy-duty industry that has a limited number of engine manufacturers, the industry has made little use of the trading provisions in the ABT program. As described in Chapter 1 of the DRIA for this proposed rule, since MY 2012, only four NO_X emissions credit trades have occurred. The absence of trading and the limited banks of NO_X credits necessary for utilizing production volume allowance reduces its effectiveness as a flexibility and threatens the continued availability of the low volume HD vehicles for which the provision was intended to address. This situation further supports the proposed change to eliminate the requirement of using NO_X credits to access the interim production volume allowance.

The proposed change affects only up to five percent of U.S.-directed Heavy HDE production in MYs 2027 to 2029 and would have a small impact on the emissions inventory. All other engines would remain subject to the MY 2027 standards, and engines certified under the allowance would still meet the MY 2026 requirements. This approach preserves the core emissions benefits of the 2023 Final Rule while addressing discrete implementation needs. See section VII of this preamble and Chapter 2 of the DRIA for this proposed rule for more details on the estimated emissions impacts of the proposed change to 40 CFR 1036.150(k).

[31] Engines certified under this production volume allowance would meet the pre-MY 2027 engine provisions of 40 CFR part 86, subpart A.

[32] See Chapter 1 of the DRIA for this proposed rule.

The EPA requests comment on the proposed change to the MYs 2027–2029 allowance under 40 CFR 1036.150(k), including whether it appropriately balances the implementation needs and protection of emissions benefits. (C–7). The EPA also requests comment on whether this flexibility should apply to fewer MYs (*e.g.,* only MY 2027, or MYs 2027 and 2028), or more MYs (*e.g.,* also MY 2030 or beyond). The EPA also requests comment on whether the five percent cap should be lower or higher, and if the cap should remain constant or phase down over time. See section III.D for other credit flexibilities the EPA may consider to lower compliance costs and make implementation of standards smoother.

D. Credit Flexibilities

In the 2023 Final Rule, the EPA established NO_X FEL caps at 65 mg/hp·hr for MYs 2027 through 2030 and 50 mg/hp·hr for MYs 2031 and later. This prevents a manufacturer from certifying an engine with NO_X emissions greater than the FEL cap, even if a manufacturer has enough emission credits to continue producing a type of engine that is greater than the FEL caps.

In addition to establishing FEL caps, the 2023 Final Rule also restricts NO_X credits that can be used in MYs 2027 and later to those credits earned beginning in MY 2022. NO_X credits from MYs 2021 and earlier can be used through MY 2026, but not beyond. The 2023 Final Rule also retained the EPA's historical approach of separate averaging sets based on primary intended service class: heavy-duty spark-ignition engines (Spark-Ignition HDE), light heavy-duty engines (Light HDE), Medium HDE, and Heavy HDE. NO_X emissions ABT is only allowed within each of these averaging sets; that is, no emissions can be averaged or traded between the categories. Additional information on the 2023 Final Rule ABT program provisions, as well as the industry NO_X emissions credit banks through MY 2024, can be found in Chapter 1 of the DRIA for this proposal.

In the past year, multiple regulated entities requested the EPA modify the NO_X ABT program for MYs 2027 and later. This section III.D summarizes and solicits comment on whether to increase the NO_X FEL cap, allow the use of NO_X credits across engine service classes (*i.e.,* Spark-Ignition HDE, Light HDE, Medium HDE, and Heavy HDE), and allow the use of NO_X emission credits generated prior to MY 2022.

1. NO_X FEL Cap

The EPA recognizes that increasing the FEL cap, even in the short-term, could reduce the economic costs of the requirements, potentially without significant foregone emissions reductions. However, the EPA also recognizes that doing so would be a change in Agency position. In the 2023 Final Rule, the NO_X FEL cap was set below the existing standard of 200 mg/hp·hr to avoid competitive disruptions and ensure that the majority of new engines introduced into commerce would include updated emissions control technologies compared to the emissions control technologies manufacturers were using to meet the existing standards.[33] The EPA also explained in the 2023 Final Rule that this was consistent with the Agency's past practice when issuing rules for heavy-duty onroad engines or nonroad engines in which there was a substantial (*i.e.,* greater than 50 percent) difference between the numeric levels of the existing and new standards).[34] Comments received on the 2023 Final Rule from manufacturers suggested that the EPA should set an FEL cap at a level between 50 and 100 mg/hp·hr, stating that such a cap would help to prevent competitive disruptions (*i.e.,* require all manufactures to make improvements in their emissions control technologies). In the 2023 Final Rule, the EPA explained that the specific numeric levels of the final FEL caps were selected to balance several factors. The EPA stated that these factors include providing sufficient assurance that lower-emissions technologies will be introduced in a timely manner, which was consistent with the Agency's past practice,[35] and providing manufacturers with flexibility in their product planning or assurance against unforeseen emissions-related problems that may arise. In the 2023 Final Rule, the EPA explained that the FEL cap of 65 mg/hp·hr selected for the early years of the program (*i.e.,* MYs 2027 through 2030) placed more emphasis on providing manufacturers flexibility and assurance against unforeseen emissions control issues to ensure a smooth transition to the new standards and avoid market disruptions, as a smooth transition in the early years of the program helps ensure the public health benefits of the final program by avoiding delayed emissions reductions due to slower fleet turnover than may occur without the flexibility of the ABT program in the 2023 Final Rule. In the 2023 Final Rule, the EPA stated that the FEL cap of 50 mg/hp·hr selected for the later years of the program (*i.e.,* MYs 2031 and later), placed more emphasis on ensuring continued improvements in the emissions control technologies installed on new engines.

At the time of this proposed rule, engine manufacturers are generally making progress toward adopting new emissions control technologies to meet the standards; however, one engine manufacturer has indicated that an increased FEL cap of 200 mg/hp·hr for up to two MYs could help them in the transition to meeting the MYs 2027 and later standards. With respect to potential emissions impact, the EPA notes that a company would only be able to make use of a higher FEL cap if the company had NO_X credits available. See Chapter 1 of the DRIA for this proposal for a discussion of emissions ABT and data regarding engine manufacturers' NO_X credit balances.

The EPA notes that if a higher NO_X FEL cap were established in the final rule of this proposal, this would be optional and would not require any company to make use of the higher FEL cap. The EPA notes that some engine manufacturers may have concerns with the change in the competitive landscape from an increase in the FEL cap, as a higher FEL cap may allow a firm to sell an engine with a less-effective emissions control technology at a lower cost.

The EPA requests comment on increasing the NO_X FEL cap to a level greater than 65 mg/hp·hr, but less than or equal to the MY 2026 standard of 200 mg/hp·hr. (C–8) The EPA also requests comment on the number of MYs over which a higher FEL cap should apply, including whether it is appropriate to not include an end date for a higher FEL cap. For example, the EPA may consider a higher FEL cap for a few MYs during the transition to the lower NO_X standard followed by a return to 65 mg/hp·hr, followed by the 50 mg/hp·hr cap for MYs 2031 and later, or an alternative level, or an increase in the FEL cap without a specified MY end date. The EPA requests comment on the possible economic and emissions impacts of allowing older credits to be used in the MYs 2027 and later program. The EPA also requests comment on any reliance interest engine manufacturers or others may have, including the specific reliance concerns and available data supporting a reliance argument.[36]

[33] 88 FR 4296 at 4393.

[34] 69 FR 38997 (June 29, 2004); 66 FR 5111 (Jan. 18, 2001).

[35] See 69 FR 38997 (June 29, 2004).

[36] See section II.E of this preamble.

2. Use of Pre-MY 2022 Emission Credits

The EPA recognizes that allowing the use of pre-MY 2022 emission credits would be a change in Agency position. The 2023 Final Rule restricted credit use to those generated in MYs 2022 and later, noting that a majority of the existing credit balances were accumulated before MY 2009 to create flexibility in transitioning to the MYs 2007–2010 standards and those credits were generated from engines without modern emissions control technologies.[37] Additionally, to account for the addition of a new low-load test cycle (LLC), standard and moving average window in-use test procedures and emission standards for MYs 2027 and later, and the resulting difference in emission controls, the 2023 Final Rule applies up to a 40 percent discount on NO_X credits earned between MYs 2022 and 2026 when those credits are used in the MYs 2027 and later program. By applying these restrictions, the 2023 Final Rule expected to incentivize manufacturers to maximize their development and introduction of the best available emissions control technologies ahead of when they are required to do so in MY 2027, instead of relying on older credits.

As noted previously, at the time of this proposed rule, engine manufacturers are generally making progress toward adopting new emissions control technologies to meet the standards. The EPA's proposals to expand access to the existing transitional production volume allowance for Heavy HDE and establish NCPs for Medium HDE and Heavy HDE are also expected to help manufacturers needing additional time to transition to the MYs 2027 and later standards for those engine categories. However, some manufacturers have expressed an interest in using the pre-MY 2022 credits. Manufacturers have indicated the pre-MY 2022 credits could be used as an alternative to the use of NCPs, or could be used for other product planning purposes, such as to increase the FEL of a MY 2027 or later engine family, and/or to increase the number of engines produced in the future at a given FEL above the standard.

The EPA notes that if the use of pre-MY 2022 credits were allowed in the final rule of this proposal, this would be optional. The EPA notes that some engine manufacturers may have concerns with changing this credit use provision due to potential changes in the competitive landscape from the use of older credits, as a firm may now be able to sell an engine with a less-effective emissions control technology at a lower cost.

The EPA requests comment on whether, and how, banked NO_X emission credits earned prior to MY 2022 should be allowed for use in MYs 2027 and later. (C–9). As shown in Chapter 1 of the DRIA for this proposed rule, no NO_X emission credits were generated in MYs 2010–2021, so allowing pre-MY 2022 credits would in practice be credits generated in MYs 2004–2009. The EPA notes that some of the MY 2004 to MY 2009 engines may be nearing the end of their practical use (or have been retired or scrapped) and on average are accumulating fewer annual vehicle miles relative to MYs 2027 and later engines.[38] Furthermore, as noted previously, credits generated from MYs 2004 to 2009 engines were generated by engines without modern emission controls and relative to different test procedures and standards. A discount of up to 40 percent is applied when using credits earned during MYs 2022–2026 for MYs 2027 and later, and the EPA requests comment on an appropriate discount that could be applied to credits earned from the MYs 2004 to 2009 engines for use in MYs 2027 and later. Finally, the EPA requests comment on the possible economic and emissions impacts of allowing these older NO_X credits to be used in the MYs 2027 and later program. The EPA also requests comment on any reliance interest engine manufacturers or others may have, including the specific reliance concerns and available data supporting a reliance argument.[39]

3. Credit Use Across Averaging Sets

The EPA recognizes that allowing the use of emission credits across averaging sets would be a change in Agency position. The EPA first established the NO_X emission credit banking and trading flexibilities for heavy-duty engines in 1990, which expanded the averaging program already in place for those engines.[40] That 1990 rule continued the use of averaging sets to denote the heavy-duty engine subcategory within which credits could be averaged, banked, or traded. The EPA established a single averaging set for all Spark-Ignition HDE, referred to as ''Otto-cycle engines'' at the time, and light, medium, and heavy averaging sets for compression-ignition HDE (''diesel cycle engines''). That 1990 rule expanded the existing averaging set restrictions to include trading and banking such that emission credit averaging and trading are not permitted between averaging sets and banked credits can only be used in the averaging set in which they were generated.[41] In the proposal to that 1990 rule,[42] the EPA justified the averaging set restrictions by noting concern that cross-subclass credit exchanges would affect the environment and competition. In the 1990 final rule, the EPA noted that commenters requesting the Agency permit such an approach did not offer solutions that would adequately address the concerns discussed in the proposed rule.

The 2023 Final Rule retained the existing averaging sets (*i.e.,* Spark-Ignition HDE, Light HDE, Medium HDE, Heavy HDE) and allowed ABT only within those averaging sets. The 2023 Final Rule noted the approach was consistent with the Agency's historical approach, which avoids creating unfair competitive advantages or environmental risks due to credit inconsistency.[43] The 2023 Final Rule did include one temporary exception allowing credits generated by MY 2026 Heavy HDE to be used for certifying Medium HDE after applying a 10 percent discount.[44] This exception was intended as a transitional credit pathway to encourage the early introduction of lower-emitting engines as manufacturers prepared for the new MYs 2027 and later program.[45]

The EPA requests comment on whether and how emission credits could be utilized between engine service classes. (C–10). As included in the 2023 Final Rule, specific limited allowances for cross-averaging set transfers have been allowed to encourage the early introduction of lower-emitting engines during the transition to new emission standards. These flexibilities allow manufacturers, for a limited period, to focus their investments on a specific service class

[37] 88 FR 4296 at 4395.

[38] As shown in the relative mileage accumulation rates of Figure 6–4 in the MOVES Technical Report ''Population and Activity of Onroad Vehicles in MOVES5'' (EPA–420–R–24–019, November 2024), Single Unit Trucks and Combination Trucks that are 20 years or older are predicted to travel 75 percent fewer miles than their new counterparts. *https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P101CUN7.pdf.*

[39] See section II.E of this preamble.

[40] 55 FR 30534 (July 26, 1990).

[41] Id. at 30588.

[42] 54 FR 22670 (May 25, 1989).

[43] See 55 FR 30585 (July 26, 1990); 66 FR 5002 (Jan. 18, 2001).

[44] See the 2026 service class pull ahead transitional credit pathway under 40 CFR 1036.150(a)(4).

[45] See 88 FR 4296 at 4397 and Attachment 5 to the 2023 Final Rule's Stakeholder Meeting Log in the docket for that rule: *https://www.regulations.gov/document/EPA-HQ-OAR-2019-0055-2895* for a discussion of the 10 percent cross-service class credit discount.

and then use those emission credits in other services classes. If the EPA were to finalize an allowance for cross-averaging set trading, it could similarly allow manufacturers to prioritize their resources.

If the EPA were to allow cross-averaging set NO_X credit transfers, the Agency requests comment on whether a credit discount should be applied, the value of such a discount, and if that discount should differ depending on from which averaging set the credits come. For example, in the ''2026 service class pull-ahead credits'' provision in 40 CFR 1036.150(a)(4), credits generated from the certification of Heavy HDE can be used to certify Medium HDE after a 10 percent discount is applied. A credit discount can help address the concern of credit emissions value inconsistency between averaging sets. Emission credits are determined from the difference in the FEL of the engine family and the standard (in mg/hp·hr), the work over the duty cycle miles (in hp·hr/miles) for each engine family, the number of engines, and the useful life (in miles) of engines in each averaging set. There are uncertainties in real-world work and miles traveled for the range of vehicles in an averaging set compared to the certification duty cycles, and the useful life of each averaging set can have a different relationship to the real-world operating life of the range of engines in the averaging set. These uncertainties could result in an underestimate or overestimate of the true value of the emissions credit. However, since the existing averaging sets were established, the EPA has accepted the uncertainties within averaging sets such that the parameters used in the credit calculation generally represent the engines within each averaging set and ensure that a calculated emissions credit has a consistent relationship to an emissions change in the environment within a given averaging set.[46] However, the uncertainties are compounded when considering the relationship between calculated and real-world emissions across averaging sets, and the use of a discount factor can help balance those uncertainties to ensure that credit trading between service classes is environmentally protective.

The EPA notes that if credit use across averaging sets is allowed in the final rule of this proposal, this would be optional and would not require any company to make use of the flexibility. The EPA notes engine manufacturers may have concerns with the change in the competitive landscape, since finalizing such an allowance close to the implementation date could result in only benefiting manufacturers that sell engines in more than one engine service class.

Finally, the EPA requests comment on the possible economic and emissions impacts of allowing credits to be used across averaging sets in the MYs 2027 and later program. The EPA also requests comment on any reliance interest engine manufacturers or others may have, including the specific reliance concerns and available data supporting a reliance argument.[47]

4. Combination of the Requests

The EPA recognizes that the three requests for comment in this preamble section III.D. have potential interactions. For example, if the EPA were to finalize all three elements (an increase in the NO_X FEL Cap, use of pre-MY 2022 NO_X credits, and use of NO_X credits across engine service classes), this could reduce the compliance costs for some companies, while potentially negatively impacting other companies due to a change in the competitive landscape. The same is true if two of the three credit flexibilities were included in the final rule of this proposal, independent of the combination, as not all companies have pre-MY2022 NO_X credits, and not all heavy-duty engine companies sell engines in multiple service classes. The EPA requests comment on the potential interactions of these three credit flexibilities, including the impacts on the overall emissions reductions of the MYs 2027 and later program, the costs of the program, and any potential impacts on the competitive landscape for the regulated industry. (C–11).

E. Other Regulatory Amendments

To further aid in the implementation of the MYs 2027 and later heavy-duty engine emissions program, the EPA is proposing discrete revisions across a range of issues to correct or clarify regulatory provisions. This section III.E describes the background and purpose of many of those individual proposed amendments. In several cases, this section III.E also describes the types of proposed amendments without listing all the specific instances for which the EPA is proposing to change the regulations in the same manner. For example, some proposed amendments simply correct inaccurate cross-references, fix typographical errors, reproduce figures, tables, or equations to correct publishing errors, remove obsolete or redundant content, or make modest changes to maintain consistent terminology or improve clarity. The EPA is also proposing to update the regulations to reflect office reorganization within the Agency, with new work unit titles where staff contact information is provided.

It is important to note that while this proposed rule includes a range of amendments to the regulations, the EPA is not reopening and is neither proposing nor requesting comment on the changes to underlying standards or program requirements.

1. Proposed Revisions for Heavy-Duty Engines (40 CFR part 1036)

a. 40 CFR Part 1036, Subpart B—Emission Standards and Related Requirements

Heavy-duty engine manufacturers have the option to test hybrid powertrains rather than testing an engine alone to demonstrate compliance with the emission standards of 40 CFR part 1036. In 40 CFR 1036.101(b), the EPA proposes to further clarify the existing requirement that manufacturers can only use the powertrain testing option if they demonstrate compliance with all the requirements of 40 CFR part 1036. For example, if an engine manufacturer chooses powertrain testing to demonstrate that their hybrid configuration meets the engine criteria pollutant standards of 40 CFR 1036.104, they must also use powertrain testing to demonstrate that it meets the OBD requirements of 40 CFR 1036.110.

Under existing 40 CFR 1036.104(a)(3), compression-ignition engine NO_X standards for off-cycle testing are adjusted for ambient temperature over a shift day. In Table 3 to 40 CFR 1036.104(a), the EPA proposes to revise the table heading for the adjustment column from ''Temperature adjustment'' to a more accurate and clearer ''Temperature-based adjustment for NO_X''. The EPA is also proposing to revise the footnote in Table 3 to provide further clarity on the units for temperature in the adjustment equation and note the final units of g/hr for Bin 1 and mg/hp·hr for Bin 2 for the temperature-based adjustment to the specified NO_X standard.

The EPA is proposing to reorganize the existing introductory text of 40 CFR 1036.125 to begin with the instruction to manufacturers to give the ultimate purchaser of each new engine written instructions for maintaining and using the engine, consistent with other parts. The EPA is also proposing corrections to Table 1 to paragraph (a)(2) of § 1036.125 to add missing parentheses, and to correct the maintenance interval for Medium HDE ''Catalyst system components, EGR system components

[46] 55 FR 30585 at 30588.

[47] See section II.E of this preamble.

(other than filters or coolers), particulate filtration system components, and turbochargers'' in Table 2 to paragraph (a)(2) of § 1036.125 by replacing the 50,000 miles interval with 150,000 miles as intended, consistent with the interval for Heavy HDE. The EPA is proposing to revise Table 1 to paragraph (a)(2) of § 1036.125 to allow shorter minimum maintenance intervals for catalyst substrates and particular filter substrates before MY 2030, consistent with proposal to delay the longer regulatory useful life periods for heavy-duty engines. In Table 1, the EPA proposes that the minimum maintenance interval mileages for catalyst substrates and particulate filter substrates that would apply to MYs 2029 and earlier engines would match the useful life mileages that apply for those MYs. The proposed hours-based intervals are calculated using an average speed of 33 miles per hour, consistent with the existing intervals.

Under the existing maintenance regulations of 40 CFR 1036.125, owners are responsible for properly maintaining their engines, and the regulation notes in paragraph (g) that this generally includes paying for scheduled maintenance. The EPA is proposing to revise 40 CFR 1036.125(g) to further clarify that an owner's responsibility generally includes paying for scheduled maintenance even if it is within the warranty period. As part of their certification, a manufacturer must demonstrate that any critical maintenance must occur at a given interval, and the maintenance intervals for certain components (*e.g.,* spark plugs, crankcase filters) may be more frequent than the warranty period of an engine but that does not suggest a manufacturer must cover those costs for scheduled maintenance.[48] The EPA notes that there are circumstances in which a manufacturer offers maintenance for a component free of charge to their customers as part of the maintenance demonstration under 40 CFR 1036.125(a)(1)(iv) or because it is required under the conditions specified in 40 CFR 1036.125(g). In these cases, the maintenance instructions within the owner's manual would include this information and the owner would not be responsible for paying for scheduled maintenance on that component.

The EPA is proposing to revise the installation instruction provisions under 40 CFR 1036.130. This proposed revision would add a new paragraph (b)(10) providing the manufacturers certifying powertrain families, under 40 CFR part 1036, would include a description of any limitations on the type or configuration of vehicles in which the powertrain could be installed in their installation instructions for vehicle manufacturers.

The EPA is proposing to add a new interim provision 40 CFR 1036.150(aa) that would allow engine manufacturers to use deterioration factors generated from durability data generated with service accumulation hours determined with prescribed test sequence 1 and 2 speeds of 40.26 mi/hr and 44.48 mi/hr respectively in 40 CFR 1036.245, for engine families that qualify for carryover certification as described in 40 CFR 1036.235(d). The EPA is proposing to eliminate the default average vehicle speeds of 40.26 mi/hr and 44.48 mi/hr for test sequences 1 and 2, respectively, in 40 CFR 1036.245(c)(7) that are used in the total service accumulation hours calculated using Equation 1036.245–1. The default values underestimate the aging hours for Light and Medium HDE because the vehicles in which these engines are installed are vehicles that operate at lower average speeds than those of test sequences 1 and 2. This can result in total service accumulation hours that are too low, which results in inadequate time to adequately account for catalyst chemical exposure and thermal exposure due to infrequent regeneration events. The current solution, to address the underestimation of aging hours from the use of average vehicle speeds of 40.26 mi/hr and 44.48 mi/hr, is for engine manufacturers to extend the service accumulation hours beyond those calculated using Equation 1036.245–1, which ensures that deterioration factors determined using the current default test sequence average vehicle speeds are not deficient. Given this current solution, the EPA is proposing to allow their continued use for carryover engine families. More details on this topic can be found in the discussion surrounding the updates the EPA is proposing to 40 CFR 1036.245 in section III.E.1.b of this preamble.

The EPA is also proposing revisions to the OBD provisions of 40 CFR 1036.110. The 2023 Final Rule included a requirement for manufacturers to identify additional data stream signals as freeze-frame conditions. The EPA is proposing to amend 40 CFR 1036.110(b)(8) to more clearly describe how this requirement interfaces with the California Air Resources Board (CARB) regulation at 13 California Code of Regulations (CCR) 1971.1(h)(4.3).

The 2023 Final Rule included a requirement for manufacturers to submit additional information as needed to demonstrate that they meet the OBD requirements in 40 CFR 1036.110 that are not covered by CARB's OBD program. The EPA is proposing to clarify in 40 CFR 1036.110(b)(11)(i) that for additional EPA OBD requirements, such as in-cab display and data stream parameter requirements, this demonstration can be achieved through attesting that these requirements are met, in lieu of submitting additional test data.

The 2023 Final Rule included a requirement at 40 CFR 1036.110(c)(1) for manufacturers to identify fault codes with an in-cab display for any SCR- or diesel particulate filter (DPF)-related condition causing the engine to initiate a speed reduction or torque derate. First, the EPA is requesting comment on whether in-cab display information requirements should remain part of the ''diagnostic system.'' (C–12). The required in-cab display information is not always part of the OBD system which may complicate the usual standardization efforts for diagnostic system elements. Second, the EPA has learned that some derate conditions may occur without the engine's diagnostic system generating a fault code to display. The fault code might materialize after some continued operation, or it may not come at all. To address this concern, the EPA is proposing to amend the in-cab display provision to require the displayed fault code ''as applicable''. The engine's diagnostic system would need to display any code that is available, as applicable. This proposed amendment is intended only to allow manufacturers to design their in-cab display to omit a requirement to display a code that has not yet been set.

The EPA is also proposing to revise the language in 40 CFR 1036.110(b) to clarify the intended incorporation by reference in 40 CFR 1036.810 of 13 CCR 1971.1 such that it matches the Agency's position that diagnostics for hybrid components are only required if hybrid components are optionally certified to criteria pollutant standards with the engine through powertrain testing.

The EPA is proposing to remove the requirements for additional data-stream parameters for spark ignition engines in 40 CFR 1036.110(b)(10). This requirement is not useful for some applications such as natural-gas based spark ignition engines for which it would generally report a value of zero, which would be confusing to serviceability operations and not

[48] See the emission-related warranty periods specified in 40 CFR 1036.120(b) and the minimum maintenance intervals specified 40 CFR 1036.125(a).

aligned with the intent of adding data-stream parameters.

The EPA is proposing to incorporate certain changes CARB intended to make to OBD through its 2022 OBD update and its 2025 Omnibus Amendment rule.[49] [50] The EPA is proposing to align OBD test procedures with EPA test procedures. Specifically, the EPA is proposing that manufacturers can use the Federal Test Procedure cycle as defined in 40 CFR 1036.512, and the Supplemental Emission Test as defined in 40 CFR 1036.510 in lieu of the procedures defined in 13 CCR 1971.1(c). Similarly, the EPA is proposing that manufacturers can use the accelerated aging test procedure and requirements in 40 CFR 1036.245 instead of the testing and data collection requirements in 13 CCR 1971.1(i)(2.3.4). This proposed change would help reduce testing burden and harmonize test procedures for OBD and emission-related testing.

The EPA is proposing to allow manufacturers to use a test-out threshold of 30 percent instead of the 15 percent referenced in 13 CCR 1971.1(e)(8.2.4)(A)(iii) for catalyzed PM filters to be exempt from non-methane hydrocarbon (NMHC) conversion capability monitoring.[51]

During the development of CARB's 2022 OBD update, CARB included relaxation of requirements for feedgas generation performance monitoring due to concerns regarding the lack of feasible monitoring strategies.[52] The EPA is proposing to harmonize the Agency's regulations with changes to NMHC catalyst and DPF feedgas requirements finalized in CARB's 2022 OBD update. Specifically, the EPA is proposing that for OBD systems that have an NMHC catalyst conversion efficiency monitor that fulfills the requirements of 13 CCR 1971.1(e)(5.2.2), the manufacturer may use the NMHC catalyst conversion efficiency monitor to fulfill the feedgas generation performance monitoring requirements of 13 CCR 1971.1(e)(5.2.3)(B).

Further, for OBD systems that have a catalyzed PM filter NMHC conversion monitor or are exempt from the catalyzed PM filter NMHC conversion monitoring requirements in accordance with section 13 CCR 1971.1(e)(8.2.4)(A), the manufacturer is not required to meet the feedgas generation performance monitoring requirements of 13 CCR 1971.1(e)(8.2.4)(B).[53] The EPA is also proposing the alternative approach of entirely waiving the requirements for catalyzed PM filters in 13 CCR 1971.1(e)((8.2.4)(A) and (B) based on instead meeting the PM filtering performance requirements in 13 CCR 1971.1(e)(8.2.1). These flexibilities are important to avoid fault codes being set that may improperly indicate a malfunctioned catalyst. The NMHC impacts can be so low that they are not reliably measurable and test results can instead be strongly influenced by test-to-test variation. The use of the DPF Efficiency monitor is appropriate because DPF's generally experience mechanical failure prior to catalyst failure due to their operating conditions.

The EPA is also proposing to clarify that the regeneration events counter associated with the in-cab display requirements in 40 CFR 1036.110(c)(2) is specific only to active and completed regeneration events. Similarly, the EPA is proposing to clarify that the requirements in 40 CFR 1036.110(c) are to display on-demand the ''lifetime'' rate of DEF consumption, not ''historical.''

The EPA is proposing to revise the in-cab display requirements in 40 CFR 1036.110(c)(1). These existing requirements state that when SCR- or DPF-related problems occur that result in engine derates (including inducements), that manufacturers must make the fault code responsible for the derate available on-demand in the cab. With the proposal to replace SCR-related derates with visible and/or audible notifications, as described in section V of this preamble, the EPA is proposing to update the text to clarify that this requirement pertains to fault codes that change the status of an aftertreatment system and isolate the display requirements that apply broadly from those that apply to AECDs that result in an engine derate (*i.e.,* for any DPF-related or SCR-related derates that may remain). The EPA notes that some AECDs may continue to result in engine performance derates for engine protection events such as low coolant to avoid overheating and damaging the engine or catastrophic damage to the aftertreatment system. The intent of the original requirement in 40 CFR 1036.110(c)(1) was to properly communicate what problem caused an engine derate to facilitate quick repair. The proposed amendment is relevant even if the EPA finalizes the proposal in section V.C.2 to replace SCR-related derates with visible and/or audible notifications because the display requirements also apply and would continue to apply to derates caused by the SCR or DPF system.

Finally, the EPA is proposing to clarify in 40 CFR 1036.110(c)(4) that manufacturers can use discretion to decide what to safely display while the vehicle is in-motion, which may be a more limited set of the required information than is displayed when the vehicle is stationary.

b. 40 CFR Part 1036, Subpart C—Certifying Engine Families

The EPA is proposing to amend 40 CFR 1036.205(r)(1) by referring to ''physically adjustable parameters'' instead of ''practically adjustable parameters'' to conform to the terminology established in the existing, more detailed provisions for adjustable parameters in 40 CFR 1068.50. Under those existing provisions, the regulations describe how to determine the practically adjustable range for both physically adjustable operating parameters and programmable operating parameters.

The EPA is proposing to clarify in 40 CFR 1036.235(b) how manufacturers test their flexible-fuel emission-data engines. Specifically, manufacturers may operate with the fuel mixture that best represents in-use operation or is most likely to have the highest NO_X emissions, or they may test with both fuels separately if they demonstrate to the EPA that intermediate mixtures are not likely to occur. The EPA is also proposing to replace the incorrect paragraph (a) reference in 40 CFR 1036.235(e) with a reference to paragraph (b) that describes testing.

The EPA is proposing a revision in 40 CFR 1036.240(b) that adds ''duty-cycle'' to clarify the applicable emission standard. The EPA also proposes to add a provision to 40 CFR 1036.240(c) allowing for assigned deterioration factors for small-volume engine families. Each manufacturer would be able to use assigned deterioration factors for any number of engine families, up to a combined annual production volume of 10,000 engines. This would restore certification provisions that apply through MY 2026 under 86.094–14. As

[49] California Air Resources Board. (2025) ''Appendix A–1: Proposed Amendments to Omnibus Title 13 Regulation Order.'' *https://ww2.arb.ca.gov/rulemaking/2025/orhdomnibus.*

[50] California Air Resources Board. (2022) ''Final Regulation Order: Section 1971.1 of Title 13, CCR.'' *https://ww2.arb.ca.gov/resources/documents/obd-ii-regulations-and-rulemaking.*

[51] California Air Resources Board. (2025). See page 90 of ''Appendix A–1: Proposed Amendments to Omnibus Title 13 Regulation Order.'' *https://ww2.arb.ca.gov/rulemaking/2025/orhdomnibus.*

[52] California Air Resources Board. (2022). See page 21 of the ''Final Regulation Order: Section 1971.1 of Title 13, CCR.'' *https://ww2.arb.ca.gov/resources/documents/obd-ii-regulations-and-rulemaking.*

[53] California Air Resources Board. (2022). See page 35 of the ''Final Regulation Order: Section 1971.1 of Title 13, CCR.'' *https://ww2.arb.ca.gov/resources/documents/obd-ii-regulations-and-rulemaking.*

part of the migration to 40 CFR part 1036, the EPA set up deterioration factor requirements in 40 CFR 1036.240 and 1036.245 to broadly allow companies to share deterioration factors across families using similar technologies. Manufacturers have raised concerns that this approach does not work for engines using alternative fuels or other technologies that are not uniformly deployed across their product line. Allowing assigned deterioration factors for small-volume engine families would remove the significant test burden associated with durability testing for those niche products. Such engines remain subject to the emission standards throughout the useful life.

The EPA is proposing changes throughout 40 CFR 1036.245 to accommodate the proposed addition of an accelerated aging procedure for heavy-duty spark-ignition engines in 40 CFR part 1065, subpart L. See the discussion of these changes in section III.E.3.j of this preamble.

The EPA is proposing to revise 40 CFR 1036.245(c) to clarify that the deterioration factors must be based on representative deterioration due to infrequent regeneration and that engine dynamometer hours accumulated during emission testing do not count toward total service accumulation hours. The EPA is proposing to revise 40 CFR 1036.245(c)(1) to clarify that the minimum engine dynamometer service accumulation hours include the dynamometer engine stabilization time accumulated prior to performing the low-hour emission measurement. The EPA is proposing to revise 40 CFR 1036.245(c)(2) to allow manufacturers to use the average of multiple emission tests to determine emission values used to calculate the deterioration factor. The EPA is proposing to allow this to minimize the influence of any variability associated with the emission measurement.

In 40 CFR 1036.245(c)(4), (c)(4)(i), and (c)(4)(ii) the EPA is proposing to clarify that, for hybrid powertrains, manufacturers may conduct service accumulation under paragraphs (c)(4)(i) or (ii) without the hybrid components by following 40 CFR 1037.551. The EPA is also proposing to add new paragraphs (c)(4)(i)(F) and (ii)(F) to clarify how to perform cycle validation during service accumulation, and state that cycle validation needs to be performed on at least one of each duty cycle type each time the engine is operated over the duty cycle sequence. These proposed clarifications are appropriate for the same reason described in the discussion of the proposed addition of the new 40 CFR 1036.245(c)(5) and (6).

The EPA is also proposing to clarify that spark-ignition engines may exclude the LLC from the service accumulation test sequences in 40 CFR 1036.245(c)(4)(i) and (ii) as these engines are not subject to certification over the LLC. The LLC has normalized speeds up to 106.4 percent. For spark-ignition engines with high-speed governors that are just above the maximum power of the engine, a normalized speed of 106.4 percent puts the test speed above the governed speed when using typical denormalization procedures. Thus, requiring service accumulation over the LLC for spark-ignition engines would require the manufacturer to apply the alternate maximum test speed provision in 40 CFR 1065.610(a)(2) not only for the LLC, but also the Federal test procedure (FTP) and supplemental emissions test (SET) duty cycles. Rather than force the engine manufacturers to test the engine over the FTP and SET duty cycles at an alternate maximum test speed just to accommodate the LLC, a duty cycle to which they are not required to certify, the EPA is proposing to update 40 CFR 1036.245(a)(3) to allow exclusion of the LLC for spark-ignition engines for the two-engine service accumulation test sequences.

The EPA is proposing to add a new 40 CFR 1036.245(c)(5) and (6) that includes alternative duty cycle validation criteria for service accumulation for engine dynamometer testing. Meeting the existing cycle validation criteria that are required for engine certification testing is not as important for service accumulation when using an engine dynamometer, especially when most of the service accumulation on the aftertreatment system is being done via the accelerated aging procedure in 40 CFR part 1065, subpart L. Furthermore, if one of the many duty cycles run during service accumulation failed the existing cycle validation criteria, the EPA recognizes that it would be impractical to void all of the service accumulation testing to date because one duty cycle did not pass the cycle validation criteria. The proposed revised cycle validation criteria would help ensure that the duty cycles are followed appropriately for service accumulation when using an engine dynamometer, while also avoiding situations in which a duty cycle is deemed invalid. Under the proposed provisions, setting the dynamometer command to minimum and using the operator demand to control speed for nonmotoring dynamometers would not adversely affect the aging of the aftertreatment during service accumulation and would allow service accumulation to be carried out on an eddy current dynamometer (which cannot motor due to load imparted on the engine from cooling water and bearing drag). Allowing the use of eddy current dynamometers under the proposed provisions would also open up additional test cells for use in service accumulation testing and increase test facility throughput.

In 40 CFR 1036.245(c)(7), the EPA is proposing to clarify that emission measurements for all regulated pollutants must be taken after the manufacturer finishes the required service accumulation that is conducted on an engine dynamometer.

The EPA is proposing to add clarification to 40 CFR 1036.245(c)(8)(i) that the useful life milage used in the calculation of the total service accumulation, representing hours of engine operation over the useful life, is based on the longest useful life for which the deterioration factors will be used. The EPA is proposing to eliminate the default average vehicle speeds of 40.26 mi/hr and 44.48 mi/hr for test sequences 1 and 2 in 40 CFR 1036.245(c)(7) that are used in the total service accumulation hours calculated using Equation 1036.245–1. The default values underestimate the aging hours for Light and Medium HDE because the vehicles in which these engines are installed are vehicles that operate at lower average speeds than those of test sequences 1 and 2. This can result in total service accumulation hours that are too low, which results in inadequate time to accurately account for catalyst chemical exposure and thermal exposure due to infrequent regeneration events. The current solution, to address the underestimation of aging hours from the use of average vehicle speeds of 40.26 mi/hr and 44.48 mi/hr, is for engine manufacturers to extend the service accumulation hours beyond those calculated using Equation 1036.245–1, which ensures that deterioration factors determined using the current default test sequence average vehicle speeds are not deficient. Under the proposed changes, manufacturers are now directed to develop their own average vehicle speed based on the applications used for determining the thermal exposure for the engine family as described in the field data discussion in 40 CFR 1065.1131 or 40 CFR 1065.1147. The EPA is also proposing to require the use of an average vehicle speed of 20 mi/hr if the average speed from the field data is less than 20 mi/hr. This is because a speed of lower than 20 mi/hr will result in the service accumulation hours exceeding the

useful life hours in Table 4 to paragraph (e) of 40 CFR 1036.104. The EPA proposes to allow the use of previously developed deterioration factors that used the test sequence default average vehicle speeds for carryover engine families in 40 CFR 1036.150(aa) for engine families that qualify for carryover certification as described in 40 CFR 1036.235(d). The EPA is also proposing in 40 CFR 1036.245(c)(8)(ii) to clarify that the service accumulation duration could be different if the testing is used for multiple primary intended service classes.

The EPA is proposing to clarify in 40 CFR 1036.245(c)(9) how to calculate the number of hours of testing remaining to finish service accumulation over the useful life for the accelerated bench aging of aftertreatment devices portion of the testing.

The EPA is proposing to clarify in 40 CFR 1036.245(c)(10) on what emission data engine the aftertreatment devices can be reinstalled once the accelerated aging portion of the testing has been completed.

The EPA is proposing to clarify in 40 CFR 1036.245(c)(11) and (12) references to applicable sections in the procedure in this section to enhance the ability to follow what is being required.

The EPA is proposing to revise 40 CFR 1036.245(c)(13) to remove the sentence instructing the manufacturer to create a linear curve fit of the emission measurements if the deterioration factor testing included multiple test points and proposing that the deterioration factor is determined using the emission data from the low-hour and useful life test points. Since the emissions measurements are made at the low-hour and useful life for each standard, a linear curve fit of the emission data is not needed and could result in unrepresentative results.

The EPA is proposing to add a new 40 CFR 1036.245(c)(14) to clarify how to determine separate deterioration factors for engines corresponding to a shorter useful life.

The EPA is proposing to correct a typographical error regarding the spelling of ''stabilized'' in 40 CFR 1036.246(b)(1)(i)(C).

c. 40 CFR Part 1036, Subpart E—In-Use Testing

The EPA is proposing to revise 40 CFR 1036.410(c) to correct a paragraph reference error. The section currently requires the manufacturer to notify the EPA before disqualifying any vehicle based on an illuminated malfunction indicator light (MIL) or stored OBD trouble codes as described in 40 CFR 1036.415(b)(2). However, 40 CFR 1036.415(b)(2) concerns the appearance of a MIL during in-use testing and how to address the MIL. The correct paragraph reference should be 40 CFR 1036.415(b)(3), which addresses vehicle disqualification due to the presence of an MIL if the vehicle cannot be repaired in a timely manner, which is the only provision that allows disqualification of a vehicle due to an illuminated MIL.

The EPA is proposing to revise 40 CFR 1036.415(d), 1036.420(c) and (d), and 1036.430(a)(3)(vii) to replace the term ''windows'' with ''test intervals'' as the Agency believes this term is clearer given that the 300 seconds of data that are averaged for binning purposes constitute a test interval. The EPA is also proposing to clarify that if a manufacturer does not measure total hydrocarbon emissions (THC) during the off-cycle emission test, they would set $x_{THCmeas}$ to zero in the chemical balance calculations required under 40 CFR 1065.655.

The EPA is proposing to add a new 40 CFR 1036.415(h) to clarify that, for hybrid powertrains that do not operate the engine at zero vehicle speed, the 1-Hertz (Hz) emission rate for all pollutants after the engine has started must be set to zero when the engine is off, the vehicle speed is zero, and the powertrain is keyed on and that the data points should not be excluded under 40 CFR 1036.530(c)(3)(ii). This proposed provision is similar to what currently exists in 40 CFR 1036.415(g) for stop-start and automatic engine shutdown systems and allows test intervals to be accrued and counted toward the idle bin minimum test interval limits when the engine is off.

The EPA is proposing to provide clarifications in 40 CFR 1036.420(d) on extending testing over multiple shift days to combine test intervals to achieve the minimum test interval requirement for each bin. The EPA proposes to include four examples of what circumstances might lead to the extension of testing to an additional shift day: data lost from gas analyzer range validation failure (40 CFR 1065.935(g)(5)(i)), drift validation failure (40 CFR 1065.935(g)(5)(ii)), excluded data (40 CFR 1036.530(c)(3)), and insufficient operation during the shift day (40 CFR 1036.415(f)).

The EPA is proposing changes to 40 CFR 1036.420(d) and 40 CFR 1036.425(c) to clarify how to determine the average ambient temperature used to calculate the off-cycle NO_X emission standard in 40 CFR 1036.104(a)(3). The EPA is proposing in 40 CFR 1036.420(d) to determine the mean ambient temperature, $\overline{T}_{amb}$, by averaging the continuous ambient temperature, $\overline{T}_{amb}$, over all shift days needed to reach the minimum test interval requirements for each bin. The EPA is proposing changes to 40 CFR 1036.425(c) to clarify that the mean ambient temperature is determined by taking the mean of $\overline{T}_{amb}$ from each of the engine tests.

The EPA is proposing in 40 CFR 1036.420(d)(2) to clarify that, for hybrid powertrains that do not operate the engine at zero vehicle speed, the manufacturer may populate Bin 1 with additional test intervals by setting the 1-Hz emission rate for all regulated pollutants to zero as described in 40 CFR 1036.415(h). This proposed provision is similar to what currently exists in 40 CFR 1036.420(d)(2) for stop-start and automatic engine shutdown systems and allows Bin 1 to accumulate exactly 2,400 Bin 1 test intervals in instances in which the number of test intervals falls short.

The regulation at 40 CFR 1036.430(a)(1)(ii) instructs manufacturers to include a summary of the vehicles they have disqualified from in-use testing and the reasons they disqualified them. The EPA is proposing to revise 40 CFR 1036.430(a)(1)(ii) to clarify that for vehicles disqualified from in-use testing for a MIL, the test report should include a description of the illuminated MIL or stored OBD trouble codes. The intent in 40 CFR 1036, subpart E, was for manufacturers to notify the EPA of any vehicles disqualified from in-use testing due to MIL illumination or OBD fault codes, and this proposed addition to 40 CFR 1036.430(a)(1)(ii) clarifies what information is expected to support vehicle disqualification actions.

d. 40 CFR Part 1036, Subpart F—Test Procedures

The EPA is proposing to revise 40 CFR 1036.501(h) to clarify that, for nonhybrid engines that qualify and use the powertrain test procedures, the provisions specified for nonhybrid powertrain testing should be used. For example, in 40 CFR 1036.520, for nonhybrid powertrains, continuous rated power ($P_{contrated}$) equals rated power (P_{rated}).

The EPA is proposing to add a new Figure 1 to 40 CFR 1036.501 to provide an example of a test sequence for determining criteria pollutant emissions for plug-in hybrid powertrains.

The EPA is proposing to revise 40 CFR 1036.510(c) to clarify that testing over the SET duty cycle is required for both compression-ignition and spark-ignition engines as SET standards exist for both combustion types in 40 CFR 1036.104.

The EPA is proposing to revise Figure 1 of 40 CFR 1036.510, Figure 1 of 40 CFR 1036.512, and Figure 2 of 40 CFR 1036.545 by removing ''Engine Start'' to eliminate confusion for plug-in hybrid powertrains in which the engine starts multiple times during charge-depleting operation to blend engine and electric power.

The EPA is proposing to revise 40 CFR 1036.510(g), 1036.512(c), 1036.514(d), 1036.530(j)(1), and 1036.545(o)(7) to clarify that, for hybrid powertrains, when determining total work over a test interval in 40 CFR 1065.650(d), system power (P_{sys}) from 40 CFR 1036.520(f) is used in place of the shaft power determination in 40 CFR 1065.650(d)(2) and paragraph 40 CFR 1065.650(d)(6) does not apply. In 40 CFR 1036.514(d), the EPA is also proposing to clarify that manufacturers would not exclude accessory loads when calculating total work over the LLC. The proposed clarification would be helpful because the direction in 40 CFR 1065.650(d)(6) to ''set all power values to zero during idle periods with a corresponding reference torque of 0 N·m'' could potentially lead someone to incorrectly believe that the accessory loads in 40 CFR 1036.514(c) should be excluded from the calculation of total work.

The EPA is proposing to revise 40 CFR 1036.510(b)(2) to clarify that, for hybrid powertrain testing, the manufacturer may set the battery to the lowest state-of-charge level that results in charge sustaining operation after preconditioning to help meet the net-energy-change requirement in 40 CFR 1036.545(a)(6). The EPA is also proposing to add a reminder to follow 40 CFR 1065.610(d)(3)(ii) to apply optional declared accessory loads. The EPA is proposing to revise 40 CFR 1036.510(b)(2)(iii) to correct the solution to the example problem for the calculation of C_dA.

The EPA is proposing to republish the SET duty cycle in 40 CFR 1036.510, Table 1, as the current version has only three significant figures for the road-grade coefficients. This table was intended to originally be published with four significant figures for these coefficients to be consistent with the road grade coefficients in the transient test interval for spark-ignition engines and powertrains under 40 CFR 1036.512 in paragraph (b) of Appendix B to 40 CFR part 1036, the transient test interval for compression-ignition engines and powertrains under 40 CFR 1036.512 in paragraph (c) of Appendix B to 40 CFR part 1036, and the transient duty cycle for compression-ignition engines and powertrains under 40 CFR 1036.514 in paragraph (d) of Appendix B to 40 CFR part 1036. The number of significant figures influences the amount of work the engine does over the duty cycle. Updating the SET road-grade coefficients from three to four significant figures would result in a relatively large difference in work (up to 90 percent) for a few of the low power mode points, but would only result in a total cycle work difference of less than 0.2 percent.

The EPA is proposing to remove the charge-depleting (CD) test requirement for criterial pollutant testing for SET in 40 CFR 1036.510(d). The criteria pollutant testing requirements for CD testing are currently not consistent with how CD testing has been historically carried out on light-duty vehicles, for which CD testing is only required on the FTP for criteria pollutant testing. When the EPA originally drafted and finalized the CD criteria pollutant testing requirements in the 2023 Final Rule, the Agency intended to put heavy duty testing on par with light duty testing for plug-in hybrids. For that to occur, CD testing for heavy-duty engines should only apply to the FTP. Note that this proposed change requires moving the CD test procedure from 40 CFR 1036.510(d)(2) through (4) to 40 CFR 1036.510(e)(1) through (3) as both charge-sustaining (CS) and CD testing are still required over the SET for the National Highway Transportation Safety Administration's (NHTSA) fuel economy program.

The EPA is proposing to update 40 CFR 1036.510(g) by adding new subparagraphs (1), (2), and (3) to provide three exceptions when calculating work over the test interval from hybrid powertrains as described in 40 CFR 1065.650(d). These exceptions require determining shaft power at each point in the test interval using the system power from 40 CFR 1036.520(f) instead of calculating it according to 40 CFR 1065.650(d)(2) and not setting power values to zero as described in 40 CFR 1065.650(d)(6). Under this proposal, the first exemption is to keep powertrain testing consistent with engine testing by requiring the shaft power to be determined at the engine shaft regardless of where power is measured. Under this proposal, the second exemption is needed because the engine in a hybrid powertrain may start multiple times during the test and it would be unrepresentative to zero out this power, since the energy to start the engine is coming from the powertrain. Under this proposal, the third exemption is needed to correct the total work for criteria pollutant testing by the additional energy from the battery if the net energy change (NEC) over the duty cycle is greater than 1 percent and less than or equal to 5 percent. The correction is needed because the total work of the powertrain includes both the energy produced by the engine and the energy that comes from the battery. The EPA is not proposing to allow correction to total work if the NEC is less than −1 percent since the additional energy in the battery may have come from regenerative braking near the end of the duty cycle. In addition, the EPA is proposing in 40 CFR 1036.545(a)(6) to increase the tolerance of NEC from ± 1 percent to ± 5 percent.

The EPA is proposing to update 40 CFR 1036.512(c) to clarify the total mass of each constituent and the total work over the test interval is determined as described in 40 CFR 1036.510(g). This would make this process consistent across duty cycles and test intervals.

The EPA is proposing to update 40 CFR 1036.512(d) to clarify the determination of criteria pollutant emissions over the FTP for plug-in hybrid powertrains, including adding a new 40 CFR 1036.512(d)(1)(i) to carry out preconditioning of the engine or powertrain as described in 40 CFR 1065.518(c)(1).

The EPA is proposing to update the composite emission calculation for criteria pollutant determinations for CD testing of plug-in hybrid powertrains in 40 CFR 1036.512(d)(1)(iv). The FTP duty cycle was designed such that the engine would have 20 minutes of operation, starting from a cold soak, resulting in fully warmed-up operation prior to the soak period that precedes the start of the hot-start test interval. Testing of plug-in hybrid vehicles could result in a scenario in which, during the CD testing, the engine starts near the end of the test interval, resulting in the engine not being fully warmed up by the end of the test interval. This would result in the inclusion of what would be considered some cold-start operation in the hot-start test interval, which could have the potential to bias the composite emission value high, as the emissions from the hot-start test interval are 85.7 percent of the composite test cycle. To ensure that FTP emissions from plug-in hybrid powertrains are treated in the same manner as regular or hybrid powertrains, the EPA is proposing to calculate the composite emission value as follows:

1. Determine the average of the sum of emissions over the first test intervals in which engine operation occurs and the subsequent test interval and add that to six times the emissions from the third

test interval, which is the true hot-start test interval.

2. Then divide that value by the average of the sum of the work over the first test intervals in which engine operation occurs and the subsequent test interval plus six times the work from the third test interval, which is the true hot-start test interval.

The EPA is proposing to update Figure 1 to paragraph (d)(4) of 40 CFR 1036.512 to remove the arrow that denotes ''engine start'' as the engine could start in other FTP test intervals without the engine entering charge sustaining operation. The EPA is also proposing to update the figure to support the proposed changes to 40 CFR 1036.512(d)(1)(iv).

The EPA is proposing to add a new Figure 1 to paragraph (d)(5) of 40 CFR 1036.512 to provide an example of the FTP CS criteria pollutant test sequence to provide an illustration of how the test sequence is carried out.

The EPA is proposing to revise 40 CFR 1036.514(a)(1)(i) to clarify what is meant by the statement that ''Declared idle torque must be zero.'' This proposed clarification is that the use of the optional declared idle torque in 40 CFR 1065.510(f)(5)(iii) is not allowed and must be zero. The EPA is proposing to revise 40 CFR 1036.514(b) to delete the existing paragraph 40 CFR 1036.514(b)(4) because there are no adjustments made to the procedures in the referenced 40 CFR 1036.510(d). The EPA is proposing to relocate the exception to replace ''SET'' with ''LLC'' to 40 CFR 1036.514(b)(1) and renumber subsequent paragraphs as the replacement of SET with LLC should be first in the order of exceptions.

The EPA is proposing to revise 40 CFR 1036.514(d) to reference 40 CFR 1036.510(g) to calculate the total mass of each constituent and the total work over the test interval rather than describing such in this paragraph. Doing this would provide one common location for total mass and work determination, including exceptions for hybrid powertrain testing. The EPA is also proposing to add a reminder that the work for accessory loads is not excluded from the work calculation as the LLC duty cycle has accessory load requirements that must be included.

The EPA is proposing to revise 40 CFR 1036.520(d) to clarify that when the manufacturer carries out the powertrain power and vehicle speed determination, the state-of-charge of the rechargeable energy storage system (RESS) must be at a representative level to deliver maximum power. The EPA is also proposing to change the warmup cycle to the FTP, rather than a recommendation of any vehicle speed and road grade that results in 75 percent of maximum power, to standardize the warmup and provide a level playing field across engine manufacturers. The EPA is also proposing to provide an initial ramp up of the vehicle speed to five mi/hr with a five second hold at this speed as the initial acceleration was not intended to be wide-open throttle from the initial depression of the pedal, which could cause problems for some powertrain architectures. The EPA is also proposing to alter the wide-open throttle maneuver after the five second hold at five mi/hr to ramp to the maximum driver demand for full load acceleration within three seconds. The EPA anticipates that these adjustments would provide some relief to the powertrain from the aggressive acceleration.

The EPA is proposing to revise 40 CFR 1036.520(e) and (f) to replace occurrences of ''transmission input'' with ''engine's primary output'' since the output shaft of the engine is the more commonly used term to identify where system power is determined for a conventional powertrain configuration.

The EPA is proposing to revise 40 CFR 1036.520(h) and (k)(2) to change the maximum coefficient of variation (COV) of the vehicle system power from two percent to one half of one percent. The COV is used to select data that determine measured rated power, which is then used to determine rated power and continuous rated power. The EPA is proposing this change because recent data from engine hybrid testing in which the transmission is simulated have shown that measured rated power is elevated during transmission upshift events, which can result in unrepresentatively high determinations of rated power and continuous rated power. Reducing the maximum COV of measured rated power from two percent to one half of one percent would lead to more representative values of rated power and continuous rated power by reducing the influence of shifting.

The EPA is proposing to limit the values of $P_{\text{contrated}}$ and P_{rated}, determined in 40 CFR 1036.520, for hybrids and plug-in hybrid powertrains. These values are used for determining the vehicle test mass and road grade in 40 CFR 1036.510, 1036.512, and 1036.514, using the equations in 40 CFR 1036.510. The equations were developed based on the rated power of non-hybrid diesel engines and with the assumption that hybrid powertrains would be designed to have comparable rated power to their non-hybrid diesel engine counterparts.[54] However, if a hybrid powertrain is designed to have higher rated power than its non-hybrid diesel engine counterparts, calculated values for vehicle test mass and road grade can result in a duty cycle that is not representative for the hybrid powertrain. To illustrate this, for example, the EPA has estimated that the Tesla Semi[55] has a $P_{\text{contrated}}$ of 740 kilowatts (kW), which would result in a vehicle test mass of 86,630 kg (190,987 pounds) using Eq. 1036.510–1.[56] In this case, the vehicle test mass is not representative since the vehicle has a gross combined vehicle weight rating of 82,000 pounds. The EPA proposes to address this in 40 CFR 1036.520 by limiting the values of $P_{\text{contrated}}$ and P_{rated} to the maximum value of rated power of non-hybrid diesel engines in that category. The EPA proposes to use the certification data for MY 2021 to 2024 diesel engines, which would result in the maximum rated power for Light HDE, Medium HDE, and Heavy HDE of 260, 340, and 450 kW, respectively.[57] For spark-ignition HDE, the EPA proposes using the same 260 kW value used for Light HDE. These rated power values would result in a maximum vehicle test mass of 22,009, 31,276, and 45,153 kg for Light HDE, Medium HDE, and Heavy HDE, respectively, using Eq. 1036.510–1. These values for vehicle test mass are comparatively high for vehicles with Light HDE, Medium HDE, and Heavy HDE, but the EPA's analysis supports that the power demand from the cycles would be representative when accounting for the corresponding road grade in each of the FTP, SET, and LLC duty cycles.[58]

[54] Memorandum to docket EPA–HQ–OAR–2026–0728. ''Summary of the Development of the Powertrain FTP, SET, and LLC Duty Cycles.'' June 2026.

[55] There are currently no publicly available data on the rated power from heavy-duty plug-in hybrids. For this illustration, the EPA instead used the rated power of heavy-duty battery electric vehicles since the same e-motors can be used for plug-in hybrids and battery electric vehicles.

[56] The $P_{\text{contrated}}$ of the Tesla Semi was estimated by using the performance specifications from Tesla's website (see *www.tesla.com/semi*) of zero to 60 miles per hour (MPH) in 20 seconds, with a gross combined vehicle weight rating of 82,000 lbs and physics-based calculations for heavy-duty vehicles.

[57] The certification data for diesel engines were used since data from diesel engines were used to develop the equations in 40 CFR 1036.510 for defining the vehicle model. Values were determined using rated power expressed to the nearest 10 kW. See Heavy-Duty Highway Gasoline and Diesel Certification Data (Model Years: 2015–Present). *www.epa.gov/compliance-and-fuel-economy-data/annual-certification-data-vehicles-engines-and-equipment.*

[58] Memorandum to docket EPA–HQ–OAR–2026–0728. ''Summary of the Development of the Powertrain FTP, SET, and LLC Duty Cycles.'' June 2026.

The EPA is proposing to update the emission sampling duration in the clean idle test in 40 CFR 1036.525(b)(3) from 1,200 second to 1,800 seconds to align this test with the CARB test procedure in 13 CCR 1956.8.

The EPA is proposing to add a new paragraph (c) to 40 CFR 1036.530 to add the already-existing requirement to perform drift verification as described in 40 CFR 1065.935(g)(5)(ii) and (iii). The EPA is also proposing to clarify that, for drift verification of CO and HC under 40 CFR 1065.935(g)(5)(ii), the manufacturer must determine a corrected value of the off-cycle emission values for Bin 2 in g/kW·hr using equation 1036.530–3 for each interval between analyzer verifications. Under this proposal, the corrected value is then compared to the uncorrected value or to the Bin 2 emission standard in 40 CFR 1036.104(a)(3), whichever is greater, to determine whether the drift is within the specified percentage limit in 40 CFR 1065.935(g)(5)(ii). The EPA notes that carbon dioxide (CO_2) drift correction and verification is based on the mass of CO_2 as described in 1065.935(g)(5)(ii), which references 40 CFR 1065.550(b)(3)(ii)(A). Since there is no off-cycle standard for CO_2, 40 CFR 1065.550(b)(3)(ii)(A) indicates that the verification is done on a mass basis. The EPA notes that the NO_X drift verification is based on an analyzer zero-verification limit of ±2.5 parts per million (ppm) for each interval between analyzer verifications, a zero-drift limit over the shift day of ±10 ppm, and a span-drift limit for each interval between analyzer span verifications of ±4 percent of the measured span gas value. The EPA is proposing to revise 40 CFR 1036.530(c)(2) to replace the term ''windows'' with ''test intervals'' as the Agency believes this term is clearer given that the 300 seconds of data that are averaged for binning purposes constitute a test interval. The EPA is proposing to revise 40 CFR 1036.530(c)(3)(ii) to clarify that no data is valid when the operator has the engine off beyond the existing exceptions for stop-start and automatic engine shutdown systems and a proposed additional exception for certain hybrid powertrains. Hybrid powertrains for which the engine does not operate at zero vehicle speed when the powertrain is keyed on work in a similar manner to stop-start and automatic engine shutdown technologies by eliminating engine idle when the engine is off, the vehicle speed is zero, and the powertrain is keyed on. The EPA is proposing to add a cross-reference to the newly proposed 40 CFR 1036.415(h) to consistently allow this hybrid powertrain type of idle reduction technology to report an emission rate of zero during these scenarios. The EPA is also proposing to add two test interval data condition exclusions at 40 CFR 1036.530(c)(3)(viii) and (ix), gas analyzer range validation failure according to 40 CFR 1065.935(g)(5)(i) and any data that does not meet the drift criteria in 40 CFR 1065.935(g)(5)(ii). This data is currently required to be excluded under existing 40 CFR 1065.935(g)(5); however, the EPA is proposing conforming additions under this provision for completeness and clarity, to make it easier for manufacturers to locate all the exclusion requirements in one place. The EPA is additionally proposing to revise the variable description for $e_{CO2FTPFCL}$ in 40 CFR 1036.530(e) to clarify that it is also the CS CO_2 emissions over the FTP duty cycle for plug-in hybrid powertrains. The variable $e_{CO2FTPFCL}$ is used as a surrogate for work and, if the CD CO_2 under the existing variable description was used, it would give a reduced work value as the CO_2 emissions under CD operation do not represent the amount of work being done due to the hybrid contribution. The EPA is thus proposing that the CS CO_2 emissions must be used to properly determine the normalized CO_2 emission mass over a 300-second test interval for off-cycle emissions. The EPA is also proposing to revise the variable description for m_{CO2} in 40 CFR 1036.530(g)(1) to clarify that it is the total drift-corrected CO_2 emission mass over the test interval. Drift correction is required for all gaseous pollutants measured during off-cycle testing as described in 40 CFR 1065.935(g)(5)(ii). This clarification is a reminder to the manufacturer that the CO_2 emission mass over the test interval must be drift corrected.

The EPA is considering a revision to 40 CFR 1036.530(c)(3)(iii) to allow the existing exclusion of data during an infrequent regeneration event to include any additional time needed for emissions levels to return to normal baseline levels. Under 40 CFR 1065.680, as amended in the 2023 Final Rule, the EPA specified that the duration of a regeneration event continues until aftertreatment performance and emission levels have fully returned to normal. The EPA adopted this change for certification because the FTP, SET, and LLC duty cycles are relatively short and data from operation immediately following regeneration may unrepresentatively bias measured emissions high on the short certification cycles. In addition, 40 CFR 1065.680 is structured to capture the emissions over the complete cycle, including operation during regeneration and the period until the next regeneration event occurs. As a result, defining the operation after a regeneration event when emissions are still stabilizing as part of the regeneration does not change the calculated infrequent regeneration adjustment factor and mitigated concerns that post-regeneration operation would otherwise be treated as normal baseline operation. The EPA requests comment on whether a corresponding redefinition of the regeneration event is warranted for off-cycle testing under 40 CFR 1036.530(c)(3)(iii). (C–13). The EPA notes that operation subject to off-cycle test procedures differs from certification duty cycles in that off-cycle testing spans significantly longer durations, reducing the likelihood that post-regeneration stabilization periods would disproportionately bias emissions high. In fact, exclusion of this data may result in biasing the emissions subject to the off-cycle standards low.[59]

The EPA is proposing amendments to 40 CFR 1036.545 to clarify and improve the powertrain test procedures. The EPA is proposing to update 40 CFR 1036.545(a)(3)(i) to clarify how the transmission state (in gear or idle) should be updated in the Greenhouse Gas Emissions Hardware-in-the-Loop (GEM HIL) model. The update should occur in the driver interface block. The EPA is proposing to revise 40 CFR 1036.545(a)(3)(ii) to clarify that a human driver can be used instead of a driver model. The EPA is proposing to revise Figure 1 to paragraph (a)(11) of 40 CFR 1036.545 by removing the appearance of ''drive idle'' and ''parked idle'' duty cycles from box 7, as they are only required to be run for engines installed in vocational vehicles under the existing 40 CFR 1036.535(c). Also in Figure 1, the EPA is proposing to modify the duty cycle exceptions notes for SET, FTP, and LLC to include notes, in addition to the existing note to disregard duty cycles in step 7, to disregard the duty cycles in step 8 and to disregard steps 10 and 11 in their entirety. The EPA is proposing these additions in this figure as these steps are not relevant to testing powertrains over SET, FTP, and LLC duty cycles. The EPA is also proposing to redesignate the paragraph that the figure resides in as 40 CFR 1036.545(a)(13).

[59] 40 CFR 1036.420(c) requires that Bin 1 include at least 2,400 test intervals (which is approximately 45 minutes of engine operation) and Bin 2 include at least 10,000 test intervals (which is approximately three hours of engine operation).

The EPA is proposing to revise Equation 1036.545–4 in the vehicle model calculations of 40 CFR 1036.545(f)(3) to clarify that cumulative distance, $D_{i\text{-}1}$, used to determine the percent grade ($G_{i\text{-}1}$), is calculated at each time step *i* to determine the cumulative distance driven from the test cycle grade profile in 40 CFR part 1037, appendix D.

The EPA is proposing to revise 40 CFR 1036.545(j)(4) to set the dynamometer target torque to zero when ramping to the target speed at 1 mi/hr/s. The proposed change is intended to minimize the energy used from the plug-in hybrid battery before the CD test sequence has started and to clarify the ramp rate. The EPA is proposing to revise 40 CFR 1036.545(j)(5) to clarify that, for plug-in hybrids, for a CD cruise cycle test sequence, the manufacturer must transition to the next duty cycle without altering the powertrain speed. This is because plug-in hybrid powertrains run the same vehicle configuration for the cruise cycles back-to-back to go from CD to CS, therefore they should not transition to zero vehicle speed between each cruise cycle. In 40 CFR 1036.545(j)(6), the EPA proposes to remove hyphens in the term ''duty cycle'' and clarify that the start of the next duty cycle must be within 60 to 180 seconds after shutting off the powertrain for non-plug-in hybrid and conventional powertrains. This is a conforming proposed revision as the plug-in hybrid would be able to run the duty cycles immediately per the update the EPA is proposing to 40 CFR 1036.545(j)(5).

The EPA is proposing to update 40 CFR 1036.545(m) to clarify that the manufacturer may delete points before performing the cycle validation when a hybrid engine is at idle. The EPA is also proposing to clarify that when manufacturers validate the measured output speed, they may time-align the reference and measured output speed values by up to 0.5 seconds as described in 40 CFR 1065.514(c).

The EPA is proposing to revise Equation 1036.545–9 used to create the GEM input for the simulated vehicle configurations in 40 CFR 1036.545(o)(3) to clarify that cumulative distance, $D_{CDi\text{-}1}$, is calculated at each test interval to determine the cumulative distance driven under CD conditions, which is then used to determine the utility factor.

The EPA is proposing to revise 40 CFR 1036.545(o)(4)(i) to correct an error in the equation referenced for testing with the torque measurement at the wheel hubs. The reference should be to Eq. 1036.545–10 instead of Eq. 1036.545–8.

The EPA is proposing to revise 40 CFR 1036.555(a) to replace the term ''windows'' with ''test intervals'' as the Agency believes this term is clearer given that the 300 seconds of data that are averaged for binning purposes constitute a test interval.

e. 40 CFR Part 1036, Subpart I—Definitions and Other Reference Information

The EPA proposes several revisions to the definitions of 40 CFR 1036.801. The EPA proposes new definitions for the terms ''certified configuration'' and ''useful life'' that are used throughout 40 CFR part 1036 but not explicitly defined. The EPA proposes corrections to the definition of ''designated compliance officer'' to reflect a recent reorganization in the Agency's Office of Transportation and Air Quality.

The EPA is proposing to update ASTM D975, ASTM D4809, ASTM D4814, and ASTM D7467, that are incorporated by reference in 40 CFR 1036.810(a), to the latest versions. The EPA is also proposing to correct existing 40 CFR 1036.810(d)(4) by adding the missing document title for CARB's 2019 regulation ''13 CCR 1971.5'' in the incorporation by reference entry.

f. 40 CFR Part 1036, Appendix B—Transient Duty Cycles

The EPA proposes to amend the footnotes for the transient test intervals for spark-ignition and compression-ignition engines in paragraphs (b) and (c), respectively, of Appendix B to 40 CFR part 1036 and the transient duty cycle for compression-ignition engines in paragraph (d) of Appendix B to 40 CFR part 1036 to change them from ''Close throttle motoring'' to ''Minimum operator demand.'' This proposed change would alleviate any confusion for engines that do not have throttles. The intent of the motoring points in these test intervals and duty cycles is to operate the engine with minimum operator demand, which results in the throttle being closed for engines that have throttles.

2. Proposed Revisions for Heavy-Duty Vehicles (40 CFR Part 1037)

The existing regulation at 40 CFR 1037.103 establishes evaporative and refueling standards for heavy-duty vehicles. For vehicles using liquefied natural gas, the existing regulation establishes hold-time requirements to limit off-gassing of fuel by referencing SAE J2343. The EPA is proposing to update the reference to the February 2018 version of SAE J2343 for the hold-time requirements that apply to those refueling systems. Also, the existing regulation specifies fuel connection requirements for vehicles using compressed natural gas by referencing the ANSI NGV1 standard in 40 CFR 86.1813–17. The EPA is similarly proposing to update the reference to the version of the ANSI NGV1 standard that was published December 2022.[60]

An earlier final rule included provisions allowing limited numbers of qualified heavy-duty highway vehicles to have certified engines meet alternative standards derived from the EPA's nonroad engine programs.[61] The provisions apply to amphibious vehicles, vehicles with maximum operating speeds of 45 mph or less, and all-terrain vehicles with portal axles. The provisions also apply to hybrid vehicles with engines that provide energy for an RESS. The EPA added a sunset clause for hybrid vehicles at the end of MY 2027 based on the expectation that greenhouse gas standards would lead to widespread availability of engines certified with hybrid power systems to emission standards under 40 CFR part 1036. Once there are engines certified to heavy-duty highway standards under 40 CFR part 1036 that meet the design requirements of these vehicles, it will no longer be necessary to preserve the option to use engines meeting the alternative standards. However, the EPA's observation is that engine manufacturers have been hesitant to pursue certification with hybrid powertrain systems and that the available highway-certified engines are too large for these applications, which leaves vehicle manufacturers with very limited prospects for pursuing these specific heavy-duty highway vehicle designs with hybrid powertrains after MY 2027. The EPA is proposing to address this by extending the allowance to use the alternative standards through MY 2030. At the same time, the EPA is proposing to reduce the annual limit on the number of such vehicle manufacturers may produce from 1,000 to 200. This change would treat specialty vehicles with hybrid powertrains the same as the other types of specialty vehicles. The EPA is not aware of any company having plans to produce more than 200 heavy-duty highway vehicles with hybrid powertrains per year that meet the qualifications in 40 CFR 1037.605. The proposed reduction in the maximum number of covered vehicles is intended only to avoid creating an incentive for companies to develop new

[60] See the proposed changes to the incorporation by reference provisions in 40 CFR 1037.810 and 40 CFR 86.1.

[61] 80 FR 73478 (Oct. 25, 2016).

plans to exploit the provision to circumvent the more stringent standards for heavy-duty engines certified under 40 CFR part 1036. The EPA is aware that this proposal comes at a time when it is difficult to predict how technology and marketing developments will lead to new availability of engines to serve vehicle manufacturers intending to make these specific hybrid vehicles beyond MY 2027. The EPA accordingly requests comment on the possible need to entirely remove the sunset on alternative standards for engines installed in hybrid vehicles. Similarly, the EPA requests comment on the need for a different limit on the annual number of hybrid vehicles with engines certified to the alternative standards, including maintaining the limit at 1,000. (C–14).

The EPA is also proposing minor amendments to 40 CFR 1037.605 to include references to the engine standards in 40 CFR part 86, subpart A. 40 CFR 1037.605 describes how vehicle manufacturers can use engines certified to alternative standards for certain specialty vehicles. The EPA previously amended 40 CFR 1037.605 to refer to the alternative standards specified in 40 CFR 1036.605. However, those alternative standards do not take effect until MY 2027 and the proposed amendments refer to analogous alternative standards that apply currently to heavy-duty engines under 40 CFR 86.007–11 and 86.008–10. The EPA is proposing to add the part 86 references to 40 CFR 1037.605 to clarify the appropriate cross-references through MY 2026.

The EPA proposes to revise 40 CFR 1037.801 to update the definition of ''Designated Compliance Officer'' to reflect recent Agency reorganization.

3. Proposed Revisions for Engine-Testing Procedures (40 CFR Part 1065)

a. 40 CFR Part 1065, Subpart A—Applicability and General Provisions

The EPA proposes to clarify in 40 CFR 1065.1(e) the use of the term ''test procedures'' to include actions related to required measurements, not just measurements related to emission standards.[62] The EPA is proposing several revisions to 40 CFR 1065.10, which specifies how other procedures can apply to testing. First, the EPA is proposing to remove paragraph (d) and move the existing text into the introductory text of paragraph (c) for clarity. The EPA proposes to correct terminology in the introductory text of paragraph (c) for two references to paragraphs within the section. The EPA also proposes to revise paragraph (c)(6) to clarify that, while the regulations generally allow manufactures to continue to use previously applicable test procedures for up to 12 months following the effective date, the Agency may, through a rulemaking, identify an earlier start date under the standard setting regulations for certain changes to test procedures, consistent with existing 40 CFR 1065.5(b). For example, the EPA may require manufacturers to use an updated equation starting on the effective date of a rule. The EPA proposes to revise paragraph (c)(7) for consistency with the corresponding engine testing provisions for recreational engines and vehicles in 40 CFR part 1051. Specifically, existing text in 40 CFR 1051.501(g)(2) states that ''We may reject data you generate using alternate procedures if later testing with the otherwise specified procedures shows contradictory emission data.'' The proposed revision would copy the text from 40 CFR 1051.501(g)(2) into 40 CFR 1065.10(c)(7) to clarify that the principle applies universally for all sectors.

In 40 CFR 1065.10 and 1065.12, the EPA proposes to replace references to ''alternate procedures'' with ''alternative procedures'' to be more precise. This proposed update in terminology, including for similarly imprecise uses of ''alternate'' (*e.g.,* ''alternate methods''), is reflected in proposed changes throughout 40 CFR parts 1036, 1037, and 1065.[63]

b. 40 CFR Part 1065, Subpart B—Equipment Specifications

The EPA is proposing to add a new 40 CFR 1065.140(b)(2)(vi) to allow the option to measure PM background concentrations for full and partial flow dilution sampling systems according to 40 CFR 1066.110(b)(2)(i). Currently, 40 CFR 1065.140(b) only allows measurement of the PM background concentration from the dilution air itself from the full-flow or partial-flow sampling system and the measurement must be carried out simultaneously with the emissions test. During the development of the vehicle testing procedures in 40 CFR part 1066, specifically during the light-duty vehicle Tier III rule, the EPA promulgated PM background measurement options for vehicle testing that could be used in addition to provisions in 40 CFR 1065.140(b).[64] These options were to address concerns from thermophoretic wall loss and subsequent re-entrainment of VOCs and semi-VOCs that can occur in the sampling system during a vehicle test and carry over to other vehicle tests. This concept is known as sampling artifact and can result in mass contribution to the sample filter due to both condensation of the hydrocarbons into PM and the filter materials ability to absorb gas-phase hydrocarbons. The filter mass gain associated with sampling artifacts could be test site-specific or similar across multiple test sites.

The PM background concentration measurement options that the EPA is proposing to allow include:

1. Use of a single test-site or multi test-site derived PM background correction using a moving-average background value if the PM sample media were all made by the same manufacturer and material.

2. Sampling of the PM background any time before or after an emission test provided the dilution tunnel blower is on, the vehicle is disconnected from the laboratory exhaust tubing, and the laboratory exhaust tubing is capped.

3. The duration of the background sample may be different than that of the test cycle in which the background correction is being applied.

4. The PM background correction may not exceed 5 micrograms (µg) or five percent of the net PM mass expected at the standard, whichever is greater.

Given the precedent set in the vehicle testing procedures, the EPA proposes that it is appropriate to provide engine manufacturers with similar relief to address PM sampling artifact associated with the engine testing procedures. The filter loading for a heavy-duty highway engine complying with the 2027 p.m. standard of 5 mg/hp·hr, tested in compliance with the minimum overall dilution ratio requirements in 40 CFR 1065.140(e)(2), will be around 80 µg on average and 35 µg at around 2 mg/hp·hr, which is the PM certification level expected. At 40 percent of the standard, the maximum allowable PM background correction of 5 µg would only reduce the resulting brake-specific mass result by 14.5 percent, with a 6.5 percent effect at the standard.

c. 40 CFR Part 1065, Subpart C—Measurement Instruments

In 40 CFR 1065.225(a)(1), the EPA proposes to correct a publication error that removed paragraph (a)(1) introductory text.

[62] This proposed revision is consistent with the proposed revision to 40 CFR 1066.1(f).

[63] Memorandum to docket EPA–HQ–OAR–2026–0728. ''Detailed Description of Proposal to Migrate Provisions for Nonconformance Penalties from 40 CFR part 86, subpart L, to 40 CFR part 1071.'' June 2026.

[64] 79 FR 23829 (April 28, 2014).

In 40 CFR 1065.257(d)(2), the EPA proposes to change the section reference for H_2O laser infrared analyzer (LIA) interference verification from 40 CFR 1065.375, which is the interference verification procedure for N_2O analyzers, to a newly proposed verification in 40 CFR 1065.358 that is specific to H_2O LIAs. Additional information on the proposed new interference verification can be found in section of this preamble describing changes to 40 CFR part 1065, subpart D.

d. 40 CFR Part 1065, Subpart D—Calibrations and Verifications

The EPA is proposing to revise the linearity verification frequency for torque in Table 1 to 40 CFR 1065.303. The regulation in 40 CFR 1065.303 currently requires linearity verification of torque measurement transducers and systems upon initial installation, within 370 days of testing, and after major maintenance. Linearity verifications typically involve the use of a series of calibration weights and a lever arm or use of a reference load cell or proving ring in series. Ratings for torque meters used for testing transmissions, axles, and large engines (*e.g.,* a 2-megawatt engine) can be 6 to 10 kilonewton-meters (kN·m) or higher. For these high-load torque systems, in-house calibration with weights and a lever arm or a reference load cell is not practical due to the space constraint and the time involved in the setup. Torque systems of this capacity are instead typically sent to the manufacturer for calibration. The calibration can take up to six months, including shipping time. This generally requires labs to have two sets of torque measurement systems to avoid downtime. The linearity verification requirements are set up to create an expectation of annual verifications. However, this arrangement of alternating measurement systems forces a lab to do the calibrations and then store the equipment until the calibration approaches expiration for the alternative set of equipment. The anticipated 370 days of testing for the calibration is typically reduced by several months after calibration during this storage period. This results in additional cost to the test lab. Data provided by torque measurement system manufacturers have indicated that, for systems or transducers sent off-site for linearity verification and then stored in a controlled environment, there is no degradation in the linearity for at least 185 days prior to re-entering service. To recognize the validity of a full year of calibrated measurement from torque measurement transducers and systems, the EPA is proposing to delay the start of the 370-day period by up to 185 days for equipment stored in a controlled environment. The extra time for preserving the calibrated equipment includes time to transport the equipment, before or after delivery to the test lab, even with no controlled environment during shipping.

The EPA is proposing to add the H_2O Fourier transform infrared (FTIR) spectroscopy interference verification in 40 CFR 1065.357, the H_2O LIA interference verification in 40 CFR 1065.358, and the ammonia (NH3) interference verification in 40 CFR 1065.377 to Table 1 to 40 CFR 1065.303 as they were accidentally omitted from the table when these sections were added to the CFR in a previous rule.

The EPA is proposing to revise the linearity verification frequency for H_2O LIAs in Table 1 to 40 CFR 1065.303. H_2O LIAs, which are a new analyzer type added to the CFR during a previous rule, are required to follow the linearity verification frequency for general gas analyzers of within 35 days before testing. H_2O FTIR analyzers are required to follow the linearity verification frequency for FTIR analyzers within 370 days before testing. At the time the H_2O LIAs and FTIR analyzers were added to 40 CFR part 1065, the H_2O LIA was not added to the list of analyzers that are allowed a longer verification frequency in Table 1 to 40 CFR 1065.303. The FTIR analyzers and H_2O LIAs'' linearity is inherently more stable than other analyzer types. Thus, for these reasons, the EPA is proposing to decrease the linearity verification frequency from 35 days to 370 days before testing to put this analyzer type on a level field with the FTIR. The EPA also notes that since H_2O analyzers were recently added to 40 CFR part 1065 to facilitate the certification of engines operating on zero-carbon fuels, no one has certified to date using the existing procedure that this proposed correction would revise.

The EPA is proposing to add a new 40 CFR 1065.358 to provide a procedure to verify interference from H_2O LIAs that is specific to this type of analyzer. Under the current 40 CFR 1065.257(d)(2), which was a new section added to the CFR during a previous rule, H_2O LIAs are required to follow the interference verification procedure in 40 CFR 1065.375 for N_2O analyzers, while H_2O FTIR analyzers are required to follow the FTIR specific procedure in 40 CFR 1065.357. At the time 40 CFR 1065.257 was written, it was thought that the H_2O LIA could use the same verification as the N_2O analyzer. The H_2O FTIR analyzer procedure was not appropriate for H_2O LIAs as CO_2 is the interference gas for FTIRs and the interference gas(es) for H_2O LIAs is dependent on the infrared absorption band. Recently, it was brought to the EPA's attention that there are multiple issues with requiring H_2O LIAs to use the N_2O analyzer interference verification procedure. Specifically, the system requirement (interference limit) is two orders of magnitude more stringent for the N_2O interference verification for the H_2O LIA than what is required for FTIR; 1.0 micromoles per mol (μmol/mol) (1 ppm) for N_2O verification versus 0.4 millimoles per mol (mmol/mol) (400 ppm) for the H_2O FTIR. The full-scale range for both the FTIR and H_2O LIAs is greater than 30 percent, therefore, system requirement should be 0.4 mmol/mol for both analyzers. The other issue is that the interference species are dependent on the H_2O infrared absorption band and some of the interferent species may dissolve in water. The current required N_2O interference procedure for H_2O infrared analyzers requires that the interference gases are humidified by passing them through a bubbler. Thus, for these reasons, the EPA no longer considers the N_2O interference procedure appropriate for the H_2O infrared analyzer. This proposed new H_2O infrared analyzer interference verification procedure would put this analyzer type on a level field with the FTIR. The EPA also notes that since H_2O analyzers were recently added to 40 CFR part 1065 to facilitate the certification of engines operating on zero-carbon fuels, no one has certified to date using the existing procedure that this proposed correction would revise.

The EPA is proposing to lower the tolerance on the value returned from successive mass determinations of reference PM sample media (filters) during reference sample weighing for the PM balance weighing process verification in 40 CFR 1065.390(d). The process currently requires that successive mass determinations of the reference filters return the same value within ±10 μg or ±10 percent of the net PM mass expected at the standard, whichever is higher.

The ±10 μg tolerance is a wide range for particulate filter-equipped engines and vehicles meeting current emission standards. A review of some engine and vehicle manufacturer PM weigh rooms indicated that their weighing process verification returns values within ±5 μg when everything is working properly, indicating that a tighter tolerance is warranted to dictate quality PM weighing process practice. The EPA notes that there are still some engine categories with PM standards that are

not particulate filter forcing, specifically category 1 and 2 marine engines and locomotive engines. For these engines, a tolerance of ±5 µg is unnecessarily tight, as the PM standards for these engines are generally one to two orders of magnitude higher than passenger vehicles, heavy-duty highway engines, and nonroad land-based engines regulated in 40 CFR parts 86, 1036, and 1039, respectively. To address this, the EPA will maintain the inclusion of the ±10 percent of the net PM mass expected at the standard option, which will maintain a larger tolerance for category 1 and 2 marine engines and locomotive engines.

e. 40 CFR Part 1065, Subpart F—Performing an Emission Test Over Specified Duty Cycles

The EPA is proposing to remove references to ''electronic integrating devices'' throughout 40 CFR part 1065, which includes deleting 40 CFR 1065.530(b)(8), redesignating the following paragraphs, and revising paragraphs (c)(1), (c)(2), and (c)(3). The use of ''electronic integrating devices'' predates the use of current electronic data loggers. This step in the pre-emission sampling process is obsolete and, therefore, the EPA is proposing to remove it.

The EPA is proposing to replace all occurrences of ''results'' with ''values'' in 40 CFR 1065.550 because the term ''values'' more closely resembles the emissions that are being verified for drift. The EPA is also proposing to delete all occurrences of ''brake-specific'' when referring to drift verification as the drift verification can be done on a brake-specific or mass per unit time (off-cycle Bin 1 testing) basis. Removal of ''brake-specific'' will make the drift verification procedure more universal.

f. 40 CFR Part 1065, Subpart G—Calculations and Data Requirements

The EPA is proposing to revise the variable descriptions for Equation 1065.640–1 to better define the terms by clarifying which variables are from the reference flow meter and which flow rates are at standard conditions.

The EPA is proposing to revise 40 CFR 1065.642(c)(2) to replace the variable V_{stdref} with $\dot{V}_{stdref}$ as the variable description indicated that the term is a volume flow rate and rate variables are denoted by an ''over dot'' in the NIST SP 811 style guide. The EPA is also proposing to revise the variable description to clarify that this is the standard volume flow rate output by the critical flow venturi (CFV) constant volume sampler (CVS) flow meter at a standard temperature and standard pressure.

The EPA is proposing to update the default CO_2 background concentrations from 375 µmol/mol to 428 µmol/mol to reflect the increase in background CO_2, which affects the carbon balance error verification and chemical balance calculations. These calculations are used to determine the exhaust gas mass flow that is needed for criteria pollutant mass emission calculations. The updates are being proposed to 40 CFR 1065.643 for the exhaust mass flow carbon balance error verification, Table 1 of 40 CFR 1065.655 for the amount of intake air CO_2 per mole of dry intake air and for the amount of dilution gas CO_2 per mole of dry dilution gas, Table 1 of 40 CFR 1065.656 for the amount of intake air CO_2 per mole of dry intake air and for the amount of dilution gas CO_2 per mole of dry dilution gas, and 40 CFR 1065.672 for drift correction. This proposed updates also affect the flow meter calibrations for CFV and subsonic venturis. Specifically, the molar mass of dry air is used in the molar mass of exhaust calculation in Equation 1065.640–9 of 40 CFR 1065.640, resulting in the need to update the molar mass of dry air value to 28.96623 grams per mol (g/mol). Updating this value results in a change of 0.002 percent when compared to the existing value of 28.96559 g/mol. Proposing this change also requires updating the molar mass of dry exhaust value from 28.7805 g/mol to 28.7812 g/mol in the example problems in 40 CFR 1065.640(d)(1) and 1065.642(b) and (c).

The EPA proposes to republish 40 CFR 1065.645(b) to improve the publication quality of existing Equation 1065.645–3.

The EPA proposes to republish 40 CFR 1065.650(b) and (g)(2)(ii) to improve the publication quality of existing equations.

The EPA is proposing to update 40 CFR 1065.650(d)(6) to clarify that all power values are set to zero during idle periods with a corresponding denormalized reference torque of 0 Newton-meters (Nm). For test cycles like the LLC that have long idle durations in which only accessory torque is applied, per the standard setting part, this work is required to be included in the cycle work calculation. However, as 40 CFR 1065.650(d)(6) currently exists, one could argue that this work is not included because curb-idle transmission torque (CITT) isn't applied, reference speed and torque are idle speed and 0 Nm (0 percent, 0 percent), and there is no mention of accessory load.

The EPA is proposing to update 40 CFR 1065.650(e)(2) to correct an equation reference error. The equation to calculate mean power is Equation 1065.650–14, but the paragraph incorrectly references Equation 1065.650–13.

The EPA proposes to republish 40 CFR 1065.655(c)(4) and (f) to improve the publication quality of existing equations in those paragraphs. The EPA is also proposing to revise 40 CFR 1065.655(e)(1)(i) to clarify that when verifying that the carbon, hydrogen, oxygen, sulfur, and nitrogen mass fractions add up to a total mass of 100 ±0.5 percent, normalization of the mass fraction results to total 100 percent is not allowed. This is to address concerns and ensure that test labs do not normalize their test results to falsely give the appearance that the test results meet the 100 ±0.5 percent requirement.

The EPA proposes to republish 40 CFR 1065.650(g)(2)(ii) and 1065.656(f) to improve the publication quality of existing variables in the text.

g. 40 CFR Part 1065, Subpart H—Engine Fluids, Test Fuels, Analytical Gases, and Other Calibration Standards

The EPA is proposing to revise 40 CFR 1065.750(a)(6) to extend the use of this procedure, which generates H_2O calibration gases with a humidity generator, to H_2O LIAs. The paragraph, as currently written, inadvertently limits the use to H_2O FTIR analyzers. Both of these analyzer types require the use of a humidity generator to generate the calibration gases needed to perform the required 40 CFR 1065.307 linearity checks.

h. 40 CFR Part 1065, Subpart J—Field Testing and Portable Emission Measurement Systems

The EPA is proposing to remove references to ''electronic integrating devices'' throughout 40 CFR part 1065, which includes removing 40 CFR 1065.935(c)(1), redesignating the following paragraphs, and revising 40 CFR 1065.935(d)(2). The use of ''electronic integrating devices'' predates the use of current electronic data loggers. This step in the pre-emission sampling process is obsolete and, therefore, the EPA is proposing to remove it.

The EPA is proposing to revise 40 CFR 1065.935(g)(4)(ii) by deleting the last sentence that provides instruction regarding data that do not meet the drift criterion. This instruction is redundant, already addressed by the reference to 40 CFR 1065.550 in 40 CFR 1065.935(g)(4)(ii). 40 CFR 1065.550 provides a step-by-step process for

validating drift and calculating emission results.

The EPA is proposing to revise 40 CFR 1065.935(g)(5)(i) to clarify that invalidation of data for the whole shift day due to exceedance of the overrange data limit applies only to the gas analyzer, and thus pollutant, for which the overrange occurred (specifically CO or HC). The EPA also proposes to revise 40 CFR 1065.935(g)(5)(i) to further clarify that if NO_X or CO_2 are invalidated for range, the data for the entire shift day for all pollutants is invalid. The EPA is proposing to revise 40 CFR 1065.935(g)(5)(ii) to delete the occurrence of ''brake-specific'' and to delete the last sentence that provides instruction regarding data that does not meet the drift criterion for the reasons explained for similar proposed revisions in section III.D.3.h of this preamble. The EPA is also proposing to revise 40 CFR 1065.935(g)(5)(ii) to clarify that CO and HC drift is verified as described in 40 CFR 1065.550(b)(3)(i)(A) and CO_2 drift is verified as described in 40 CFR 1065.550(b)(3)(ii)(A). The EPA is also proposing to clarify that for the purpose of verifying drift for CO, CO_2, and HC bin testing, the test intervals are the intervals between analyzer verifications. The EPA is also proposing to revise 40 CFR 1065.935(g)(5)(ii) to clarify that data is invalidated for the CO and CO_2 gas analyzers if they do not meet the drift criteria in 40 CFR 1065.550. This proposed change would alleviate potential confusion as the 40 CFR 1065.550 drift criteria are specific to CO and CO_2 only. The off-cycle HC criterion is different and covered in 40 CFR 1065.935(g)(5)(ii), as is the off-cycle NO_X criterion, which is covered in 40 CFR 1065.935(g)(5)(iii).

The EPA is proposing to revise 40 CFR 1065.935(g)(5)(iii) to clarify that the data for all pollutants is invalid if the NO_X analyzer drift limits in 40 CFR 1065.935(g)(5)(iii)(A) and (B) are not met. In 40 CFR 1065.935(g)(5)(iii)(B), the EPA is proposing to clarify that the span value is for a gas.

The EPA is proposing to delete the occurrence of ''brake-specific'' as it refers to off-cycle emission calculations in 40 CFR 1065.940(a). Emission calculations can be done on a brake-specific or mass per unit time (off-cycle Bin 1 testing) basis. Removal of ''brake-specific'' will make the off-cycle emission calculations more universal.

i. 40 CFR Part 1065, Subpart K—Definitions and Other Reference Information

The EPA is proposing to add a new definition for ''gas analyzer range'' in 40 CFR 1065.1001 to clarify what is meant by the gas analyzer overrange limit of one percent in 40 CFR 1065.935(g)(5)(i). By proposing to define gas analyzer range, the EPA is clarifying on what the one percent over range limit is based.

The EPA is proposing to revise the definition of ''oxygenated fuels'' in 40 CFR 1065.1001 by clarifying that the fuel is composed of at least 25 percent oxygen-containing compounds by volume. This is consistent with the use of oxygenated fuels in 40 CFR part 1065, subpart I.

The EPA is proposing to revise the definition of ''span'' to clarify that it is an adjustment based on the analyzer response to a calibration gas that is 75 to 100 percent of the range of the instrument as opposed to the instrument's maximum value. This proposed change is a conforming revision with the proposed addition of the new ''gas analyzer range'' definition.

The EPA is proposing to update the following ASTM methods, that are incorporated by reference in 40 CFR 1065.1010, to the latest version for each method: D86–23ae2, D93–20, D130–26, D381–25, D445–24, D525–12a, D613–25a, D910–24, D975–24a, D1267–23, D1319–25, D1655–25, D1837–17, D1838–21, D1945–25, D2158–21, D2163–23e1, D2598–21, D2622–24a, D2699–25, D2700–23, D2713–24, D2880–23, D2986–95a, D3231–25, D3237–22, D4052–22, D4629–24, D4814–25a, D4815–22, D5186–24, D5191–22, D5291–26, D5453–25, D5599–22, D5762–24, D5769–25, D5797–21, D5798–25, D6348–12, D6550–25, D6615–25, D6667–21, D6751–24, D7039–24, and F1471–09. The EPA is proposing to incorporate by reference, in 40 CFR 1065.1010, ASTM method E178–21, which is an outlier determination method proposed for use in 40 CFR 1065.1121(d).

j. 40 CFR Part 1065, Subpart L—Methods for Unregulated and Special Pollutants and Additional Procedures

The EPA is proposing a new 40 CFR 1065.1102 to provide a list of measurement systems under 40 CFR 1065, subpart L, that require linearity verifications using the requirements and procedures in 40 CFR 1065.307. This addresses flow rate and temperature measurement systems in the recently added vanadium sublimation and catalyst accelerated aging test procedures.

The EPA is proposing to revise the vanadium sublimation in SCR catalysts test procedure in 40 CFR 1065.1113 through 1065.1121, after receiving and considering feedback on the test procedure from labs carrying out these tests. The proposed revisions are as follows:

1. The EPA is proposing the following revisions to 40 CFR 1065.1115:

1.1. The EPA is proposing to add a new paragraph (d) that would allow the inclusion of an ammonia slip catalyst downstream of the vanadium SCR catalyst in certain circumstances, specifically only in the catalyst-coated monolith section of the reactor setup where the ammonia slip catalyst is part of the production aftertreatment system. Under the proposed provision, the ammonia slip catalyst must be sized based on the highest production system volume ratio of vanadium to ammonia slip catalyst expected. The intent of this proposed addition is for the testing to more closely reflect how vanadium sublimation will be affected by the presence of an ammonia slip catalyst. The EPA is also proposing to specify that the manufacturer may use a small amount of quartz wool between the vanadium and ammonia slip catalysts to address catalyst core alignment, with an allowance in such circumstance to exceed the 3-inch maximum core length in paragraph (a) of this section by up to 2 inches.

1.2. The EPA is proposing to modify the redesignated paragraph (g) to require measurement of vanadium, titanium, and either tungsten or antimony above their respective detection limits if the manufacturer wants to correct for vanadium-loaded particle contamination of the capture bed due to physical abrasion. The proposed addition (compared to the existing requirement) of the requirement for measurement and detection of tungsten or antimony would provide an additional quality check on whether the source of the titanium is abrasion from the act of coring or handling the catalyst core, as tungsten or antimony (or both) will be present if there is abrasion of the washcoat.

2. The EPA is proposing the following revisions to 40 CFR 1065.1117:

2.1. The EPA is proposing to revise paragraph (a) to denote that the space velocity target is over the catalyst-coated monolith system (which could include both vanadium and ammonia slip catalysts) and not just the vanadium catalyst itself. The EPA is also proposing to add a space velocity calculation and equation in paragraph (a) of this section as paragraph (a)(1) and redesignating the following paragraph.

2.2. The EPA is proposing to revise paragraph (b) by removing the five percent water test point. Test results using this procedure have shown that emissions of vanadium are always higher for the 10 percent water test

point versus the five percent test point as water has a significant effect on vanadium sublimation. The EPA is proposing to eliminate the five percent test point to streamline testing and reduce test burden, without impacting the robustness of the testing. The EPA is also proposing to clarify that this test point is required for diesel-fueled engines and that for engines fueled by fuels other than diesel fuel (*e.g.,* spark-ignited hydrogen-fueled engines) the manufacturer must use good engineering judgment to select an H2O volume percentage consistent with the maximum expected exhaust H2O content for that fuel, and thus test at a higher water content (maximum expected), as other fuels could have higher water content (more than 10 percent) in the exhaust. The EPA is also proposing to change the reactor temperature increase increment from 50 °C to ''up to 25 °C.'' The purpose of this change is to require labs to use shorter temperature intervals to better capture the sublimation temperature, which will also prevent labs from having to test at 25 °C lower than the temperature at which vanadium sublimation begins. The EPA is aware that labs may not be able to wait for the test results to determine when sublimation occurred and then go back and test at a point 25 °C lower. Therefore, the EPA's understanding is that most labs are testing over a series of temperatures for a given catalyst formulation in increments of 25 °C to determine the vanadium sublimation threshold temperature. Thus, the change the EPA is proposing more closely reflects how labs are testing today to meet the existing provisions and streamlines the provisions.

2.3. The EPA is proposing to revise paragraph (c) to include a new methodology for determining the effective sublimation temperature. To help address method detection limit (MDL) variability when determining the MDL and actual vanadium emitted during the sublimation test, the EPA is now proposing to require interpolation between the sublimation temperature and next lowest temperature, in conjunction with the MDL threshold, to determine the actual sublimation temperature.

3. The EPA is proposing the following revisions to 40 CFR 1065.1119:

3.1. The EPA is proposing to remove the requirement for analyzing field blanks from paragraph (c) of this section as the Agency did not provide a use for these blanks in the procedure. While the EPA does not expect environmental contamination of the catalyst core monolith or capture bed from the environment, any environmental contamination from the reactor setup would be captured by the reactor blank that would remain from the existing provisions.

3.2. The EPA is proposing to change the reactor temperature for the reactor blank test from the average test temperature to 750 °C or the highest temperature the reactor can maintain. This would ensure that any vanadium in the reactor system is volatilized for the reactor blank determination. The existing provision's use of average test temperature is problematic in that it varies for testing of different vanadium formulations and does not provide a consistent reactor blank temperature target. Moving to 750 °C or the highest temperature the reactor can maintain would allow a consistent temperature across all reactor blank tests within a laboratory and would allow the blank results to be used to maintain a rolling MDL.

3.3. The proposed addition to 40 CFR 1065.1115 to optionally test with the ammonia slip catalyst brought to light an issue in which the total volume of gas flow through the reactor may differ from that during the reactor blank test when maintaining the target space velocity of 35,000 hr-1. Testing at different volumetric flow rates could bias the method detection limit low if the volume of gas flowed through the catalyst coated monolith system is higher than that during the reactor blank test. The same holds true for the method detection limit threshold, which also scales with volume of gas flowed. To address this, the EPA is proposing to require an adjustment to both the lab-determined MDL from the existing 40 CFR 1065.1119(d)(1) (proposed 40 CFR 1065.1121(d)(2)) and the MDL threshold from the proposed 40 CFR 1065.1121(d)(3) via the proposed 40 CFR 1065.1119(c)(3), for which the volumetric flow rate differs between the two tests. The adjustment would be required to be carried out as described in 40 CFR 1065.1121(d)(4).

4. The EPA is proposing the following revisions to 40 CFR 1065.1121:

4.1. The EPA is proposing an addition to the introductory paragraph of this section to note that this section can be used to determine the mass of titanium, tungsten, antimony, and other elements contained in the catalyst material in addition to vanadium.

4.2. The EPA is proposing an addition to paragraph (a) of this section to note that all of the sample materials must be weighed prior to sample digestion. This includes the alumina capture bed, quartz wool, and quartz tube.

4.3. The EPA is proposing to add a new paragraph (c) to this section that provides an equation to calculate the vanadium test result.

4.4. The EPA is proposing to redesignate the current paragraph (c) of this section as paragraph (d) and to remove the determination of the reporting limit as there is no requirement to submit this to the Agency. The EPA is also proposing to revise proposed introductory paragraph (d) of this section to correct and replace ''average'' with ''median,'' as it is the median that is used to determine the inductively coupled plasma mass spectrometer (ICP–MS). The EPA is also proposing to revise redesignated paragraph (d)(1) of this section to correct the ICP instrument detection limit units, as they were mistakenly originally given as nanograms per liter (ng/L) and labs have been reporting this in milligrams per kilogram (mg/kg).

4.5. The EPA is proposing to revise the redesignated paragraph (d)(2) of this section to require that the MDL determined using at least seven reactor blank samples is maintained by the manufacturer using good engineering judgment to generate additional blanks and remove old blanks as needed. The EPA is proposing to allow an outlier check using section 7 of ASTM E178–21 to remove any data points for which results are not consistent with the sampled reactor blanks. The maintenance of the MDL over time can be done by maintaining a rolling MDL, updating it by removing the oldest reactor blank results as new reactor blank samples are taken. These proposed changes would provide the lab with more direction and certainty on how to carry out and maintain the MDL determination over time, as well as provide an appropriate means to remove data from the determination that are deemed inconsistent with respect to the historical reactor blank results.

4.6. The EPA is proposing to revise the redesignated paragraph (d)(3) of this section to lower the MDL from an optional 15 micrograms per cubic meter (µg/m3) to a required value at or below 7 µg/m3. Data generated at labs performing this test indicate that an MDL at or below this value is readily attainable if included with an outlier check. This also would address the concern that labs could potentially dial in a higher MDL under the current procedure, which equates to a higher vanadium sublimation threshold temperature during testing. The EPA is also proposing a requirement to report the MDL at a precision of two significant figures and to report the results and calculated MDL at the same

level of precision as the threshold. The EPA is also proposing to add a description regarding on what the 7 µg/m3 threshold is based with respect to volume flowed through the reactor, space velocity, test duration, and catalyst core volume.

4.7. The EPA is proposing to add a new paragraph (d)(4) to this section to provide the calculation method for correction of differences in volume flowed during the actual catalyst test and reactor blank test. This same calculation would also be used to adjust the MDL threshold and the lab-determined MDL. An example problem, results, and discussion of the results is also provided in the proposed provisions in new paragraphs (d)(4) and (d)(5) of this section.

4.8. The EPA is proposing to expand the existing paragraph (b)(4) of this section, which the Agency is proposing to redesignate as paragraph (e), to provide calculations for performing correction to the vanadium test results to account for physical abrasion of the catalyst. Correction would be based on either the manufacturer-supplied ratio of vanadium to titanium or the actual ratio from testing, if qualifiers are met (ratios of co-catalysts, tungsten or antimony, as a quality assurance/quality control check that they are within 10 percent of each other and 20 percent of catalyst supplier provided number).

The EPA is proposing to revise 40 CFR 1065.1125(d)(2) to allow the use of partial flow exhaust opacity measurement as an alternative to full flow exhaust opacity measurement without Agency approval. Full flow exhaust opacity measurement is done directly in the path of the exhaust pipe, while partial flow is done by extracting an undiluted portion of the exhaust for measurement in a pipe of predetermined path length that is part of the analyzer. 40 CFR 1065.1123, 1065.1125, and 1065.1127 were developed from the nonroad exhaust opacity measurement procedure in 40 CFR part 86, subpart I, and the locomotive procedure in 40 CFR 1033.525. Historically, partial flow exhaust opacity measurement was allowed without EPA approval for locomotive testing in 40 CFR 1036.525 prior to migration of that portion of 40 CFR 1033.525 to 40 CFR 1065.1125. The nonroad exhaust opacity measurement procedure in 40 CFR part 86, subpart I, did not mention partial flow measurement. In the development of the 40 CFR part 1065 procedure, the EPA inadvertently added a clause to 40 CFR 1065.1125(d)(2) to require Agency approval for partial flow exhaust opacity measurement systems. The EPA is proposing to remove the requirement for Agency approval. The EPA notes that correction of the measurement path length to account for the difference in path lengths between the partial flow exhaust opacity meter and the standardized exhaust path length is addressed in 40 CFR 1033.525 for locomotives and 40 CFR 1065.1127(e)(2) for everything other than locomotives.

The EPA is proposing to revise 40 CFR 1065.1127(d)(4) to remove the requirement to program the dynamometer to operate in torque-control mode throughout testing. This requirement was added in error when this procedure was migrated over from 40 CFR part 86, subpart I, as the test would be very difficult to carry out if the dynamometer was using torque control. The EPA is also proposing to extend the use of dynamometer motoring assist with negative flywheel torque to the acceleration in 40 CFR 1065.1127(d)(4)(iv). When the EPA migrated this procedure over from 40 CFR part 86, subpart I, the Agency inadvertently excluded this paragraph, only allowing motoring assist to be applied to the accelerations in paragraphs 40 CFR 1065.1127(d)(4)(i) and (ii).

The EPA is proposing to revise 40 CFR 1065.1133(a)(3) and 40 CFR 1065.1139(h)(2) to clarify that manufacturers may adjust the 10-ppm fuel sulfur rate during accelerated aging if the fuel on which the engine operates is shown to have a sulfur level that differs from diesel fuel. For example, under the proposed revisions, manufacturers might alter the target fuel sulfur level if the engine is fueled on natural gas.

The EPA is proposing to revise 40 CFR 1065.1137(d)(1)(ii)(B)(1) and (d)(2) to revise the variable for the thermal aging rate constant, kD. The current variable description is given as the equation for kD that is Equation 1065.1137–5. To simplify, the EPA is proposing to reference the section where Equation 1065.1137–5 appears (paragraph (d)(1)(ii)(A) of that section) rather than reproduce the equation for kD each time it appears.

The EPA is proposing to revise 40 CFR 1065.1137(d)(4)(iii)(A) to address the variable for the thermal aging rate constant, kD. The current variable description is given as the equation for kD that is Equation 1065.1137–14. To simplify, the EPA is proposing to reference the section where Equation 1065.1137–14 appears (paragraph (d)(4)(i) of that section) rather than reproduce the equation for kD each time it appears.

The EPA is proposing to revise 40 CFR 1065.1139(a) to clarify that if the standard setting part does not provide the manufacturer with a target number of useful life hours, the manufacturer must use good engineering judgement to determine the appropriate number of hours representing useful life based on the manufacturer's field data, developing a metric to equate miles to hours. The EPA is also proposing to clarify that if the manufacturer's aging of the aftertreatment includes service accumulation hours performed on an engine dynamometer, the manufacturer must subtract those hours, along with any engine stabilization hours, from the useful life total prior to determining the remaining hours needed for accelerated aging. The EPA is proposing to correct a reference error in 40 CFR 1065.1139(b)(2)(i) as paragraph (b)(1) is referenced, but it is not clear in what section of the CFR the paragraph is. The EPA is proposing to correct an editorial in 40 CFR 1065.1139(b)(2)(v)(C) where variables are missing italics. The EPA is proposing to add a reminder that if the manufacturer determines a lower acceleration factor in 40 CFR 1065.1139(e)(6)(v), that lower value is used in place of the default value of 10. The EPA is proposing to update the example that is given for determining the total number of accelerated aging hours for a Heavy HDE to better align with the example given in 40 CFR 1036.245. The EPA is proposing to replace the term ''alternate'' with ''alternative'' in 40 CFR 1065.1139(b)(1)(iv) for consistency of use.

The EPA is proposing to revise 40 CFR 1065.1139(d)(1) to clarify that the total number of regenerations during accelerated aging must be adjusted to account for the regenerations that occurred during service accumulations on an engine dynamometer.

The EPA is proposing to update 40 CFR 1065.1139(e)(3)(iii) and (iv) and (g)(1) and 40 CFR 1065.1145 introductory text and paragraph (d) to remove and replace the term ''full useful life'' with ''useful life'' as ''useful life'' is the term used throughout the standard-setting parts.

The EPA is proposing to revise 40 CFR 1065.1141(h) and 1065.1143(h) to clarify that the mass of ash found by DPF weight over the predicted mass of ash based on oil consumption is a ratio range and not a range of percent.

The EPA is proposing to revise 40 CFR 1065.1141(j) to allow sulfur to be added directly to the fuel line that feeds the engine as one of the options for accelerated aging for engine-based aging stands.

The EPA is proposing to add a new 40 CFR 1065.1143(j) to allow sulfur to be added directly to the fuel tank or the fuel line that feeds the burner as options for accelerated aging for burner-based aging stands.

The EPA is proposing to revise 40 CFR 1065.1145(a)(1)(i) to provide clarification that the NO_X target level for the cycle-average NO_X mass rate is consistent with the application if Method 1 is used to develop the accelerated aging cycle under 40 CFR 1065.1133(b) and is consistent with the weighted lab cycle NO_X measurements if Method 2 is used. The EPA is proposing to correct a typographical error in 40 CFR 1065.1145(a)(1)(ii) by changing ''will the be'' to ''will be the.''

The EPA is proposing to revise the recommended oxygen and water target ranges for burner-based accelerated aging for diesel-fueled engines in 40 CFR 1065.1145(a)(2)(i). Oxygen and water targets are not recommended for engine-based accelerated aging under 40 CFR 1065.1145(a)(1)(i), as the oxygen and water content of the exhaust is a product of the combustion of the fuel on which the engine is operating. Recommended targets are needed for burner-based accelerated aging as burner combustion can be different than engine combustion. The existing specifications require meeting oxygen and water targets during aging modes within ±2 percent for oxygen and ±2 percent for water. The 2 percent tolerance is an error, as it should not be 2 percent of the target level or 2 percent of the allowable range in volume percent; both of those tolerances are too narrow. The proposed ranges provide flexibility when carrying out the aging cycle, while not impacting catalyst aging. The EPA is also proposing to provide clarification that the NO_X target level for the cycle-average NO_X mass rate is consistent with the application if Method 1 is used to develop the accelerated aging cycle under 40 CFR 1065.1133(b) and is consistent with the weighted lab cycle NO_X measurements if Method 2 is used. The EPA is also proposing a NO_X tolerance of ±25 percent of the target level for burner-based accelerated aging, which was previously undefined for a burner-based platform. Adding the NO_X tolerance puts the burner-based platform on par with the engine-based platform, which already has a NO_X tolerance. However, note that the NO_X tolerance for the burner-based platform is less restrictive because there are limitations on the amount of NO_X that the burner can produce for any given mode, requiring undershooting of the NO_X target for some modes and overshooting at other modes. The EPA is proposing an exhaust flow tolerance of ±25 percent for individual cycle modes and a ±10 percent weighted cycle average for both burner-based and engine-based platforms to provide some assurance that the target exhaust flows are representative and being met. The EPA is proposing to correct a typographically error in 40 CFR 1065.1145(a)(2)(ii) by changing ''will the be'' to ''will be the.''

The EPA is proposing to add an accelerated catalyst aging test procedure for spark-ignition heavy-duty engine durability demonstration as sections 40 CFR 1065.1147 through 40 CFR 1065.1155. Accelerated catalyst aging for heavy-duty highway engines is allowed as an option for deterioration factor determination for certifying an engine's emissions out to its useful life in 40 CFR 1036.245. 40 CFR 1036.245 references the accelerated aging test procedures for compression-ignition engines in 40 CFR 1065.1131 through 40 CFR 1065.1145. 40 CFR 1036.245 provides a reference to the light-duty vehicle catalyst accelerated aging test procedure in 40 CFR part 86, subpart S, as an example of a procedure that a manufacturer might use for accelerated aging of heavy-duty spark-ignition engines. The EPA received requests from heavy-duty spark-ignition engine manufacturers to add a catalyst accelerated aging test procedure specific to heavy-duty spark-ignition engines to 40 CFR part 1065. To address this request, the EPA is proposing to adapt the light-duty vehicle accelerated aging test procedure in 40 CFR 86.1823–08 for heavy-duty spark-ignition engines and add this procedure to 40 CFR part 1065. This includes adapting portions of 40 CFR part 86, Appendices V, VII, VIII, and IX, as referenced in 40 CFR 86.1823–08. The new sections include a standard catalyst bench-aging procedure that provides a means to accelerate aging of the catalyst-plus-oxygen-sensor system on a catalyst aging bench using the standard bench cycle. The procedure also allows the manufacturer to develop their own bench aging procedure with EPA approval. The migration and adjustment of this test procedure to 40 CFR part 1065 will provide the engine manufacturers with certainty regarding the expectations of accelerated heavy-duty spark-ignition engine testing, while providing flexibility to the test process.

IV. Nonconformance Penalties for Diesel-Fueled Medium HDE and Heavy HDE

Under CAA section 206(g), a manufacturer is allowed to produce engines that do not meet the applicable standards ''if such manufacturer pays a nonconformance penalty as provided under regulations promulgated by the Administrator after notice and opportunity for public hearing.'' [65] CAA section 206(g) also requires that such regulations provide a formula to determine the NCP amounts, and that those amounts:

- May vary from pollutant to pollutant;
- May vary by class or category or vehicle or engine;
- Shall take into account the extent to which actual emissions of any air pollutant exceed allowable emissions standards;
- Shall be increased periodically to create incentives for the development of production vehicles or engines which achieve the required degree of emission reduction; and
- Shall remove any competitive disadvantage to manufacturers whose engines or vehicles achieve the required degree of emission reduction.[66]

Since the promulgation of the first NCP rule in 1985, subsequent NCP rules generally have been described as continuing ''phases'' of the initial NCP rule. The first NCP rule (Phase I), sometimes referred to as the ''generic'' NCP rule, established three basic criteria for determining the eligibility of emission standards for NCPs in any given MY.[67] The first criterion is that the emission standard in question must become more difficult to meet. This can occur in two ways, either by the emission standard itself becoming more stringent or due to its interaction with another emission standard that has become more stringent. Second, substantial work must be required to meet the emission standard. The EPA considers ''substantial work'' to mean the application of technology not previously used in that vehicle or engine class/subclass, or a significant modification of existing technology, to bring that vehicle/engine into compliance. The EPA does not consider minor modifications or calibration changes to be classified as substantial work. Third, the EPA must find that a manufacturer is likely to be noncomplying for technological reasons (referred to in earlier rules as a ''technological laggard''). Prior NCP rules have considered such a technological laggard to be a manufacturer who cannot meet a particular emission standard due to technological (not economic) difficulties

[65] 42 U.S.C. 7525(g).

[66] 42 U.S.C. 7525(g)(3).

[67] 50 FR 35374 (Aug. 30, 1985). For existing regulatory language, *see* 40 CFR 86.1103–87.

and who, in the absence of NCPs, might be forced from the marketplace.

The criteria and methodologies established in the 1985 NCP rule have since been used to determine eligibility and to establish NCPs for a number of heavy-duty emission standards. NCP Phases II through VII, published between 1985 and 2012,[68] established NCPs that, in combination, cover the full range of heavy-duty vehicles and engines—from heavy light-duty trucks (6,000–8,500 pounds gross vehicle weight) to the largest diesel trucks and urban bus engines. NCPs have been established for HC, CO, NO_X, and PM. The most recent NCP rule, the Phase VII rule, established NCPs for the MYs 2012 and later NO_X standard for Heavy HDE. This proposed rule would establish a new Phase VIII in that series of NCP rules.

Once a regulation promulgated by the Administrator after notice and opportunity for public hearing specifies NCP provisions for a class of engines, any manufacturer may certify engines from that class using NCPs. Manufacturers using NCPs would go through the certification process, submitting data showing that the engine complies with emission standards, except that NO_X emissions may exceed the applicable standard, but can be no higher than the upper limit (UL) established through an NCP rulemaking.[69] Certification would generally be contingent on performing tests in a production compliance audit (PCA) to establish a compliance level.[70] The compliance level is in turn used to calculate the NCP for certifying engines with emissions above the applicable NO_X standard.[71]

A. NCP Eligibility

As discussed in this section, the EPA must determine that the above-named three criteria are met to determine that an NCP should be established in any given MY.[72] The EPA believes these criteria have been met for the MY 2027 NO_X standard for Medium HDE and Heavy HDE and the Agency is therefore proposing to establish NCPs.

The first criterion is that the emission standard is more stringent, which is the case for the new NO_X, PM, HC, and CO emission standards under the MY 2027 program.

The second criterion is that substantial work must be required to meet the emission standard. The EPA believes that only the NO_X emission standard from the 2023 Final Rule meets the second NCP criterion.[73] The previous NO_X emission standard for heavy-duty engines was 200 mg/hp·hr. The MY 2027 standards are 35 mg/hp·hr for NO_X for the FTP and SET duty cycles and 50 mg/hp·hr for a new duty cycle that covers low-load operation (LLC). When promulgated, the EPA concluded that the 35 mg/hp·hr NO_X standard was a technology-forcing standard because the Agency projected new technology hardware would be required to meet the standard. For example, the EPA demonstrated that one way to meet the MY 2027 NO_X standard was equipping the engine with cylinder deactivation (CDA), dual-SCR aftertreatment configuration, closed crankcase, and heated DEF dosing. It is therefore logical to conclude that substantial work is required to meet the MY 2027 NO_X emission standard.

Third, the EPA must find that a manufacturer is likely to be noncomplying for technological reasons. The EPA is proposing to establish NCPs for diesel-fueled Medium HDE and Heavy HDE because the Agency has information indicating that multiple engine manufacturers will likely be unable to demonstrate their technology of choice will meet the MY 2027 NO_X standards for some engines in these two engine categories by January 2, 2027 (the start of the MY). Without the availability of NCPs, one or more engine manufacturers will be forced to stop selling specific engine families until their development processes are complete. This is based on multiple meetings the EPA has had with individual engine and vehicle manufacturers over the past year, and detailed confidential information provided by engine and vehicle manufacturers regarding the development status of Medium and Heavy HDEs.

B. Nonconformance Penalty Rates

The NCP rates proposed in this rule rely on the existing NCP regulatory principles established in previous NCP rules. This section briefly reviews the NCP rate formula originally promulgated in the Phase I rulemaking (currently found at 40 CFR 86.1113–87) and discusses how the EPA arrived at the NCP rates proposed in this rule.

As described in section IV.D of this preamble, the EPA is proposing to migrate the NCP provisions from 40 CFR part 86, subpart L, to a new 40 CFR part 1071. This proposed migration is intended to retain the primary principles established in past NCP rules while modernizing outdated provisions, improving clarity, and harmonizing current certification and other testing practices. The main revisions the EPA is proposing for the NCP regulations include new cost parameters to reflect the compliance costs for the MY 2027 standards, a new UL relative to the MY 2027 NO_X standards, and a change in the units of the cost parameters from g/hp·hr to mg/hp·hr to match the MY 2027 standards.

The proposed NCP rates are specified for MY 2027. As required in CAA section 206(g)(3)(D), the existing regulations include a formula that increases the NCP rates with each new MY. The EPA proposes to apply this annual adjustment formula to the NCPs by setting the 2027 MY as year one. Consistent with past NCP Phases, these proposed NCPs would be available the first year of the new emission standard, which becomes year one for purposes of the annual escalator.

As in the previous NCP Phases, the EPA is proposing five key parameters that would be applied in the NCP formula to define the per engine NCP for a given engine family based upon its compliance level. First, the UL is the emission level above which no engine may be certified. Second, the average cost of compliance (COC50) is an estimate of the industry-wide average incremental cost per engine (including any changes to vehicles to install these new engines) associated with meeting the standard for which an NCP is offered, compared with meeting the UL. Third, the 90th percentile cost of compliance (COC90) is an estimate of the 90th percentile incremental cost per engine associated with meeting the standard for which an NCP is offered, compared with meeting the associated UL. Conceptually, COC50 represents costs for a typical or average manufacturer to comply, while COC90

[68] The previous NCP rules include: the Phase VII rulemaking (77 FR 54384, Sept. 5, 2012), the Phase VI rulemaking (67 FR 51464, Aug. 8, 2002), the Phase V rulemaking (61 FR 6949, Feb. 23, 1996), the Phase IV rulemaking (58 FR 68532, Dec. 28, 1993), the Phase III rulemaking (55 FR 46622, Nov. 5, 1990), the Phase II rulemaking (50 FR 53454, Dec. 31, 1985), and the Phase I rulemaking (50 FR 35374, Aug. 30, 1985).

[69] *See* 40 CFR 86.1106–87(a) and proposed 40 CFR 1071.15.

[70] *See* 40 CFR 86.1106–87 and proposed 40 CFR 1071.30. *See* also 86.1112–87 and proposed 40 CFR 1071.40.

[71] *See* 40 CFR 86.1113–87 and proposed 40 CFR 1071.85.

[72] *See* 40 CFR 86.1103–2016(b).

[73] The EPA adopted new HC, CO, and PM standards for MYs 2027 and later heavy-duty engines in the 2023 Final Rule. The EPA is not proposing NCPs for any of these pollutants because the Agency does not project the standards to require additional technology, since these standards were set to prevent emissions from increasing above the levels engines are already achieving. *See* section IV.B.4 of this preamble for the HC, CO, and PM standards the EPA proposes would apply under certain NCP scenarios.

represents costs for the manufacturers with the highest compliance costs.[74]

Fourth, the average marginal cost of compliance (MC50) is an estimate of the industry-wide average marginal cost of compliance per unit of reduced pollutant associated with the least cost-effective emission control technology installed to meet the new standard. In this proposal, MC50 is measured in dollars per mg/hp·hr for heavy-duty engines. Fifth, F is a factor used to derive the 90th percentile marginal cost of compliance (MC90) based on MC50 (the minimum value of F is 1.1, the maximum value of F is 1.3). MC90 defines the slope of the NCP rate curve near the standard and is equal to MC50 multiplied by F.

The derivation of the cost parameters is described in a Draft Technical Support Document (DTSD) for this rulemaking.[75] All costs are presented in 2024 dollars. The DTSD also includes alternative cost analyses that were considered, which are summarized in section IV.C of this preamble.

1. Upper Limit

As described below, the EPA is proposing the UL for NO_X for this NCP rule at 200 mg/hp·hr, which is the level of the NO_X standard that applies to MYs 2026 and earlier heavy-duty engines. The UL is the emission level established by regulation above which NCPs are not available and a heavy-duty engine cannot be certified or introduced into commerce. CAA section 206(g)(2) refers to the UL as a percentage above the emission standard, set by regulation, that corresponds to an emission level the EPA determines to be ''practicable.'' The UL is an important aspect of the NCP regulations not only because it establishes an emission level above which no engine may be certified, but it is also a critical component of the cost analysis used to develop the NCP rates. The regulations specify that the relevant costs for determining COC_{50} and COC_{90} are the differences between an engine at the UL and one that meets the applicable standards (*see* existing 40 CFR 86.1113–87 and the proposed new 40 CFR 1071.80 that would apply to MYs 2027 and later engines).

Under the Phase I rulemaking, the EPA concluded that the UL should be reasonably achievable by all manufacturers with engines in the relevant class.[76] Setting an UL below the standard that applied before the new standard is in effect may lead a manufacturer to invest in intermediate technologies, when the manufacturer could instead direct its resources and additional lead time offered by NCPs to developing a fully compliant engine. Similarly, a manufacturer of a previously certified engine or vehicle should not be forced to immediately remove a heavy-duty engine or vehicle from the market when an emission standard becomes more stringent. The prior NO_X emission standard meets these goals because manufacturers have already certified their vehicles to that standard.

Manufacturers are currently certifying all of their engines at or below the 200 mg/hp·hr NO_X standard. Thus, the EPA is proposing the UL for this NCP rule at 200 mg/hp·hr NO_X. This will conform to the purpose of NCPs, which is to allow manufacturers to continue selling engines they are currently producing while developing engines which meet the new standard.

2. General Methodology

Based on the available data, the EPA has determined that the best methodological approach for this proposal is to rely on the approach the Agency took in the 2023 Final Rule to determine the incremental technology needed to meet the MY 2027 standards. The EPA selected a baseline engine technology package that would employ the same basic emission controls used to meet the MY 2026 NO_X and PM emission standards, which includes exhaust gas recirculation, optimized turbocharging, optimized fuel injection, diesel oxidation catalysts, DPFs, and liquid urea-based SCR with a single dose. For estimates of COC_{50} and COC_{90} for NCPs in this proposal, the EPA assumes a technology package that includes an engine equipped with CDA, dual-SCR aftertreatment configuration, closed crankcase, and heated DEF dosing systems, consistent with the technology package used in the Agency's feasibility demonstration and cost projections for the 2023 Final Rule. In this proposal, the EPA estimated $COC_{50}$and COC_{90} using component cost data from the 2023 Final Rule's technology cost teardown study of the aftertreatment systems of an engine meeting MY 2026 standards and one designed to meet the MY 2027 standards. As described in the DTSD for this proposal, the EPA believes estimating the NCPs based on public data that the Agency has already released through a notice and comment process is a reasonable basis upon which to determine compliance costs. The EPA is requesting comment on other data sources and alternative methodologies based on other technology packages manufacturers are developing to meet the MY 2027 standards. (C–15).[77]

A key element of the NCP cost parameters is COC_{90}, which defines the maximum NCP for engines emitting at the UL. Figure IV–1 is an illustrative figure of an NCP NO_X curve for MY 2027.

[74] As was done in previous NCP rules, costs include additional manufacturer costs and additional owner costs, but do not consider certification costs because both complying and noncomplying manufacturers must incur certification costs.

[75] U.S. Environmental Protection Agency. ''Amendments and Nonconformance Penalties for Model Year 2027 and Later Heavy-Duty Highway Engines and Amendments to Inducement Provisions for SCR-Equipped Diesel Engines: Draft Technical Support Document—Nonconformance Penalty Analysis''. June 2026. EPA–420–D–26–003.

[76] 50 FR 35374 (Aug. 30, 1985).

[77] *See* section IV.C.4 of this preamble.

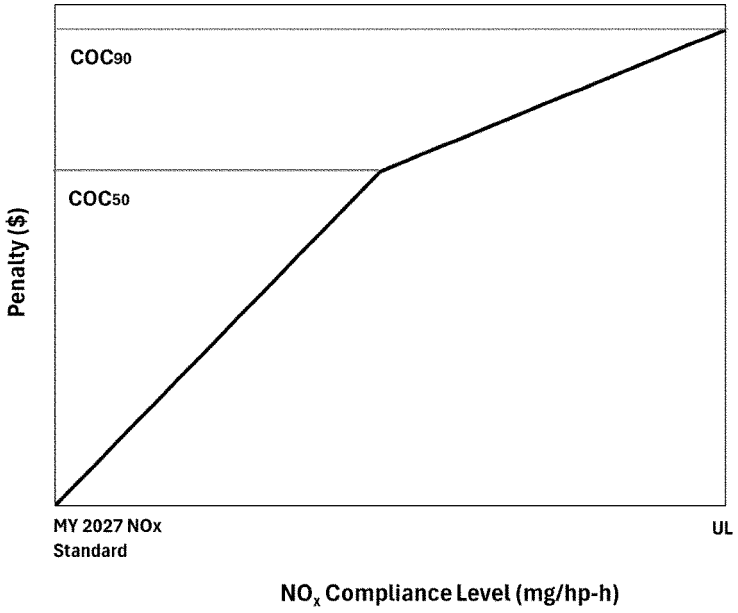

Figure IV-1 – Generic NCP Versus Compliance Level

The NCP for engines at the UL would be equal to the EPA's estimate of the highest marginal cost paid by a complying manufacturer for reducing NO_X emissions from 200 mg/hp·hr to 35 mg/hp·hr. If the EPA estimates that marginal compliance costs change as the compliance level approaches the standard, COC50 would define the point on the curve at which the slope changes. For this proposal, the EPA calculated COC50 using the direct manufacturing costs, updated to 2024 dollars, from the 2023 Final Rule's projected technology package, which included aftertreatment catalyst volumes for engines representing average displacements within each of the Medium HDE and Heavy HDE categories. The EPA calculated COC_{90} using the same cost methodology for COC_{50}, but with the aftertreatment catalyst volumes increased to match the largest displacement Medium HDE and Heavy HDE for each category. This resulted in a roughly 33 percent and 13 percent increase in the catalyst and canning costs for Medium and Heavy HDE, respectively.

In addition to using the direct manufacturing costs to estimate COC_{50} and COC_{90}, the EPA includes the indirect costs and the incremental lifetime DEF consumption. For the indirect costs, the EPA relied on the retail price equivalent (RPE) factors used in the 2023 Final Rule. See Table IV–1 for these RPE factors.

Table IV-1 Retail Price Equivalent Factors in the Heavy-Duty Truck Industry

Cost Contributor	Value
Direct manufacturing cost	1.00
Indirect cost category contributor	
Warranty	0.03
R&D	0.05
Other (admin, retirement, health, etc.)	0.29
Profit (cost of capital)	0.05
RPE multiplier	**1.42**

To estimate the incremental lifetime DEF consumption, the EPA relied on the 2023 Final Rule's analysis that estimated lifetime DEF consumption for each MOVES vehicle type and regulatory class. For this analysis, the EPA created a single cost for each MOVES regulatory class by using a population-weighted average of each MOVES vehicle type. Lifetime costs were determined using a 7 percent discount rate, which the EPA expects to match how the heavy-duty industry considers future costs. The lifetime DEF costs for Medium HDE and Heavy HDE were estimated to be $433 and $2,041, respectively, in 2024 dollars.

To estimate MC_{50}, the EPA assumed use of a less cost-effective emission control technology to reduce NO_X emissions from 65 mg/hp·hr to 35 mg/hp·hr. Reducing emissions by the last 30 mg/hp·hr requires a technology that can raise the exhaust temperatures under

low-load and cold-start operation. For the 2023 Final Rule, this level of emissions reduction was achieved by a combination of equipping the engine with cylinder deactivation and raising the engine idle speed. An alternative technology would be to install an electric exhaust heater with a 48-volt (V) generator (e-heater). Since the incremental cost for an e-heater is greater (*i.e.,* less cost-effective) than the costs of CDA and engine calibration, the EPA used the cost of the e-heater system to determine MC_{50}. In addition to basing MC_{50} on the incremental direct and indirect manufacturing costs, the EPA also estimated the incremental increase in DEF needed to reduce NO_X from 65 mg/hp·hr to 35 mg/hp·hr.

The F factor is defined in existing 40 CFR 86.1113–87(a)(4) and in the proposed new 40 CFR 1071.80(a) as the ratio of MC_{90} to MC_{50}. To estimate the F factor, the EPA proposes to use the ratio of COC_{90} to COC_{50}, which reasonably approximates the increase in MC_{90} over MC_{50} since the EPA expects the marginal cost of compliance to scale with the absolute cost of compliance. With this approach, the F factors for Medium HDE and Heavy HDE are 1.176 and 1.093, respectively. Consistent with the existing and new proposed definitions that limit F to values between 1.1 and 1.3, the EPA proposes to round the F factor for Heavy HDE up from 1.093 to 1.1. The EPA requests comment on whether the F factor should be rounded to 1.1 or should be kept at 1.093. (C–16).

3. Proposed NCP Parameter Values and Resulting Penalties

In this action, the EPA proposes to specify that the values in Table IV–2 be used in the NCP formula for the MYs 2027 and later NO_X standard of 35 mg/hp·hr for Medium HDE and Heavy HDE. The complete derivation of these parameters is described in the DTSD for this proposal. The EPA requests comment on the Agency's estimates of these parameters (C–17).

Table IV-2 – Proposed MY 2027 NCP Calculation Parameters, 2024 Dollars

Parameters	Medium HDE	Heavy HDE
COC_{50}	$3,683	$6,202
COC_{90}	$4,330	$6,781
MC_{50}	$72 per mg/hp·hr	$82 per mg/hp·hr
F	1.176	1.1
UL	200 mg/hp·hr	200 mg/hp·hr

The proposed calculation parameters in Table IV–2 are used to calculate the NCP rate. These parameters are used in the NCP rate formulas, which are defined in the existing 40 CFR 86.1113(a) and proposed new 40 CFR 1071.85. Using the parameters in Table IV–2, the EPA plotted NCP rates versus compliance levels in Figure IV–2 and Figure IV–3 for Medium HDE and Heavy HDE, respectively.[78] The vertical dashed lines in Figure IV–2 and Figure IV–3 are at the emissions levels defined by the variable ''X'' where the NCP is equal to COC_{50}. Manufacturers would calculate a per-engine NCP for an NCP family depending on whether the compliance level is above X or at or below X. Using the proposed parameters in Table IV–2, X equals 78.5 mg/hp·hr and 103.8 mg/hp·hr for Medium HDE and Heavy HDE, respectively. These NCP curves are for the first year of use of the NCPs (*i.e.,* the annual adjustment factors have been set to one). The existing NCP rate formulas are designed so that the NCP is lower as compliance level approaches the standard. For example, if a MY 2027 Heavy HDE engine family had a NO_X compliance level of 100 mg/hp·hr, under the proposal, the per engine NCP would be $5,875. For a MY 2027 Heavy HDE engine family with a NO_X compliance level of 45 mg/hp·hr, under the proposal, the per engine NCP would be $904. For MY 2027 Medium HDE engine families with the same NO_X compliance levels of 100 mg/hp·hr and 45 mg/hp·hr, the proposed per-engine NCPs would be $3,799 and $851, respectively.

CAA section 206(g)(3)(E) requires that the NCP be set at such a level that it removes any competitive disadvantage to a complying manufacturer.[79] The EPA 1985 NCP Phase I rule developed a generic NCP curve designed to remove any competitive disadvantage to the complying manufacturers, with the specific values to be determined via rulemaking for the specific emission standards and engine service class for which the NCPs are being established. The methodology for developing the NCPs is detailed in section IV.B.2 of this preamble and the DTSD for this proposal. Consistent with previous NCP rules, the EPA's projection for the cost to comply with the MY 2027 standards includes the change in technologies, calibration changes, and increased use of DEF, all of which are elements based on the projected costs of the 2023 Final Rule (adjusted for inflation) and representative of the cost to comply with the MY 2027 standards. For these reasons, the EPA believes that the NCPs proposed in this rulemaking would remove any competitive disadvantage that complying manufacturers may face.

[78] The compliance level is determined from the production compliance audit, which consists of testing three to 24 engines (see existing 40 CFR 86.1112–87 and the proposed new 40 CFR 1071.40 that would apply to MYs 2027 and later engines).

[79] 42 U.S.C. 7525(g)(3)(E).

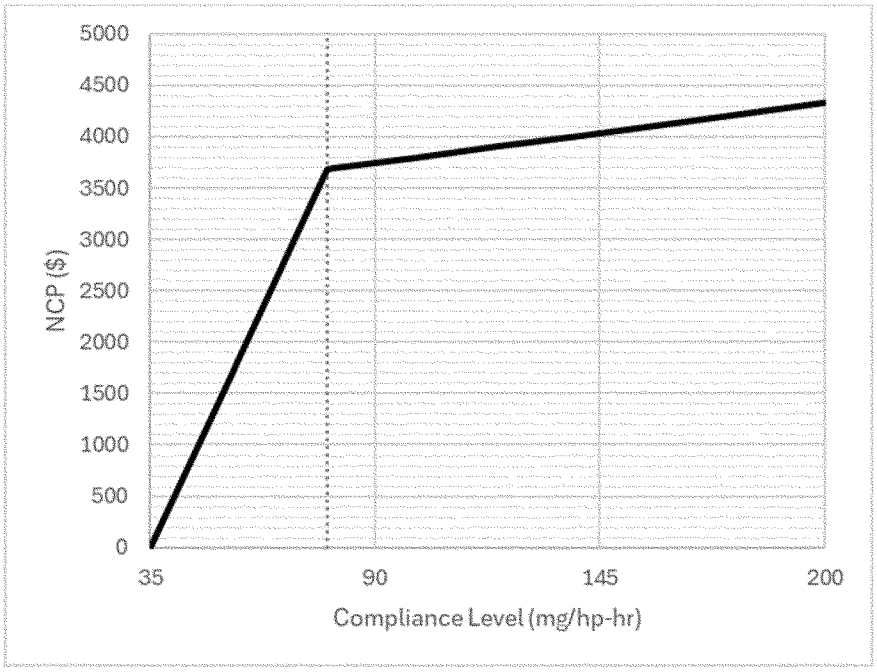

Figure IV-2 – Per-Engine Penalty Value as a Function of NO_X Compliance Level for Medium HDE

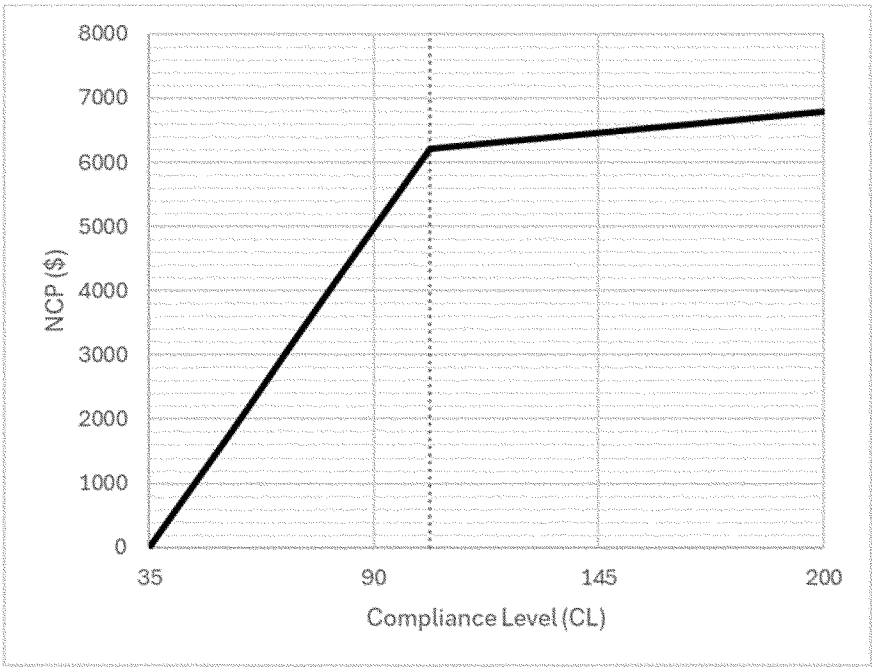

Figure IV-3 – Per-Engine Penalty Value as a Function of NO_X Compliance Level for Heavy HDE

4. Proposed NCPs for Engines Certified Under 40 CFR Part 86

In the 2023 Final Rule, the EPA made comprehensive changes to certification requirements beyond lowering the numeric values of the NO_X standards. In addition to the useful life and warranty provisions the EPA is proposing to change in this action, the 2023 Final Rule also added a new LLC and updated the off-cycle test procedure for engines certified as Light, Medium, and Heavy HDE. The 2023 Final Rule made several changes to update OBD requirements and to improve the serviceability of new engines, making it easier for owners and operators to repair their trucks. The 2023 Final Rule also lowered the HC, CO, and PM standards. Although not projected to require additional

technology, these standards were set to prevent emissions from increasing above the levels engines were already achieving. The new requirements were added to 40 CFR part 1036, whereas the MYs 2026 and earlier requirements are in 40 CFR part 86, subpart A.

If a manufacturer has not completed the development of their engines for MY 2027, NCPs are needed to carry over MY 2026 engine families into MY 2027. The EPA proposes allowing this carryover with NCPs because the additional requirements in 40 CFR part 1036 require additional engine development, which manufacturers may not have time to complete for these carryover engines that they were planning to retire before the start of MY 2027. Since the main purpose of NCPs is to provide a path for manufacturers to stay in the market with noncompliant engines, the EPA is proposing an option to carry over MY 2026 engines. Under the proposed new 40 CFR 1071.80(d), manufacturers would be allowed to certify an engine family under 40 CFR part 86, subpart A, but would be assigned a compliance level at the UL and the maximum NCP would apply.[80] The EPA considers this to be reasonable because the Agency projected that additional technology and calibration would be needed to control emissions under the broader range of operation covered by the certification requirements in 40 CFR part 1036, compared to 40 CFR part 86. This additional technology and calibration would result in greater compliance costs and NO_X reductions than are reflected by just those families' NO_X levels on the FTP and SET. The proposed approach is consistent with the provisions of the 2023 Final Rule, which discounted NO_X credits by 40 percent for engine families certified to 40 CFR part 86.[81]

Under this approach, the EPA is proposing that a separate NCP would not be required for the HC, CO, and PM standards. The NCP at the UL would cover the total cost difference in compliance between engine families meeting the 35 mg/hp·hr standard and engine families certified under 40 CFR part 86.

This approach would also allow manufacturers to carry over their engine families certified under 40 CFR part 86 without having to meet the additional certification requirements in 40 CFR part 1036, such as OBD and serviceability requirements. The EPA is proposing that manufacturers demonstrate compliance with phase-in and testing requirements in 40 CFR 1036.110, excluding engine families certifying to OBD requirements in 40 CFR part 86. The EPA is also proposing to allow manufacturers to continue to use approved deficiencies through model year 2029. These are important considerations because it is likely that these engines would not be able to comply with the EPA's revised OBD program, for example due to the significant hardware and software changes needed to meet in-cab display requirements. The EPA is requesting comment on whether the Agency should consider modifying additional OBD provisions to accommodate the certification of engines to the proposed NCP requirements. (C–18).

For these carryover engine families certified under 40 CFR part 86, the EPA is proposing to provide some relief by not requiring PCA testing and, instead, the engine family would be assigned a compliance level of 200 mg/hp·hr. The EPA believes this compliance level is justified because PCA testing would not reduce the NCP for these families. In addition, these carryover engine families have already been certified to meet the 200 mg/hp·hr NO_X standard.

C. Other Considerations for MY 2027 NCPs

1. Alternative Technology Package for Developing MY 2027 NCPs

As discussed in section IV.B of this preamble, the proposed NCPs are based on one technology package capable of meeting the MY 2027 NO_X standard—dual SCR technology with a close-coupled (CC) SCR catalyst combined with cylinder deactivation. The EPA recognizes there are other technology packages that some firms likely will use to achieve the MY 2027 NO_X standard. Other technology packages may have a different incremental cost impact, which could affect the estimated NCPs. One technology path of which the EPA is aware is an e-heater system. For this proposal, in addition to the primary methodology for developing the proposed NCPs, the EPA also developed an estimate of NCPs based on the use of e-heater systems to meet the MY 2027 NO_X standard. With this e-heater technology package, the e-heater system replaces the CDA hardware and the CC SCR catalysts, CC DEF doser, and CC mixer. The e-heater technology package also requires a power generation source (a 48–V generator) and supporting technology (a DC–DC convertor and a cooling system). To estimate the cost of the e-heater, 48–V generator, DC–DC converter, and cooling system, the EPA relied on a study conducted by the International Council on Clean Transportation (ICCT) in 2021 to estimate the technology costs to meet Euro VII standards.[82] The EPA is not basing the proposed NCP parameters on a technology package with an e-heater, as the Agency only has one publicly citable source for a cost estimate for the e-heater systems, which has not gone through a public comment process and it is unclear if that source has been peer reviewed. Nevertheless, the EPA presents an estimate of NCPs based on the e-heater technology package in the DTSD for this proposal. The EPA requests comment on whether to rely on an e-heater technology package and requests references to other publicly available data for the components of such a system. (C–19).

In several previous NCP rules, the EPA relied on CBI from manufacturers to inform the NCP parameters. However, the EPA does not have sufficient information at the time of this proposal to use this approach. Nevertheless, if in response to this proposal the EPA receives CBI cost data from manufacturers (*e.g.,* suppliers, engine manufacturers, or vehicle manufacturers), the Agency will consider that information in the development of the final rule.

2. Methodology for Determining MC50 and MC90

As discussed in section IV.B.2 of this preamble, the EPA determined MC50 based on the technology needed to reduce emissions from 65 mg/hp·hr to standard of 35 mg/hp·hr, which is consistent with the approach taken in previous rules of determining the marginal cost of compliance based on the incremental cost to reduce an increment of emissions near the standard. However, in the Phase VII rulemaking, the EPA determined MC50 by dividing COC50 by the difference in emissions from the upper limit and the standard, and MC90 by dividing COC90 by the difference in emissions from the upper limit and the standard.[83] The approach of determining MC90 based on the marginal cost between the upper limit and the standard would result in slopes of NCP versus compliance level that are constant at $22 mg/hp·hr and $38 mg/hp·hr for Medium and Heavy HDE, respectively. Figure IV–4 shows how the proposed NCP curve would

[80] As discussed in preamble section IV.B.3, for engine families that are certified to the requirements in 40 CFR 1036, the NCP is determined by the compliance level of the engine family.

[81] See 40 CFR 1036.150(a)(1).

[82] Ragon, P., Rodriquez, F. (2021). Estimated cost of diesel emissions control technology to meet future Euro VII standards, *https://theicct.org/wp-content/uploads/2021/06/tech-cost-euro-vii-210428.pdf.*

[83] Phase VII rulemaking (77 FR 54384, Sept. 5, 2012).

change for Heavy HDE if the EPA were to take this approach. The EPA requests comment on using this approach for the final rule. (C–20).

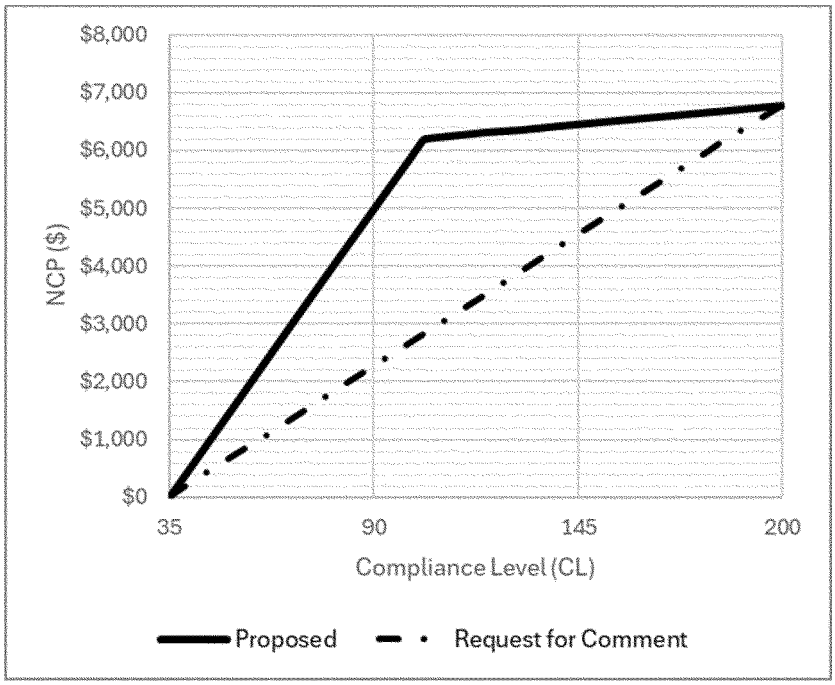

Figure IV-4 – Per-Engine Proposed Penalty Value and Request for Comment as a Function of NO_X Compliance Level for Heavy HDE

3. Inclusion of Other Costs in NCPs

For this proposal, the EPA did not include local and State sales tax or Federal excise tax in the NCP calculation. The EPA expects that at least some portion of the NCPs will be passed on to the customer in the final vehicle price, which will be taxed as applicable. The EPA requests comment on this approach. (C–21).

For this proposal, the EPA included lifetime DEF costs in the NCP values using a 7 percent discount rate. This approach is consistent with other NCP rules in which the EPA included lifetime fuel and DEF costs.[84] NCPs must be set at a level to remove any competitive disadvantage for complying manufacturers, but they are not intended to unduly penalize noncomplying manufacturers. Considering the need to balance these two requirements, the EPA requests comment on alternatively including DEF costs for only the initial two to four years of an engine's life instead of the full lifetime costs. (C–22).

Regarding the indirect costs, the EPA relied on the RPE values for the ''heavy-duty truck industry,'' which is consistent with how the Agency estimated the indirect costs in the 2023 Final Rule.[85] The EPA requests comment on this approach. (C–23). An alternative to this approach would be to use the indirect costs for heavy-duty engine or vehicle manufacturers as shown in Table IV–3. The use of the indirect costs for the heavy-duty truck manufacturer could be justified if it is appropriate to assume that the markup for the truck dealers will include a markup on the NCP.

[84] For example, in the Phase VII rulemaking (77 FR 54384, Sept. 5, 2012) the EPA included lifetime DEF and fuel costs.

[85] These retail price equivalent factors were included in Tables 7–13 of the 2023 Final Rule RIA. See Control of Air Pollution from New Motor Vehicles: Heavy-Duty Engine and Vehicle Standards, Regulatory Impact Analysis. December 2022. EPA–420–R–22–035.

Table IV-3 Retail Price Equivalent Factors for the Heavy-Duty Truck Industry, Engine Manufacturer, and Truck Manufacturer

Cost Contributor	Heavy-Duty Truck Industry	Heavy-Duty Engine Manufacturer	Heavy-Duty Truck Manufacturer
Direct manufacturing cost	1.00	1.00	1.00
Warranty	0.03	0.02	0.04
Research and Development	0.05	0.04	0.05
Other (admin, retirement, health, etc.)	0.29	0.17	0.22
Profit (cost of capital)	0.05	0.05	0.05
RPE	1.42	1.28	1.36

4. Alternative Methodologies for Determining Annual Adjustment Factor

This proposed rule includes the equations from 40 CFR part 86, subpart L, for calculating and applying the Annual Adjustment Factor (AAF) to determine NCP values. The AAF includes a term to increase NCP values over time, with the goal of preventing manufacturers from relying on NCPs as a long-term compliance strategy. The AAF equation accounts for this by including a years counter, i, as an exponent on the factor characterizing the fraction of the engine fleet certified using NCPs. The calculation applies much like a calculation of compounding interest over several years. This has the effect of applying the AAF from a given year as if it has been in place every year that NCPs have been available.

$$AAF_{\mathrm{i}} = 1 + I_{i-1} + A_i \cdot \left(\frac{1}{1 - frac_{i-1}}\right)^{i}$$

Where:

*I*i-1 = The fractional value representing the increase in overall consumer price index in year (i − 1), as described in 40 CFR 86.1113–87 and in the proposed 40 CFR 1071.85.

*A*i = The usage adjustment factor in year i: Let Ai = 0.08, except that A1 = 0 and A2 = 0.10.

fraci − 1 = The fraction of vehicles or engines in a class that are certified using NCPs in the year before the current year i, as described in 40 CFR 86.1113–87 and in the proposed 40 CFR 1071.85. If *fraci* − 1 is above 0.50, calculate AAFi using *fraci* − 1 = 0.50.

In 40 CFR 86.1113–87 and in the proposed 40 CFR 1071.85, there is no AAF for the first year but the factor with the exponent applies the adjustment to the second year as if it applied to both years. Another complicating factor is that the NCP equation requires calculating a base NCP value for the first year and then multiplying by the product of past and current AAFs. This approach applies additional compounding on top of the compounding incorporated into the calculation of the AAF. Separate from inflation and without the inclusions of the exponent, the largest AAF (for which half of the engines from the class use NCPs in the previous year) is 1.2. Including the exponent (i = 2) in the AAF calculation causes the value of the NCP to increase by 40 percent in the second year. For the third year (still with half the engines from the class using NCPs in the previous year), the AAF equation would increase the NCP by a compounded factor of 1.64 (a 64 percent increase). Multiplying the three AAF together would cause the NCP for the third year to increase by 130 percent ($1 \times 1.40 \times 1.64 = 2.30$). The AAF of 2.28 for the fourth year would lead to more than a five-fold increase in the value of the NCP. This scenario, for which 50 percent of the engines in a class continue to use NCPs over multiple years, is unlikely and this effect would be much less dramatic as the fraction of the fleet needing NCPs approaches zero. Nevertheless, this calculation methodology accelerates the increasing NCP values over time beyond what would apply based on compounding calculations.

The EPA requests comment on retaining the existing exponent and on two options to change the Agency's historical approach. Retaining the existing exponent would provide the most motivation for manufacturers to meet the standards in later years instead of using NCPs. If it is likely that manufacturers will continue to need additional time to meet the standards for a large fraction of the engines in a class, another option could be to remove the exponent from the AAF calculation, resulting in a standard compounding rate that would avoid the NCPs becoming cost-prohibitive to the point that certifying with NCPs is no longer a marketable option. A second option could be to replace the exponent ''*i*'' with ''*i*-1,'' which would apply some accelerated compounding and aligns the calculations with the existing approach of not having an AAF for the first year. The EPA requests comment on these potential alternative approaches. (C–24).

5. Use of Credits and NCPs in the Same Engine Family

In the proposed new 40 CFR 1071.15(b), the EPA is proposing to migrate the Agency's longstanding policy that engines may exceed emission standards using either emission credits or NCPs, but never in combination.[86] Specifically, this proposed provision would continue to require manufacturers to isolate engines using NCPs into NCP families that are separate from a manufacturer's averaging sets to simplify the implementation and clearly distinguish which compliance provisions apply to a given engine family. The EPA expects manufacturers would continue to use emission credits that are available before using NCPs. The proposed text notes that manufacturers might be able to use emission credits to delay their initial use of NCPs until well after the start of MY 2027, and manufacturers would also have the option to separate an existing engine family into one that would use credits and one that would use NCPs to comply with the standards.

The EPA's 1990 final rule that established banking and trading for NO_X emissions included a discussion of the

[86] See 40 CFR 86.004–15(g).

interaction of NCPs and ABT.[87] To prevent manipulation of the NCP and ABT programs, the EPA finalized that credits could not be generated by a single family for which NCPs are used or any engine families in an averaging set for which NCPs are used. To avoid any program design complications caused by simultaneous NCP and credit use by a family, the 1990 rule required an engine family needing both NCPs and credits to meet the emission standard to be separated into two families. One family would strictly use credits, be assigned an FEL, and involve only the number of engines that can be certified to the emission standard using the credits available. The other family would strictly use NCPs and be comprised of the remainder of the engines in the original engine family. The 1990 rule noted that the manufacturer would assign the number of engines to each family (as available credits allow) to always ensure a compliance with the standard and, thus, to provide a means of quick remedy of any noncompliance, since future production could be shifted to the NCP family. Consistent with this historical approach, the proposed new 40 CFR 1071.15(b) includes a similar restriction on using credits and NCPs in the same family and the EPA proposes to use the term ''NCP families'' throughout the proposed new 40 CFR part 1071 for a clear distinction.

The EPA notes that the proposal to the 1990 rule considered a general guideline that use of credits provides an air quality benefit compared to use of NCPs, since the higher emissions from NCP engines are not offset by correspondingly lower emissions from other engine families. Using that guideline, the EPA proposed that any manufacturer that desires to pay NCPs for an engine family that has credits available for use in that averaging set would lose all of these available credits.[88] That proposal was intended to optimize environmental benefits by incentivizing manufacturers to use their available credits before paying NCPs. However, the EPA did not finalize that restriction, noting that those credits could be used to offset noncompliance in other engines or remain banked with no environmental disbenefit.

In this proposed rule, the EPA is requesting comment on allowing manufacturers to use NO_X emission credits in the NCP program to lower the penalty with the benefit of offsetting NO_X emissions from higher-emitting NCP engines. The EPA recognizes that doing so would be a change in Agency position. However, a manufacturer could reduce the NCP for a given engine family if NO_X credits could be applied to that engine family to lower the effective compliance level from which the NCP is calculated. The EPA believes there would also be an emissions benefit from this approach, as a manufacturer could offset a portion of the emissions above the standard from an NCP engine with banked NO_X emission credits earned from engines which performed at a level below the NO_X standard, and those emission credits would no longer be available to offset future credit-using engine families. The EPA notes there would be an additional reporting and recordkeeping burden, for both the manufacturer and the Agency, associated with tracking credit use in addition to the proposed NCP provisions. The EPA requests comment on allowing NO_X emission credits to be used in the NCP program, including any competitive concerns, environmental impacts, and reporting and recordkeeping burdens. (C–25). The EPA also requests comment regarding how NO_X credits may impact the statutory requirements that NCPs ''shall take into account the extent to which actual emissions of any air pollutant exceed allowable emissions under the standards . . .'' and that NCPs ''shall remove any competitive disadvantage to manufacturers whose engines or vehicles achieve the required degree of emission reduction.'' Finally, the EPA requests comment on any interaction with the credit flexibilities request for comment in section III.D of this preamble.

D. Migrating Regulation to 40 CFR Part 1071 and Proposed Revisions to the Regulation

The EPA first adopted regulations in 1985 to establish NCP provisions at 40 CFR part 86, subpart L.[89] Several subsequent rulemakings established new NCP provisions for specific emission standards and classes of engines or vehicles, with various amendments to the program structure along the way. This proposed rule provides an opportunity to clarify and improve the wording of the existing NCP regulations in plain language and with improved organization. In this rule, the EPA is proposing to migrate the NCP provisions to a new 40 CFR part 1071 as described in this section.

Consistent with this migration, the proposed provisions discussed in this section refer to the proposed regulations in their proposed new location in 40 CFR part 1071. In general, this migration is not intended to change the NCP program previously specified in 40 CFR part 86, except as specifically proposed in this rulemaking. The proposed 40 CFR part 1071 accordingly sets up provisions to establish the general construct of the program to allow noncompliant heavy-duty engines and vehicles to pay NCPs instead of meeting current standards. The full scope of NCP provisions includes heavy-duty engines certified under 40 CFR part 1036 and vehicles above 6,000 pounds GVWR certified under 40 CFR part 86, subpart S. This proposed rule includes specific NCP provisions only for certain heavy-duty engines relative to the 2027 NO_X standard, as described in this section IV.

While the EPA is proposing extensive wording changes in some cases to achieve more plain language, the goal in drafting most of the proposed text for 40 CFR part 1071 is to preserve the overall structure and function of the program. The proposed new regulation at 40 CFR part 1071 makes improvements in four broad areas. First, the EPA is proposing several minor adjustments to modernize the regulation. For example, the proposal specifies how to make electronic payments through *www.pay.gov* since the Federal government no longer accepts payments with paper checks. The EPA has also updated emission calculation instructions to include infrequent regeneration adjustment factors and reference 40 CFR part 1066 for vehicle-testing procedures.

Second, the proposed regulation streamlines descriptions, eliminates obsolete content, and moves historical NCP information to an appendix. The overall effect of these drafting changes is to reduce the length of the regulatory text by about half.

Third, the EPA carefully reviewed the provisions at 40 CFR part 86, subpart L, and found several ways to improve clarity and address various ambiguities of the existing program. Some examples of these ambiguities include: (1) Determining the relationship between emission credits and NCPs, (2) understanding the possible scenarios for starting and discontinuing NCPs, (3) deciding which configurations to include in PCAs, (4) determining the AAF and other aspects of the NCP calculation, and (5) identifying how many engines are subject to NCPs in a given calendar quarter.

Fourth, the EPA harmonized the regulation with similar provisions that already apply to certification testing and selective enforcement audits. For example, the EPA and the regulated

[87] 55 FR 30604 (July 26, 1990).

[88] 54 FR 22680 (May 25, 1989).

[89] Phase I rulemaking (50 FR 35374, Aug. 30, 1985).

industries have many years of experience implementing existing compliance provisions in other parts, including test orders, pass-fail determinations, instructions for preparing test engines, reporting and recordkeeping for test data, Agency entry and access to a manufacturer's testing facility, and handling of CBI. The proposed regulation at 40 CFR part 1071 includes several references to these other existing provisions. In other cases, the EPA copied text into the proposed 40 CFR part 1071 with minor adjustments to fit the NCP context.

The following examples illustrate how the proposed regulation at 40 CFR part 1071 expands on the existing regulation under 40 CFR part 86, subpart L, to either remove ambiguity or adjust regulatory provisions:

- *Section 1071.15(b):* Clarifying that engines may exceed emission standards using either emission credits or NCPs, but never in combination. See section IV.C.5 of this preamble for a discussion of other approaches the EPA is considering. Section 1071.30: Existing 40 CFR 86.1106–87(a)(2) specifies that PCA testing must be conducted on the same configurations that exceeded the standards in certification but that the EPA may approve testing more or fewer configurations. Also, existing 40 CFR 86.1110–87(a) describes a process of the EPA giving manufacturers instructions for selecting specific engines for PCA testing. The proposed new 40 CFR 1071.30 specifies that the compliance level from PCA testing would apply to the whole NCP family, unless the manufacturer chooses to divide the family into subfamilies to establish separate compliance levels for groups of engine configurations. The proposed new 40 CFR 1071.30 also refers to a proposed new 40 CFR 1071.35, which describes a plan for the EPA to send instructions to manufacturers analogous to a test order for a selective enforcement audit. Considering that the compliance level serves as the emission standard for compliance testing, as specified in proposed 40 CFR 1071.1(c), the EPA also proposes that manufacturers would be allowed to divide configurations into NCP subfamilies based on similar emission characteristics, which could result in different compliance levels. In some cases, a ''worst-case'' configuration may be necessary to represent a given NCP family. In proposed new 40 CFR 1071.35(b), the text states that the EPA's test order would be designed such that the test sample properly represents the NCP family to ensure that all engines from the NCP family have emissions at or below the compliance level. This arrangement is intended to preserve the approach described in 40 CFR part 86, subpart L.
- *Section 1071.40:* Allowing manufacturers to select a compliance level that is numerically greater than the value determined from PCA testing. The compliance level is used to calculate the NCP, but it also serves as the emission standard for any compliance testing. As a result, selecting a higher compliance level would result in a greater NCP but would also give the manufacturer a bigger compliance margin for managing their compliance risk. In no case would the compliance level exceed the UL.
- *Section 1071.40(a):* Calculating the compliance level from PCA testing must account for infrequent regeneration adjustment factors where appropriate.
- *Section 1071.40(b):* Replacing the table for identifying the 60th percentile result from PCA testing with an instruction to use a ceiling function. The ceiling function effectively rounds up to the next higher integer if there is any non-zero decimal value.[90] The ceiling function comes into effect only if manufacturers test more than 24 engines to determine the compliance level.
- *Section 1071.50(a):* Changing the deadline for reporting the results of a production compliance audit from five days to 30 days. This change aligns with the analogous deadline for reports under selective enforcement audits under 40 CFR part 1068 and is intended to allow additional time to ensure that the reported information is correct and complete.
- *Section 1071.50(a)(4):* Omitting the requirement for the audit report to identify the method for selecting emission-related components.
- *Section 1071.65(a):* Clarifying labeling requirements. (1) The engine's label must meet requirements that apply to all certified engines, except that the label acknowledges that the engine complies with current standards using NCPs. (2) Adding NCP labels to engines that have already been shipped requires manufacturers to either apply labels or assign the task to an agent. This contrasts with simply shipping labels to distributors or vehicle owners to apply labels at their discretion. (3) Adding a requirement for manufacturers to apply good engineering judgment in selecting the location for supplemental NCP labels. It is best for all compliance information to be on a single label, but the EPA is proposing to allow a supplemental label with NCP information that is near the primary label. The EPA may direct manufacturers to adjust label location if there is an achievable way to allow better access to the information.
- *Section 1071.80(a)(5):* Clarifying that MC_{90} is graphically represented by the slope of the line segment on the NCP curve from the published standard up to x.
- *Section 1071.80(d)(3):* The EPA is proposing that the compliance level be based on engine testing over the FTP duty cycle.
- *Section 1071.80(d)(4):* The EPA is proposing that the adjusted values for the compliance level for the LLC, idle testing, and off-cycle testing, as applicable, apply to certification and in-use testing, as these values serve as the emission standards.
- *Section 1071.85(b):* Adjusting nomenclature to consistently use *i* as the counter for calculating NCP values, up to the current or final value of *n* years. The current regulation seems to use both *i* and *n* without describing whether they are interchangeable. The proposal also combines terms as needed to include equations that do not involve intermediate quantities (such as PR_1 and PR_2).
- *Section 1071.85(c):* Correcting the usage factor Ai. 40 CFR 86.1113–87(a)(4) states that Ai = 0.08 for i < 2. This would suggest that there is a usage factor of 0.08 for the first year of allowing NCPs; however, there can be no annual adjustment in the first year based on what happened in the previous year. The current regulation also identifies no value of Ai after the second year of allowing NCPs. The EPA understands the 0.08 value to apply to i > 2 (for years three and later).
- *Section 1071.85(d)(2):* Clarifying that the EPA determines the usage factor fraci − 1 based on the extent to which all manufacturers used NCPs in the previous MY. The result is that all manufacturers use the same AAF, independent of their own NCP usage.
- *Section 1071.85(d)(3):* Including a website for a standardized reference to consumer price index for calculating annual inflation adjustments.
- *Section 1071.90(c):* The EPA is proposing to assess NCPs based on engines produced during each calendar quarter. This contrasts with existing 40 CFR 86.1113–87(g), which assesses NCPs based on engines that have been produced and distributed into commerce. Since every produced engine will presumably be distributed into commerce in its production configuration, there is no compelling need to increase the complexity of counting affected engines by factoring in

[90] This is analogous to an hourly parking fee that increases at the start of each successive hour.

the marketing disposition of individual engines.

- *Section 1071.90(c)(1):* Removing the requirement to include the date and identification number for the certificate. These items can be readily identified based on the engine family, which the EPA is proposing to include in penalty-related reporting.
- *Section 1071.105(a):* Adjusting the reporting requirements relative to engines found during PCA testing to exceed the Compliance Level or an emission standard. The EPA is proposing to require notification within five days after determining that an engine has failed, and requiring manufacturers to submit a report describing how they remedied the problem before introducing that engine into U.S. commerce. In that case, manufacturers could also include the remedy description in the report describing the results of the audit.

In this rule, the EPA is proposing to migrate the NCP provisions to a new 40 CFR part 1071. In general, this migration is not intended to change the compliance program specified in 40 CFR part 86, except as specifically stated in this proposal. See the EPA's docket memorandum for a detailed description of the proposed migration.[91] The EPA requests comment on proposed provisions that are substantively different than what applies under 40 CFR part 86, subpart L. (C–26). In cases where the EPA is not proposing substantive changes to the regulation, the Agency requests comment on those amendments as editorial changes.

V. Improvements for SCR Reliability and Changes to DEF Inducements for Highway Engines and Vehicles and for Nonroad Diesel Engines

The EPA has heard from farmers, truckers, motor coach operators, and owners and operators of other diesel equipment who are frustrated by performance derates that result from problems with emission control systems in their diesel engines. The result is that these reliance issues encourage noncompliance with EPA regulations instead of ensuring the environmental benefits from working emission control technologies. As described in this section, SCR is a unique emission control technology because it relies on operators to supply the system with quality DEF for it to work properly. Consequently, engine manufacturers have unique requirements to demonstrate that operators properly maintain the SCR systems compared to other emission control systems. Throughout this preamble, the term ''inducements'' refers to SCR-related strategies to induce operators to maintain appropriate levels of high-quality DEF and not tamper with SCR systems. This section describes proposed amendments to replace the SCR-related engine performance derates with visible and/or audible notifications, and includes corresponding proposed changes to OBD and related certification requirements to improve SCR reliability. This proposal generally does not include amendments to derates manufacturers use for catastrophic engine and aftertreatment protection.

The EPA is aware of these real-world concerns from heavy-duty vehicle owners and operators due to inducements. For example, during the development of the 2023 Final Rule, the EPA received comments such as: ''We have experienced downtime due to lack of power, clogged filters, DEF issues, and derate issues that put us in a very unsafe situation with no place or time to pull over safely. Then the cost of downtime at a dealer, the high cost of towing, and the loss of revenue and a broker or shipper upset because of all the failures from these new engines.'' [92] Operators described how costs go well beyond financial and can also cost them their reputation or contracts due to missed or late deliveries. Motorcoach operators described the high financial cost due to performance restricting inducements, such as when they need to reimburse passengers for missed events or plane tickets, as well as the risk it presents when they are providing emergency evacuation services, such as during hurricanes.[93] Another commenter shared that inducements have resulted in people who otherwise would have remained compliant being motivated to disable emission controls.[94]

Section V.C of this preamble discusses the proposed changes to inducement regulations for new MYs 2027 and later highway heavy-duty engines. Section V.D of this preamble discusses proposed changes intended to improve the reliability of SCR systems. Section V.E of this preamble includes a proposal for inducement regulations for new light-duty and medium-duty vehicles and for new nonroad diesel engines similar to the proposed requirements for new highway heavy-duty engines. Finally, section V.F of this preamble discusses the EPA's consideration of new inducement guidance for in-use diesel engines, vehicles, and equipment.

A. Background

In 2001, the EPA finalized a rule that promulgated lower NO_X standards for MYs 2007 and later heavy-duty highway engines.[95] The EPA adopted those new performance-based standards based on a projection that manufacturers could use catalyzed particulate filters and NO_X absorber catalysts on diesel-fueled engines. To reduce NO_X emissions, manufacturers ultimately deployed urea-based SCR systems beginning with MY 2010. SCR is different from other emission control technologies in that it requires operators to maintain an adequate supply of DEF to control emissions.[96] DEF is stored in a tank located on the vehicle and is injected into the engine's exhaust upstream of the SCR system.

As manufacturers focused on developing SCR technology to meet the MY 2010 NO_X standards, the EPA had three major concerns related to these systems achieving the intended level of emission control if operators did not maintain a supply of DEF.

The first concern was that at the time (prior to 2010), there was no nationwide infrastructure to provide a reliable supply of DEF at refueling stations. Today, DEF is widely available at retail stores and filling stations often offer it via pumps in the same lanes as where diesel-fuel pumps are located.[97]

The second concern was that operators would leave DEF tanks empty or would fill DEF tanks with water to reduce operating costs. Filling DEF tanks is a form of emission-related scheduled maintenance. Historically, scheduled maintenance was focused on replacing engine components, such as fuel injectors, to ensure that emission

[91] Memorandum to docket EPA–HQ–OAR–2026–0728. ''Detailed Description of Proposal to Migrate Provisions for Nonconformance Penalties from 40 CFR part 86, subpart L, to 40 CFR part 1071.'' June 2026.

[92] Memorandum to Docket EPA–HQ–OAR–2019–0055, regarding Summary of ANPR Comments Relating to Inducements. *www.regulations.gov/document/EPA–HQ–OAR–2019–0055–0826.*

[93] Memorandum to Docket EPA–HQ–OAR–2019–0055, regarding Letter to EPA from Bus and Motorcoach Operators Regarding Inducement Experiences In-Use. *www.regulations.gov/document/EPA–HQ–OAR–2019–0055–0779.*

[94] National Automobile Dealers Association Comment on the EPA's Advance Notice of Proposed Rulemaking. EPA–HQ–OAR–2019–0055–0369. *www.regulations.gov/document/EPA–HQ–OAR–2019–0055–0369.*

[95] 66 FR 5002 (Jan. 18, 2001). *See* section I of the preamble to that rule for more information on the history of emission regulations for this sector.

[96] The International Organization for Standardization defines DEF as a water-based solution with a 32.5 percent urea concentration. ISO 22241–1:2019 Diesel engines, available here: *https://www.iso.org/standard/66408.html.*

[97] Travel Centers of America. ''Where To Find DEF In Your Area.'' *https://www.ta-petro.com/professional-drivers/def-fuel/.*

controls would work properly throughout an engine's useful life. The EPA would only allow the use of SCR if manufacturers could demonstrate that it is reasonably likely that in-use operators would maintain a consistent supply of DEF. Therefore, to certify engines that use DEF, manufacturers had to demonstrate to the EPA that operators were reasonably likely to perform the ''emission-related scheduled maintenance'' of refilling DEF tanks.[98] These requirements help ensure that maintenance occurs so that in-use engines achieve the intended emission reductions. These requirements also ensure that engine manufacturers do not demonstrate compliance with the EPA standards using maintenance practices that are unlikely to occur in the real world.

The third concern was related to operators not using a supply of quality DEF (*i.e.,* filling the DEF tank with the wrong fluid or diluting DEF with water). The EPA has treated both DEF supply and DEF quality as ''adjustable parameters'' based on the possibilities that operators may keep DEF tanks full, let them run empty, or fill them with the wrong fluid or diluted DEF. The EPA's existing adjustable parameter requirements were designed to ensure manufacturers demonstrate emission standards will be met when an operator could physically adjust engine components. For example, on older diesel engines, if a fuel screw was adjustable by an operator using a standard screwdriver, the manufacturer would need to meet emission standards no matter how the screw was adjusted (*i.e.,* across the entire ''practically adjustable range''). A manufacturer could instead set the screw to a particular point and prevent an operator from physically adjusting the screw (*e.g.,* to prevent an adjustment increasing the amount of fuel provided to the engine) by using a screw that required a special tool, permanently gluing the screw in place so it was not adjustable, or shearing off the head of the screw. Limiting the adjustment of such a parameter would limit the conditions for which manufacturers were liable to meet emission standards. Although ensuring that operators maintained a supply of quality DEF was different than the historic need for these requirements to prevent mechanical adjustment, the EPA similarly treated DEF supply and DEF quality as adjustable parameters.

The EPA issued three guidance documents between 2007–2013 to describe how manufacturers could demonstrate a reasonable likelihood that operators would perform the scheduled maintenance of adding DEF to engines with SCR systems.[99] The guidance suggested manufacturers could demonstrate that operators would add DEF by sizing the DEF tank to correspond with the size of the fuel tank (to allow for adding diesel fuel and DEF at the same time) and by programming the engine to derate engine performance and vehicle speed when the DEF tank was nearly empty. The EPA's guidance suggested that warnings with a visible notification and a performance derate that ended in a vehicle speed derate of 5 mph after four hours was a possible primary approach to notifying and compelling operators to use high-quality DEF. The EPA's 2013 guidance resulted in the widespread use of urea quality sensors (UQS) to ensure high-quality DEF was used by operators. This proposal reassesses the continued need for manufacturers to use derates to demonstrate the reasonable likelihood of operators using quality DEF to meet emission-related scheduled maintenance requirements.

In addition to derates for DEF supply and DEF quality, the EPA guidance described a likely need for inducements to prevent operators from tampering with SCR systems, such as disabling the DEF pump. The EPA guidance provided a list of components that should likely be monitored for disconnection (*e.g.,* DEF quality sensors) or blockage (*e.g.,* to avoid someone crimping a DEF line to prevent flow). The guidance described applying an inducement of 5 mph after detecting a tampering condition. This proposal reassesses the continued need for manufacturers to use derates to demonstrate that operators are not tampering with SCR systems.

The EPA has also observed that the number of fault conditions causing inducements has steadily increased far beyond the initial need to detect problems related to DEF supply, DEF quality, and tampering with SCR systems. The EPA has learned that malfunctioning components, such as defective sensors or corroded wiring, can cause performance derates even though operators are using quality DEF with an adequate supply. This has contributed to the frustrations expressed by operators who find themselves unable to operate their vehicles even though they have properly performed the SCR-related scheduled maintenance and have not tampered with their engines or emission control systems. The more stringent 2027 NO_X standard will require that engine manufacturers update their designs with additional components that work together as part of a larger and more complex system to more carefully control emissions and continuously monitor performance with additional sensors and logic for diagnosing emission-related malfunctions. This greater complexity increases the risk of defects, both for malfunctions involving increased emissions and for diagnostic malfunctions that show up as faults even though emissions do not increase.[100] These experiences have motivated the EPA to reassess the Agency's approach to certifying SCR-equipped engines, which require DEF.

The following sections describe recent EPA actions and policymaking deliberations related to maintenance, defects, and inducements. The EPA requests comment on the broader context of operator frustration with inducements caused by defects rather than operator behavior. (C–27). Inducements were intended to motivate proper use of DEF in SCR systems to reduce NO_X emissions. DEF has become widely available and widely used, and late MY trucks and equipment emit far less than older models. However, in the wake of implementation of inducement schedules, strong negative public sentiment toward DEF has emerged due to system failures stemming from sources like failed sensors and the delayed availability of replacement parts rather than inadequate DEF or an intent of noncompliance. The EPA has heard from individuals who have experienced traumatic events, such as lost harvests or stranded vehicles and products. Observation and word-of-mouth have created secondary distrust of SCR systems and DEF. The EPA is requesting comment on the extent to which negative public sentiment about engine derates has created a distrust associated with SCR system and DEF failures and how to address the challenge of rebuilding positive culture around the use of SCR systems and DEF. This might take the form of educational outreach by manufacturers of engines and manufacturers of emission-related components. For example, to increase

[98] The EPA first issued regulations in 1993 (*see* 40 CFR 86.094–25(b)(6)(ii) as published in 58 FR 4020 (Jan. 12, 1993) to address how a manufacturer could demonstrate that emission-related scheduled maintenance was reasonably likely to occur using one of six methods, including a visible notification, performance deterioration, surveying in-use vehicles, or doing the maintenance for free.

[99] Docket EPA–HQ–OAR–2019–0055–0778. ''Inducement-Related Guidance Documents, and Workshop Presentation.'' March 15, 2022. *https://www.regulations.gov/document/EPA-HQ-OAR-2019-0055-0778.*

[100] *See* section V.C of this preamble for a discussion of technologies that manufacturers are expected to use to meet the 2027 NO_X standard.

public awareness of possible software updates that provide relief from derate, or to help operators learn how to practice better preventive maintenance to reduce downtime. This might also take the form of additional engineering to focus on product improvements for which defects are most common.

B. Recent Developments

1. Changes to Inducements Made in the 2023 Final Rule

The 2023 Final Rule formalized an updated approach for demonstrating that operators would maintain a consistent supply of quality DEF for SCR-equipped in-use engines used in heavy-duty highway engines and vehicles. Specifically, the EPA codified requirements that describe how manufacturers can design engines with a derate schedule to demonstrate that operators would be reasonably likely to maintain a supply of quality DEF.[101]

The 2023 Final Rule also specifies that DEF supply and DEF quality are adjustable parameters.[102] Regarding DEF supply, the EPA finalized that the physically adjustable range includes any amount of DEF for which the engine's control system does not trigger an inducement. For DEF supply, the EPA also finalized that the inducement schedule starts with visible notifications three hours prior to the tank being empty.

The EPA did not finalize proposed revised requirements for determining the physically adjustable range of DEF quality in the 2023 Final Rule. This is discussed in more detail in section V.D.1 of this preamble.

The 2023 Final Rule made several changes to reduce the severity of inducements, as compared to the EPA's prior SCR-related guidance. Importantly, the regulation does not specify a derate to 5 mph within four hours after detecting a fault condition. The regulation instead specified an immediate initial restriction in allowable speed and further decreases in allowable speed until a final inducement speed of 25 mph is reached. The time prior to final inducement depends on the average speed of the vehicle's actual operation, varying from 30 hours to 164 hours.

The EPA also added requirements to ensure the engine's control system will validate when an inducement condition no longer exists and remove the inducement. For example, if an operator flushed and refilled a DEF tank to replace poor quality DEF, the system will recognize this action and remove the inducement. The 2023 Final Rule also required generic scan tools to report SCR- and DPF-related derate fault code information and to be capable of removing a final inducement condition. Expanding the capability of generic scan tools helps users avoid costly towing bills and trips to repair facilities after taking action to address problems. These provisions continue to be important during the proposed transition from performance derates to visible and/or audible notifications.

2. The EPA's August 2025 Inducement Guidance

In the 2023 Final Rule, the EPA indicated a willingness to allow manufacturers to modify in-use heavy-duty highway engines and vehicles with software updates that incorporate some or all of the inducement provisions in the 2023 Final Rule. To encourage manufacturers to make updates to in-use engines and vehicles, in August 2025 the EPA issued revised inducement guidance for existing vehicles up to and including MY 2026 to allow more time before a final inducement of 25 mph.[103] [104] This guidance applied not only to highway heavy-duty engines, but also to in-use highway light-duty and medium-duty vehicles and nonroad diesel engines.

3. EPA Requests for Manufacturer SCR-Related Warranty Data

Under CAA section 208(a), the EPA is authorized to require manufacturers to provide information needed to assess whether emission control systems are functioning properly and whether manufacturers are meeting their obligations to identify and fix defects. On February 3, 2026, the EPA requested information from the top 14 highway and nonroad diesel engine manufacturers that account for over 80 percent of all products using SCR systems. Specifically, the EPA requested data on warranty claims, failure rates, and repair information for MYs 2016, 2019, and 2023 emission control products to determine whether ongoing DEF system failures are related to a specific generation of products or specific SCR-system components.[105] The EPA has received this data and is evaluating it to independently evaluate ongoing system failures, and the Agency may take further action based on what the Agency learns from this data.

4. The EPA's March 2026 DEF Quality Monitoring Guidance

In 2013 for SCR-equipped highway diesel engines and in 2014 for SCR-equipped nonroad diesel engines, the EPA issued guidance describing the adjustable parameter provisions of the Agency's regulations, and the Agency's conclusion that UQS) could be installed in new highway vehicles by MY 2016 and in new nonroad equipment by MY 2017 to meet the Agency's adjustable parameter regulations.[106] [107] The EPA also acknowledged that NO_X sensors had been successfully used to meet these requirements in previous MYs, and NO_X sensors could continue to be used to meet requirements related to DEF quality. Since that time, only one diesel engine manufacturer has continued to demonstrate compliance using NO_X sensors to determine urea concentration. All other manufacturers switched to UQS because of the UQS's ability to directly measure DEF quality and more quickly determine if DEF has been diluted. Together with the manufacturers, the EPA has recently identified UQS as having among the highest failure rates of any SCR components and that using alternative detection methods (*e.g.,* NO_X sensors) could further improve SCR system robustness and reduce unnecessary inducements. The EPA's preliminary assessment of warranty data submitted to the Agency in response to the February 2026 information requests further suggests that UQS failures are a significant source of warranty claims and DEF-related inducement. Given this, the EPA issued revised guidance in March 2026 to make clear that alternative methods of meeting the adjustable parameter provisions, including the use of NO_X sensors, are allowed under EPA regulations. The

[101] *See* the inducement requirements specified in 40 CFR 1036.111.

[102] *See* 40 CFR 1036.115(f).

[103] U.S. Environmental Protection Agency. (2025). ''At Iowa State Fair, EPA Administrator Zeldin Announces Diesel Exhaust Fluid (DEF) Fix.'' *www.epa.gov/newsreleases/iowa-state-fair-epa-administrator-zeldin-announces-diesel-exhaust-fluid-def-fix.*

[104] U.S. Environmental Protection Agency. (2025). IACD–2025–10, ''Revised Guidance for Light Duty Vehicles, Heavy-Duty Diesel Engines and Nonroad Compression-Ignition (CI) Engines Using Selective Catalyst Reduction (SCR) Technologies.'' *www.epa.gov/system/files/documents/2025-08/def-ltr-manufacturer-2025-0811.pdf.*

[105] U.S. Environmental Protection Agency. (2026). ''Administrator Zeldin Takes Additional Measures to Address Diesel Exhaust Fluid (DEF) Issues for American Farmers and Truckers.'' *https://www.epa.gov/newsreleases/administrator-zeldin-takes-additional-measures-address-diesel-exhaust-fluid-def-issues.*

[106] U.S. Environmental Protection Agency. (2013). CISD–13–13, ''Testing of Heavy-Duty Diesel On-Highway Engines with Adjusted Diesel Exhaust Fluid (DEF) Quality.'' *https://dis.epa.gov/otaqpub/display_file.jsp?docid=31221&flag=1.*

[107] U.S. Environmental Protection Agency. (2014). CISD–14–10, ''Certification of Nonroad Diesel Engines Equipped with SCR Emission Controls.'' *https://dis.epa.gov/otaqpub/display_file.jsp?docid=32298&flag=1.*

EPA also stated that software updates using certain alternative detection methods may be made to existing diesel engine products in place of, or to augment, existing UQS-based systems without such action being considered tampering under the CAA.[108]

C. The EPA's Proposed Inducement Revisions

This section discusses the EPA's reasons for reconsidering existing inducement regulations for MYs 2027 and later highway heavy-duty engines and vehicles, and proposed changes to the Agency's existing inducement requirements.

1. The EPA's Reassessment of Inducements

The EPA Administrator has said ''[a]s I traveled to all 50 states during my first year as EPA Administrator, I heard from truck drivers, farmers, and many others rightly complaining about DEF and pleading for a fix.'' [109] In response to feedback and concerns that the EPA continues to receive regarding the impact of inducements that affect the performance of heavy-duty engines and vehicles, the Agency is reassessing whether derates are necessary for SCR compliance. This section presents key reasons the EPA is reassessing the need for derates for SCR compliance.

The 2023 Final Rule presented a series of principles the EPA considered when evaluating how to address concerns related to maintaining the operation of emission control systems.[110] The EPA's 2023 Final Rule also raised questions about how restrictive derates should be to provide a reasonable basis for demonstrating that operators would continue to add quality DEF in tanks and not tamper with SCR systems. However, the 2023 Final Rule did not include any reference to relying on visible and audible notifications instead of derates as the sole means of prompting operators to perform maintenance.

The reassessment in this proposed rule revisits questions and principles discussed in the 2023 Final Rule, including how to apply these principles to find the least restrictive means of accomplishing the goal of ensuring operators add quality DEF in tanks and prevent tampering with SCR systems. The three principles considered in the 2023 Final Rule that are of particular relevance are: (1) ensuring critical emission-related scheduled maintenance has a reasonable likelihood of being performed while also deterring tampering of the SCR system, (2) addressing operator concerns with false inducements and low inducement speed restrictions that occur quickly, and (3) reducing the likelihood of in-use tampering by reducing operator frustration with derates. While vehicle owners and operators have not yet experienced the inducement requirements finalized in the 2023 Final Rule, the EPA has heard from enough owners and operators of diesel engines frustrated with SCR inducement derates that the Agency has decided to reassess the need to continue to rely on derates for diesel engines using SCR.[111]

Comments received in response to the proposal of the 2023 Final Rule were also reviewed as part of this reassessment of inducements. Commenters expressed frustration with the process of relying on the engine's electronic controls to make a judgment on tampering without being able to consider problems caused by component failure.[112] Commenters stated that engines are designed with algorithms that calculate a probability that tampering has occurred, without being able to confirm it has occurred.[113] Commenters shared their experiences with derates for system defects unrelated to tampering, with no opportunity for operators to appeal to demonstrate that no tampering occurred prior to or even after a derate had been initiated by the engine's control system.[114] Commenters stated that, in some cases, components were identified as defective by the diagnostic system but were not actually faulty, which means that derate occurred despite emission controls working properly.[115] Furthermore, one manufacturer commented that it was difficult to differentiate between tampering or urea crystallization that can cause plugged lines that prevent DEF flow.[116]

In response to these concerns, the EPA narrowed the list of tampering triggers in the 2023 Final Rule. Inducements depend on the engine's diagnostic systems being able to accurately distinguish between problems directly caused by an operator tampering or not supplying quality DEF and problems caused by defective components. The EPA attempted to refocus inducement triggers in the 2023 Final Rule, for example by limiting the tampering-related triggers to ''open circuit'' faults that would occur if an operator unplugged a component (*e.g.,* a DEF pump). However, there remains risk that the judgments made by the engine's diagnostic system on the remaining inducement triggers may not always accurately distinguish between tampering and defective components but nevertheless uses derates for both. This concern for recognizing the limits of algorithm-based judgments is an important factor to consider in reassessing the role of derates to ensure that operators are maintaining the DEF supply and not tampering.

The February 2026 SCR-related warranty claim data, which the EPA required highway and nonroad diesel engine manufacturers to provide, can help identify certain areas in which improvements to components or software calibrations might be made to improve SCR system reliability (*see* section B.3. for further discussion on the Agency's request). It is important to note that most of this data is likely to provide insight into failures within the manufacturer's warranty period (*e.g.,* generally under 200,000 miles and two years for heavy-duty highway engines and vehicles) versus over the entire useful life. In general, heavy-duty highway diesel SCR systems were first introduced in MY 2010, and nonroad diesel SCR systems were first introduced in MY 2014. Therefore, much of the in-use fleet of SCR-equipped engines, vehicles, and equipment are now outside of the manufacturer's warranty period. The SCR failures that are frustrating owners

[108] U.S. Environmental Protection Agency. (2026). ''DEF Quality Monitoring Using Alternate Sensor Technologies,'' Guidance Document: IACD–2026–05 (LDV, HDE, NRCI). *www.epa.gov/system/files/documents/2026-03/iacd-2026-05-def-guidance-ltr-2026-0326.pdf.*

[109] U.S. Environmental Protection Agency. (2026). ''Administrator Zeldin Takes Additional Measures to Address Diesel Exhaust Fluid (DEF) Issues for American Farmers and Truckers,'' *www.epa.gov/newsreleases/administrator-zeldin-takes-additional-measures-address-diesel-exhaust-fluid-def-issues.*

[110] 88 FR 4377 (Jan. 24, 2023).

[111] U.S. Environmental Protection Agency. (2026). ''Administrator Zeldin Takes Additional Measures to Address Diesel Exhaust Fluid (DEF) Issues for American Farmers and Truckers.'' *www.epa.gov/newsreleases/administrator-zeldin-takes-additional-measures-address-diesel-exhaust-fluid-def-issues.*

[112] *See, e.g.,* American Trucking Associations comment on the EPA's Advance Notice of Proposed Rulemaking. EPA–HQ–OAR–2019–0055–0357. *www.regulations.gov/document/EPA-HQ-OAR-2019-0055-0357.*

[113] *See, e.g.,* National Association of Small Trucking Companies comment on the EPA's Advance Notice of Proposed Rulemaking. EPA–HQ–OAR–2019–0055–0456. *www.regulations.gov/document/EPA-HQ-OAR-2019-0055-0456.*

[114] *See, e.g.,* Indiana Motor Truck Associations comment on the EPA's Notice of Proposed Rulemaking. EPA–HQ–OAR–2019–0055–0357. *www.regulations.gov/document/EPA-HQ-OAR-2019-0055-1095.*

[115] Memorandum to Docket EPA–HQ–OAR–2019–0055, ''Summary of ANPR Comments Relating to Inducements.'' *www.regulations.gov/document/EPA-HQ-OAR-2019-0055-0826.*

[116] Cummins comment on the EPA's Notice of Proposed Rulemaking. EPA–HQ–OAR–2019–0055–1325. *https://www.regulations.gov/comment/EPA-HQ-OAR-2019-0055-1325.*

and operators may reflect design defects that could be revealed in the warranty data, but also likely reflect harsh real-world conditions in which diesel engines operate for hundreds of thousands of miles. For example, wiring harness degradation due to age or corrosion in connectors after hundreds of thousands of miles can provide inaccurate readings that, as discussed above, can be interpreted by the engine's diagnostic system as a tampering event and result in an engine derate.[117]

One factor the EPA considered in the 2007 to 2010 timeframe, when manufacturers informed the Agency of their plans to introduce SCR technology for heavy-duty highway applications beginning in MY 2010, was the availability of DEF. At that time, DEF was not available at most diesel refueling stations or other retail outlets. That reality informed the EPA's early guidance documents regarding the use of DEF and inducements. As discussed in section V.A of this preamble, DEF availability is no longer a constraint to the operational feasibility of SCR technology in heavy-duty highway applications. DEF is widely available nationwide, including at fuel stations with dedicated dispensing pumps, meaning DEF can be refilled at the same time diesel is being pumped. Diesel vehicle owners and operators are now familiar with DEF and have over a decade of experience using it across the country.

Today, many engine manufacturers utilize compensation algorithms that adjust the amount of DEF injected to account for DEF that is not at the nominal 32.5 percent urea concentration, such that adding water to dilute DEF would only cause the engine to increase the amount of DEF injected to achieve the manufacturer's intended quantity of urea for controlling emissions. The EPA believes this discourages the potential for operators to purposefully dilute DEF as a potential means to reduce operating costs. The increased DEF consumption due to the compensation algorithms increases the risk that DEF tanks would be empty prior to the next refueling event, which would require operators to spend more time stopping to refill DEF. This could take away the convenience of refilling DEF at the pump with fuel refills. Adding water could also void an aftertreatment warranty claim and, even after the warranty period has expired, many operators would also not want to risk damaging the SCR system by intentionally using the wrong fluid.

As a part of this reconsideration of inducements that reduce engine and vehicle performance, the EPA has considered other examples of vehicle operations that encourage an operator to take specific action. In particular, the EPA reviewed two recent studies on the success of visible and audible notifications used to prompt light-duty vehicle drivers to wear seatbelts.[118] [119] There are clearly differences in the use of seatbelts and the use of DEF. For example, the financial impact is different; the use of DEF increases the operating cost of a diesel-fueled vehicle while the use of a seatbelt is free. The risks are also different; not wearing a seatbelt can have severe repercussions for the operator, including serious injury or death, while currently not using DEF can result in a vehicle speed derate. The underlying principle of designing a system to motivate seatbelt usage is very relevant for the EPA when considering inducements. As NHTSA stated in a final rule in 2025, ''[a]n optimized warning system balances effectiveness and annoyance, so that the warning is noticeable enough that the occupants will be motivated to fasten their belts, but not so intrusive that an occupant may attempt to circumvent or disable it or the public will not accept it.'' [120] The seatbelt studies noted previously stated that frequent audible warnings that last for 90 seconds or longer can significantly increase seatbelt use compliance. One of these studies also found that seatbelt speed-limiting interlocks (*e.g.,* a 15-mph speed limit enacted when seatbelts were not fastened) were not more effective than frequent, long audible warnings; participants circumvented the speed-limiting interlock to drive unbelted more than with audible reminders.

2. Proposed Inducement Requirements

The EPA is proposing to replace engine performance derates for SCR-related inducements with the alternative approach of having the engine's control system alert operators with visible and/or audible notifications of the need to address concerns with the emission control systems, such as to replenish DEF supply or warn of possible tampering. The proposed audible notification would be in addition to visible notifications already being used. The EPA expects these proposed revisions to the Agency's SCR inducement requirements for heavy-duty diesel engines would require software-based changes, which are considered indirect costs associated with research and development. See section 3.1.2 of the DRIA for this proposed rule for a discussion on indirect costs. The EPA requests comment on any costs or savings associated with these changes relative to the 2023 Final Rule (*i.e.,* software development costs or savings associated with removing the 2023 Final Rule requirement to determine a vehicle's average speed and then assign a specific derate schedule based on that speed). (C–28).

Visible notifications for certain SCR-related maintenance issues were included in the EPA's early guidance on the use of DEF and are also used by the OBD system, which displays the MIL (*i.e.,* the ''check engine light'') to flag system faults. The 2023 Final Rule included requirements to display additional information on SCR system and DPF problems (*e.g.,* erratic temperature sensor readings that prevent DPF regenerations from occurring which can result in a plugged DPF) that result in a derate. The regulations at 40 CFR 1036.110(c) currently specify basic elements of visible notifications and require EPA approval for detailed specifications. The EPA will work with industry to adopt standardized specifications for SCR-related notifications if additional changes are needed.

The EPA is proposing a separate audible notification schedule for DEF level because, as discussed in section V.A of this preamble, industry has proven that refilling DEF is easy and DEF is readily available at retail stores and diesel refueling stations nationwide. Therefore, it should not require much time to find and refill DEF to resolve the audible notification.

The EPA is proposing that a 90-second audible notification would be required at the frequency shown in Table V–1 below. The EPA is proposing a 90-second audible notification because studies have shown that a 90-second notification is effective in increasing seatbelt usage in passenger cars.[121]

[117] *See* Memorandum to docket EPA–HQ–OAR–2019–0055–0967. ''TSB Aftertreatment Faults.'' Sept. 9, 2021.

[118] Kidd, D. G., and Singer, J. (2019). The effects of persistent audible seat belt reminders and a speed-limiting interlock on the seat belt use of drivers who do not always use a seat belt. *Journal of Safety Research. www.iihs.org/research-areas/bibliography/ref/2185.*

[119] Kidd, D. G., and O'Malley, S. (2023). Increasing seat belt use in the United States by promoting and requiring more effective seat belt reminder systems. *Traffic Injury Prevention, 24*(sup1), S80–S87. *https://doi.org/10.1080/15389588.2022.2134730.*

[120] 90 FR 396 (Jan. 3, 2025).

[121] Kidd, D. G., and O'Malley, S. (2023). Increasing seat belt use in the United States by promoting and requiring more effective seat belt reminder systems. Traffic Injury Prevention,

There are important differences between passenger vehicle operators and heavy-duty truck operators that the EPA considered when developing the proposed schedule. For example, truck drivers have additional professional licensing and training requirements. As commercial vehicle operators, they are accustomed to paying close attention to warning lights in general because they rely on the vehicle operating as intended to support a business and one check engine light can indicate multiple problems. Additionally, line-haul trucks operate in a manner that routinely takes them far away from their home location, in many cases thousands of miles away, and freight movement generally pays by the mile. Other commercial operators, such as refrigerated food and beverage trucks or refuse trucks, may be particularly motivated to avoid breakdowns to remain on schedule.

The EPA also considered both how long operators are in their vehicles and how far apart refueling stations are when developing the proposed audible notification schedule. Operators of heavy-duty vehicles are bound by Hours-of-Service requirements published by the Department of Transportation.[122] The basic requirement is that drivers must take a 30-minute break when they have driven for a cumulative 8-hour period. It is not uncommon for drivers to spend 2–4 hours on the road between breaks. In addition, it is reasonable to estimate that the average distance between most refueling stations is 50 miles, or approximately one hour, although this depends on where a truck is operating.[123] For example, in or close to a city there are stations and retail stores that sell DEF within minutes of each other. On the other hand, there are remote areas where there may be a few hours between stops. The general expectation is that (1) drivers will refill DEF tanks when they refill diesel fuel and, with the 1:1 ratio of DEF to diesel fuel, running out of DEF should not occur between fuel stops, and (2) fuel stops are available on average one hour apart.

For this reason, the EPA is proposing a different frequency for DEF level audible notification. This audible notification schedule attempts to balance effectiveness and annoyance by making it frequent enough to motivate an operator to refill DEF, but allowing adequate time between notifications to stop and refill to avoid a notification that is so intrusive that they may attempt to circumvent or disable, resulting in prolonged NO_X emissions above the standards.

The EPA is proposing to retain the provision in 40 CFR 1036.111(b)(1) that the first inducement notification will start three hours prior to the tank becoming empty or when the tank is at 2.5 percent full. This three-hour warning for low DEF is something operators are used to and should provide more than sufficient time for stopping to refill DEF during a scheduled break in a manner that would avoid interrupting their trip. The EPA is requesting comment on whether this provision should be retained, modified, or not included in the revised inducement requirements. (C–29).

The EPA is proposing to retain the tampering inducement triggers described in 40 CFR 1036.111(b)(4) and to set a schedule for DEF quality and tampering signals that is slightly different than the schedule for DEF level. This is because it is expected that, due to the improvements the EPA made in the 2023 Final Rule to reduce the number and type of tampering triggers and to reduce the number of false inducements, these inducements would occur only if there was a problem not easily solvable by adding DEF. As discussed in section V.C.1 of this preamble, the EPA is concerned that these types of failures mostly occur because the engine's diagnostic system has difficulty detecting the difference between tampering and faulty components. These issues can be more difficult to resolve and may require specialized repair facilities and tools. As the EPA discussed in the proposal to the 2023 Final Rule, commenters noted that it can take three days to schedule an appointment with a repair facility. Therefore, for DEF quality- and tampering-related failures, the EPA is proposing a less frequent audible notification schedule than the proposed audible notification schedule for DEF level. The EPA is proposing that for DEF level, the first audible notification occurs three hours prior to the tank becoming empty, at the time the tank is empty, 30 and 60 minutes after becoming empty, with a final frequency of every hour until the condition is resolved. The EPA is proposing that for DEF quality and tampering, the first audible notification occurs at the time the condition is detected, 30 and 90 minutes after detection, with a final frequency of every three hours until the condition is resolved.

Table V-1 Proposed DEF Audible Notifications

	Audible Notification Frequencies	
	DEF Level	**DEF Quality or Tampering**
Initial	Prior to empty[a]	When detected
	When empty	30 minutes after detected
	30 and 60 minutes after empty	90 minutes after detected
Final	Every hour	Every 3 hours

[a] The existing provision in 40 CFR 1036.111(b)(1) would be retained, for DEF supply falling to 2.5 percent of DEF tank capacity or a level corresponding to three hours of engine operation, based on available information on DEF consumption rates

The EPA is requesting comment on several aspects of the proposed requirements for audible notifications as shown in Table V–1. (C–30). The EPA requests comment on advantages and disadvantages to creating a separate audible notification schedule for DEF level. The EPA requests comment on the audible notification length, including whether it should last for more or less than 90 seconds each time. The EPA is requesting comment on the frequency of the notifications, including whether more or less frequent notifications would be appropriate for demonstrating

24(sup1), S80–S87. *https://doi.org/10.1080/15389588.2022.2134730.*

[122] Hours of Service information can be found here: *https://www.fmcsa.dot.gov/regulations/hours-of-service.*

[123] See *https://www.mmcginvest.com/post/the-u-s-truck-stop-economy-an-ultimate-guide-to-full-service-travel-plazas.*

that operators are reasonably likely to take appropriate action, including but not limited to whether the notification should be only at key-on or if there should be a certain number of notifications during a single trip. The EPA requests comment on whether audible notifications are helpful in addition to visible notifications, as a prompt for operators to refill DEF or take other action to maintain SCR systems. The EPA requests comment on whether visible notifications should be continuously illuminated, or whether a flashing indicator would be more effective. The EPA requests comment on whether visible and/or audible notifications are inadequate for providing a reasonable assurance that operators will provide a supply of quality DEF in tanks and not tamper with SCR systems. The EPA requests comment on whether the regulation should preserve a more modest schedule of performance derates than specified in the 2023 Final Rule to prompt operators to take action or derates similar to the schedules the Agency included in the August 2025 guidance. For example, the regulation could keep the derate schedule as adopted in 40 CFR 1036.111 for low-speed, medium-speed, and high-speed vehicles, but apply only one or two derate steps after detecting an inducement triggering condition to include more or different criteria in the list of inducement triggering conditions. Finally, the EPA requests comment on whether changes to notifications and derates should lead the Agency to include more or different criteria in the list of inducement triggering conditions.

The proposed approach includes several amendments to the regulations that were adopted in the 2023 Final Rule. First, the EPA is proposing to remove 40 CFR 1036.111(a)(2), which specifies how a manufacturer must determine to what speed-category a vehicle belongs.

Second, the EPA is proposing to remove 40 CFR 1036.111(a)(3), which specifies the rate at which a vehicle speed derate is implemented.

Third, the EPA is proposing to remove 40 CFR 1036.111(d), which includes the derate schedule for vehicles.

Fourth, the EPA is proposing to modify 40 CFR 1036.110(c) requirements to remove all requirements related to displaying the inducement derate schedule.

Fifth, the EPA is proposing to amend 40 CFR 1036.111(e) to replace references to ''derates'' with ''visible and/or audible notifications,'' and to remove paragraph (e)(3) that requires restarting derates at the same point in the derate schedule for inducement triggering conditions that recur after less than 40 hours of engine operation. If the EPA retained paragraph (e)(3) for the audible notification schedule in Table V–1, a recurring inducement condition could trigger an audible notification at the final frequencies of one notification every 1–3 hours. By removing the recurring fault requirement, the proposed audible notifications would occur at the more frequent initial levels. The EPA is requesting comment on whether this provision should instead be retained or modified. (C–31).

Sixth, the EPA is proposing to modify 40 CFR 1036.125(h)(8) to adjust the requirements related to information in the owner's manual describing the inducement derate schedule to reflect the proposed visible and/or audible notifications.

Seventh, the EPA acknowledges that manufacturers may choose to continue to apply derates to protect the engine or aftertreatment system from catastrophic damage, for example if low coolant is causing the engine to overheat, or if a lack of DEF could cause a DEF injector to overheat and fail.[124] The EPA is therefore proposing to clarify that manufacturers may continue to use engine derates to protect the engine or aftertreatment systems from catastrophic damage. The EPA is requesting comment on whether this proposal should be more or less restrictive. (C–32).

The EPA is proposing to require manufacturers to design their engines with visible and/or audible notifications to prompt operators to supply quality DEF in tanks instead of derating, as described in this proposal, no later than MY 2029. Under the proposal, manufacturers may also make this transition for new engines any time before MY 2029. The EPA recognizes that manufacturers have been working toward designing their heavy-duty diesel engines and vehicles with inducement requirements as adopted in the 2023 Final Rule. This proposal retains the general requirements specified in 40 CFR 1036.110 and 1036.111 for MYs 2027 and 2028. The EPA requests comment on the potential need to provide additional lead-time for implementing the proposed inducement changes, specifically if the Agency should, instead, require this change by MY 2030 or MY 2031. At the same time, the EPA is interested in accelerating the change to the long-term approach described in this proposal. Toward that end, the EPA requests comment on adjustments or simplifications to the inducement provisions adopted in the 2023 Final Rule that engine and vehicle manufacturers could apply before MY 2029, considering the need for sufficient time to implement such changes. (C–33).

D. Proposed Revisions To Improve SCR Reliability

This section also includes proposals to modify existing OBD requirements aimed at improving the reliability of heavy-duty highway diesel engines and vehicles with SCR systems.

1. DEF Quality Detection Proposal

It has been over a decade since the EPA has evaluated how best to consider adjustable parameters requirements as they apply to DEF quality, which can vary due to production or storage issues, degradation with age or environmental conditions, or dilution with water. In this section, the EPA proposes several amendments to improve how manufacturers can comply with emission standards by ensuring that operators are reasonably likely to use proper quality DEF. The purpose of these proposed changes is to design a program that will monitor for meaningful DEF quality issues and not create operator frustration with overly precise monitoring.

As described in sections V.A and V.C.1 of this preamble, there was concern when SCR was first introduced into the market over a decade ago that DEF availability may be limited and some operators may use water instead of DEF. Today, quality DEF is widely available and operators have an established practice of purchasing DEF along with diesel fuel. While information on nationwide in-use tampering rates is difficult to find, the EPA expects there is very little intentional diluting of DEF.[125] In the unlikely event that an operator fills the DEF tank with water or mistakenly adds diesel fuel to the DEF tank, the engine's control system prompts operators to take action. As discussed in section V.C.1 of this preamble, users are generally aware that such actions can damage equipment and void warranty claims, and the EPA expects they would quickly address the problem by flushing the system and replacing DEF. Also,

[124] Gribbins, K. (2020). ''Beat the Heat: Daily Maintenance for Off-Highway Engines Dealing with Hot Weather and Work.'' *https://compactequip.com/engines/beat-the-heat-daily-maintenance-for-off-highway-diesel-engines-dealing-with-hot-weather-and-work.*

[125] U.S. Environmental Protection Agency. (2021). ''Tampered Diesel Pickup Trucks: A Review of Aggregated Evidence from EPA Civil Enforcement Investigations.'' *https://www.epa.gov/enforcement/tampered-diesel-pickup-trucks-review-aggregated-evidence-epa-civil-enforcement.*

manufacturers have developed DEF dosing compensation algorithms that can increase or decrease the amount of DEF being dosed to address DEF variability. These compensation features cause DEF dilution to be a self-defeating strategy, as any dilution generally results in more volume of DEF being consumed and more time spent stopping to refill DEF tanks. DEF dilution has therefore become an unlikely scenario that does not cause the same weight of concern it once did. However, the EPA recognizes that in-use DEF might have varying concentration for reasons other than tampering, such as production variability or DEF degradation due to long-term storage, sun exposure, or storage temperature, which can occur after a DEF tank was filled with DEF with the nominal 32.5 percent urea concentration.[126] Manufacturers' compensation algorithms are designed to address DEF variability caused by production variability or storage conditions by increasing or decreasing the amount of DEF being dosed.

In preparation for submitting comments on the 2023 Final Rule, CARB performed a limited survey of 33 randomly selected California fleets to better understand their experience with inducements.[127] CARB commented that ''In the survey, fleets that experienced derates were asked for the cause, and 37 percent were for failed NO_X sensors or DEF quality sensors. This was by far the most common cause of derate conditions.'' The comment noted that no fleets reported derates due to bad DEF quality (*e.g.,* urea concentration outside of a manufacturer's specification or diluted with water), which CARB suggested was consistent with industry efforts to assure the high-quality DEF supply chain and CARB staff's earlier surveys of DEF availability and driver usage.

In the 2023 Final Rule, the EPA promulgated 40 CFR 1036.115(f)(3), which maintains that DEF supply and DEF quality are adjustable parameters, and specifies that the practically adjustable range includes any amount of DEF supply for which the engine's control system does not trigger an inducement under 40 CFR 1036.111. The EPA proposed, but did not finalize, in the 2023 Final Rule to further specify in regulatory text that the physically adjustable range would also include any quality of DEF for which the engine's diagnostic system does not trigger inducement. Instead, as stated in the 2023 Final Rule, for compliance with 40 CFR 1036.115(f)(3) with regard to DEF quality, manufacturers could continue to rely on the existing guidance in CISD–13–13 describing how manufacturers can demonstrate compliance with emission standards over the practically adjustable range for DEF quality.[128] In the 2023 Final Rule, the EPA intended to further consider the relationship between inducements and the practically adjustable range for DEF quality in the future.

In the EPA's guidance document CD–13–13, the Agency explained that DEF quality would generally be considered an adjustable parameter, and that ''poor quality DEF'' is any urea concentration at which the engine is unable to meet emission standards. This point can vary from manufacturer to manufacturer and from engine to engine. The guidance explained that the EPA considered the practically adjustable range for emission testing to be from nominal DEF with a 32.5 percent urea concentration down to the point at which the engine is unable to meet emission standards (the first point at which a manufacturer must start an inducement). This means that manufacturers must be able to precisely detect urea concentrations different than the nominal 32.5 percent, demonstrate that they can meet emission standards by compensating, or trigger an inducement for a DEF quality concern.

In the 2023 Final Rule, some commenters raised concerns that the numerically lower NO_X standards for MY 2027 will cause the corresponding range of adjustment to be narrower. For example, the Truck and Engine Manufacturers Association (EMA) commented on the 2023 Final Rule, noting ''. . . manufacturers have too little experience with the complex future emissions control systems required to meet the proposed very stringent standards to know if compliance can be assured at the urea concentration limits detectable by [DEF Quality Sensor] systems.'' EMA added that they were concerned that the EPA did not perform testing to demonstrate the impacts of DEF quality with lower NO_X standards.[129] The EPA acknowledges that manufacturers using the guidance in CD–13–13 to certify to MYs 2027 and later NO_X standards would have a smaller margin to tolerate fluctuations in DEF outside of the nominal specification due to variations in urea concentration.

While the EPA is proposing to remove inducements as noted in section V.C of this preamble, the Agency also wants to ensure the detection systems are not overly precise such that visible and/or audible notifications are improperly triggered for conditions outside of the operator's control. For example, the EPA has learned that DEF quality sensors can trigger false urea concentration faults after a simple DEF refill that creates bubbles in the fluid.[130]

The EPA is proposing the following amendments to maintain the integrity of DEF quality notifications by ensuring they are only triggered for meaningful DEF quality problems. First, the EPA is proposing to amend 40 CFR 1036.115(i) by adding a requirement for manufacturers to design their engines to include compensation algorithms that adjust DEF flow to maintain emission control by compensating for DEF with a reduced urea concentration. This is intended to reflect current practice. Compensation algorithms would need to adjust DEF flow to maintain a level of emission control that is comparable to operation with DEF at the nominal 32.5 percent urea concentration. Compensation would be required up to the hardware limits. For example, given the design of a DEF injector, it will have a maximum amount of DEF flow that limits the amount of compensation that is possible. As a point of reference, the EPA has adopted a similar approach of requiring compensation for nonroad spark-ignition engines using noncommercial fuels, such as those that operate on field gas from landfills or oil wells.[131] The EPA is also proposing to amend 40 CFR 1036.205(b)(12) to require manufacturers to describe their design for compensation algorithms related to DEF quality in the application for certification. The EPA is requesting comment on the feasibility of DEF dosing continuing after a DEF quality notification is enacted (*e.g.,* if the urea concentration is less than 20 percent). (C–34). For example, DEF with a low concentration of urea may still provide NO_X emission reductions, but there may be a concern for protecting the SCR system from damage if urea concentration is at or near zero as a

[126] DEF exposed to temperatures above 86 °F can degrade, decreasing urea concentration. DEF stored in conditions below freezing can develop ice that dilutes the urea concentration.

[127] California Air Resources Board comments on the EPA's proposed rule. EPA–HQ–OAR–2019–0055–1186. *https://www.regulations.gov/document/EPA-HQ-OAR-2019-0055-1186.*

[128] U.S. Environmental Protection Agency. (2014). CISD–14–10, ''Certification of Nonroad Diesel Engines Equipped with SCR Emission Controls.'' *https://dis.epa.gov/otaqpub/display_file.jsp?docid=32298&flag=1.*

[129] Truck and Engine Manufacturers comments on the EPA's proposed rule. EPA–HQ–OAR–2019–0055–1203., p. 125. *https://www.regulations.gov/document/EPA-HQ-OAR-2019-0055-1203.*

[130] See *https://www.fama.org/wp-content/uploads/2021/12/TC081-FAMA-DEF-Sensor-Guidance-211227-2.pdf.*

[131] *See* 40 CFR 1048.625.

result of a fluid other than DEF being added to the DEF tank.

Second, in 40 CFR 1036.111(b), the EPA is proposing to specify that systems must detect if urea concentration falls below a specified value of 20 percent by weight.[132] The EPA is proposing to allow manufacturers to measure DEF quality either directly with a UQS or indirectly with NO_X sensors or other measurement of a surrogate value. The EPA is proposing that this less precise detection of DEF quality is appropriate because manufacturers are generally able to apply compensation algorithms to account for varying DEF quality above 20 percent. Resetting the threshold value for triggering a fault condition based on DEF quality shifts the purpose of the fault detection from the original approach of ensuring control relative to DEF quality as an adjustable parameter to instead ensuring that tampering has not occurred. The EPA is requesting comment on the proposed threshold of 20 percent as the urea concentration at which manufacturers would start to notify operators. (C–35).

Third, the EPA would not expect DEF quality to vary appreciably between DEF refills. The EPA is therefore further proposing that DEF quality detection may be limited to each time a refill event occurs to further reduce inaccurate detection of DEF quality. The EPA is aware that engines might not detect cases in which DEF quality has degraded after sitting in the tank for several weeks if a truck is out of service. The EPA is requesting comment on whether an additional DEF quality check should occur after a specified number of days to address concerns with DEF quality degradation during extended time out of service. (C–36).

Fourth, measurement methods and operating characteristics can substantially affect the time needed to determine urea concentration. For example, extended high-load operation after a DEF refill would allow the engine to stabilize DEF flow and NO_X emissions to quickly enable the evaluation of urea concentration. In contrast, engines may need more time to achieve the right conditions for evaluating urea concentration if there is extended idle. Requiring an assessment of DEF quality within a certain time would introduce the risk of forcing a premature judgment, which would increase the number of instances of incorrectly warning operators that DEF quality is poor. The EPA is therefore proposing to require that manufacturers use good engineering judgment to assess DEF quality promptly after a DEF refill event. The EPA is requesting comment on whether there are other modifications needed to enable this proposal, such as to allow temporary disablement of DEF compensation strategies to give NO_X sensors an opportunity to measure DEF quality without the confounding effect of compensation. (C–37).

Fifth, the EPA is proposing changes related to testing. Specifically, the EPA is proposing to amend 40 CFR 1036.501(b) to establish a default expectation that laboratory testing (including OBD certification testing) will involve DEF meeting nominal specifications (32.5 ± 0.7 percent urea). This approach is consistent with measuring emissions using a test fuel that meets a standard specification. The EPA is proposing to address varying DEF quality by requiring compensation algorithms that adjust DEF flow and inducement notifications for very low urea concentrations, rather than by requiring manufacturers to demonstrate compliance with emission standards over a range of urea concentrations. Note that this approach for testing is also consistent with testing specifications that are already established in 40 CFR 1065.735.

Sixth, the EPA is proposing to amend 40 CFR 1036.415(c) to perform testing with the as-received DEF, with the allowance to add fresh DEF as needed for completing the test run. Also, regardless of the as-received DEF urea concentration, the vehicle must be tested in as-received condition under the proposed amendment. Low-quality DEF would not be a basis for invalidating a test. Manufacturers therefore would determine the number of engines to test and would determine the pass-fail result for the engine family based on test results including any measurements with low-quality DEF. Manufacturers may flush the DEF tank, refill with on-spec DEF and retest if the first test fails. Results of any repeat testing with fresh DEF would not replace the results from testing in the as-received condition, but the EPA would consider the results of repeat testing in deciding whether or how to pursue a compliance action.

A remaining question is whether the EPA should continue to treat DEF quality as an adjustable parameter under 40 CFR 1036.115(f)(3). Guidance documents have historically treated DEF quality as an adjustable parameter based on the possibility of operators diluting DEF with water. That consideration leads to the obligation for manufacturers to comply with standards across the adjustable range. With engines designed to derate performance based on poor quality DEF, the urea concentration value used to initiate a derate for DEF quality is also used to establish the practically adjustable range for demonstrating compliance with standards. Implementing this requirement has resulted in the issues raised in this section with DEF quality inducements being a major source of frustration with operators. More recently, the EPA issued revised guidance to alleviate some of the problems resulting from the precise monitoring of DEF quality in-use (*see* section V.B.4).[133]

This proposal notes several relevant changes with respect to treating DEF quality as an adjustable parameter. As described earlier in this section, the EPA has a general expectation that operators will fill DEF tanks with commercially available DEF, which should always be very close to 32.5 percent urea concentration. Further, the EPA's proposal to name below 20 percent urea concentration as the point for triggering visible and/or audible notifications is intended to reduce the precision needed to monitor DEF quality to address concerns about accurately and consistently identifying poor DEF quality. The more stringent NO_X standard starting in MY 2027 further increases the technical challenge of ensuring engines can be designed to tolerate reasonable fluctuations in DEF quality such that operators are alerted to actual DEF quality problems. The EPA's proposal in this section addresses these concerns by specifying how DEF quality should be treated for varying urea concentrations. This section also describes the EPA's proposal to require manufacturers to design their engines with compensation algorithms to achieve a comparable level of control rather than keeping the open-ended requirement to meet standards at all urea concentrations down to the onset of the inducement triggering condition (20 percent urea). The combination of proposed provisions is intended to address concerns about controlling emissions across a wider range for DEF quality. These proposed provisions would have the effect of shifting the

[132] Engine manufacturers predominantly recommend use of DEF meeting the industry-recognized ISO 22241–1:2019 quality standard. This standard by the International Organization for Standardization defines DEF as a water-based solution with a 32.5 percent urea concentration. Available here: *https://www.iso.org/standard/66408.html.*

[133] U.S. Environmental Protection Agency. (2026). ''DEF Quality Monitoring Using Alternate Sensor Technologies,'' Guidance Document: IACD–2026–05 (LDV, HDE, NRCI). *www.epa.gov/system/files/documents/2026-03/iacd-2026-05-def-guidance-ltr-2026-0326.pdf.*

focus of compliance away from demonstrating at certification that engines comply with standards across the adjustable range. For these reasons, the EPA is requesting comment on whether DEF quality should remain an adjustable parameter. (C–38).

In summary, high-quality DEF is widely available and operators have little incentive to dilute DEF. The changes the EPA is proposing related to DEF quality are intended to account for the fact that current engine designs can generally compensate for real-world fluctuations in DEF quality. The proposed revisions are intended to properly focus on requiring that an engine's control system monitors for, and alerts operators to, significant DEF quality issues while limiting overly precise detection requirements that could lead to frequent or improper notifications. Any actions the EPA can take to reduce downtime would improve owner experiences operating and maintaining heavy-duty engines and reduce the likelihood of occurrences of tampering, which helps ensure in-use emission reductions. Due to widespread DEF availability and familiarity with operators, the EPA acknowledges that operators will readily find and continue to use high-quality DEF.

2. DEF Freeze Protection Proposal

In 2009 guidance, CISD–09–04 Revised, the EPA discussed concern that in cold weather DEF may freeze and not immediately flow to the SCR system, which could reduce expected emission benefits.[134] This guidance stated that if DEF did not flow during such conditions, this would fall under the EPA's Auxiliary Emission Control Device (AECD) requirements (*see* 40 CFR 86.082–2). To meet the EPA's AECD requirements, manufacturers must show they are not incorporating strategies that reduce emission control effectiveness compared to strategies used during applicable Federal testing procedures. The guidance added that the EPA can examine an engine's SCR control system during certification to ensure proper dosing will occur during extreme cold ambient temperature conditions. This guidance stated that the EPA expected manufacturers to either use a reducing agent (*e.g.,* a form of DEF) that would not freeze or design the SCR system to prevent freezing through the use of heated components. The EPA included a test procedure in this guidance that manufacturers could use to demonstrate adequate DEF freeze protection. The procedure includes an expectation that DEF would thaw and the SCR system should be fully functional within 70 minutes of engine starting. There are multiple reasons that cold weather can lead to an inducement on existing engines, such as failure of DEF heating components, false faults associated with DEF heating components, and DEF that has not fully thawed that is incorrectly judged by the UQS as being poor quality DEF. The EPA has heard from operators and concerned citizens, specifically in Alaska, that their extreme cold weather makes it difficult to avoid freezing DEF, and their frequently remote operation increases the risk of serious problems if trucks are derated.[135] Recently, the Senate Environment and Public Works Committee held a hearing to examine S. 3135, the *Cold Weather Diesel Reliability Act*, legislation introduced by Senators Dan Sullivan and Cynthia Lummis.[136]

The EPA did not modify or codify freeze protection test requirements in the 2023 Final Rule. The EPA is proposing to amend 40 CFR 1036.115(i) to require manufacturers to include features that provide freeze protection. That proposed codification would include reference to a proposed procedure in 40 CFR 1036.560 for demonstrating compliance for certification, consistent with the procedure established in guidance. The EPA recognizes that SCR systems may not dose properly in certain extreme cold ambient temperature conditions. The EPA is requesting comment on whether there are changes that may improve the freeze protection test procedure, such as more or less time in soak or to thaw DEF, more or less time spent at idle, time at engine load, and percent engine load, or if there is an alternative procedure that would be more effective. (C–39).

The EPA is also proposing to amend 40 CFR 1036.111 to allow manufacturers to temporarily disable the audible notifications proposed in section V.C of this preamble when the ambient temperature is below 12 °F (the freezing point of DEF). Under this proposed allowance, manufacturers would be expected to restore the audible notifications after ambient temperatures rise to a level that allows reliable system monitoring. The EPA is proposing to require restarting audible notifications for inducement triggering conditions when ambient temperatures rise to 32 °F for a given trip to provide sufficient time for the system to stabilize. The EPA is proposing that audible notifications would restart for the next key-on event if ambient temperatures were above 12 °F. The EPA requests comment on this approach and other approaches the Agency should consider to address SCR reliability in cold weather conditions, including but not limited to application-based or geographic-based exemptions or different ambient temperature thresholds.[137] (C–40).

Also, the EPA is aware that some manufacturers may use DEF for component protection external to the SCR system. Operating the engine with frozen DEF may therefore cause problems of which operators should be aware, aside from the usual concern about supplying DEF for catalyst performance. The EPA requests comment on whether there is a need to continue to require audible notifications to the operator to ensure that they refill DEF or address other issues that may prevent DEF from reaching those components in very cold weather. (C–41). The EPA is aware that during very cold temperatures the engine's diagnostic system can set false codes if DEF is unable to be thawed and injected, and is proposing these changes such that operators can maintain confidence in the engine's diagnostic system, to ensure the SCR system is not damaged, and to reduce the possibility of tampering.

3. Proposed Changes to SCR-Based OBD Requirements

The EPA has heard from truck and engine manufacturers that there are changes that can be made to existing OBD requirements that can help eliminate false faults causing inducement and downtime that lead to

[134] U.S. Environmental Protection Agency. (2009). CISD–09–04 Revised, ''Revised Guidance for Certification of Heavy-Duty Diesel Engines Using Selective Catalyst Reduction (SCR) Technologies.'' *https://dis.epa.gov/otaqpub/display_file.jsp?docid=20532&flag=1.*

[135] *See* docketed ''Email exchange with Nolan Willis'', including a Petition for Conditional Delay and Alaska Exemption in 2027 Heavy-Duty Low-NO_X Rule Reconsideration. Feb. 22, 2026.

[136] U.S. Senate Environment and Public Works Committee. ''EPW Committee Holds Hearing On Sullivan's Cold Weather Diesel Reliability Act.'' Transcripts available here: *www.sullivan.senate.gov/imo/media/doc/ryan_anderson_testimony_03112026.pdf.*

[137] *See* 40 CFR 85.1716 and 1039.670, which allow approval of an emergency vehicle field modification to prevent engines with aftertreatment from experiencing power loss when emission controls are not working properly. *See also* 40 CFR 1036.655 and 1039.655, which describe how diesel-fueled engines sold in American Samoa or the Commonwealth of the Northern Mariana Islands are subject to less stringent standards based on unreliable access to ultra-low-sulfur diesel fuel. Less stringent standards for engines used in Alaska would presumably be based on engine reliability in Arctic conditions instead of or in addition to fuel constraints, but could otherwise be implemented in the same way as the existing alternative standards for these remote island territories.

operator frustration. The EPA is proposing several OBD amendments intended to improve SCR reliability. These proposed OBD changes are important to maintain the integrity of the diagnostic system and the MIL to ensure that operators are properly alerted to the need for critical emission-related maintenance.

The first proposed amendment is to modify the in-use performance monitoring ratio (IUMPR) requirements. The IUMPR is a ratio where the numerator represents the number of times a monitor ran successfully and the denominator represents the number of times a defined trip has occurred. An IUMPR of 0.100 means a monitor must run on average successfully one time out of 10 such trips. For heavy-duty diesel engines, a trip is defined as an engine being started and operated for at least 600 seconds where the engine is operated above 1150 rpm for at least 300 seconds and idled for at least 30 seconds.[138] The denominator of the IUMPR for heavy-duty engines is incremented (increased by one) for each trip, which could happen multiple times if a vehicle makes a series of short trips where, for example, the engine is started, idled for 30 seconds, driven for 10 minutes, and then shutoff. If certain diagnostics or monitors cannot run successfully during short trips, the numerator may not be incremented, and therefore the IUMPR ratio would not be met. Long trips do not necessarily offset problems meeting the IUMPR because numerators are not incremented more than one time per trip and the UL for a heavy-duty diesel defined trip is four hours with no key-off event. For example, to meet an IUMPR of 0.100 on average, a vehicle would need to take one long trip for every nine short trips where a monitor was not able to run successfully.

The 2019 version of CARB OBD that the EPA incorporated by reference in the 2023 Final Rule included an increase in the IUMPR from 0.100 to 0.300. This means that certain diagnostics must run successfully approximately three out of every ten trips. For vehicles making a series of short trips where a monitor cannot run successfully, one long trip could be needed for every two short trips to meet the 0.300 IUMPR. The real-world usage of commercial operators will not always be able to meet the revised IUMPR, and without sufficient time to run diagnostics there will be a risk of false faults occurring that frustrate operators.

For vehicles taking very short trips, an IUMPR of 0.300 can mean on average a monitor must run successfully three times in less than an hour. During the development of CARB's 2019 OBD rule, CARB staff believed that an IUMPR of 0.300 was technically feasible based on manufacturers' data because CARB found that most monitors were able to naturally run more frequently and meet a 0.300 ratio at that time.[139] In CARB's analysis for this change, CARB said that manufacturers would have to make little or no calibration change to meet a 0.300 IUMPR. CARB added that typically only a single diagnostic needed recalibration to meet a 0.300 IUMPR. However, CARB also noted that some monitors would have difficulties in meeting the proposed ratio (*e.g.,* nonmethane hydrocarbon (NMHC) catalyst monitors) and included modified requirements to enable these monitors to meet a 0.300 IUMPR.

Since the EPA adopted updated CARB 2019 OBD requirements in 2023, the Agency has become concerned with the impacts on SCR reliability due to the increase of the IUMPR. As a result of monitors needing to run three times as often, manufacturers may not be able to wait for conditions to be satisfactory and may need to trigger a fault condition even if it is based on insufficient information, increasing the risk of false failures that may have been preventable with additional monitoring time. For example, there may not be sufficient time for the DEF level to drop enough in a DEF tank for the system to reliably recognize and characterize the change before making a pass/fail decision on the proper functioning of the DEF level sensor. In this example, the system could mistakenly interpret a lack of change in DEF level to conclude that the DEF level sensor is not working properly, which would trigger a fault condition and possibly an inducement. This can create frustration for operators due to the increased potential for false fault codes, which may add to some operators' impressions that SCR systems are unreliable and risks operators losing confidence that the MIL is an accurate indicator of serious problems that warrant attention. The emissions benefit of this increased frequency of monitoring is also unclear, as there are operational constraints that limit how quickly an operator can pull over and respond to a dashboard indication of an OBD fault condition. The EPA is therefore proposing to restore the 0.100 IUMPR requirement for all monitors, which is consistent with the Agency's heavy-duty OBD requirements that have been in place since 2009.

Having an appropriate IUMPR value is even more important due to the lower NO_X standards effective in MY 2027, which may require new emission control strategies and technologies (*e.g.,* dual SCR or e-heaters). Achieving an IUMPR of 0.300 may be possible for some monitors, but will likely necessitate additional provisions to account for cases in which it is not achievable when the new standards go into effect. The proposal to restore the IUMPR requirement to 0.100 may result in engines that over-comply in some cases (*i.e.,* many monitors will continue to naturally run more frequently), but would also provide more stability for OBD system design as manufacturers deploy a mix of technologies and diagnostic strategies to meet the more stringent NO_X standards.

The second proposed change in 40 CFR 1036.110(b) is to no longer apply comprehensive component monitoring (CCM) requirements to components or systems that provide input to inducement strategies. CCM requires monitoring of electronic powertrain components or systems not otherwise monitored for malfunction that either directly or indirectly provide input to or receive commands from an on-board computer or smart device that may affect emissions during any reasonable in-use driving condition. These requirements add significant burden for manufacturers to develop[140] and test for failure modes that are unlikely to improve in-use compliance but serve instead to increase operators' impressions that SCR systems are unreliable. An example of how this requirement may affect SCR reliability is by requiring rationality monitoring of the DEF level sensor. Rationality monitoring is a requirement to attempt to verify the accuracy of a signal while it is in the range of normal operation and when it is compared to all other available information, *i.e.,* a check to see that the value makes sense given current operating conditions. CCM can require manufacturers to develop another monitor using a software algorithm to do rationality checks on the DEF level sensor. This is usually in addition to diagnostics that monitor the DEF level

[138] *See* Additional regulatory constraints include operation must be at an elevation of less than 8,000 feet above sea level and at an ambient temperature of greater than or equal to 20 degrees Fahrenheit (−6.7 °C). 13 CCR 1971.1 (d)(4.3.2)(B).

[139] California Air Resources Board. (2018). Public hearing to consider proposed revisions to on-board diagnostic system requirements, including the introduction of real emissions assessment logging (real), for heavy-duty engines, passenger cars, light-duty trucks, and medium-duty vehicles and engines: Final Statement of Reasons for Rulemaking, Including Summary of Comments and Agency Response. *https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2018/hdobd18/fsor.pdf.*

[140] *See* 13 CCR 1971.1 (g)(3).

sensor voltage reading for other abnormal readings which can indicate wiring harness problems or a faulty sensor. As an example, this means that even if a DEF tank is full, an operator could experience a fault code and possibly an inducement if the rationality algorithm incorrectly determines that the DEF level sensor is faulty. The EPA has already established inducement triggering conditions in 40 CFR 1036.111. This redundancy only increases system complexity and the risk of error. This proposal aims to further reduce the potential for increased risk of false fault conditions. If the EPA finalizes the proposal to replace inducements with visible and/or audible notifications, this proposed change to CCM requirements will remain important for maintaining the integrity of the diagnostic system and notifying operators of serious issues. This proposal does not eliminate monitoring for inducement-related components as described in section V.C.2; these components would continue to be used to trigger visible and/or audible notifications. The EPA is also requesting comment on whether 40 CFR 1036.110 should be modified to acknowledge that, where OBD requirements in the 2019 version of CARB's OBD with which the EPA harmonized depend on inducements, engines meeting 40 CFR 1036.111 would be considered to meet any inducement-related requirements included in the Agency's OBD program. (C–42).

The third proposed SCR-related change is to allow an increase in the required time before the denominator must be incremented for multiple catalyst aftertreatment architectures. The EPA recognizes that there is a need to remove OBD barriers to certifying emission-control systems with more than one catalyst. The EPA is proposing the same amendment proposed by CARB in their November 2025 Omnibus Amendment rule, which allows the denominator for systems with more than one catalyst to be incremented using the criteria for emission controls that experience infrequent regeneration events, in 13 CCR 1971.1(d)(4.3.2)(G).[141] Ensuring that robust diagnostic decisions are made can reduce the likelihood of false fault conditions.

The fourth proposed change is to provide relief to prevent potential problems with readiness status of an OBD system that can occur if a manufacturer chooses to use a newer OBD communication protocol. Readiness is when an OBD system has stored enough information that the system can indicate it is ready for a compliance test (*e.g.,* a test to meet inspection and maintenance requirements). The 2023 Final Rule allowed manufacturers to choose whether they want to use the new OBD J1979–2 communication protocol. However, to use this communication protocol, manufacturers will need relief from readiness requirements that were included in the 2019 version of CARB OBD that the EPA adopted. This 2019 OBD program included a reorganization of how monitors were grouped to establish readiness and can create readiness errors resulting in vehicles being unable to pass inspection tests. The EPA is proposing to adopt amendments that were included in CARB's 2022 OBD update to address these issues.

Fifth, the EPA is requesting comment on the need to clarify the language in 40 CFR 1036.110(b) that states ''We may approve your request to certify an OBD system meeting alternative specifications if you submit information as needed to demonstrate that it meets the intent of this section. For example, we may approve your request for a system that meets a later version of CARB's OBD requirements if you demonstrate that it meets the intent of this section.'' While this example identifies later versions of CARB OBD requirements, the EPA did not intend for this to preclude earlier versions of CARB OBD requirements as allowable alternatives. The EPA also intended the term ''alternative specifications'' to mean, for example, parts of 13 CCR 1971.1 that differed from the version the Agency adopted in the 2023 Final Rule. The example provided in the regulatory section did not intend for this to preclude selectively applying provisions from different versions of CARB OBD requirements. (C–43).

Finally, in CARB's 2022 OBD update, industry expressed concern that it is not technically feasible for the second and third NO_X sensors to fully meet the monitoring requirements, and that systems may not be able to detect a sensor fault that prevents the SCR monitor from detecting when one of the catalysts may be losing effectiveness.[142] In CARB's response to comments document, CARB stated that the requirements for NO_X sensor monitoring only apply ''to the extent feasible,'' therefore CARB did not see a need to provide specific relief and did not provide any specific amendments to address this concern. However, the EPA is concerned that, absent clear requirements for systems with multiple catalysts, the existing requirements will result in false pass and false fail monitoring decisions. The EPA is therefore requesting comment on realistic expectations for monitoring systems with multiple SCR catalysts and NO_X sensors and whether requirements need to be modified to accommodate this new technology without driving false fault codes and burdensome testing with little benefit to operators or the environment. (C–44).

E. Applying Proposed SCR Inducement Changes to Light-Duty Vehicles, Medium-Duty Vehicles, and Nonroad Engines

Many aspects of the background and guidance described in this section for highway heavy-duty engines apply equally to diesel-fueled light-duty and medium-duty vehicles certified under 40 CFR part 86, subpart S, and for nonroad compression-ignition engines certified under 40 CFR part 1039. For that reason, the owners and operators of these SCR-equipped vehicles and equipment may also experience the in-use frustrations with falsely triggered inducements and the impacts on performance that the EPA has heard from highway heavy-duty vehicle owners and operators. In particular, the EPA has heard from many owners and operators of nonroad diesel equipment frustrated with DEF inducements. For this reason, the EPA is also proposing regulatory changes for new SCR-equipped light-duty and medium-duty vehicles and for new SCR-equipped nonroad land-based diesel engines, as described in this section. The EPA expects these proposed revisions to the Agency's SCR inducement requirements for such vehicles and certain nonroad equipment with diesel engines would only require software-based changes, which are considered indirect costs associated with research and development. *See* section 3.1.2 of the DRIA for this proposed rule for a discussion on indirect costs. The EPA requests comment on any costs or savings associated with these changes to light-duty, medium-duty, and certain nonroad engines and equipment (*i.e.,* development costs to harmonize inducement requirements across vehicle classes). (C–45). The EPA is also considering issuing new guidance related to the SCR-equipped vehicles, engines, and equipment that have already been certified by the EPA and are operating in the field, as described in this section.

[141] California Air Resources Board. (2025). Appendix A–1, Proposed Amendments to Title 13 Regulation Order.

[142] NO_X sensor monitoring requirements can be found in 13 CCR 1971.1(e)(9.2.2)(D).

1. Certification Provisions for New Light-Duty and Medium-Duty Vehicles

Most of the light-duty and medium-duty vehicles with SCR sold today are diesel-fueled pickup trucks and vans. These vehicles have been designed with inducement features very similar to the derating inducements for heavy-duty engines and may be unable to restart after engine shutdown based on a detected fault condition.[143] The updated inducement provisions from the 2023 Final Rule were not applied to MYs 2027 and later light-duty and medium-duty vehicles, so those vehicles remain subject to guidance recommendations. Until recently, the guidance that applied to these vehicles recommended that manufacturers derate speeds to 5 mph after detecting problems with DEF supply or after detecting tampering. These vehicles are subject to the revised guidance released in August of 2025, as described in section V.B.2 of this preamble.

Light-duty vehicles are mostly personal vehicles; medium-duty vehicles are often used in a commercial capacity. The operating characteristics of light-duty and medium-duty vehicles are different than heavy-duty vehicles in some ways, but the dynamic of depending on the vehicle's diagnostic system to make an accurate assessment of the lack of quality DEF or tampering and providing reasonable assurance that the operator will supply quality DEF are similar to heavy-duty vehicles. Some engines installed in medium-duty vehicles are certified to heavy-duty engine requirements under 40 CFR part 1036 and will be able to certify to the inducement provisions in 40 CFR 1036.111. However, others that are nearly identical and perform similar functions are certified differently and do not have analogous requirements under 40 CFR part 86. This different application of requirements to similar vehicles can lead to confusion for operators, especially if these vehicles are used for commercial purposes.

The list of inducement triggering conditions for heavy-duty engines under 40 CFR 1036.111 is an example of what should apply equally for light-duty and medium-duty vehicles. Limiting inducement triggering to DEF supply, DEF quality, and certain types of fault conditions associated with tampering is appropriate for light-duty and medium-duty vehicles because they have the same technology and the same need to ensure that operators perform scheduled maintenance with no tampering of SCR-related hardware.

The EPA is therefore proposing to extend the proposed SCR-related changes described for new highway heavy-duty engines earlier in this section V to apply equally to light-duty and medium-duty vehicles starting no later than MY 2029. The EPA adopted many of these foundational elements in the 2023 Final Rule, including the specific inducement triggering conditions and provisions allowing for owners to reset systems without dealer involvement after correcting the problem. In addition to those provisions from the 2023 Final Rule, the EPA is proposing to rely on visible and/or audible notifications for all sizes and types of motor vehicles. The proposed requirements for light-duty and medium-duty vehicles would include the following main features, most of which are referenced in 40 CFR 86.1810–17(l):

- Specifying a schedule of visible and/or audible notifications, instead of vehicle speed derates, to provide reasonable assurance that operators take steps to provide a supply of quality DEF in tanks (codified in 40 CFR 1036.111(c), with proposed amendments).
- Specifying limited criteria that qualify as inducement triggering conditions (codified in 40 CFR 1036.111(b), with proposed amendments).
- Codifying specifications related to the volume of DEF tanks (codified in 40 CFR 1036.115(i)).
- Requiring compensation algorithms to account for varying DEF quality (proposed in 40 CFR 1036.115(i)).
- Codifying protection from DEF freezing (proposed in 40 CFR 1036.115(i)).
- Describing design specifications for visible and/or audible notifications and for compensation algorithms in the application for certification (proposed in 40 CFR 86.1844–01(d)).

The EPA is requesting comment on all aspects of this proposal to codify provisions for ensuring proper maintenance of SCR systems used with diesel-fueled light-duty and medium-duty vehicles regulated under 40 CFR part 86, subpart S, including the proposal to rely on visible and/or audible notifications for SCR-related inducements. The request for comment on amending the regulation for light-duty and medium-duty vehicles also applies to all the issues and questions identified in the discussion on inducements for heavy-duty engines in this section V. The EPA is also requesting comment on whether chassis-certified medium-duty vehicles that already meet 40 CFR 1036.111 should be required to meet the in-cab display requirements in 40 CFR 1036.110. (C–46).

2. Certification Provisions for New Nonroad Diesel Engines

Nonroad diesel engines subject to standards under 40 CFR part 1039 are used in many different types of equipment with widely varying operating characteristics, including for farming, construction, industrial, and mining uses. These nonroad diesel engines are subject to SCR-related inducements similar to the inducements that apply to highway heavy-duty engines. Note that separate emission standards apply to diesel engines used in locomotives (40 CFR part 1033) and in marine vessels (40 CFR part 1042); diesel engines used in these other applications are not subject to SCR-related performance derates and are therefore not covered by this proposal.

In the 2023 Final Rule, the EPA did not extend the revised inducement approach to nonroad diesel engines because those derate schedules were inherently based on vehicle speed, which did not translate easily to nonroad diesel engines for which vehicle speed is not a useful measure of equipment performance. However, the approach the EPA is proposing in this rule, to rely on visible and/or audible notifications, creates a basis for proposing to adopt similar provisions to prompt nonroad equipment operators to perform SCR-related maintenance.

The EPA issued guidance in 2014 that described expectations for ensuring nonroad engine and equipment operators used quality DEF, including instructions for engine manufacturers to incorporate designs to prevent equipment from operating after detecting problems with DEF supply or DEF quality.[144] The EPA provided examples in the 2014 guidance of effective final inducements to disable equipment and prevent operators from being able to perform work, including completely shutting the engine down or limiting the engine to idle with no power. The 2014 guidance indicated an expectation that disablement would occur within four hours of the triggering condition. For example, the 2014 guidance indicated that a final inducement for a combine harvester that

[143] U.S. Environmental Protection Agency. (2007). ''Certification Procedure for Light-Duty and Heavy-Duty Diesel Vehicles and Heavy-Duty Diesel Engines Using Selective Catalyst Reduction (SCR) Technologies,'' Guidance Document: CISD–07–07. *https://dis.epa.gov/otaqpub/display_file.jsp?docid=16677&flag=1.*

[144] U.S. Environmental Protection Agency. (2014). Guidance Document CISD–14–10, ''Certification of Nonroad Diesel Engines Equipped with SCR Emission Controls.'' *https://dis.epa.gov/otaqpub/display_file.jsp?docid=32298&flag=1.*

completely disables use of any implements may be an acceptable method of preventing operators from being able to perform work, whereas a 40 percent engine derate would not be considered sufficient to prevent operators from being able to perform work. Nonroad equipment can be very difficult to transport to a repair facility. An alternative for completely disabled engines is for a technician to travel to the equipment for repair. Either of these remedies could be very expensive and involve several days or weeks of downtime. The EPA also notes that the problem may be caused by improper diagnosis from a defective sensor, with the emission control system working properly the whole time. Nonroad diesel engines were not subject to the inducement provisions finalized in the 2023 Final Rule. However, nonroad diesel engines were subject to the revised DEF inducement guidance released in August of 2025, as described in section V.B.2 of this preamble, which may still result in an idle-only inducement condition after a lengthened time period. As described for highway heavy-duty engines, these performance limitations are often caused by misdiagnosing a fault condition, resulting in operator frustration from not being able to use equipment as intended. Nonroad diesel equipment impacted by a performance inducement can also have meaningful negative consequences for the operators, owners, and businesses that rely on such equipment, as well as others that rely on the productivity of such equipment downstream, such as consumers.

As described in the previous section for light-duty and medium-duty vehicles, the list of inducement triggering conditions for heavy-duty engines under 40 CFR 1036.111 is an example of what should apply equally to nonroad diesel engines. Limiting inducement triggering to DEF supply, DEF quality, and certain types of fault conditions associated with tampering is appropriate for nonroad diesel engines because they have the same technology and the same need to ensure that operators perform scheduled maintenance with no tampering of SCR-related hardware.

Given the similarity of the technology for highway and nonroad engines, the EPA is proposing to extend the basic elements of the proposed changes described in this section to nonroad diesel engines with SCR starting no later than MY 2029. The proposed requirements include the following main features:

- Specifying a schedule of visible and/or audible notifications, instead of approaches to prevent operators from being able to perform work, to provide reasonable assurance that operators take steps to provide a supply of quality DEF in tanks (40 CFR 1039.111(c)).
- Specifying limited criteria that qualify as inducement triggering conditions (40 CFR 1039.111(b)).
- Codifying specifications related to the volume of DEF tanks (40 CFR 1039.115(h)).
- Requiring compensation algorithms to account for varying DEF quality (40 CFR 1039.115(h)).
- Codifying protection from DEF freezing (40 CFR 1039.115(h), with a reference to the measurement procedure in 40 CFR 1036.650).
- Requiring engine manufacturers to give installation instructions to equipment manufacturers related to SCR maintenance, including the instruction to facilitate visible and/or audible notifications on the operator interface for the equipment (40 CFR 1039.130(b)).
- Describing design specifications for visible and/or audible notifications and for compensation algorithms in the application for certification (40 CFR 1039.205(b)).

One important distinction for nonroad equipment is the possibility of operation without an operator present at all times. This includes portable equipment, such as generators, fans, and compressors, as well as autonomous vehicles, such as farm equipment. Visible and audible notifications do not have the same meaning if there is no on-site (in-cab) operator. On the other hand, anyone depending on the performance of unattended equipment would need to be able to provide fuel and DEF for continued operation, and would need to be able to respond if the engine goes into a derate condition. Even unattended operation depends on having an operator checking in periodically to add fuel (and DEF) and otherwise ensure the equipment is working properly. In such a circumstance, an operator would still be alerted to the need for maintenance, but not as quickly as for equipment controlled directly by an operator. Since the SCR-related maintenance is generally tied to refueling intervals, the proposed visible and/or audible notifications would still be expected to provide timely notification for maintaining equipment for any SCR-related issues. The EPA requests comment on how to design visible and/or audible notifications that would be effective for unattended equipment operation. For example, engine manufacturers may be able to facilitate a different kind of notification for equipment manufacturers to incorporate into portable equipment, especially with constant-speed engines. (C–47).

The EPA is requesting comment on all aspects of the proposal to codify provisions for ensuring proper maintenance for SCR systems used with nonroad diesel engines regulated under 40 CFR part 1039, including the proposal to rely on visible and/or audible notifications for SCR-related inducements. The request for comment on amending the regulation for nonroad diesel engines also applies for all the issues and questions identified in the discussion on inducements for new heavy-duty engines in this section V. (C–48).

F. Potential for Additional EPA Inducement Guidance for In-Use Engines and Vehicles

The August 2025 guidance described in section V.B.2 of this preamble described a path for manufacturers to modify all types of in-use diesel-fueled engines and vehicles with less severe inducements. The guidance generally included recommendations allowing more operating time before derates reach a point of preventing normal operation. As part of the process of preparing the August 2025 guidance, the EPA considered manufacturers' concerns that the control algorithms for in-use engines provided very little flexibility to create a modified strategy for timing and extent of derates.

Now that the EPA is proposing to replace derates with visible and/or audible notifications for new engines and vehicles, there may be greater flexibility to modify in-use engines to conform to the inducement notifications described in this proposed rule. At the same time, retrofitting in-use engines to include specific visible or audible notifications may require a level of development and testing that makes it unrealistic to expect a widespread practice of retrofitting in-use engines or vehicles. Nevertheless, the EPA anticipates that even limited retrofits would be a welcome upgrade for those cases in which the manufacturer is able to support that initiative. The EPA is therefore considering a process to issue updated guidance that would allow manufacturers to modify in-use engines and vehicles to switch from derates to visible and/or audible notifications, consistent with any changes that the Agency adopts for certifying new engines and vehicles for DEF-related inducements.

The EPA requests comment on the potential to retrofit in-use engines and vehicles with visible and/or audible

notifications instead of performance derates. (C–49). The EPA also requests comment on adapting any new guidance to accommodate specialized concerns, such as operation in Alaska or other areas of extreme cold as described in section V.D.2 of this preamble for highway heavy-duty engines.

VI. Program Costs

The EPA used the same cost calculation methods as the 2023 Final Rule but with updated inputs to reflect the proposed changes to the emission-related warranty and useful life provisions of the 2023 Final Rule. Detailed descriptions of the underlying data and methods of the cost analysis are discussed in Chapter 3 of the DRIA for this proposed rule. The EPA requests comment on the data and methods, including estimated costs, cost savings, benefits, disbenefits, and transfers, that were applied in the analyses for this proposed rule. The EPA is also soliciting comment on the assumptions, modeling, and results of potential cost savings and the associated increase in operational cost increase for purchasers. (C–50).

The costs for the proposed amendments were updated for the action and no-action cases to estimate the cost impacts. The EPA included all the provisions of the 2023 Final Rule to estimate the costs of the no-action case for this proposal and reduced the emission-related warranty period for the action case. The updated costs reflect the expected reduced emission-related warranty costs and changes to vehicle operating costs, which include increased emissions repair costs and reduced DEF costs.[145] The change in emission-related warranty costs and operating costs are estimated on a year-over-year basis and are shown in Chapter 3.3. As described in section III.A of this proposal, the EPA expects, in a competitive market, that engine manufacturers will pass on most, if not all, of the warranty cost savings to the purchaser of the vehicle, such that on net, the trucking industry, including vehicle owners, should realize the total projected cost savings of this action. There are no changes to direct manufacturing costs between the proposed action case and no-action case. The EPA projects that manufacturers have finished their technology designs for MY 2027 engines, and the Agency believes that manufacturers are likely to maintain a steady design for MY 2028 and MY 2029 and will not redesign engines in response to the proposed shorter useful life periods for only two years.

The cost impacts of this proposed rule are shown in Table VI–1 and Table VI–2. These impacts include savings due to the reduced emission-related warranty periods, increased operating costs, and a net cost savings.

[145] The EPA projects a small increase in NO_X emissions from the proposed changes to emissions-related warranty and regulatory useful life periods. DEF consumption is proportional to NO_X reduced by the SCR system, and the EPA has projected a small decrease in DEF used due to the increase in NO_X emissions. Note that the EPA did not quantify any potential change in NO_X emissions as related to the proposed change in SCR performance inducements.

Table VI-1: Year-Over-Year Emission-Related Warranty Savings, Operating Costs, and Net Cost Savings of the Proposed Action Case Relative to the No-Action Case, Millions of 2024 Dollars*

Calendar Year	Emission-Related Warranty Savings	Operating Costs	Net Cost Savings
2027	$2,400	-$42	$2,400
2028	$2,300	-$400	$1,900
2029	$2,200	-$820	$1,300
2030	$2,100	-$1,100	$940
2031	$2,000	-$1,200	$770
2032	$1,900	-$1,300	$600
2033	$1,900	-$1,400	$480
2034	$1,900	-$1,400	$430
2035	$1,900	-$1,500	$370
2036	$1,900	-$1,500	$350
2037	$1,900	-$1,500	$370
2038	$1,900	-$1,500	$380
2039	$1,900	-$1,500	$380
2040	$1,900	-$1,500	$370
2041	$1,900	-$1,500	$360
2042	$1,900	-$1,500	$350
2043	$1,800	-$1,500	$340
2044	$1,800	-$1,500	$330
2045	$1,800	-$1,500	$320
2046	$1,800	-$1,500	$300
2047	$1,800	-$1,500	$290
2048	$1,800	-$1,500	$280
2049	$1,800	-$1,500	$300
2050	$1,800	-$1,500	$310
2051	$1,800	-$1,500	$320
2052	$1,800	-$1,500	$330
2053	$1,800	-$1,500	$340
2054	$1,800	-$1,500	$350
2055	$1,800	-$1,500	$360

* Values show two significant figures; positive values indicate cost savings in expenditures.

Table VI-2: Present Value and Annualized Value Emission-Related Warranty Savings, Operating Costs, and Net Savings of the Proposed Action Case Relative to the No-Action Case, Millions of 2024 Dollars*

Value Basis and Discount Rate	Emission-Related Warranty Savings	Operating Costs	Net Cost Savings
PV, 3%	$37,000	-$25,000	$12,000
PV, 7%	$24,000	-$15,000	$9,400
AV, 3%	$1,900	-$1,300	$640
AV, 7%	$2,000	-$1,200	$770

* Values show two significant figures; positive values indicate cost savings in expenditures.

Table VI–3 shows the projected cost savings due to the proposed shorter emission-related warranty period per vehicle for MY 2027 by regulatory class and fuel type.

Table VI-3: Per-Engine Cost Savings Due to Reduced Emission-Related Warranty Period for MY 2027 by Regulatory Class and Fuel Type, 2024 Dollars*

Regulatory Class	Diesel	Gasoline	CNG
Light HDE	$6,152	$2,783	
Medium HDE	$4,130	$2,838	
Heavy HDE	$5,358		$6,270
Urban Bus	$6,004		$6,878

* Blank cells indicate that there are no HDEs in a specific regulatory class for that fuel type; positive values indicate cost savings in expenditures; values do not include operating costs.

VII. Estimated Emissions Changes From the Proposed Program Amendments

The EPA projected an emissions impact associated with the proposed revisions to emission-related warranty, regulatory useful life, and the five percent production volume allowance. As described in detail in section III of this preamble, the EPA proposes to shorten the emission-related warranty periods for MYs 2027 and later engines to the levels that apply to MYs 2026 and earlier and to delay implementation of the extended useful life requirements for MYs 2027 and later engines until MY 2030. These proposed changes would result in an increase in NO_X emissions from highway heavy-duty engines and vehicles (about 4 to 12 percent, depending on the year), small increases in PM and VOC (less than one percent), and a small increase in CO, as described later in this section. These projected increases in emissions from highway heavy-duty engines and vehicles are due to a higher level of ''age-effects'' over the heavy-duty vehicle fleet lifespans.[146]

In addition, the EPA proposes to amend the five percent production allowance for Heavy HDE in MYs 2027–2029. To account for this allowance, MOVES emission rates for heavy heavy-duty vehicles (Class 8 and urban bus regulatory classes) are further adjusted by assuming five percent of MYs 2027–2029 heavy heavy-duty vehicles would have emission rates equivalent to pre-MY 2027 vehicles.

Section VII.A of this preamble provides an overview of the methods used in MOVES to estimate emission changes under the proposed revisions. Section VII.B of this preamble presents the projected emission changes from the proposed amendments to 2023 Final Rule, with additional detail in Chapter 2 of the DRIA for this proposed rule.

The EPA has not projected an emissions impact associated with the proposed NCPs, consistent with the approach taken in all past NCP rules. The EPA is not able to accurately project the degree to which firms may make use of the NCPs. The EPA's expectation is that any use of the NCPs would be temporary and short-lived, given the nature of NCPs, which are a temporary bridge for any companies that need additional time to bring engines into compliance with the MY 2027 NO_X standards.

The EPA has also not projected an emissions impact associated with the proposed revisions to the Agency's SCR inducement requirements for heavy-duty diesel engines.[147] [148]

The proposed amendments to the SCR inducement requirements would further reduce operator frustrations with SCR emission controls, but many uncertainties remain in terms of quantifying the potential impact. As described in section V of this preamble, diesel vehicle owners and operators have over a decade of experience using DEF, refilling DEF is easy, and DEF is readily available at retail stores and diesel refueling stations nationwide, which suggests operator access and familiarity under the proposed amendments would not change DEF use relative to today. Also, in section V of this preamble, the EPA summarizes two recent studies on the impact of visible and audible notifications used to prompt light-duty vehicle drivers to wear seatbelts.[149] [150]

In this proposal, the ''no-action'' case represents the 2023 Final Rule. It is unclear how owner or operator behavior would have changed in response to the speed restrictions that were set to apply starting in MY 2027 under the 2023 Final Rule. It is equally unclear how the proposed new audible notification schedule would change behavior relative to that no-action case.

At this time, the EPA is not able to accurately project the degree to which SCR systems would be ineffective due to low DEF levels, low-quality DEF, or component-level tampering that can lead to improper DEF dosing, and therefore the Agency cannot project any associated increase in emissions. The EPA is also unable to estimate whether the proposed removal of derates under this proposal would result in a reduction in emissions due reduced user frustration and fewer instances of in-use tampering.

A. Emission Inventory Methodology

To estimate the emissions impacts of the proposed amendments to the 2023 Final Rule, the EPA used a regulatory version of the Agency's MOVES model, known as MOVES5.R2.[151] MOVES5.R2 is derived from the latest public version (MOVES5) but includes several updates to vehicle population and activity based on the latest information. Detailed descriptions of the underlying data and analyses that informed the model updates are discussed in Chapter 2.2 of the DRIA for this proposed rule.

First, the EPA modeled a baseline (no-action) scenario that retains all provisions of the 2023 Final Rule. Then, the EPA modeled a control (action) scenario to incorporate the proposed changes to the provisions. The

[146] For details of how MOVES accounts for changes in the emission-related warranty and useful life provisions, refer to Chapter 2.2.2 of the DRIA for this proposed rule.

[147] See the EPA's response to inducement-related comments in section 8.1 (p 740) of the response to comments for the 2023 Final Rule. ''Control of Air Pollution from New Motor Vehicles: Heavy-Duty Engine and Vehicle Standards—Response to Comments''. December 2022. EPA–420–R–22–036.

[148] U.S. Environmental Protection Agency. (2021). ''Tampered Diesel Pickup Trucks: A Review of Aggregated Evidence from EPA Civil Enforcement Investigations.'' *https://www.epa.gov/enforcement/tampered-diesel-pickup-trucks-review-aggregated-evidence-epa-civil-enforcement.*

[149] Kidd, D.G., and Singer, J. (2019). The effects of persistent audible seat belt reminders and a speed-limiting interlock on the seat belt use of drivers who do not always use a seat belt. *Journal of Safety Research. https://www.iihs.org/research-areas/bibliography/ref/2185.*

[150] Kidd, D.G., and O'Malley, S. (2023). Increasing seat belt use in the United States by promoting and requiring more effective seat belt reminder systems. *Traffic Injury Prevention, 24*(sup1), S80–S87. *https://doi.org/10.1080/15389588.2022.2134730.*

[151] *See* Chapter 2 of the ''Revision of Tier 4 Criteria Pollutant Standards, Part 1: Amendments to Phase-In Schedule for Light-Duty and Medium-Duty Vehicles—Draft Regulatory Impact Analysis'' EPA–420–D–26–001. May 2026.

emissions impacts of the proposed amendments were estimated by calculating the emissions difference between the no-action and the action cases. Inputs developed to model the national emission inventories, including those representing the action case, are discussed in Chapter 2.2.2 of the DRIA for this proposed rule.

B. Emission Inventory Impacts

As discussed in section III of this preamble, the proposed amendments include modifications to the regulatory useful life and emission-related warranty periods provisions, as well as the five percent production allowance for MYs 2027–2029 heavy heavy-duty vehicles, in the 2023 Final Rule. The combined emissions impacts of the proposed revisions in calendar years 2030, 2040, 2045, and 2055 [152] are presented in Table VII–1 (emissions changes in tons) and Table VII–2 (percent changes relateive to the no-action case). The EPA also evaluated the isolated effects of removing the longer emission-related warranty periods and delaying the lengthened regulatory useful life by three years. Because the proposed delay would shorten useful life periods only for MY 2027 through MY 2029, and vehicles and fleet turnover limits its influence, the EPA projects no impact on NO_X inventory from this proposed change in the analysis years, with the exception of urban buses.[153] Accordingly, all NO_X increases estimated in Table VII–1 are attributable to the removal of the longer warranty periods.

Using MOVES5.R2, the EPA estimates that the 2023 Final Rule, as amended by this proposal, would continue to reduce the onroad heavy-duty NO_X inventory in 2055 by about 42 percent—over 260,000 tons of NO_X—compared to the 2055 heavy-duty NO_X inventory without the 2023 Final Rule.[154] The proposed amendments would retain nearly 90 percent of the NO_X reductions originally projected to result from the 2023 Final Rule because the more stringent standards and more representative test cycles finalized in the 2023 Final Rule remain in place.

Chapter 2.3.3 of the DRIA for this proposal includes additional details on the emission changes by vehicle regulatory class. Chapter 2.4 of the DRIA for this proposal provides the estimates of year-over-year criteria pollutant emissions for both the no-action and action cases in calendar years 2027 through 2055.

Table VII-1: National Heavy-Duty Vehicle Emission Changes in U.S. Tons in Calendar Years 2030, 2040, 2045, and 2055 — Proposed Action Case Emissions Relative to No-Action Case[155]

	Increase in U.S. Short Tons			
Pollutant	**2030**	**2040**	**2045**	**2055**
NO_X	30,626	39,819	37,917	36,673
VOC	84	122	118	116
Primary Total $PM_{2.5}$	29	49	47	46
CO	5,902	8,502	8,260	8,084

Table VII-2: National Heavy-Duty Vehicle Emission Percentage Changes in Calendar Years 2030, 2040, 2045, and 2055 — Proposed Action Case Emissions Relative to No-Action Case

	Increase in U.S. Short Tons			
Pollutant	**2030**	**2040**	**2045**	**2055**
NO_X	4.2%	10.5%	11.3%	11.6%
VOC	0.1%	0.2%	0.1%	0.1%
Primary Total $PM_{2.5}$	0.1%	0.3%	0.3%	0.3%
CO	0.4%	0.6%	0.6%	0.4%

VIII. Air Quality Impacts of the Proposed Rule

Section VII of this preamble presents projections of the emissions changes due to this proposed rule. When feasible and appropriate, the EPA conducts full-scale photochemical air quality modeling to accurately project levels of criteria and air toxic pollutants. For this proposal, however, the EPA did not conduct air quality modeling to determine how these emissions increases could change the ambient concentrations of air pollutants. Making predictions about air quality based solely on emissions changes is extremely difficult because the atmospheric chemistry related to ambient concentrations of $PM_{2.5}$, ozone, and air toxics is very complex, and the emissions changes are spatially variable. Nevertheless, considering the air quality modeling conducted for the 2023 Final Rule, the projected increase in total onroad emissions from the proposed amendments would mean that the modeled air quality improvements from the 2023 Final Rule would not be fully realized. The magnitudes of the onroad emissions increases from the proposed amendments are smaller than the onroad emissions reductions that were modeled for the 2023 Final Rule, so the resulting changes in ambient concentrations of air pollutants are also expected to be relatively smaller than what was previously modeled. The EPA expects that the increased vehicle emissions would reduce the estimated overall air quality improvements of the 2023 Final Rule on ambient levels of ozone, $PM_{2.5}$, NO_2, and other traffic-

[152] The 2023 Final Rule inventory analysis included calendar years up to 2045. For the proposed amendments, the EPA extended analysis years to 2055 to better estimate the impact of fleet turnover further into the future.

[153] Because urban buses have lower annual mileage than other heavy-duty regulatory classes but a higher mileage limit (*see* Table 2–3 of the DRIA for this proposed rule), the shortened useful life for MYs 2027–2029 urban buses would contribute only about a 0.02 percent increase to the heavy-duty NO_X inventory in calendar year 2040; no impact is projected for other analysis years.

[154] Because this proposal and the 2023 Final Rule rely on different versions of MOVES that incorporate updated underlying data, the emissions estimates in this proposal are not directly comparable to those presented in the 2023 Final Rule.

[155] The EPA estimates no change in CO_2 emissions from the proposed revisions.

related pollutants. Additional information, including information on current air quality, is available in Chapter 4.1 of the DRIA for this proposal.

IX. Projected Changes in Human Health and Welfare From the Proposed Rule

Air pollutants emitted from the highway heavy-duty engines and vehicles subject to the proposed rule impact public health, welfare, and the environment. Motor vehicle emissions contribute to ozone, $PM_{2.5}$, and air toxics, which are linked to premature death and other serious health impacts, including respiratory illness, cardiovascular problems, and cancer. This air pollution affects people nationwide, especially those who live or work near transportation corridors. Detailed information on the health and welfare effects associated with exposure to pollutants impacted by this proposed rule can be found in sections II.B–C of the 2023 Final Rule preamble and Chapter 4 of the 2023 Final Rule RIA.

The EPA sometimes performs air quality modeling to conduct a full assessment of the $PM_{2.5}$-related and ozone-related human health benefits of the Agency's regulatory actions. As discussed in section VIII of this preamble, the EPA did not conduct air quality modeling for this proposal.

The EPA is obligated to present the Agency's best scientific understanding and the implications of that science when developing policies and regulations. However, historically, the EPA's analytical practices may not have presented the full range of uncertainties and associated confidence level regarding the potential benefit estimates from reduction in exposure to $PM_{2.5}$ and ozone. In addition, the science regarding the exposure, health effects from exposure, and valuation of reduction in health effects are evolving with better data and methods, especially at low concentrations of PM and ozone. In past regulatory analyses when the EPA did not conduct air quality modeling, the Agency has used benefit per ton (BPT) values as a reduced-complexity method to estimate the health benefits related to changes in pollutant emissions. However, the EPA's use of BPT monetized values introduces additional uncertainty. Although developed as a screening tool when full-form photochemical modeling was not feasible, the BPT approach reduces complex spatial and atmospheric relationships and may be more suited to model emissions that are geographically more uniform and for which the pollutant species are better mixed, thereby adding uncertainty associated with those estimates. Some of the sources of uncertainties include the set of assumptions used in projecting the health impact of reducing PM. These projections are based on a series of models that take into account emissions changes, the resulting distributions of changes in ambient air quality, the estimated reductions in health effects from changes in exposure, and the composition of the population that will benefit from the reduced exposure. Each component includes assumptions, each with varying degrees of uncertainty.

In addition, the EPA historically provided point estimates rather than just ranges of emission-related effects or only quantifying emissions when monetizing proved to be too uncertain. Therefore, to address these concerns, the EPA is refraining from providing primary estimates resulting from changes in $PM_{2.5}$ and ozone exposure resulting from changes in direct $PM_{2.5}$, NO_X, and VOC emissions but will continue to quantify the emissions until the Agency is confident enough in the modeling to robustly monetize those impacts.

A more robust description of the potential health and welfare disbenefits associated with emissions increases due to the proposal is contained in Chapter 5 of the DRIA for this proposed rule.

X. Economic Impact Analysis

This section describes the economic impact analysis of this proposal. The analysis focuses on the potential impacts to vehicle sales (including the number of vehicles sold and the timing of vehicle purchases), the rate of replacement of used vehicles in the fleet with new ones (fleet turnover), impacts on the shipping choices by heavy-duty vehicle users (mode shift), and impacts on the choice of heavy-duty class purchased (class shift).

In section VI of this preamble and Chapter 3 of the DRIA for this proposed rule, the EPA estimates the net cost savings to manufacturers. Manufacturers may pass on some, if not all, of the savings to vehicle purchasers in the form of a lower-priced product. Basic economic theory indicates that a decrease in purchase price due to decreased manufacturer costs could lead to an increase in sales. Thus, the manufacturer cost savings from this proposal could lead to some increase in heavy-duty vehicle sales, but the size of the impact would depend on the magnitude of the cost decreases and the degree to which the cost decreases are passed on to vehicle purchasers.

As discussed in section VI of this preamble and Chapter 3.3.2 of the DRIA for this proposed rule, the shortened emission-related warranty period could shift some of the burden of repair costs from manufacturers to users. Thus, purchasers could consider both an increase in operating costs and any decrease in purchase price when making a purchase decision. The EPA is unable to quantify these effects because existing literature does not provide sufficient insight into the relationship between emission-related warranty changes, increases in prices due to increased emission-related warranty periods, and sales impacts.

The EPA also considered how this proposal could affect the timing of planned heavy-duty vehicle purchases in response to regulatory changes, often referred to as the potential for ''pre-buy'' and ''low-buy.'' Pre-buy occurs when a purchaser pulls ahead a planned future purchase before implementation of a regulation in anticipation that a future vehicle may have a higher upfront or operational cost or have reduced reliability. Low-buy occurs when a vehicle that would have been purchased before the implementation of a regulation is either not purchased at all or the purchase is delayed after the implementation of the regulation. Low-buy may occur directly as a function of pre-buy (where a vehicle was instead purchased prior to implementation of the new regulation) or due to a vehicle purchaser delaying the purchase of a vehicle due to cost or uncertainty. Pre- and low-buy are short-term effects, with research indicating that effects are seen for one year or less before and after a regulation is implemented.[156]

In Chapter 10.1.1 of the 2023 Final Rule RIA, the EPA discussed that purchase decisions and their timing related to a change in a regulatory standards are affected by many factors, including macroeconomic conditions, costs and timing of cost changes, and current and predicted operating and maintenance costs.[157] Given the current industry-described stagnant freight market, the timing of this proposal, the imminent release of the MY 2027 heavy-duty vehicles, and other macroeconomic uncertainties, it is not clear whether there will be any pre-buy associated with the 2023 Final Rule and what, if

[156] *See* the EPA report ''Analysis of Heavy-Duty Vehicle Sales Impacts Due to New Regulation'' at *https://cfpub.epa.gov/si/si_public_pra_view.cfm?dirEntryID=349838&Lab=OTAQ* for a literature review and EPA analysis of pre-buy and low-buy due to heavy-duty regulations.

[157] U.S. Environmental Protection Agency. (2022) Control of Air Pollution from New Motor Vehicles: Heavy-Duty Engine and Vehicle Standards, Regulatory Impact Analysis. EPA–420–R–22–035. *See* Chapter 10.1.1 on impacts to the timing of sales.

any, impact this proposal would have on the timing of purchase decisions.[158]

When there are measurably higher sales in a vehicle fleet, the EPA typically expects an increase in fleet turnover. Vehicle purchasers may replace older, less efficient vehicles with new, cleaner vehicles at a faster rate. However, the EPA does not expect that any increase in sales due to this proposal would be large enough to meaningfully affect fleet turnover.

Transportation mode shift is a change from using a heavy-duty truck to ship goods to using another mode of transportation (typically rail or marine). Whether shippers switch to a different transportation mode for freight depends not only on the cost per mile of the shipment (freight rate), but also the value of the shipment, the time needed for shipment, and the availability of supporting infrastructure. This proposal is not expected to have an impact on truck freight rates given that the price of the truck is only a small part of the cost per mile of a ton of goods. The 2023 Final Rule did not anticipate mode shift effects, and the EPA similarly does not expect mode shift effects from this proposal.[159]

Class shift occurs when a vehicle purchaser decides to purchase a different class of vehicle than originally intended due to a new regulation. For example, a purchaser may buy a Class 8 vehicle instead of the Class 7 vehicle they may have purchased in the absence of a regulation. The EPA does not expect any class shift due to this proposed rule.

XI. Summary of Requests for Comment in This Proposed Rule

While the EPA is not limiting comment on this proposed rule to identified areas, the Agency is specifically soliciting comment on key aspects of the proposed rule. To facilitate comment on those portions of the rule, the EPA has indexed each comment solicitation with a unique identifier below (*e.g.,* ''C–1,'' ''C–2'') to provide a consistent framework for effective and efficient solicitation of comments. Accordingly, the EPA asks that commenters include the corresponding identifier when providing comments relevant to that comment solicitation by including the identifier either in a heading or within the text of each comment. Specifically, the EPA is soliciting comment on the following:

1. The EPA acknowledges that this proposal would, if finalized, change the Agency's previous assessments in the 2023 Final Rule with respect to the emission-related warranty, regulatory useful life, and other program elements. The EPA believes that the revisions proposed in this action relieve obligations in a manner that promotes compliance and cost savings without undermining existing investments in compliance. Nevertheless, the EPA requests comment on whether regulated parties have any significant reliance interests with respect to the changes in emission-related warranty, regulatory useful life, and other program elements contained in this proposal. (C–1).

2. The EPA further understands that other interested parties may have relied on the MY 2027 heavy-duty program for independent purposes, including compliance with relevant National Ambient Air Quality Standards (NAAQS) and related planning obligations, among others. The EPA believes that the relatively small foregone emissions reductions involved in this proposed revision, coupled with the relatively short amount of time that has passed since promulgation of the 2023 Final Rule, means that such interests do not supersede the Agency's obligation to ensure that program elements are appropriate and reflect technical and market realities. Moreover, the EPA notes that emissions from mobile sources are just one consideration among many involved in planning to attain the NAAQS and related obligations. Nevertheless, the EPA requests comment on such reliance interests and how such interests should be taken into account in any final action on this proposal. (C–2).

3. The EPA requests comment on the nature and extent of any other reliance interests that may arise from this proposed action and is committed to assessing any such interests, determining whether they are significant, and weighing such interests against competing rationales, as required by law. (C–3).

4. The EPA is proposing two methods under a new interim provision in 40 CFR 1036.150, which would apply to MY 2027 through MY 2029, depending on whether the manufacturer conducted an emissions test at the useful life periods that apply to MYs 2026 and earlier (*e.g.,* equivalent 435,000-mile point for Heavy HDE) or only at the MYs 2027 and later useful life (*e.g.,* equivalent 650,000 miles for Heavy HDE). If available, the EPA is proposing under that interim provision that manufacturers must use test data from the point that is equivalent to the useful life periods that apply to MYs 2026 and earlier. If manufacturers did not collect data at that point, the EPA would allow manufacturers to interpolate their data to the shorter useful life periods that apply to MYs 2026 and earlier using the data at the low-hour and longer useful life test points. The EPA requests comment on this interim provision. (C–4).

5. The EPA does not expect manufacturers who have products ready for MY 2027 to change their emissions control technology plans for the MYs 2027 through 2029 period because of this proposed change. However, manufacturers that have not completed their durability demonstration for the longer useful life may choose to stop the demonstration at the current useful life values, which could result in a small reduction in testing costs that manufacturers could pass on to their customers. For this proposal, the EPA has taken a conservative approach to estimating the cost impacts of the proposed change to useful life and found that there would be no change in costs. The EPA requests comments on the cost savings from this provision. (C–5).

6. The EPA requests comment on indefinitely keeping the MYs 2026 and earlier regulatory useful life periods for MYs 2027 and later. (C–6).

7. The EPA requests comment on the proposed change to the MYs 2027–2029 allowance under 40 CFR 1036.150(k), including whether it appropriately balances the implementation needs and protection of emissions benefits. The EPA also requests comment on whether this flexibility should apply to fewer MYs (*e.g.,* only MY 2027, or MYs 2027 and 2028), or more MYs (*e.g.,* also MY 2030 or beyond). The EPA also requests comment on whether the five percent cap should be lower or higher, and if the cap should remain constant or phase down over time. (C–7).

8. EPA requests comment on increasing the NO_X FEL cap to a level greater than 65 mg/hp·hr, but less than or equal to the MY 2026 standard of 200 mg/hp·hr. The EPA also requests comment on the number of MYs over which a higher FEL cap should apply, including whether it is appropriate to not include an end date for a higher FEL cap. For example, the EPA may consider a higher FEL cap for a few MYs during the transition to the lower NO_X standard followed by a return to 65 mg/hp·hr or

[158] For example, *see* Heavy Duty Trucking, ''Goodbye, 2027 Truck Prebuy'' at *https://www.truckinginfo.com/articles/goodbye-2027-truck-prebuy* and Transport Topics, ''Uncertainty Dominated Pre-Buy Discussion Ahead of 2027'' at *https://www.ttnews.com/articles/uncertainty-pre-buy-trucks-2027.*

[159] U.S. Environmental Protection Agency. (2022) Control of Air Pollution from New Motor Vehicles: Heavy-Duty Engine and Vehicle Standards, Regulatory Impact Analysis. EPA–420–R–22–035. *See* Chapter 10.1.4 for more information regarding mode shift.

an alternative level, or a permanent increase in the FEL cap. The EPA requests comment on the possible economic and emissions impacts of allowing older credits to be used in the MYs 2027 and later program. The EPA also requests comment on any reliance interest engine manufacturers or others may have, including the specific reliance concerns and available data which supports a reliance argument. (C–8).

9. The EPA also requests comment on whether, and how, banked NO_X emission credits earned prior to MY 2022 should be allowed for use in MYs 2027 and later. A discount of up to 40 percent is applied when using credits earned during MYs 2022–2026 for MYs 2027 and later, and the EPA requests comment on an appropriate discount that could be applied to credits earned from the MYs 2004 to 2009 engines for use in MYs 2027 and later. Finally, the EPA requests comment on the possible economic and emissions impacts of allowing these older NO_X credits to be used in the MYs 2027 and later program. The EPA also requests comment on any reliance interest engine manufacturers or others may have, including the specific reliance concerns and available data which supports a reliance argument. (C–9).

10. The EPA requests comment on whether and how emission credits could be utilized between engine service classes. If the EPA were to allow cross-averaging set NO_X credit transfers, the Agency requests comment on whether a credit discount should be applied, the value of such a discount, and if that discount should be different depending on which averaging set the credits are coming from. Finally, the EPA requests comment on the possible economic and emissions impacts of allowing credits to be used across averaging sets in the MYs 2027 and later program. The EPA also requests comment on any reliance interest engine manufacturers or others may have, including the specific reliance concerns and available data which supports a reliance argument. (C–10).

11. The EPA recognizes that the three requests for comment in this preamble section III.D. have potential interactions. For example, if the EPA were to finalize all three elements (an increase in the NO_X FEL Cap, use of pre-MY 2022 NO_X credits, and movement of NO_X credits across engine service classes) this could reduce the compliance costs for some companies, while potentially negatively impacting other companies due to a change in the competitive landscape. The same is true if two of the three credit flexibilities were included in the final rule, independent of the combination, as not all companies have pre-MY2022 NO_X credits, and not all HD engine companies sell engines in multiple service classes. The EPA requests comment on the potential interactions of these three credit flexibilities, including the impacts on the overall emissions reductions of the MY 2027 and later program, the costs of the program, and any potential impacts on the competitive landscape for the regulated industry. (C–11).

12. The 2023 Final Rule included a requirement at 40 CFR 1036.110(c)(1) for manufacturers to identify fault codes with an in-cab display for any SCR- or diesel particulate filter (DPF)-related condition causing the engine to initiate a speed reduction or torque derate. First, the EPA is requesting comment on whether in-cab display information requirements should remain part of the ''diagnostic system.'' The required in-cab display information is not always part of the OBD system which may complicate the usual standardization efforts for diagnostic system elements. (C–12).

13. The EPA is considering a revision to 40 CFR 1036.530(c)(3)(iii) to allow the existing exclusion of data during an infrequent regeneration event to include any additional time needed for emissions levels to return to normal baseline levels. The EPA adopted this change for certification because the FTP, SET, and LLC duty cycles are relatively short, and data from operation immediately following regeneration may unrepresentatively bias measured emissions high on the short certification cycles. The EPA requests comment on whether a corresponding redefinition of the regeneration event is warranted for off-cycle testing under 40 CFR 1036.530(c)(3)(iii). (C–13).

14. An earlier final rule included provisions allowing limited numbers of qualified heavy-duty highway vehicles to have certified engines meet alternative standards derived from the EPA's nonroad engine programs.[160] The provisions apply to amphibious vehicles, vehicles with maximum operating speed of 45 mph or less, and all-terrain vehicles with portal axles. The provisions also apply to hybrid vehicles with engines that provide energy for an RESS. The EPA added a sunset clause for hybrid vehicles at the end of MY 2027 based on the expectation that greenhouse gas standards would lead to widespread availability of engines certified with hybrid power systems to emission standards under 40 CFR part 1036. The EPA is proposing to extend the allowance to use the alternative standards through MY 2030. At the same time, the EPA is proposing to reduce the annual limit on the number of such vehicle manufacturers may produce from 1,000 to 200. This change would treat specialty vehicles with hybrid powertrains the same as the other types of specialty vehicles. The EPA accordingly requests comment on the possible need to entirely remove the sunset on alternative standards for engines installed in hybrid vehicles. Similarly, the EPA requests comment on the need for a different limit on the annual number of hybrid vehicles with engines certified to the alternative standards, including maintaining the limit at 1,000. (C–14).

15. Based on the available data, the EPA has determined that the best methodological approach for this proposal is to rely on the approach the Agency took in the 2023 Final Rule to determine the incremental technology needed to meet the MY 2027 standards. In this proposal, the EPA estimated COC_{50} and COC_{90} using component cost data from the 2023 Final Rule's technology cost teardown study of the aftertreatment systems of an engine meeting MY 2026 standards and one designed to meet the MY 2027 standards. As described in the DTSD for this proposal, the EPA believes estimating the NCPs based on public data that the Agency has already released through a notice and comment process is a reasonable basis upon which to determine compliance costs. The EPA is requesting comment on other data sources and alternative methodologies based on other technology packages manufacturers are developing to meet the MY 2027 standards. (C–15).

16. The F factor is defined in existing 40 CFR 86.1113–87(a)(4) and in the proposed new 40 CFR 1071.80(a) as the ratio of MC_{90} to MC_{50}. To estimate the F factor, the EPA proposes to use the ratio of COC_{90} to COC_{50}, which reasonably approximates the increase in MC_{90} over MC_{50} since the EPA expects the marginal cost of compliance to scale with the absolute cost of compliance. With this approach, the F factors for Medium HDE and Heavy HDE are 1.176 and 1.093, respectively. Consistent with the existing and new proposed definitions that limit F to values between 1.1 and 1.3, the EPA proposes to round the F factor for Heavy HDE up from 1.093 to 1.1. The EPA requests comment on whether the F factor should be rounded to 1.1 or should be kept at 1.093. (C–16).

[160] 80 FR 73478 (Oct 25, 2016).

17. In this action, the EPA proposes to specify that the values in Table IV–2 be used in the NCP formula for the MYs 2027 and later NO_X standard of 35 mg/hp·hr for Medium HDE and Heavy HDE. The complete derivation of these parameters is described in the DTSD for this proposal. The EPA requests comment on the Agency's estimates of these parameters. (C–17).

18. The EPA is also proposing to allow manufacturers to continue to use approved deficiencies through MY 2029. These are important considerations because it is likely that these engines would not be able to comply with the EPA's revised OBD program, for example due to the significant hardware and software changes needed to meet in-cab display requirements. The EPA is requesting comment on whether the Agency should consider modifying additional OBD provisions to accommodate the certification of engines to the proposed NCP requirements. (C–18).

19. The EPA is not basing the proposed NCP parameters on a technology package with an e-heater, as the Agency only has one publicly citable source for a cost estimate for the e-heater systems, which has not gone through a public comment process and it is unclear if that source has been peer reviewed. Nevertheless, the EPA presents an estimate of NCPs based on the e-heater technology package in the DTSD for this proposal. The EPA requests comment on whether to rely on an e-heater technology package and requests references to other publicly available data for the components of such a system. (C–19).

20. The approach of determining MC_{90} based on the marginal cost between the upper limit and the standard that would result in slopes of NCP versus compliance level that are constant at $22 mg/hp·hr and $38 mg/hp·hr for Medium and Heavy HDE, respectively. The EPA requests comment on using this approach for the final rule. (C–20).

21. For this proposal, the EPA did not include local and State sales tax or Federal excise tax in the NCP calculation. The EPA expects that at least some portion of the NCPs will be passed on to the customer in the final vehicle price, which will be taxed as applicable. The EPA requests comment on this approach. (C–21).

22. For this proposal, the EPA included lifetime DEF costs in the NCP values using a 7 percent discount rate. NCPs must be set at a level to remove any competitive disadvantage for complying manufacturers, but they are not intended to unduly penalize noncomplying manufacturers. Considering the need to balance these two requirements, the EPA requests comment on alternatively including DEF costs for only the initial two to four years of an engine's life instead of the full lifetime costs. (C–22).

23. Regarding the indirect costs, the EPA relied on the RPE values for the ''heavy-duty truck industry,'' which is consistent with how the Agency estimated the indirect costs in the 2023 Final Rule. The EPA requests comment on this approach. An alternative to this approach would be to use the indirect costs for heavy-duty engine or vehicle manufacturers as shown in Table IV–3. The use of the indirect costs for the heavy-duty truck manufacturer could be justified if it is appropriate to assume that the markup for the truck dealers will include a markup on the NCP. (C–23).

24. The proposed rule includes the equations from 40 CFR part 86, subpart L, for calculating and applying the AAF to determine NCP values. The AAF includes a term to increase NCP values over time, with the goal of preventing manufacturers relying on NCPs as a long-term compliance strategy. The AAF equation accounts for this by including a years counter, *i*, as an exponent on the factor characterizing the fraction of the engine fleet certified using NCPs. The EPA requests comment on retaining the existing exponent and on two options to change the Agency's historical approach. Retaining the existing exponent would provide the most motivation for manufacturers to meet the standards in later years without using NCPs. If it is likely that manufacturers will continue to need additional time to meet the standards for a large fraction of the engines in a class, another option could be to remove the exponent from the AAF calculation, resulting in a standard compounding rate that would avoid the NCPs becoming cost-prohibitive to the point that certifying with NCPs is no longer a marketable option. A second option could be to replace the exponent ''*i*'' with ''*i*–1,'' which would apply some accelerated compounding and aligns the calculations with the existing approach of not having an AAF for the first year. The EPA requests comment on these potential alternative approaches. (C–24).

25. The EPA is proposing to isolate engines using NCPs into NCP families that are separate from a manufacturer's averaging sets to simplify the implementation and clearly distinguish which compliance provisions apply to a given engine family. The EPA requests comment on allowing NO_X emission credits to be used in the NCP program. A manufacturer could reduce the NCP for a given engine family if NO_X credits could be applied to that engine family to lower the effective compliance level from which the NCP is calculated. The EPA believes there may be an emissions benefit from this approach, as a manufacturer would offset a portion of the emissions above the standard with banked NO_X emission credits earned from engines which performed at a level below the NO_X standard. The EPA notes there would be an additional reporting and recordkeeping burden, for both the manufacturer and the Agency, associated with tracking credit use in addition to the proposed NCP provisions. The EPA also requests comment regarding how NO_X credits may impact the statutory requirement that NCPs ''shall remove any competitive disadvantage to manufacturers whose engines or vehicles achieve the required degree of emission reduction.'' (C–25).

26. In this rule, the EPA is proposing to migrate the NCP provisions to a new 40 CFR part 1071. In general, this migration is not intended to change the compliance program specified in 40 CFR part 86, except as specifically stated in this proposal. The EPA requests comment on proposed provisions that are substantively different than what applies under 40 CFR part 86, subpart L. In cases in which the EPA is not proposing substantive changes to the regulation, the Agency requests comment on those amendments as editorial changes. (C–26).

27. The EPA requests comment on the broader context of operator frustration with inducements caused by defects rather than operator behavior. In the wake of implementation of inducement schedules, strong negative public sentiment toward DEF has emerged due to system failures stemming from sources like failed sensors and the delayed availability of replacement parts rather than inadequate DEF or an intent of noncompliance. The EPA has heard from individuals who have experienced traumatic events, such as lost harvests or stranded vehicles and products. Observation and word-of-mouth have created secondary distrust of SCR systems and DEF. The EPA is requesting comment on the extent to which negative public sentiment has created a distrust associated with SCR system and DEF failures and how to address the challenge of rebuilding positive culture around the use of SCR systems and DEF. This might take the form of educational outreach for manufacturers of engines and manufacturers of emission-related

components to help operators learn how to practice better preventive maintenance of vehicles to reduce the risk of component defects. This might also take the form of additional engineering to focus on product improvements for which defects are most common. (C–27).

28. The EPA expects these proposed revisions to the Agency's SCR inducement requirements for heavy-duty diesel engines would require software-based changes, which are considered indirect costs associated with research and development. The EPA requests comment on any costs or savings associated with these changes relative to the 2023 Final Rule (*i.e.,* software development costs or savings associated with removing the 2023 Final Rule requirement to determine a vehicle's average speed and then assign a specific derate schedule based on that speed). (C–28).

29. The EPA is proposing to retain the provision in 40 CFR 1036.111(b)(1) that the first inducement notification will start three hours prior to the tank becoming empty or when the tank is at 2.5 percent full. The EPA is requesting comment on whether this provision should be retained, modified, or not included in revised inducement requirements. (C–29).

30. The EPA is requesting comment on several aspects of the proposed requirements for audible notifications as shown in Table V–1. The EPA requests comment on advantages and disadvantages to creating a separate audible notification schedule for DEF level. The EPA requests comment on the audible notification length, including whether it should last for more or less than 90 seconds each time. The EPA is requesting comment on the frequency of the notifications, including whether more or less frequent notifications would be appropriate for demonstrating that operators are reasonably likely to take appropriate action, including but not limited to whether the notification should be only at key-on or if there should be a certain number of notifications during a single trip. The EPA requests comment on whether audible notifications are helpful in addition to visible notifications as a prompt for operators to refill DEF or take other action to maintain SCR systems. The EPA requests comment on whether visible notification should be continuously illuminated or whether a flashing indicator would be more effective. The EPA requests comment on whether visible and/or audible notifications are inadequate for providing a reasonable assurance that operators will provide a supply of quality DEF in tanks and not tamper with SCR systems. The EPA requests comment on whether the regulation should preserve a more modest schedule of performance derates than specified in the 2023 Final Rule to prompt operators to take action or derates similar to the schedules the Agency included in the August 2025 guidance. For example, the regulation could keep the derate schedule as adopted in 40 CFR 1036.111 for low-speed, medium-speed, and high-speed vehicles, but apply only one or two derate steps after detecting an inducement triggering condition. Finally, the EPA requests comment on whether changes to notifications and derates should lead the Agency to include more or different criteria in the list of inducement triggering conditions. (C–30).

31. The EPA is proposing to amend 40 CFR 1036.111(e) to replace references to ''derates'' with ''visible and/or audible notifications,'' and to remove paragraph (e)(3) that requires restarting derates at the same point in the derate schedule for inducement triggering conditions that recur after less than 40 hours of engine operation. If the EPA retained paragraph (e)(3) for the audible notification schedule in Table V–1, a recurring inducement condition could trigger an audible notification at the final frequencies of one notification every 1–3 hours. By removing the recurring fault requirement, the proposed audible notifications would occur at the more frequent initial levels. The EPA is requesting comment on whether this provision should instead be retained or modified. (C–31).

32. The EPA is proposing to clarify that manufacturers may continue to use engine derates to protect the engine or aftertreatment systems from catastrophic damage. The EPA is requesting comment on whether this proposal should be more or less restrictive. (C–32).

33. The EPA recognizes that manufacturers have been working toward designing their heavy-duty diesel engines and vehicles with inducement requirements as adopted in the 2023 Final Rule. This proposal retains the general requirements specified in 40 CFR 1036.110 and 1036.111 for MYs 2027 and 2028. The EPA requests comment on the potential need to provide additional lead-time for implementing the proposed inducement changes, specifically if the Agency should, instead, require this change by MY 2030 or MY 2031. At the same time, the EPA is interested in accelerating the change to the long-term approach described in this proposal. Toward that end, the EPA requests comment on adjustments or simplifications to the inducement provisions adopted in the 2023 Final Rule that engine and vehicle manufacturers could apply before MY 2029, considering the need for sufficient time to implement such changes. (C–33).

34. The EPA is requesting comment on the feasibility of DEF dosing continuing after a DEF quality warning is enacted (*e.g.,* if the urea concentration is less than 20 percent). For example, DEF with a low concentration of urea may still provide NO_X emission reductions, but there may be a concern for protecting the SCR system from damage if urea concentration is at or near zero as a result of a fluid other than DEF being added to the DEF tank. (C–34).

35. In 40 CFR 1036.111(b), the EPA is proposing to specify that systems must detect a fault condition if urea concentration falls below a specified value of 20 percent by weight. The EPA is proposing to allow manufacturers to measure DEF quality either directly with a UQS or indirectly with NO_X sensors or some other measurement of a surrogate value. The EPA is proposing that this less precise detection of DEF quality is appropriate because manufacturers are generally able to apply compensation algorithms to account for varying DEF quality above 20 percent. The EPA is requesting comment on the proposed threshold of 20 percent as the urea concentration at which manufacturers would start to notify operators. (C–35).

36. The EPA is requesting comment on whether an additional DEF quality check should occur after a specified number of days to address concerns with DEF quality degradation during extended time out of service. (C–36).

37. The EPA is proposing to require that manufacturers use good engineering judgment to assess DEF quality promptly after a DEF refill event. The EPA is requesting comment on whether there are other modifications needed to enable this proposal, such as to allow temporary disablement of DEF compensation strategies to give NO_X sensors an opportunity to measure DEF quality without the confounding effect of compensation. (C–37).

38. This proposal notes several relevant changes with respect to treating DEF quality as an adjustable parameter. The EPA is requesting comment on whether DEF quality should remain an adjustable parameter. (C–38).

39. The EPA included a test procedure in guidance CISD–09–04R that manufacturers could use to demonstrate adequate DEF freeze

protection. The EPA is proposing to include a requirement for manufacturers to design their systems with freeze protection. The EPA is requesting comment on whether there are changes that may improve the freeze protection test procedure, such as more or less time in soak or to thaw DEF, more or less time spent at idle, time at engine load, and percent engine load, or if there is an alternative procedure that would be more effective. (C–39).

40. The EPA is proposing to amend 40 CFR 1036.111 to allow manufacturers to temporarily disable the audible notifications proposed in section V.C of this preamble when the ambient temperature is below 12 °F (the freezing point of DEF). Under this proposed allowance, manufacturers would be expected to restore the audible notifications after ambient temperatures rise to a level that allows reliable system monitoring. The EPA is proposing to require restarting audible notifications for inducement triggering conditions when ambient temperatures rise to 32 °F, and that this temperature allowance should be revisited at each key-on event. The EPA requests comment on this approach and other approaches the Agency should consider to address SCR reliability in cold weather conditions, including but not limited to geographic-based or application-based exemptions or different ambient temperature thresholds. (C–40).

41. The EPA is aware that some manufacturers may use DEF for component protection external to the SCR system. Operating the engine with frozen DEF may therefore cause problems of which operators should be aware, aside from the usual concern about supplying DEF for catalyst performance. The EPA requests comment on whether there is a need to continue to require audible notifications to the operator to ensure that they refill DEF or address other issues that may prevent DEF from reaching those components in very cold weather. (C–41).

42. The EPA is requesting comment on whether 40 CFR 1036.110 should be modified to acknowledge that, where OBD requirements in the version of CARB's OBD with which the EPA harmonized depend on inducements, engines meeting 40 CFR 1036.111 would be considered to meet any inducement-related requirements included in the Agency's OBD program. (C–42).

43. The EPA is requesting comment on the need to revise the example in 40 CFR 1036.110(b) that suggests the Agency may approve an OBD system meeting a later version of CARB's OBD requirements as an alternative specification such that it is not interpreted as precluding earlier versions of CARB OBD requirements as allowable alternatives. (C–43).

44. The EPA is concerned that, absent clear requirements for systems with multiple catalysts, the existing requirements in CARB's 2022 OBD update will result in false pass and false fail monitoring decisions. The EPA is therefore requesting comment on realistic expectations for monitoring systems with multiple SCR catalysts and NO_X sensors and whether requirements need to be modified to accommodate this new technology without driving false fault codes and burdensome testing with little benefit to operators or the environment. (C–44).

45. The EPA expects these proposed revisions to the Agency's SCR inducement requirements for such vehicles and certain nonroad equipment with diesel engines would only require software-based changes, which are considered indirect costs associated with research and development. *See* section 3.1.2 of the DRIA for this proposed rule for a discussion on indirect costs. The EPA requests comment on any costs or savings associated with these changes to light-duty, medium-duty, and certain nonroad engines and equipment (*i.e.,* development costs to harmonize inducement requirements across vehicle classes). (C–45).

46. The EPA is requesting comment on all aspects of the proposal to codify provisions for ensuring proper maintenance of SCR systems used with diesel-fueled light-duty and medium-duty vehicles regulated under 40 CFR part 86, subpart S, including the proposal to rely on visible and/or audible notifications for SCR-related inducements. The request for comment on amending the regulation for light-duty and medium-duty vehicles also applies to all the issues and questions identified in the discussion on inducements for heavy-duty engines in section V of this preamble. The EPA is also requesting comment on whether chassis-certified medium-duty vehicles that already meet 40 CFR 1036.111 should be required to meet the in-cab display requirements in 40 CFR 1036.110. (C–46).

47. One important distinction for nonroad equipment is the possibility of operation without an operator present at all times. This includes portable equipment, such as generators, fans, and compressors, as well as autonomous vehicles, such as farm equipment. The EPA requests comment on how to design visible and audible notifications that would be effective for unattended equipment operation. For example, engine manufacturers may be able to facilitate a different kind of notification for equipment manufacturers to incorporate into portable equipment, especially with constant-speed engines. (C–47).

48. The EPA is requesting comment on all aspects of the proposal to codify provisions for ensuring proper maintenance of SCR systems used with nonroad diesel engines regulated under 40 CFR part 1039, including the proposal to rely on visible and/or audible notifications for SCR-related inducements. (C–48).

49. Now that the EPA is proposing to replace derates with audible or visible notifications for new engines and vehicles, there may be greater flexibility to modify in-use engines to conform to the inducement notifications described in this proposed rule. At the same time, retrofitting in-use engines to include specific visible or audible notifications may require a level of development and testing that makes it unrealistic to expect a widespread practice of retrofitting in-use engines or vehicles. The EPA requests comment on the potential to retrofit in-use engines and vehicles with visible and/or audible notifications instead of performance derates. The EPA also requests comment on adapting any new guidance to accommodate specialized concerns, such as operation in Alaska or other areas of extreme cold. (C–49).

50. The EPA requests comment on the data and methods, including estimated costs, cost savings, benefits, disbenefits, and transfers, that were applied in the analyses for this proposed rule. The EPA also solicits comment on the assumptions, modeling, and results of potential cost savings and the associated increase in operational cost increase for purchasers. (C–50).

51. As described in section XII.J of this preamble, we note that two referenced ASTM standards have been withdrawn: D2986–95a and F1471–09. We request comment on continuing to use these withdrawn standards. In particular, we request comment on referencing any alternative methods to accomplish the intended purpose. (C–51).

XII. Statutory and Executive Order Reviews

Additional information about these statutes and Executive Orders can be found at *www.epa.gov/laws-regulations/laws-and-executive-orders.*

A. Executive Order 12866: Regulatory Planning and Review

This proposed action is an economically significant regulatory action as defined under section 3(f)(1) of Executive Order 12866. Accordingly, it was submitted to the Office of Management and Budget (OMB) for review. Any changes made in response to Executive Order 12866 review have been documented in the docket, Docket ID No. EPA–HQ–OAR–2026–0728.

The EPA prepared an analysis of the impacts of this proposal on emissions and costs, which is described in detail in the DRIA for this proposed rule. In the DRIA for this proposed rule, the EPA presents an assessment of costs to regulated parties and other expected impacts of the proposed rule.

With respect to costs, this proposal projects a net cost savings when reduced warranty costs and operating costs are summed. The present value of cost savings from 2027 to 2055, shown in Table XII–1, is estimated to be $12 billion assuming a 3-percent discount rate and $9.4 billion assuming a 7-percent discount rate (2024 dollars). The annualized value of cost savings from 2027 to 2055 is estimated to be $640 million assuming a 3-percent discount rate and $770 million assuming a 7-percent discount rate (2024 dollars). This analysis is described further in section VI of this preamble and Chapter 3 of the DRIA for this proposed rule.

Table XII-1: Present Value and Equivalent Annualized Value of Compliance Cost Savings of the Proposal from 2027-2055, Millions of 2024 Dollars)[a]

	3% Discount Rate	7% Discount Rate
Present Value	$12,000	$9,400
Equivalent Annualized Value	$640	$770

[a] Discounted to 2027 assuming end of year discounting.

The proposed program amendments could result in increased emissions (*see* section VII of this preamble and Chapter 2 of the DRIA for this proposed rule). Increased emissions could also be associated with impacts to air quality, human health, and welfare. As noted in section IX of this preamble, the EPA did not quantify or monetize the health effects associated with emissions changes. The monetized net benefits associated with this proposal are therefore the cost savings presented in Table XII–1. A qualitative description of the human health and welfare effects related to emissions changes associated with this proposal is provided in Chapter 5 of the DRIA for this proposed rule.

B. Executive Order 14192: Unleashing Prosperity Through Deregulation

This action is expected to be an Executive Order 14192 deregulatory action because the action is expected to result in cost savings.

C. Paperwork Reduction Act (PRA)

The information collection activities in this proposed rule have been submitted for approval to OMB under the PRA. The Information Collection Request (ICR) document that the EPA prepared has been assigned EPA ICR number 7819.01, OMB Control Number 2060–NEW. You can find a copy of the ICR in the docket for this rule, and it is briefly summarized here.

The EPA is proposing targeted revisions to the 2023 Final Rule to support implementation of the MYs 2027 and later heavy-duty engine emissions program and to reduce the cost of the program. The proposed changes include continuing the MYs 2026 and earlier warranty periods for MYs 2027 and later engines, delaying the implementation of the MY 2027 useful life periods by three years, revising some targeted ABT credit flexibilities, and revising the SCR inducement requirements for diesel heavy-duty engines. These provisions do not have information collection impacts as the information is already collected under EPA ICR 1684.21, OMB Control Number 2060–0287, and EPA ICR 2621.02, OMB Control Number 2060–0741. The EPA is also proposing discrete revisions to correct and/or clarify certain identified regulatory provisions, which also do not have information collection impacts. Finally, the EPA is proposing to make NCPs available for MY 2027 Medium HDEs and Heavy HDEs. NCPs allow manufacturers to introduce into commerce engines that fail to conform to certain emission standards upon payment of a monetary penalty. The information collection impacts of this program element are described below and in greater detail in the draft ICR Supporting Statement, which can be found in the docket for this rule.

Respondents/affected entities: Manufacturers of Medium HDE and Heavy HDE.

Respondent's obligation to respond: Regulated entities must respond to this collection if they wish to sell their products in the United States, as prescribed by CAA section 203(a). This rule proposes to relieve manufacturers of the burden to provide certain information to the EPA as part of their annual MY vehicle certification under CAA section 208(a), which is required prior to entering vehicles into commerce. Participation in some programs is voluntary, but once a manufacturer has elected to participate, it must submit the required information.

Estimated number of respondents: 2.

Frequency of response: Annually or on occasion, depending on the type of response.

Total estimated burden: 282 hours (per year). Burden is defined at 5 CFR 1320.3(b).

Total estimated cost: $84,285 per year, which includes an estimated $50,870 from the combination of annualized capital and operation and maintenance costs, and $33,415 for labor costs.

An agency may not conduct or sponsor, and a person is not required to respond to, an ICR unless it displays a currently valid OMB control number. The OMB control numbers for the EPA's regulations in 40 CFR are listed in 40 CFR part 9.

Submit your comments on the EPA's need for this information, the accuracy of the provided burden estimates, and any suggested methods for minimizing respondent burden to the Agency using the docket identified at the beginning of this proposed rule. The EPA will respond to any ICR-related comments in the final rule. You may also send your ICR-related comments to OMB's Office of Information and Regulatory Affairs using the interface at *http://www.reginfo.gov/public/do/PRAMain.* Find this particular ICR by selecting ''Currently under Review—Open for Public Comments'' or by using the search function. OMB must receive comments no later than August 13, 2026.

D. Regulatory Flexibility Act (RFA)

I certify that this proposed action would not have a significant economic impact on a substantial number of small entities under the RFA. In making this determination, the EPA concludes that the impact of concern for this rule is any significant adverse economic impact on small entities and that the Agency is certifying that this proposed rule will not have a significant economic impact on a substantial number of small entities because the rule relieves regulatory burden on the small entities subject to the rule.

The regulated entities that are subject to the regulations the EPA is proposing to revise in this rule are heavy-duty engine manufacturers, alternative fuel converters, and independent commercial importers subject to criteria emissions standards for engines. Vehicle manufacturers that add features to incomplete vehicles are not subject to the proposed regulations because the incomplete vehicles they are finishing are already certified. Therefore, these vehicle manufacturers are not subject to the standards. The EPA identified two small alternative fuel engine converters subject to the proposed rule; none of the eleven engine manufacturers or importers subject to the rule are small. The EPA is certifying that this proposed action would not have a significant economic impact on a substantial number of small entities because the proposed action would relieve regulatory burden on all entities, including all small entities, subject to the current rules. The proposed changes include shortening emission-related warranty periods, delaying increased regulatory useful life periods, and simplifying engine DEF inducement requirements. The proposal also includes two flexibility provisions, production volume allowances and NCPs, that would also reduce costs. Finally, the proposed regulatory amendments clarify and streamline various regulatory provisions. The EPA does not anticipate that there would be any significant adverse economic impact on directly regulated small entities as a result of these revisions. The EPA has therefore concluded that this proposed action would, if finalized, relieve regulatory burden for all directly regulated small entities.

E. Unfunded Mandates Reform Act (UMRA)

This action does not contain an unfunded mandate of $100 million or more (in 1995 dollars) as described in UMRA, 2 U.S.C. 1531–1538, and does not significantly or uniquely affect small governments. This action imposes no enforceable duty on any State, local, or Tribal governments. Requirements for the private sector do not exceed $100 million in any one year.

F. Executive Order 13132: Federalism

This action does not have federalism implications. It will not have substantial direct effects on the States, the relationship between the national government and the States, or the distribution of power and responsibilities among the various levels of government.

G. Executive Order 13175: Consultation and Coordination With Indian Tribal Governments

This proposed action would not have Tribal implications as specified in Executive Order 13175. This proposed action includes targeted amendments to the EPA's heavy-duty highway engine regulations for MY 2027 and later, and proposes to make NCPs available to manufacturers of Medium HDE and Heavy HDE beginning in MY 2027. In addition, the EPA proposes to amend the requirements for SCR system inducement provisions for newly manufactured diesel-fueled highway engines and vehicles (*i.e.,* light- and medium-duty vehicles and heavy-duty engines) and nonroad engines and equipment. If finalized, it would not have substantial direct effects on Tribal governments, the relationship between the Federal government and Indian Tribes, or the distribution of power and responsibilities between the Federal government and Indian Tribes, as specified in Executive Order 13175. Thus, Executive Order 13175 does not apply to this proposed action. However, consistent with the EPA's Policy on Consultation and Coordination with Indian Tribes, the Agency plans to continue engaging with Tribal stakeholders in the development of this rulemaking by offering government-to-government consultation upon request.

H. Executive Order 13045: Protection of Children From Environmental Health and Safety Risks

Executive Order 13045 directs Federal agencies to include an evaluation of the health and safety effects of proposed regulations on children in Federal health and safety standards and explain why the regulation is preferable to potentially effective and reasonably feasible alternatives. This action is subject to Executive Order 13045 because it is an economically significant regulatory action under Executive Order 12866 section 3(f)(1) and the EPA believes the environmental health or safety risks of the pollutants impacted by this action may have a disproportionate effect on children. Accordingly, the EPA evaluated the environmental health or safety effects on children of air pollutants affected by this action.

Children are not expected to experience greater ambient concentrations of air pollutants than the general population. However, children are more susceptible than adults to air pollution and children tend to spend increased time outdoors. Children make up a substantial fraction of the United States population and often have unique factors that contribute to their increased risk of experiencing a health effect from exposures to ambient air pollutants because of their continuous growth and development. Children are more susceptible than adults to many air pollutants because they have (1) a developing respiratory system, (2) increased ventilation rates relative to body mass compared with adults, (3) an increased proportion of oral breathing, particularly in boys, relative to adults, and (4) behaviors that increase chances for exposure. Even before birth, the developing fetus may be exposed to air pollutants through the mother that affect development when the mother is exposed. A qualitative description of the human health and welfare effects related to emissions changes associated with this proposal is provided in Chapter 5 of the DRIA for this proposed rule. Furthermore, the Policy on Children's Health also applies to this action.

I. Executive Order 13211: Actions Concerning Regulations That Significantly Affect Energy Supply, Distribution, or Use

This action is not a ''significant energy action'' because it is not likely to have a significant adverse effect on the supply, distribution, or use of energy. Further, the EPA has concluded that this action is not likely to have any adverse energy effects because these amendments generally are intended to reduce the regulatory costs, support the implementation of new regulatory requirements, add clarity to the regulatory compliance provisions and correct errors in the regulations.

J. National Technology Transfer and Advancement Act (NTTAA) and 1 CFR Part 51

This action involves technical standards. The EPA proposes to use new or updated standards from ASTM International, the American National Standards Institute, and SAE International, as described in the tables

of this section. Except for the standards discussed in this section, the standards included in the regulatory text as incorporated by reference were all previously approved for incorporation by reference and no change is included in this action.

In accordance with the requirements of 1 CFR 51.5, the EPA is proposing to incorporate by reference the use of certain standards and test methods from ASTM International. The referenced standards and test methods may be obtained from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA, 19428–2959, (610) 832–9585, or *www.astm.org.* The EPA is proposing to incorporate by reference the following standards from ASTM International:

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Standard or Test Method	Part and Section of Title 40	Summary
ASTM D86–23ae2, Standard Test Method for Distillation of Petroleum Products and Liquid Fuels at Atmospheric Pressure, approved December 1, 2023	86.1, 86.113-04, 86.113-94, 86.213, 86.513, 1065.703, 1065.710, and 1065.1010	This updated standard describes procedures to characterize a fuel's distillation parameters.
ASTM D93-26, Standard Test Methods for Flash Point by Pensky-Martens Closed Cup Tester, approved March 1, 2026	86.1, 86.113-94, 1065.703, and 1065.1010	This updated standard describes the procedure to measure flash point of distillate diesel fuel.
ASTM D130-26, Standard Test Method for Corrosiveness to Copper from Petroleum Products by Copper Strip Test, approved March 1, 2026	1065.710 and 1065.1010	This updated standard describes the procedure to measure copper corrosion in gasoline.
ASTM D381-25, Standard Test Method for Gum Content in Fuels by Jet Evaporation, approved April 1, 2025	1065.710 and 1065.1010	This updated standard describes the procedure to measure the gum content of gasoline.
ASTM D445-24, Standard Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and Calculation of Dynamic Viscosity), approved April 1, 2024	86.1, 86.113-94, 1065.703, and 1065.1010	This updated standard describes the procedure to measure kinematic viscosity of distillate diesel fuel.
ASTM D525-12a (Reapproved 2025), Standard Test Method for Oxidation Stability of Gasoline (Induction Period Method, approved December 1, 2025	1065.710 and 1065.1010	This updated standard describes the procedure to measure oxidation stability of gasoline.
ASTM D613-25a, Standard Test Method for Cetane Number of Diesel Fuel Oil, approved November 1, 2025	86.1, 86.113-94, 1065.703, and 1065.1010	This updated standard describes procedures to determine the cetane number of distillate diesel fuel.
ASTM D975–24a, Standard Specification for Diesel Fuel, approved August 1, 2024	86.1, 86.1910, and 1036.415	This updated standard describes parameters to characterize a range of properties and grades of diesel fuel.
ASTM D976-21e1, Standard Test Method for Calculated Cetane Index of Distillate Fuels, approved November 1, 2021	86.1 and 86.113-94	This updated standard describes the procedure to determine the cetane index of diesel fuel.
ASTM D1267-23, Standard Test Method for Gage Vapor Pressure of Liquefied Petroleum (LP) Gases (LP-Gas Method), approved March 1, 2023	1065.720 and 1065.1010	This updated standard describes the procedure to measure the vapor pressure of liquefied petroleum gas.
ASTM D1319–20a, Standard Test Method for Hydrocarbon Types in Liquid Petroleum Products by Fluorescent Indicator Adsorption, approved August 1, 2020	86.1, 86.113-04, 86.213, 86.513, 1065.710 and 1065.1010	This updated standard describes procedures to measure a fuel's aromatic content.
ASTM D1838-21, Standard Test Method for Copper Strip Corrosion by Liquefied Petroleum (LP) Gases, approved July 1, 2021	1065.720 and 1065.1010	This updated standard describes the procedure to measure copper corrosion in liquefied petroleum gas.
ASTM D1945–25, Standard Test Method for Analysis of Natural Gas By Gas Chromatography, Approved December 1, 2019	86.113-94, 86.513, 86.1, 1036.801, 1065.715 and 1065.1010	This updated standard describes procedures to measure fuel parameters for natural gas.
ASTM D2158-21, Standard Test Method for Residues in Liquefied Petroleum (LP) Gases, approved July 1, 2021	1065.720 and 1065.1010	This updated standard describes the procedure to measure residual matter in liquefied petroleum gas.

ASTM D2163–23e1, Standard Test Method for Determination of Hydrocarbons in Liquefied Petroleum (LP) Gases and Propane/Propene Mixtures by Gas Chromatography, approved March 1, 2023	86.113-94, 1065.720 and 1065.1010	This updated standard describes procedures to measure the fuel properties of liquefied petroleum gas.
ASTM D2598-21, Standard Practice for Calculation of Certain Physical Properties of Liquefied Petroleum (LP) Gases from Compositional Analysis, approved April 1, 2021	1065.720 and 1065.1010	This updated standard describes the procedure to measure the vapor pressure of liquefied petroleum gas.
ASTM D2622–24, Standard Test Method for Sulfur in Petroleum Products by Wavelength Dispersive X-ray Fluorescence Spectrometry, approved July 1, 2024	86.1, 86.113-04, 86.113-94, 86.213, 86.513, 1065.703, 1065.710, and 1065.1010	This updated standard describes procedures to measure a fuel's sulfur content.
ASTM D2699-25, Standard Test Method for Research Octane Number of Spark-Ignition Engine Fuel, approved November 1, 2025	86.113-04, 86.213, 1065.710 and 1065.1010	This updated standard describes the procedure to determine the octane number for gasoline.
ASTM D2700-26, Standard Test Method for Motor Octane Number of Spark-Ignition Engine Fuel, approved May 1, 2026	86.113-04, 86.213, 1065.710 and 1065.1010	This updated standard describes the procedure to determine the octane number for gasoline.
ASTM D2713-24, Standard Test Method for Dryness of Propane (Valve Freeze Method), approved October 1, 2024	1065.720 and 1065.1010	This updated standard describes the procedure to measure the moisture content of liquefied petroleum gas.
ASTM D2986-95a (Reapproved 1999), Standard Practice for Evaluation of Air Assay Media by the Monodisperse DOP (Dioctyl Phthalate) Smoke Test, approved September 10, 1995	1065.170 and 1065.1010	This updated standard describes the procedure to measure the collection efficiency of PM sample media.
ASTM D3231–25, Standard Test Method for Phosphorus in Gasoline, approved May 1, 2025	86.1, 86.113-04, 86.213, 86.513, 1065.710, and 1065.1010	This updated standard describes procedures to measure the phosphorus content of gasoline.
ASTM D3237–22, Standard Test Method for Lead in Gasoline by Atomic Absorption Spectroscopy, approved October 1, 2022	86.1, 86.113-04, 86.213, 86.513, 1065.710 and 1065.1010	This updated standard describes procedures to measure the lead content of gasoline.
ASTM D4052–22, Standard Test Method for Density, Relative Density, and API Gravity of Liquids by Digital Density Meter, approved May 1, 2022	86.1, 86.113-94, 1065.703 and 1065.1010	This updated standard describes procedures to measure fuel density.
ASTM D4629-24, Standard Test Method for Trace Nitrogen in Liquid Petroleum Hydrocarbons by Syringe/Inlet Oxidative Combustion and Chemiluminescence Detection, approved October 1, 2024	1065.655 and 1065.1010	This updated standard describes procedures to determine the nitrogen mass fraction for all liquid test fuels.
ASTM D4809-25, Standard Test Method for Heat of Combustion of Liquid Hydrocarbon Fuels by Bomb Calorimeter (Precision Method)	1036.550	This updated standard describes procedures to determine the heat of combustion of a range of property and grades of diesel fuel.
ASTM D4814-25a, Standard Specification for Automotive Spark-Ignition Engine Fuel	1036.415	This updated standard describes parameters to characterize a range of properties and grades of fuel used in spark-ignition engines.

ASTM D4815-22, Standard Test Method for Determination of MTBE, ETBE, TAME, DIPE, tertiary-Amyl Alcohol and C_1 to C_4 Alcohols in Gasoline by Gas Chromatography, approved April 1, 2022	1065.710 and 1065.1010	This updated standard describes procedures to determine the presence of oxygenates in blended gasoline test fuels.
ASTM D5186–24, Standard Test Method for Determination of the Aromatic Content and Polynuclear Aromatic Content of Diesel Fuels By Supercritical Fluid Chromatography, approved July 1, 2024	86.1, 86.113-94, 1065.703 and 1065.1010	This updated standard describes procedures to measure the aromatic content of diesel fuel.
ASTM D5191–22, Standard Test Method for Vapor Pressure of Petroleum Products and Liquid Fuels (Mini Method), approved July 1, 2022	86.1, 86.113-04, 86.213, 86.513, 1065.710 and 1065.1010	This updated standard describes procedures to measure fuel volatility.
ASTM D5291-26, Standard Test Methods for Instrumental Determination of Carbon, Hydrogen, and Nitrogen in Petroleum Products and Lubricants, approved March 1, 2026	1065.655 and 1065.1010	This updated standard describes procedures to measure carbon and hydrogen mass fractions for liquid test fuels.
ASTM D5453-25, Standard Test Method for Determination of Total Sulfur in Light Hydrocarbons, Spark Ignition Engine Fuel, Diesel Engine Fuel, and Engine Oil by Ultraviolet Fluorescence, approved July 1, 2025	1065.703(b), 1065.710, and 1065.1010	This updated standard describes the procedure to measure the sulfur content of gasoline and diesel fuel.
ASTM D5599–22, Standard Test Method for Determination of Oxygenates in Gasoline by Gas Chromatography and Oxygen Selective Flame Ionization Detection, approved April 1, 2022	1065.655, 1065.710, and 1065.1010	This updated standard describes procedures to measure the volume fraction of oxygenate in gasoline.
ASTM D5762-24 Standard Test Method for Nitrogen in Petroleum and Petroleum Products by Boat-Inlet Chemiluminescence, approved July 1, 2024	1065.655 and 1065.1010	This updated standard describes procedures to determine the nitrogen mass fraction for all liquid test fuels.
ASTM D5769–25, Standard Test Method for Determination of Benzene, Toluene, and Total Aromatics in Finished Gasolines by Gas Chromatography/Mass Spectrometry, approved October 1, 2025	86.1, 86.113-04, 86.213, 86.513, 1065.710 and 1065.1010	This updated standard describes procedures to measure a fuel's volume percent of aromatic compounds.
ASTM D6348-12 (Reapproved 2020), Standard Test Method for Determination of Gaseous Compounds by Extractive Direct Interface Fourier Transform Infrared (FTIR) Spectroscopy, approved December 1, 2020	1065.257(b), 1065.266(c), 1065.275(b), 1065.277, and 1065.1010	This updated standard describes procedures to determine the presence of specific compounds in exhaust emission samples using infrared spectra.
ASTM D6550-25, Standard Test Method for Determination of Olefin Content of Gasolines by Supercritical-Fluid Chromatography, approved October 1, 2025	86.113-04, 86.213, 86.513, 1065.710 and 1065.1010	This updated standard describes the procedure to measure the olefin content of gasoline.
ASTM D6667–21, Standard Test Method for Determination of Total Volatile Sulfur in Gaseous Hydrocarbons and Liquefied Petroleum Gases by Ultraviolet Fluorescence, approved April 1, 2021	1065.720 and 1065.1010	This updated standard describes procedures to measure the sulfur content of liquefied petroleum gas.

ASTM D7039-24, Standard Test Method for Sulfur in Gasoline, Diesel Fuel, Jet Fuel, Kerosine, Biodiesel, Biodiesel Blends, and Gasoline-Ethanol Blends by Monochromatic Wavelength Dispersive X-ray Fluorescence Spectrometry, approved December 1, 2024	1065.710 and 1065.1010	This updated standard describes the procedures to measure total sulfur in test fuels.
ASTM D7467-23, Standard Specification for Diesel Fuel Oil, Biodiesel Blend (B6 to B20), approved October 1, 2023	1036.415	This updated standard describes specifications for blends of diesel fuel oil and biodiesel in the 6 to 20% range.
ASTM E178-21, Standard Practice for Dealing With Outlying Observations, approved June 1, 2021	1065.1010 and 1065.1121	This newly referenced standard describes how to evaluate data for removing outlier data points.

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If ASTM adopts an updated version of the referenced standards, the EPA would expect to reference the most recent version in the final rule. We note, however, that we intend to maintain consistency in the referenced versions of ASTM documents that also appear in 40 CFR part 1090, which establishes standards for in-use gasoline and diesel fuel. The overlapping ASTM standards include: D86, D975, D976, D1298, D1319, D2163, D2622, D3231, D3237, D4052, D5186, D5191, D5453, D5599, D5769, D6550, D6667. We also note that two referenced ASTM standards have been withdrawn: D2986–95a and F1471–09. We request comment on continuing to use these withdrawn standards. In particular, we request comment on referencing any alternative methods to accomplish the intended purpose. (C–51).

In accordance with the requirements of 1 CFR 51.5, the EPA is proposing to incorporate by reference the use of certain standards and test methods from the American National Standards Institute (ANSI). The referenced standards and test methods may be obtained from ANSI, 25 W 43rd Street, 4th Floor, New York, NY 10036, (212) 642–4900, or *www.ansi.org.* The EPA is proposing to incorporate by reference the following standard from ANSI:

Standard or Test Method	Part and Section of Title 40	Summary
CSA/ANSI NGV 1:22, Compressed Natural Gas Vehicle (NGV) Fuelling Connection Devices, Fourth edition, published December 2022	86.1 and 86.1813-17	This updated standard includes standards and specifications for fuelling connection devices for compressed natural gas vehicles.

In accordance with the requirements of 1 CFR 51.5, the EPA is proposing to incorporate by reference the use of certain standards and test methods from SAE International. The referenced standards and test methods may be obtained from SAE International, 400 Commonwealth Dr., Warrendale, PA 15096–0001, (877) 606–7323 (U.S. and Canada) or (724) 776–4970 (outside the U.S. and Canada), or *www.sae.org.* The EPA is proposing to incorporate by reference the following standard from ASTM International:

Standard or Test Method	Part and Section of Title 40	Summary
SAE J2343 FEB2018, Recommended Practice for LNG Medium and Heavy-Duty Powered Vehicles, Stabilized February 2018	1037.103 and 1037.810	This updated standard describes fuel-tank venting requirements for heavy-duty vehicles using liquefied natural gas.

The following standards appear in the amendatory text of this document and have already been approved for the locations in which they appear: 13 CCR 1968.2, 13 CCR 1971.1, NIST Technical Note 1297. No changes are proposed to the IBR material.

XIII. Statutory Provisions and Legal Authority

Statutory authority for this proposed action comes from the CAA (42 U.S.C. 7401–7675).

List of Subjects

40 CFR Part 86

Environmental protection, Administrative practice and procedure, Confidential business information, Incorporation by reference, Labeling, Motor vehicle pollution, Reporting and recordkeeping requirements.

40 CFR Part 1036

Environmental protection, Administrative practice and procedure, Air pollution control, Confidential business information, Greenhouse gases, Labeling, Incorporation by reference, Motor vehicle pollution, Reporting and recordkeeping requirements, Warranties.

40 CFR Part 1037

Environmental protection, Administrative practice and procedure, Air pollution control, Confidential business information, Incorporation by reference, Labeling, Motor vehicle pollution, Reporting and recordkeeping requirements, Warranties.

40 CFR Part 1039

Administrative practice and procedure, Air pollution control, Confidential business information, Imports, Labeling, Penalties, Reporting and recordkeeping requirements, Warranties.

40 CFR Part 1065

Environmental protection, Administrative practice and procedure, Air pollution control, Incorporation by reference, Reporting and recordkeeping requirements, Research.

40 CFR Part 1071

Environmental protection, Administrative practice and procedure, Air pollution control, Penalties, Reporting and recordkeeping requirements.

Lee Zeldin,

Administrator.

For the reasons stated in the preamble, the U.S. Environmental Protection Agency proposes to amend title 40, chapter I, of *The Code of Federal Regulations* as follows:

PART 86—CONTROL OF EMISSIONS FROM NEW AND IN–USE HIGHWAY VEHICLES AND ENGINES

■ 1. The authority citation for part 86 continues to read as follows:

Authority: 42 U.S.C. 7401–7671q.

■ 2. Amend § 86.1 by revising the introductory text and paragraphs (a) and (b) to read as follows:

§ 86.1 Incorporation by reference.

Certain material is incorporated by reference into this part with the approval of the Director of the Federal Register under 5 U.S.C. 552(a) and 1 CFR part 51. To enforce any edition other than that specified in this section, EPA must publish a document in the **Federal Register** and the material must be available to the public. All approved incorporation by reference (IBR) material is available for inspection at EPA and at the National Archives and Records Administration (NARA). Contact EPA at: U.S. EPA, Air and Radiation Docket Center, WJC West Building, Room 3334, 1301 Constitution Ave. NW, Washington, DC 20004; *www.epa.gov/dockets;* (202) 202–1744. For information on inspecting this material at NARA, visit *www.archives.gov/federal-register/cfr/ibr-locations* or email *fr.inspection@nara.gov.* The material may be obtained from the following sources:

(a) *ASTM International (ASTM).* ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA, 19428–2959; (610) 832–9585; *www.astm.org*

(1) ASTM C1549–09, Standard Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer, approved August 1, 2009 (''ASTM C1549''); IBR approved for § 86.1869–12(b).

(2) ASTM D86–23ae2, Standard Test Method for Distillation of Petroleum Products at Atmospheric Pressure, approved December 1, 2023 (''ASTM D86''); IBR approved for §§ 86.113–04(a); 86.113–94(b); 86.213(a); 86.513(a).

(3) ASTM D93–26, Standard Test Methods for Flash Point by Pensky-Martens Closed Cup Tester, approved March 1, 2026 (''ASTM D93''); IBR approved for § 86.113–94(b).

(4) ASTM D445–24, Standard Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and Calculation of Dynamic Viscosity), approved April 1, 2024 (''ASTM D445''); IBR approved for § 86.113–94(b).

(5) ASTM D613–25a, Standard Test Method for Cetane Number of Diesel Fuel Oil, approved November 1, 2025 (''ASTM D613''); IBR approved for § 86.113–94(b).

(6) ASTM D975–24a, Standard Specification for Diesel Fuel Oils, approved August 1, 2024 (''ASTM D975''); IBR approved for § 86.1910(c).

(7) ASTM D976–21e1, Standard Test Method for Calculated Cetane Index of Distillate Fuels, approved November 1, 2021(''ASTM D976''); IBR approved for § 86.113–94(b).

(8) ASTM D1319–20a, Standard Test Method for Hydrocarbon Types in Liquid Petroleum Products by Fluorescent Indicator Adsorption, approved August 1, 2020 (''ASTM D1319''); IBR approved for §§ 86.113–04(a); 86.213(a); 86.513(a).

(9) ASTM D1945–25, Standard Test Method for Analysis of Natural Gas by Gas Chromatography, approved December 1, 2019 (''ASTM D1945''); IBR approved for §§ 86.113–94(e); 86.513(d).

(10) ASTM D2163–23e1, Standard Test Method for Determination of Hydrocarbons in Liquefied Petroleum (LP) Gases and Propane/Propene Mixtures by Gas Chromatography, approved March 1, 2023 (''ASTM D2163''); IBR approved for §§ 86.113–94(f).

(11) ASTM D2622–24, Standard Test Method for Sulfur in Petroleum Products by Wavelength Dispersive X-ray Fluorescence Spectrometry, approved July 1, 2024 (''ASTM D2622''); IBR approved for §§ 86.113–04(a); 86.113–94(b); 86.213(a); 86.513(a).

(12) ASTM D2699–25, Standard Test Method for Research Octane Number of Spark-Ignition Engine Fuel, approved November 1, 2025 (''ASTM D2699''); IBR approved for §§ 86.113–04(a); 86.213(a).

(13) ASTM D2700–26, Standard Test Method for Motor Octane Number of Spark-Ignition Engine Fuel, approved May 1, 2026 (''ASTM D2700''); IBR approved for §§ 86.113–04(a); 86.213(a).

(14) ASTM D3231–25, Standard Test Method for Phosphorus in Gasoline, approved May 1, 2025 (''ASTM D3231''); IBR approved for §§ 86.113–04(a); 86.213(a); 86.513(a).

(15) ASTM D3237–22, Standard Test Method for Lead in Gasoline by Atomic Absorption Spectroscopy, approved October 1, 2022 (''ASTM D3237''); IBR approved for §§ 86.113–04(a); 86.213(a); 86.513(a).

(16) ASTM D4052–22, Standard Test Method for Density, Relative Density, and API Gravity of Liquids by Digital Density Meter, approved May 1, 2022 (''ASTM D4052''); IBR approved for § 86.113–94(b).

(17) ASTM D5186–24, Standard Test Method for Determination of the Aromatic Content and Polynuclear Aromatic Content of Diesel Fuels and Aviation Turbine Fuels by Supercritical Fluid Chromatography, approved July 1, 2024 (''ASTM D5186''); IBR approved for § 86.113–94(b).

(18) ASTM D5191–22, Standard Test Method for Vapor Pressure of Petroleum Products (Mini Method), approved July 1, 2022 (''ASTM D5191''); IBR approved for §§ 86.113–04(a); 86.213(a); 86.513(a).

(19) ASTM D5769–25, Standard Test Method for Determination of Benzene, Toluene, and Total Aromatics in Finished Gasolines by Gas Chromatography/Mass Spectrometry, approved October 1, 2025 (''ASTM 5769''); IBR approved for §§ 86.113–04(a); 86.213(a); 86.513(a).

(20) ASTM D6550–25, Standard Test Method for Determination of Olefin Content of Gasolines by Supercritical-Fluid Chromatography, approved October 1, 2025 (''ASTM D6550''); IBR approved for §§ 86.113–04(a); 86.213(a); 86.513(a).

(21) ASTM E29–93a, Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications, approved March 15, 1993 (''ASTM E29''); IBR approved for §§ 86.004–15(c); 86.007–11(a); 86.007-15(m); 86.1803–01.

(22) ASTM E903–96, Standard Test Method for Solar Absorptance, Reflectance, and Transmittance of Materials Using Integrating Spheres, approved April 10, 1996 (''ASTM E903''); IBR approved for § 86.1869–12(b).

(23) ASTM E1918–06, Standard Test Method for Measuring Solar Reflectance of Horizontal and Low-Sloped Surfaces in the Field, approved August 15, 2006 (''ASTM E1918''); IBR approved for § 86.1869–12(b).

(b) *American National Standards Institute (ANSI).* American National Standards Institute, 25 W 43rd Street, 4th Floor, New York, NY 10036; (212) 642–4900; *www.ansi.org.*

(1) CSA/ANSI NGV1:22, Compressed Natural Gas Vehicle (NGV) Fuelling Connection Devices, Fourth edition, published December 2022; IBR approved for § 86.1813–17(f).

(2) [Reserved]

* * * * *

■ 3. Amend § 86.010–18 by adding paragraph (n)(4) to read as follows:

§ 86.010–18 On-board Diagnostics for engines used in applications greater than 14,000 pounds GVWR.

* * * * *

(n) * * *

(4) For model year 2027 and later engines meeting the requirements of this section under 40 CFR 1036.150(k) or 1071.80, manufacturers may continue to use approved deficiencies through model year 2029.

* * * * *

Subpart L—[Removed and Reserved]

■ 4. Remove and reserve subpart L, consisting of §§ 86.1101–87 through 86.1117.

■ 5. Amend § 86.1810–17 by adding paragraph (l) to read as follows:

§ 86.1810–17 General requirements.

* * * * *

(l) Diesel-fueled vehicles must meet SCR-related design and maintenance provisions as specified in 40 CFR 1036.111 and 1036.115(i) starting no later than model year 2029.

■ 6. Amend § 86.1813–17 by revising paragraph (f)(1) to read as follows:

§ 86.1813–17 Evaporative and refueling emission standards.

* * * * *

(f) * * *

(1) Compressed natural gas vehicles must meet the requirements for fueling connection devices as specified in CSA/ANSI NGV 1:22 (incorporated by reference, see § 86.1).

* * * * *

■ 7. Amend § 86.1844–01 by adding paragraph (d)(22) to read as follows:

§ 86.1844–01 Information requirements: Application for certification and submittal of information upon request.

* * * * *

(d) * * *

(22) For vehicles using SCR, describe the following design features:

(i) Audible and visual signals required under § 1039.111(c).

(ii) Compensation algorithms required under § 1039.115(h)(2).

* * * * *

PART 1036—CONTROL OF EMISSIONS FROM NEW AND IN–USE HEAVY–DUTY HIGHWAY ENGINES

■ 8. The authority citation for part 1036 continues to read as follows:

Authority: 42 U.S.C. 7401–7671q.

■ 9. Amend § 1036.15 by revising paragraph (d)(6) to read as follows:

§ 1036.15 Other applicable regulations.

* * * * *

(d) * * *

(6) Defect reporting and recall.

* * * * *

■ 10. Amend § 1036.101 by revising paragraph (b) to read as follows:

§ 1036.101 Overview of exhaust emission standards.

* * * * *

(b) You may optionally test hybrid powertrains, rather than testing the engine alone, but only if you use powertrain testing to demonstrate compliance with all requirements in this part 1036. Except as specified, provisions of this part that reference engines apply equally to hybrid powertrains.

■ 11. Amend § 1036.104 by revising paragraphs (a)(3), (b), (c)(1), and (e) to read as follows:

§ 1036.104 Criteria pollutant emission standards—NO_X, HC, PM, and CO.

* * * * *

(a) * * *

(3) The following off-cycle emission standards apply for Light HDE, Medium HDE, and Heavy HDE using the procedures specified in § 1036.530, as follows:

TABLE 3 TO PARAGRAPH (a)(3) OF § 1036.104—COMPRESSION-IGNITION STANDARDS FOR OFF-CYCLE TESTING

Off-cycle bin	NO_X	Temperature-based adjustment for NO_X [a]	HC mg/hp·hr	PM mg/hp·hr	CO g/hp·hr
Bin 1	10.0 g/hr	$(25.0 - \overline{T}_{amb})$ .0.25			
Bin 2	58 mg/hp•hr	$(25.0 - \overline{T}_{amb})$ .2.2	120	7.5	9

[a] $\overline{T}_{amb}$ is the mean ambient temperature, in °C, over a shift-day, or equivalent. Adjust the off-cycle NO_X standard for $\overline{T}_{amb}$ below 25.0 °C by adding the calculated temperature adjustment to the specified NO_X standard (in g/hr for Bin 1 and mg/hp. · hr for Bin 2). Round the temperature adjustment to the same precision as the NO_X standard for the appropriate bin. If you declare a NO_X FEL for the engine family, do not apply the FEL scaling calculation from paragraph (c)(3) of this section to the calculated temperature adjustment.

(b) *Clean Idle.* You may optionally certify compression-ignition engines to the Clean Idle NO_X emission standard using the Clean Idle test specified in § 1036.525. The optional Clean Idle NO_X emission standard is 30.0 g/hr for model years 2024 through 2026, and 10.0 g/hr for model year 2027 and later. The standard applies separately to each mode of the Clean Idle test. If you certify an engine family to the Clean Idle standards, it is subject to all these voluntary standards as if they were mandatory.

(c) * * *

(1) To generate or use emission credits, you must specify a family emission limit for each engine family. Declare the family emission limit corresponding to useful life for engine operation over the FTP duty cycle, FEL_{FTP}, expressed to the same number of decimal places as the emission standard. Use FEL_{FTP} to calculate emission credits in subpart H of this part.

* * * * *

(e) *Useful life.* The exhaust emission standards of this section apply for the useful life, expressed in vehicle miles, or hours of engine operation, or years in service, whichever comes first, as follows:

TABLE 4 TO PARAGRAPH (e) OF § 1036.104—USEFUL LIFE BY PRIMARY INTENDED SERVICE CLASS

Primary intended service class	Model year 2029 and earlier			Model year 2030 and later		
	Miles	Years	Hours	Miles	Years	Hours
Spark-ignition HDE	110,000	10	.....	200,000	15	10,000
Light HDE	110,000	10	.....	270,000	15	13,000
Medium HDE	185,000	10	.....	350,000	12	17,000
Heavy HDE	435,000	10	22,000	650,000	11	32,000

* * * * *

■ 12. Amend § 1036.110 by:
■ a. Revising paragraph (b)(8);
■ b. Removing and reserving paragraph (b)(10);
■ c. Revising paragraph (b)(11)(i);
■ d. Adding paragraphs (b)(19) through (b)(27); and
■ e. Revising paragraph (c).

The revisions and additions read as follows:

§ 1036.110 Diagnostic controls.

* * * * *

(b) * * *

(8) Include the additional data-stream signals in 13 CCR 1971.1(h)(4.2.3)(E), (F), and (G) as freeze-frame conditions in the same manner as requirements for signals identified in 13 CCR 1971.1(h)(4.3).

* * * * *

(11) * * *

(i) You must submit additional information as needed to demonstrate that you meet the requirements of this section that are not covered by the California Executive order. For example, you may demonstrate compliance with the data-stream parameter requirements in paragraph (b)(9) of this section and the in-cab display requirements in paragraph (c) of this section by attesting that you meet those requirements.

* * * * *

(19) For the requirements in 13 CCR 1971.1(d), an in-use minimum performance ratio of 0.100 applies for all monitors.

(20) The comprehensive component monitoring requirements in 13 CCR 1971.1(g)(3.1) for directly or indirectly monitoring inputs related to inducement strategies do not apply.

(21) Meet the aging and data collection requirements in 13 CCR 1971.1(i)(2.3.4) using the procedures described in 40 CFR 1036.245.

(22) Use the definition of Federal Test Procedure cycle as defined in 40 CFR 1036.512, and the Supplemental Emission Test as defined in 40 CFR 1036.510 in lieu of the procedures defined in 1971.1(c).

(23) For OBD systems that have NOx converting catalyst systems with more than one catalyst in series, the manufacturer may increment the denominator for a monitor required by section (e)(6) using the criteria set forth in section 1971.1(d)(4.3.2)(G).

(24) For engines with catalyzed PM filters:

(i) The criterion for exempting catalyzed PM filters from monitoring based on an NMHC conversion capability is increasing emissions by 30% or more of the applicable standard, rather than 15% as specified in 13 CCR 1971.1(e)(8.2.4)(A)(iii).

(ii) The feedgas generation requirements in 13 CCR 1971.1(e)(8.2.4)(B) do not apply.

(iii) The NMHC conversion requirements in 13 CCR 1971.1(e)(8.2.4)(A) do not apply if you instead comply with the catalyzed PM filter integrity requirements 13 CCR 1971.1(e)(8.2.1).

(25) OBD systems that have an NMHC catalyst conversion efficiency monitor that meets 13 CCR 1971.1(e)(5.2.2) do not need to meet the feedgas generation performance monitoring requirements of sections 13 CCR 1971.1(e)(5.2.3)(B).

(26) For monitors that increment denominators using any of the criteria in 13 CCR 1971.1(d)(4.3.2), the readiness status of that monitor may be considered to have ''fully executed and determined that the component or system is not malfunctioning'' if at least 15 warm-up cycles and 400 minutes of engine run time have occurred since the fault memory last cleared, and no permanent fault code is stored for that monitor.

(27) The OBD requirements in this section do not apply for hybrid components, unless you use powertrain testing to demonstrate compliance with the requirements of this part 1036.

(c) Design the system to display the following information in the cab:

(1) For inducement triggering conditions under § 1036.111, identify whether the condition relates to DEF level, DEF quality, or tampering. The following additional requirements apply for those inducements and any other AECD related to the SCR or DPF system that derates engine output and changes the status of an aftertreatment system (for example, hydrocarbon or DEF dosing is disabled):

(i) Identify whether the fault condition is related to SCR or DPF system.

(ii) Indicate the fault code for the detected problem, a description of the fault code, and the current speed restriction, as applicable.

(iii) If there are additional derate stages, also indicate the next speed restriction and the time remaining until starting the next restriction. If the derate involves something other than restricting vehicle speed, such as a torque derate, adjust the information to correctly identify any current and pending restrictions.

(2) Identify on demand the total number of active and completed diesel particulate filter regeneration events that have taken place since installing the current particulate filter.

(3) Identify on demand the lifetime and current rate of DEF consumption, such as gallons of DEF consumed per mile or gallons of DEF consumed per gallon of diesel fuel consumed. Design the system to allow the operator to reset the current rate of DEF consumption.

(4) Manufactures can use discretion to decide what to safely display while the vehicle is in-motion, which may be a more limited set of the required information than is displayed when the vehicle is stationary.

* * * * *

■ 13. Revise § 1036.111 to read as follows:

§ 1036.111 Inducements related to SCR.

Engines using SCR to control emissions depend on a constant supply of diesel exhaust fluid (DEF). This section describes how manufacturers must design their engines to induce operators to take appropriate actions to ensure the SCR system has quality DEF. The requirements of this section apply equally for engines installed in heavy-duty vehicles at or below 14,000 lbs GVWR. The requirements of this section apply starting in model year 2027, though you may comply with the requirements of this section in earlier model years. Transitional provisions apply for model years 2027 and 2028 as

described in paragraph (f) of this section.

(a) [Reserved]

(b) *Inducement triggering conditions.* Create strategies that monitor for and trigger an inducement signal based on the following conditions:

(1) DEF supply falling to 2.5 percent of DEF tank capacity or a level corresponding to three hours of engine operation, based on available information on DEF consumption rates.

(2) DEF with a urea concentration below 20 mass percent. You may determine urea concentration based on direct measurement or based on a surrogate value such as exhaust NO_X concentration before and after an SCR catalyst. Measurement may be limited to one time for each occurrence of adding to the DEF tank. Use good engineering judgment to determine urea concentration as soon as possible.

(3) Any signal indicating that a catalyst is missing.

(4) Open circuit faults related to the following: DEF tank level sensor, DEF pump, DEF quality sensor, SCR wiring harness, NO_X sensors, DEF dosing valve, DEF tank heater, DEF tank temperature sensor, and aftertreatment control module.

(c) *Audible signals.* Design engines with audible signals corresponding to the inducement triggering conditions in paragraph (b) of this section, subject to our approval, as follows:

(1) Audible signals must be sufficient to alert the operator to the need for service. The tone must be active for 90 seconds with repeated tones on one of the following schedules:

(i) For DEF supply, the tone must occur when the system detects the triggering condition in paragraph (b)(1) of this section, when the engine detects an empty DEF tank, 30 minutes after detecting an empty DEF tank, 60 minutes after detecting an empty DEF tank, and then every 60 minutes until key-off. Reevaluate at each key-on cycle.

(ii) For all conditions other than DEF supply, the tone must occur when the system detects a triggering condition in paragraph (b)(2) through (4) of this section, 30 minutes after detecting the triggering condition, 90 minutes after detecting the triggering condition, and then every 180 minutes until key-off. Reevaluate at each key-on cycle.

(2) You may design your engines to suspend the audible signals in paragraph (c)(1) of this section when ambient temperature is below −11 °C. If the triggering condition persists, restart audible signals at the same point in the schedule identified in paragraph (c)(1) of this section when ambient temperature is above 0 °C. Reevaluate at each key-on cycle.

(d) *Speed derates.* You may rely on derating engine performance for protecting aftertreatment systems and other engine components from catastrophic damage, as long as derating is not based only on an assessment of emission control performance (such as evaluation of catalyst conversion efficiency).

(e) *Deactivating inducements.* Program the engine to deactivate inducements as follows:

(1) Evaluate whether the detected inducement triggering condition continues to apply. Deactivate inducements if the engine confirms that the detected inducement triggering condition is resolved.

(2) Allow a generic scan tool to deactivate inducement triggering codes.

(f) *Transition provisions.* The following provisions apply through model year 2028 for engines that do not meet requirements for audible signals as described in paragraph (c) of this section:

(1) The following terms and general provisions apply under this paragraph (f):

(i) As described in § 1036.110, this section relies on terms and requirements specified for OBD systems by California ARB in 13 CCR 1968.2 and 1971.1 (incorporated by reference, see § 1036.810).

(ii) The provisions of this section apply differently based on an individual vehicle's speed history. A vehicle's speed category is based on the OBD system's recorded value for average speed for the preceding 30 hours of non-idle engine operation. The vehicle speed category applies at the point that the engine first detects an inducement triggering condition identified under paragraph (b) of this section and continues to apply until the inducement triggering condition is fully resolved as specified in paragraph (e) of this section. Non-idle engine operation includes all operating conditions except those that qualify as idle based on OBD system controls as specified in 13 CCR 1971.1(h)(5.4.10). Apply speed derates based on the following categories:

TABLE 1 TO PARAGRAPH (f)(1)(ii) OF § 1036.111—VEHICLE CATEGORIES

Vehicle category [a]	Average speed (mi/hr)
Low-speed	speed ≤ 15.
Medium-speed	15 ≤ speed ≤ 25.
High-speed	speed ≥ 25.

[a] A vehicle is presumed to be a high-speed vehicle if it has not yet logged 30 hours of non-idle operation.

(iii) Where engines derate power output as specified in this section, the derate must decrease vehicle speed by 1 mi/hr for every five minutes of engine operation until reaching the specified derate speed. This paragraph (a)(3) applies at the onset of an inducement, at any transition to a different step of inducement, and for any derate that recurs under paragraph (e)(3) of this section.

(2) The provisions of this paragraph (f) apply differently based on an individual vehicle's speed history. A vehicle's speed category is based on the average speed for the preceding 30 hours of non-idle engine operation. The vehicle speed category applies at the point that the engine first detects an inducement triggering condition identified under paragraph (b) of this section and continues to apply until the inducement triggering condition is fully resolved as specified in paragraph (e) of this section. Non-idle engine operation includes all operating conditions except those that qualify as idle based on OBD system controls as specified in 13 CCR 1971.1(h)(5.4.10). Apply speed derates based on the following categories:

TABLE 2 TO PARAGRAPH (f)(2) OF § 1036.111—VEHICLE CATEGORIES

Vehicle category [a]	Average speed (mi/hr)
Low-speed	speed < 15.
Medium-speed	15 ≤ speed < 25.
High-speed	speed ≥ 25.

[a] A vehicle is presumed to be a high-speed vehicle if it has not yet logged 30 hours of non-idle operation.

(3) Where engines derate power output as specified in this paragraph (f), the derate must decrease vehicle speed by 1 mi/hr for every five minutes of engine operation until reaching the specified derate speed. This paragraph (f)(3) applies at the onset of an inducement, at any transition to a different step of inducement, and for any derate that recurs under paragraph (f)(6) of this section.

(4) You may derate based on the following inducement triggering conditions instead of the conditions specified in paragraph (b) of this section:

(i) DEF supply falling to 2.5 percent of DEF tank capacity or a level corresponding to three hours of engine operation, based on available information on DEF consumption rates.

(ii) DEF quality failing to meet your concentration specifications.

(5) Engines must follow the derate schedule described in this paragraph (f)(4) if the engine detects an

inducement triggering condition identified in paragraph (b) of this section. The derate takes the form of a maximum drive speed for the vehicle. This maximum drive speed decreases over time based on hours of non-idle engine operation without regard to engine starting.

(i) Apply speed-limiting derates according to the following schedule:

TABLE 3 TO PARAGRAPH (F)(5)(I) OF § 1036.111—DERATE SCHEDULE FOR DETECTED INDUCEMENT TRIGGERING CONDITIONS [a]

High-speed vehicles		Medium-speed vehicles		Low-speed vehicles	
Hours of non-idle engine operation	Maximum speed (mi/hr)	Hours of non-idle engine operation	Maximum speed (mi/hr)	Hours of non-idle engine operation	Maximum speed (mi/hr)
0	65	0	55	0	45
6	60	6	50	5	40
12	55	12	45	10	35
20	50	45	40	30	25
86	45	70	35	.....	.....
119	40	90	25	.....	.....
144	35	.....	.....	.....	.....
164	25	.....	.....	.....	.....

[a] Hours start counting when the engine detects an inducement triggering condition specified in paragraph (b) of this section. For DEF supply, you may program the engine to reset the timer to three hours when the engine detects an empty DEF tank.

(ii) You may design and produce engines that will be installed in motorcoaches with an alternative derate schedule that starts with a 65 mi/hr derate when an inducement triggering condition is first detected, steps down to 50 mi/hr after 80 hours, and concludes with a final derate speed of 25 mi/hr after 180 hours of non-idle operation.

(6) Treat any detected inducement triggering condition that recurs within 40 hours of engine operation as the same detected inducement triggering condition, which would restart the derate at the same point in the derate schedule that the system last deactivated the derate.

■ 14. Amend § 1036.115 by revising paragraphs (a) introductory text, (f)(3), and (i) to read as follows:

§ 1036.115 Other requirements.

(a) *Crankcase emissions.* Engines may not discharge crankcase emissions into the ambient atmosphere throughout the useful life, other than those that are routed to the exhaust upstream of exhaust aftertreatment during all operation, except as follows:

* * * * *

(f) * * *

(3) DEF supply and DEF quality are adjustable parameters. The practically adjustable range includes any amount of DEF for which the engine's diagnostic system does not trigger inducement provisions under § 1036.111.

* * * * *

(i) *SCR-related requirements.* The following additional requirements apply for engines with SCR:

(1) Diesel exhaust fluid tanks must be sized to require refilling no more frequently than the vehicle operator will need to refill the fuel tank, even for worst-case assumptions related to fuel efficiency and refueling volumes.

(2) Design engines to respond to varying DEF quality with compensation algorithms that varies DEF injection to maintain NO_X emission control that is comparable to operation with DEF conforming to the specifications referenced in the definition of ''diesel exhaust fluid'' in § 1036.801, subject to the limitations of the emission control hardware.

(3) Design engines for DEF freeze protection by including a warming system to thaw DEF to restore DEF flow into the exhaust system within 70 minutes after engine starting using the procedure described in § 1036.560.

* * * * *

■ 15. Amend § 1036.120 by revising paragraph (b) to read as follows:

§ 1036.120 Emission-related warranty requirements.

* * * * *

(b) *Warranty period.* Your emission-related warranty must be valid for at least as long as the minimum warranty periods listed in this paragraph (b) in vehicle miles, or hours of engine operation, or years in service, whichever comes first. You may offer an emission-related warranty more generous than we require. The emission-related warranty for the engine may not be shorter than any published warranty you offer without charge for the engine. Similarly, the emission-related warranty for any component may not be shorter than any published warranty you offer without charge for that component. If an extended warranty requires owners to pay for a portion of repairs, those terms apply in the same manner to the emission-related warranty. The warranty period begins when the vehicle is placed into service. The following minimum warranty periods apply:

TABLE 1 TO PARAGRAPH (b) OF § 1036.120—WARRANTY BY PRIMARY INTENDED SERVICE CLASS

Primary intended service class	Mileage	Years
Spark-Ignition HDE	50,000	5
Light HDE	50,000	5
Medium HDE	100,000	5
Heavy HDE	100,000	5

* * * * *

■ 16. Amend § 1036.125 by revising the introductory text and paragraphs (a)(2), (g) introductory text, and (h)(8) to read as follows:

§ 1036.125 Maintenance instructions and allowable maintenance.

Give the ultimate purchaser of each new engine written instructions for maintaining and using the engine. As described in paragraph (h) of this section, these instructions must identify how owners properly maintain and use engines to clarify responsibilities for regulatory requirements such as emission-related warranty and defect reporting. Maintenance includes any inspection, adjustment, cleaning, repair, or replacement of components and is classified as either emission-related or not emission-related and each of these can be classified as either scheduled or unscheduled. Further, some emission-related maintenance is also classified as critical emission-related maintenance.

(a) * * *

(2) *Minimum scheduled maintenance intervals.* You may not schedule critical emission-related maintenance more frequently than the minimum intervals specified or allowed in this paragraph (a), except as specified in paragraph (g) of this section. The minimum intervals specified for each component applies to actuators, sensors, tubing, valves, and wiring associated with that component, except as specified.

TABLE 1 TO PARAGRAPH (a)(2) OF § 1036.125—MINIMUM SCHEDULED MAINTENANCE INTERVALS FOR REPLACEMENT IN MILES (OR HOURS)

Components	Spark-ignition HDE	Light HDE	Medium HDE	Heavy HDE
Spark plugs	25,000 (750)	.....	.....	.....
DEF filters	.....	100,000 (3,000)	100,000 (3,000)	100,000 (3,000)
Crankcase ventilation valves and filters	60,000 (1,800)	60,000 (1,800)	60,000 (1,800)	60,000 (1,800)
Ignition wires and coils	50,000 (1,500)	.....	.....	.....
Oxygen sensors	80,000 (2,400)	.....	.....	.....
Air injection system components	110,000 (3,300)	.....	.....	.....
Sensors, actuators, and related control modules that are not integrated into other systems	100,000 (3,000)	100,000 (3,000)	150,000 (4,500)	150,000 (4,500)
Particulate filtration systems (other than filter substrates)	100,000 (3,000)	100,000 (3,000)	250,000 (7,500)	250,000 (7,500)
Catalyst systems (other than catalyst substrates), fuel injectors, electronic control modules, hybrid system components, turbochargers, and EGR system components (including filters and coolers)	110,000 (3,300)	110,000 (3,300)	185,000 (5,550)	435,000 (13,050)
Catalyst substrates and particulate filter substrates in model year 2029 and earlier	110,000 (3,300)	110,000 (3,300)	185,000 (5,550)	435,000 (13,050)
Catalyst substrates and particulate filter substrates in model year 2030 and later	200,000 (10,000)	270,000 (13,000)	350,000 (17,000)	650,000 (32,000)

TABLE 2 TO PARAGRAPH (a)(2) OF § 1036.125—MINIMUM SCHEDULED MAINTENANCE INTERVALS FOR ADJUSTMENT OR CLEANING

Component	Accumulated miles (hours) for components			
	Spark-ignition HDE	Light HDE	Medium HDE	Heavy HDE
Spark plugs	25,000 (750)	.....	.....	
EGR-related filters and coolers, fuel injectors, and crankcase ventilation valves and filters.	50,000 (1,500)	50,000 (1,500)	50,000 (1,500)	50,000 (1,500).
DEF filters	.....	50,000 (1,500)	50,000 (1,500)	50,000 (1,500).
Ignition wires and coils	50,000 (1,500)	.....	.....	
Oxygen sensors	80,000 (2,400)	.....	.....	
Air injection system components	100,000 (3,000)	.....	.....	
Catalyst system components, EGR system components (other than filters or coolers), particulate filtration system components, and turbochargers.	100,000 (3,000)	100,000 (3,000)	100,000 (3,000), then 150,000 (4,500).	100,000 (3,000), then 150,000 (4,500).

* * * * *

(g) *Payment for scheduled maintenance.* Owners are responsible for properly maintaining their engines; this generally includes paying for scheduled maintenance, even within the warranty period. However, you may commit to paying for scheduled maintenance as described in paragraph (a)(1)(iv) of this section to demonstrate that the maintenance will occur. You may also schedule maintenance not otherwise allowed by paragraph (a)(2) of this section if you pay for it. You must pay for scheduled maintenance on any component during the useful life if it meets all the following conditions:

* * * * *

(h) * * *

(8) Include a troubleshooting guide to address the following signals related to SCR inducement:

(i) The schedule for visual and audible signals (including indication that the signal will begin prior to the DEF tank being completely empty).

(ii) The meaning of any trouble lights that indicate specific problems (*e.g.,* DEF level).

(iii) A description of the three types of SCR-related triggers that cause the visual and audible signals (DEF level, DEF quality and tampering) and that further information on the inducement

cause (*e.g.,* trouble codes) is available using the OBD system.

* * * * *

■ 17. Amend § 1036.130 by:
■ a. Revising paragraph (b)(7)(ii);
■ b. Adding paragraph (b)(10); and
■ c. Revising paragraph (c).

The revisions and addition read as follows:

§ 1036.130 Installation instructions for vehicle manufacturers.

* * * * *

(b) * * *

(7) * * *

(ii) Describe how vehicle manufacturers must install diesel exhaust fluid tanks with sensors and equipment as needed to meet the requirements of §§ 1036.110, 1036.111, and 1036.115(i).

* * * * *

(10) For powertrain families, describe any limitations on the type or configuration of vehicles.

(c) Give the vehicle manufacturer engine data and information to support vehicle certification as described in § 1036.505.

* * * * *

■ 18. Amend § 1036.135 by revising paragraph (e) to read as follows:

§ 1036.135 Labeling.

* * * * *

(e) You may ask us to approve modified labeling requirements in this part if you show that it is necessary or appropriate. We will approve your request if your alternative label is consistent with the requirements of this part. We may also specify modified labeling requirements to be consistent with the intent of 40 CFR part 1037.

* * * * *

■ 19. Amend § 1036.150 by:
■ a. Revising paragraphs (k) and (z) introductory text; and
■ b. Adding paragraphs (aa), (bb), and (cc).

The revisions and additions read as follows:

§ 1036.150 Interim provisions.

* * * * *

(k) *Limited production volume allowance.* You may produce a limited number of Heavy HDE in model years 2027 through 2029 that continue to meet the criteria pollutant standards as they applied under 40 CFR 86.007–11. The maximum number of engines you may produce under this limited production allowance is 5 percent of the annual average of your actual production volume of Heavy HDE in model years 2023–2025. Engine certification under this paragraph (k) is subject to the following conditions and requirements:

(1) Engines must meet all the standards and other requirements that apply under 40 CFR part 86 for model year 2026. Engines must be certified in separate engine families that qualify for carryover certification as described in § 1036.235(d).

(2) [Reserved].

(3) Include the following compliance statement instead of the compliance statement in § 1036.135(c)(8): ''THIS ENGINE COMPLIES WITH U.S. EPA REGULATIONS FOR [MODEL YEAR] HEAVY-DUTY HIGHWAY ENGINES, EXCEPT THAT IT CONFORMS TO CERTAIN MODEL YEAR 2026 STANDARDS UNDER 40 CFR 1036.150(k).''

* * * * *

(z) *Alternative family pass criteria for in-use testing.* The following family pass criteria apply for manufacturer-run in-use testing instead of the pass criteria described in § 1036.425 for model years 2027 and 2028:

* * * * *

(aa) *Carryover deterioration factors.* You may certify an engine family to compression-ignition standards using carryover data with a deterioration factor based on vehicle speeds of either 40.26 mi/hr for test sequence 1 or 44.48 mi/hr for test sequence 2 under § 1036.245.

(bb) *OBD provisions for NCP engines.* If you certify a model year 2027 or later engine family under 40 CFR part 86, subpart A, as described in 40 CFR 1071.60, do not count those engine families when determining testing requirements that apply under § 1036.110.

(cc) *Deterioration factors through model year 2029.* Through model year 2029, determine deterioration factors based on estimated emission levels corresponding to the useful life that applies for the engine family. This may involve interpolation if you measured emission levels after service accumulation exceeding the useful life (in miles).

■ 20. Amend § 1036.201 by revising paragraph (h) to read as follows:

§ 1036.201 General requirements for obtaining a certificate of conformity.

* * * * *

(h) For engines that become new after being placed into service, such as rebuilt engines installed in new vehicles, we may specify alternative certification provisions consistent with the intent of this part. See 40 CFR 1068.120(h) and the definition of ''new motor vehicle engine'' in § 1036.801.

■ 21. Amend § 1036.205 by:
■ a. Adding paragraph (b)(12); and
■ b. Revising paragraphs (c), (e), and (r)(1).

The addition and revisions read as follows:

§ 1036.205 Requirements for an application for certification.

* * * * *

(b) * * *

(12) Describe the following SCR-related design features:

(i) Audible signals required under § 1036.111(c).

(ii) Compensation algorithms required under § 1036.115(i)(2).

(c) Explain in detail how the engine diagnostic system works, describing especially the engine conditions (with the corresponding diagnostic trouble codes) that cause the malfunction indicator to go on. Also describe any approved conditions under which the diagnostic system disregards trouble codes as specified in § 1036.110(b)(12) and any exceptions from comprehensive component monitoring as allowed under § 1036.110(b)(20).

* * * * *

(e) Describe any test equipment and procedures that you used, including any special or alternative test procedures you used (see § 1036.501).

* * * * *

(r) * * *

(1) For physically adjustable operating parameters, include the nominal or recommended setting, the intended practically adjustable range, and the limits or stops used to establish adjustable ranges. State that the limits, stops, or other means of inhibiting adjustment are effective in preventing adjustment of parameters on in-use engines to settings outside your intended practically adjustable ranges and provide information to support this statement.

* * * * *

■ 22. Amend § 1036.230 by revising paragraph (f)(3) to read as follows:

§ 1036.230 Selecting engine families.

* * * * *

(f) * * *

(3) If you certify both engine fuel maps and powertrain fuel maps for an engine family, you may split the engine family into two separate subfamilies. Indicate this in your application for certification, and identify whether one or both of these sets of fuel maps applies for each group of engines. If you do not split your family, all engines within the family must conform to the engine fuel maps, including any engines for which the powertrain maps also apply.

* * * * *

■ 23. Amend § 1036.235 by revising paragraphs (b) introductory text, (e), and (f) to read as follows:

§ 1036.235 Testing requirements for certification.

* * * * *

(b) Test your emission-data engines using the procedures and equipment specified in subpart F of this part. In the case of dual-fuel engines, measure emissions when operating with each type of fuel for which you intend to certify the engine. In the case of flexible-fuel engines, measure emissions when operating with the fuel mixture that best represents in-use operation or is most likely to have the highest NO_X emissions (or NO_X + NMHC emissions for engines subject to NO_X + NMHC standards), though you may ask us instead to perform tests with both fuels separately if you can show that intermediate mixtures are not likely to occur in use.

* * * * *

(e) We may require you to test a second engine of the same configuration in addition to the engines tested under paragraph (b) of this section.

(f) If you use an alternative test procedure under 40 CFR 1065.10 and later testing shows that such testing does not produce results that are equivalent to the procedures specified in subpart F of this part, we may reject data you generated using the alternative procedure.

* * * * *

■ 24. Amend § 1036.240 by revising paragraphs (b) and (c) introductory text to read as follows:

§ 1036.240 Demonstrating compliance with criteria pollutant emission standards.

* * * * *

(b) Your engine family is deemed not to comply if any emission-data engine representing that family has test results showing an official emission result or a deteriorated emission level for any pollutant that is above an applicable duty-cycle emission standard (including all corrections and adjustments). Similarly, your engine family is deemed not to comply if any emission-data engine representing that family has test results showing any emission level above the applicable off-cycle emission standard for any pollutant. This also applies for all test points for emission-data engines within the family used to establish deterioration factors.

(c) To compare emission levels from the emission-data engine with the applicable duty-cycle emission standards, apply deterioration factors to the measured emission levels for each pollutant. Section 1036.245 specifies how to test engines and engine components to develop deterioration factors that represent the deterioration expected in emissions over your engines' useful life. Section 1036.246 describes how to confirm or modify deterioration factors based on in-use verification testing. Your deterioration factors must take into account any available data from other in-use testing with similar engines. Small manufacturers may use assigned deterioration factors that we establish. Other manufacturers may request to certify engine families using assigned deterioration factors that we establish. The assigned deterioration factors may apply for a projected nationwide production volume up to 10,000 engines, including all affiliated companies. The deterioration factors apply to entire engine families. Apply deterioration factors as follows:

* * * * *

■ 25. Amend § 1036.245 by revising paragraph (c) to read as follows:

§ 1036.245 Deterioration factors for exhaust emission standards.

* * * * *

(c) If you are unable to determine deterioration factors for an engine family under paragraph (a) of this section, select engines, subsystems, or components for testing. Determine deterioration factors based on service accumulation and related testing to represent the deterioration expected from in-use engines over the useful life, including effects of crankcase emissions and infrequent regeneration. You may perform maintenance on emission-data engines as described in § 1036.125 and 40 CFR part 1065, subpart E. Use good engineering judgment for all aspects of the effort to establish deterioration factors under this paragraph (c). Send us your test plan for our preliminary approval under § 1036.210. You may apply deterioration factors based on testing under this paragraph (c) to multiple engine families, consistent with the provisions in paragraph (a) of this section. Engine dynamometer hours accumulated during emission measurements do not count toward meeting the minimum number of engine dynamometer hours in paragraph (c)(3) of this section or the total service accumulation hours in paragraph (c)(8) of this section. Determine deterioration factors based on a combination of minimum required engine dynamometer aging hours and accelerated bench-aged aftertreatment as follows:

(1) Select an emission-data engine and aftertreatment devices and systems that can be assembled into a certified configuration to represent the engine family. Stabilize the engine and aftertreatment devices and systems, together or separately, to prepare for emission measurements. These stabilization hours count toward meeting the minimum number of engine dynamometer hours in paragraph (c)(3) of this section.

(2) Perform low-hour emission measurement once the engine has operated with aftertreatment long enough to stabilize the emission control. Measure emissions of all regulated pollutants while the engine operates over all applicable duty cycles on an engine dynamometer as described in subpart F of this part. You may use the average of multiple emission tests to determine your emissions value for the purpose of calculating a deterioration factor.

(3) Perform additional service accumulation as described in paragraph (c)(3) of this section on an engine dynamometer until you reach the minimum specified number of engine dynamometer hours:

TABLE 1 TO PARAGRAPH (c)(3) OF § 1036.245—MINIMUM REQUIRED ENGINE DYNAMOMETER AGING HOURS BY PRIMARY INTENDED SERVICE CLASS

Primary intended service class	Minimum engine dynamometer hours
Spark-ignition HDE	300
Light HDE	1,250
Medium HDE	1,500
Heavy HDE	1,500

(4) Perform service accumulation in the laboratory by operating the engine or hybrid powertrain on a dynamometer repeatedly over one of the test sequences in paragraph (c)(4)(i) or (ii) of this section, or use a different test sequence (and cycle validation) that we approve in advance. For spark-ignition engines, you may exclude operation over the LLC in paragraphs (c)(4)(i)(C) and (ii)(C) of this section. If you conduct service accumulation for hybrid powertrains using an engine-based simulation of powertrain testing as specified in 40 CFR 1037.551, you may omit the hybrid components.

(i) Test sequence 1 is based on operating over the FTP, RMC, and LLC. Operate the engine or hybrid powertrain as follows for test sequence 1:

(A) Operate at idle for 2 hours.

(B) Operate for 105 ± 1 hours over a repeat sequence of one FTP followed by one RMC.

(C) Operate over one LLC.

(D) Operate at idle for 2 hours.

(E) Shut down the engine for cooldown to ambient temperature.

(F) Perform cycle validation for at least one FTP, one RMC, and one LLC for the initial run through test sequence 1. If validation fails, correct the problem and continue service accumulation. Use good engineering judgment to ensure that the engine or hybrid powertrain follows the test sequence throughout the duration of service accumulation, for example by using real-time monitors.

(ii) Test sequence 2 is based on operating over the LLC and the vehicle-based duty cycles from 40 CFR part 1037. Select the vehicle subcategory and vehicle configuration from § 1036.540 or § 1036.545 with the highest reference cycle work for each vehicle-based duty cycle. Operate the engine or hybrid powertrain as follows for test sequence 2:

(A) Operate at idle for 2 hours.

(B) Operate for 105 ± 1 hours over a repeat sequence of one Heavy-duty Transient Test Cycle, then one 55 mi/hr highway cruise cycle, and then one 65 mi/hr highway cruise cycle.

(C) Operate over one LLC.

(D) Operate at idle for 2 hours.

(E) Shut down the engine for cooldown to ambient temperature.

(F) Perform cycle validation for at least one heavy-duty transient test cycle, one 55 mi/hr highway cruise cycle, one 65 mi/hr highway cruise cycle, and one LLC for the initial run through test sequence 2. If validation fails, correct the problem and continue service accumulation. Use good engineering judgment to ensure that the engine or hybrid powertrain follows the test sequence throughout the duration of service accumulation, for example by using real-time monitors.

(5) If you use a nonmotoring dynamometer for service accumulation; when running motoring points, set the dynamometer command to minimum and use the operator demand to control speed.

(6) Use the following alternative cycle-validation criteria to validate service accumulation.

TABLE 2 TO PARAGRAPH (c)(6) OF § 1036.245—ALTERNATIVE CYCLE VALIDATION CRITERIA FOR SERVICE ACCUMULATION [a]

Parameter	Speed	Torque	Power
Slope, a_1		$0.800 \leq a_1 \leq 1.030$	$0.800 \leq a_1 \leq 1.030$.
Absolute value of intercept, $\lvert a_0 \rvert$		≤6% of maximum mapped torque	≤6% of maximum mapped power.
Standard error of the estimate, *SEE*			≤15% of maximum mapped power.
Coefficient of determination, r^2	0.95	≥0.650	≥0.650.

[a] Cycle-validation criteria apply as described in 40 CFR 1065.514 unless otherwise specified.

(7) After performing the specified service accumulation on the engine dynamometer, repeat the emission measurements described in paragraph (c)(1) of this section.

(8) Calculate the total service accumulation representing hours of engine operation over the useful life as follows:

(i) Use the following equation, except as specified in paragraph (c)(8)(ii) of this section:

$$t_{\text{total}} = \frac{UL \cdot k}{\bar{v}_{\text{agingcycle}}}$$

Eq. 1036.245-1

Where:

UL = useful life mileage representing the longest useful life that the deterioration factors would be used for.

k = 1.15 for Heavy HDE and 1.0 for all other primary intended service classes.

$\bar{v}_{\text{agingcycle}}$ = average speed of the vehicle, derived from field data, based on the applications used for determining the thermal exposure for the engine family as described in the field data discussion in 40 CFR 1065.1131 or 40 CFR 1065.1147. If the average speed from the field data is less than 20 mi/hr use 20 mi/hr as the average speed.

Example for a model year 2030 Heavy HDE for test sequence 1:

UL = 650,000 miles

k = 1.15

$\bar{v}_{\text{agingcycle}}$ = 40.26 mi/hr

$$t_{\text{total}} = \frac{650{,}000 \cdot 1.15}{40.26}$$

t_{total} = 18,567 hr

(ii) To determine deterioration factors for standards subject to a shorter useful life, you may calculate a value for hours-of-service accumulation corresponding to the shorter useful life using Eq. 1036.245–1. For example, this may apply if the testing will be used to establish deterioration factors for a different primary intended service class. Follow the procedure described in paragraph (c)(12) of this section to determine deterioration factors for a shorter useful life.

(9) Perform accelerated bench aging of aftertreatment devices to finish service accumulation over the useful life, if the aftertreatment was not aged to useful life in paragraph (c)(4) of this section.

(i) Calculate the bench aging hours by subtracting the actual engine operating hours during service accumulation from ttotal and dividing the difference by the acceleration factor determined in 40 CFR 1065.1139(a) for compression ignition engines and 40 CFR 1065.1149 for spark ignition engines. Note that engine operating hours during service accumulation is the sum of the engine stabilization hours under paragraph (c)(1) of this section, service accumulation hours under paragraph (c)(2) of this section, and engine stabilization hours under paragraph (c)(11) of this section.

(ii) For powertrains where hybrid components are part of the certified configuration, you may request a reduction in aging hours to represent charge-sustaining engine operation, with our approval. You may not account

for engine-off operation due to charge-depleting operation.

(iii) Use the accelerated bench-aging procedure in 40 CFR 1065.1131 through 1065.1145 for compression ignition engines, 40 CFR 1065.1147 through 1065.1155 for spark ignition engines, or get our advance approval to use a different procedure that adequately accounts for thermal and chemical degradation.

(10) After bench-aging aftertreatment devices, reinstall the aftertreatment devices and systems on the engine used for service accumulation in paragraph (c)(2) of this section, or install aftertreatment devices and systems on a different emission-data engine (or an equivalent engine) that has been stabilized without aftertreatment as described in paragraph (c)(1) of this section. Ensure that the aftertreatment is installed such that the engine is in a certified configuration to represent the engine family.

(11) Operate the engine with the bench-aged aftertreatment devices to allow controls to adapt to the aftertreatment condition and to stabilize emission controls. For compression ignition engines, operate at least 100 hours on an engine dynamometer as described in paragraph (c)(4) of this section. You may omit the idle and cooldown periods in paragraphs (c)(3)(i)(A), (D), and (E) or (c)(4)(ii)(A), (D), and (E) of this section. For spark ignition engines use good engineering judgment to determine the duty cycle and the operating time on an engine dynamometer.

(12) Once stabilization is complete, repeat the emission measurements described in paragraph (c)(1) of this section.

(13) Calculate each deterioration factor by comparing the highest exhaust emissions at any point during aging where you measure emissions and exhaust emissions at the low-hour test point as described in paragraph (c)(1) of this section, without extrapolation.

(14) To determine separate deterioration factors corresponding to a shorter useful life, calculate the total service accumulation corresponding to the shorter useful life as described in paragraph (c)(8)(ii) of this section. Once there is enough bench aging to represent operation corresponding to the shorter useful life, perform the steps described in paragraphs (c)(10) through (13) of this section, including emission measurement of all relevant pollutants. After this testing is complete, recalculate the required bench aging hours to account for the additional operation on the engine dynamometer and resume service accumulation to determine deterioration factors for the longer useful life.

* * * * *

■ 26. Amend § 1036.255 by revising paragraphs (a), (c)(7), (d), and (e) to read as follows:

§ 1036.255 EPA oversight on certificates of conformity.

(a) If we determine an application is complete and shows that the engine family meets all the requirements of this part and the Clean Air Act, we will issue a certificate of conformity for the engine family for that model year. We may make the approval subject to additional conditions.

* * * * *

(c) * * *

(7) Take any action that otherwise circumvents the intent of the Clean Air Act or this part.

(d) We may void a certificate of conformity if you fail to keep records, send reports, or give us information as required under this part or the Clean Air Act. Note that these are also violations of 40 CFR 1068.101(a)(2).

(e) We may void a certificate of conformity if we find that you intentionally submitted false or incomplete information. This includes doing anything after submitting an application that causes submitted information to be false or incomplete.

* * * * *

■ 27. Amend § 1036.410 by revising paragraph (c) to read as follows:

§ 1036.410 Selecting and screening vehicles and engines for testing.

* * * * *

(c) You must notify us before disqualifying any vehicle based on illuminated MIL or stored OBD trouble codes as described in § 1036.415(b)(3), or for any other reasons not specified in paragraph (b) of this section. For example, notify us if you disqualify any vehicle because the engine does not represent the engine family or the vehicle's usage is atypical for the particular application. You do not need to notify us in advance if the owner declines to participate in the test program.

■ 28. Amend § 1036.415 by:

■ a. Revising paragraph (c) introductory text;

■ b. Adding paragraph (c)(6);

■ c. Revising paragraphs (d) and (g); and

■ d. Adding paragraph (h).

The revisions and additions read as follows:

§ 1036.415 Preparing and testing engines.

* * * * *

(c) Use appropriate fluids for testing, as follows:

* * * * *

(6) Perform testing in the as-received condition with respect to DEF. You may measure the urea concentration of the as-received DEF.

(d) You must test the selected engines using the test procedure described in § 1036.530 while they remain installed in the vehicle. Testing consists of characterizing emission rates for moving average 300 second test intervals while driving, with those test intervals divided into bins representing different types of engine operation over a shift-day. Measure emissions as follows:

(1) Perform all testing with PEMS and field-testing procedures referenced in 40 CFR part 1065, subpart J. Measure emissions of NO_X, CO, and CO_2. We may require you to also measure emissions of HC and PM. You may determine HC emissions by any method specified in 40 CFR 1065.660(b). If we do not require HC measurement, set $x_{THCmeas}$ in 40 CFR 1065.655 to zero.

(2) If the engine's crankcase discharges emissions into the ambient atmosphere, as allowed by § 1036.115(a), you must either route all crankcase emissions into the exhaust for a combined measurement or add the crankcase emission values specified in § 1036.240(e) to represent emission levels at useful life instead of measuring crankcase emissions in the field.

* * * * *

(g) For stop-start and automatic engine shutdown systems meeting the specifications of 40 CFR 1037.660, override idle-reduction features if they are adjustable under 40 CFR 1037.520(j)(4). If those systems are tamper-resistant under 40 CFR 1037.520(j)(4), set the 1-Hz emission rate to zero for all regulated pollutants when the idle-reduction feature is active. Do not exclude these data points under § 1036.530(d)(3)(ii).

(h) For hybrid powertrains that are designed to turn the engine off at zero vehicle speed, set the 1-Hz emission rate to zero for all regulated pollutants after the initial engine start for the shift-day when the engine is off, the vehicle speed is zero, and the powertrain is keyed on. Do not exclude these data points under § 1036.530(d)(3)(ii).

■ 29. Amend § 1036.420 by:

■ a. Revising paragraphs (c) and (d) to read as follows:

§ 1036.420 Pass criteria for individual engines.

* * * * *

(c) For engines subject to compression-ignition standards, determine the number of test intervals for each pollutant in each bin. A bin is valid under this section only if it has at

least 2,400 test intervals for bin 1 and at least 10,000 test intervals for bin 2.

(d) Continue testing and combine valid data from all test intervals for each measured pollutant from all shift-days to achieve the minimum test interval requirements for each bin. Combine valid ambient temperature data, T_{amb}, from all shift-days, calculate the arithmetic mean of the ambient temperature,$\overline{T}_{amb}$, as specified in § 1036.530(i) and use this to calculate the off-cycle NO_X emission standard in § 1036.104(a)(3).

(1) For example, you may perform additional testing to address a shortfall in reaching the minimum test interval requirements due to any of the following reasons:

(i) Insufficient shift-day operation as described in § 1036.415(f).

(ii) Excluded data as described in § 1036.530(d)(3).

(iii) Gas analyzer range verification failure according to 40 CFR 1065.935(g)(5)(i).

(iv) Drift verification failure according to 40 CFR 1065.935(g)(5)(ii) or (iii).

(2) You may idle the engine at the end of the shift day if you are not certain if you achieved at least 2,400 bin 1 test intervals. For engine designs that shut down the engine during idle as described in § 1036.415(g) or (h), populate bin 1 with additional test intervals by setting the 1-Hz emission rate for all regulated pollutants to zero at the end of the shift day to achieve exactly 2,400 bin 1 test intervals.

* * * * *

■ 30. Amend § 1036.425 by revising paragraph (c) to read as follows:

§ 1036.425 Pass criteria for engine families.

* * * * *

(c) If two or more engines tested under paragraphs (a) and (b) of this section do not comply fully with the off-cycle bin standards, test additional engines until you have tested a total of ten engines. Calculate the arithmetic mean of the bin emissions from the ten engine tests as specified in § 1036.530(h) for each pollutant. Calculate the arithmetic mean, $\overline{T}_{amb}$, of the ambient temperature from the ten engine tests as specified in § 1036.530(i) and use this to calculate the off-cycle NO_X emission standard in § 1036.104(a)(3). If the mean values are at or below the off-cycle bin standards, the engine family passes. If the mean value for any pollutant is above an off-cycle bin standard, the engine family fails.

* * * * *

■ 31. Amend § 1036.430 by:

■ a. Revising paragraph (a)(1)(ii);

■ b. Adding paragraph (a)(2)(x); and

■ c. Revising paragraphs (a)(3)(vii).

The revisions and addition read as follows:

§ 1036.430 Reporting requirements.

(a) * * *

(1) * * *

(ii) Include a summary of the vehicles you have disqualified and the reasons you disqualified them, whether you base the disqualification on the criteria in § 1036.410(b), owner nonparticipation, or anything else. If you disqualify the vehicle based on illuminated MIL or stored OBD trouble codes, describe the MIL or trouble code information. If you disqualified a vehicle due to misfueling, include the results of any fuel sample tests. If you reject a vehicle due to tampering, describe how you determined that tampering occurred.

* * * * *.

(2) * * *

(x) Identify the time and vehicle mileage for adding DEF if the vehicle needs a DEF refill.

(3) * * *

(vii) The number of test intervals in each bin (see § 1036.420(c)).

* * * * *

■ 32. Amend § 1036.501 by:

■ a. Revising paragraph (b) introductory text;

■ b. Redesignating paragraph (b)(3) as paragraph (b)(4);

■ c. Adding a new paragraph (b)(3);

■ d. Revising paragraphs (f) and (h); and

■ e. Adding paragraph (i).

The revisions and additions read as follows:

§ 1036.501 General testing provisions.

* * * * *

(b) Use the fuels and engine fluids specified in 40 CFR part 1065 to perform valid tests, as follows:

* * * * *

(3) For engines using selective catalytic reduction, use diesel exhaust fluid that conforms to the specifications referenced in the definition of ''diesel exhaust fluid'' in § 1036.801.

* * * * *

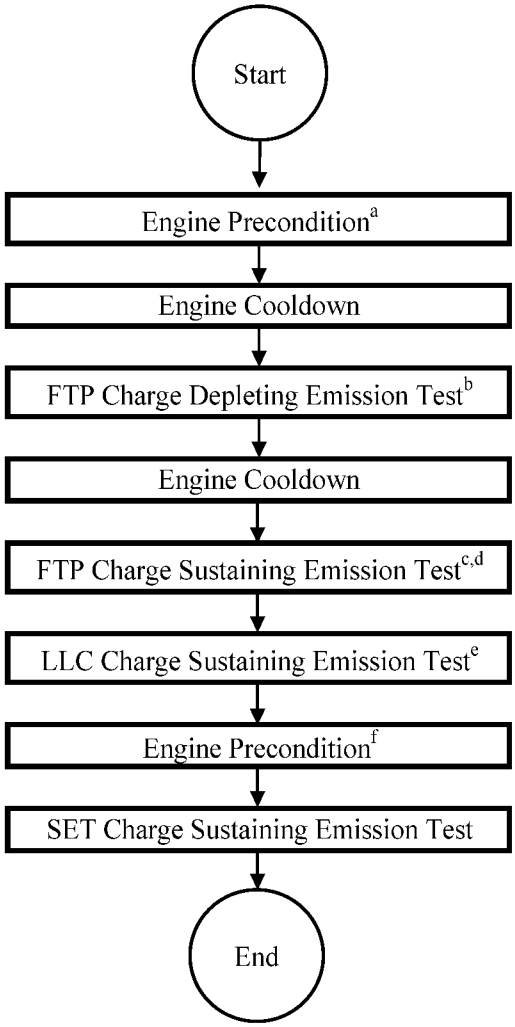
(f) You may use special or alternative procedures to the extent we allow them under 40 CFR 1065.10.

* * * * *

(h) For testing engines that use regenerative braking through the crankshaft only to power an electric heater for aftertreatment devices, you may use the nonhybrid engine testing procedures in §§ 1036.510, 1036.512, and 1036.514 and you may also or instead use the fuel mapping procedure in § 1036.505(b)(1) or (2). You may use this allowance only if the recovered energy is less than 10 percent of the total positive work for each applicable test interval. Otherwise, use powertrain testing procedures specified for hybrid powertrains to measure emissions and create fuel maps. For nonhybrid engines that use the powertrain test procedures, the provisions specified for nonhybrid powertrain testing apply. For engines that power an electric heater with a battery, you must meet the requirements related to charge-sustaining operation as described in 40 CFR 1066.501(a)(3).

(i) The following figure illustrates an example of a test sequence for determining criteria pollutant emissions for plug-in hybrid powertrains:

FIGURE 1 TO PARAGRAPH (i) OF § 1036.501— CRITERIA POLLUTANT TEST SEQUENCE



[a] Preconditioning is for the FTP charge depleting emission test.

[b] See §1036.512(d)(1).

[c] See §1036.512(d)(2).

[d] This test can be used as the preconditioning cycle for the LLC.

[e] Testing over LLC is only required for compression-ignition engines.

[f] See 40 CFR 1065.518(c)(5).

■ 33. Amend § 1036.510 by revising paragraphs (b)(2) introductory text, (b)(2)(iii) and (vii), (c) introductory text, (c)(3), (d), (e), and (g) to read as follows:

§ 1036.510 Supplemental Emission Test.

* * * * *

(b) * * *

(2) Test hybrid powertrains as described in § 1036.545, except as specified in this paragraph (b)(2). Do not compensate the duty cycle for the distance driven as described in § 1036.545(g)(4). You may set the battery to the lowest SOC level that results in charge sustaining operation after preconditioning to help meet the NEC requirement described in § 1036.545(a)(6). Follow 40 CFR 1065.610(d)(3)(ii) for applying optional declared accessory loads. For hybrid engines, select the transmission model parameters as described in § 1036.510(b)(2)(viii). Disregard duty cycles in § 1036.545(j). For cycles that begin with idle, leave the transmission in neutral or park for the full initial idle segment. Place the transmission into drive no earlier than 5 seconds before the first nonzero vehicle speed setpoint.

For SET testing only, place the transmission into park or neutral when the cycle reaches the final idle segment. Use the following vehicle parameters instead of those in § 1036.545 to define the vehicle model in § 1036.545(a)(3):

* * * * *

(iii) Determine the vehicle drag area, C_dA, as follows:

$$C_dA = \frac{(0.00299 \cdot A_{front} - 0.000832) \cdot 2 \cdot g \cdot 3.6^2}{\rho}$$

Eq. 1036.510-3

Where:

g = gravitational constant = 9.80665 m/s².
ρ = air density at reference conditions. Use ρ = 1.1845 kg/m³.

Example:

$$C_dA = \frac{(0.00299 \cdot 7.59 - 0.000832) \cdot 2 \cdot 9.80665 \cdot 3.6^2}{1.1845}$$

C_dA = 4.69 m²

* * * * *

(vii) Select a combination of drive axle ratio, k_a, and a tire radius, r, that represents the worst-case combination of top gear ratio, drive axle ratio, and tire size for CO_2 emissions expected for vehicles in which the hybrid engine or hybrid powertrain will be installed. This is typically the highest axle ratio and smallest tire radius. Disregard configurations or settings corresponding to a maximum vehicle speed below 60 mi/hr in selecting a drive axle ratio and tire radius, unless you can demonstrate that in-use vehicles will not exceed that speed. You may request preliminary approval for selected drive axle ratio and tire radius consistent with the provisions of § 1036.210. If the hybrid engine or hybrid powertrain is used exclusively in vehicles not capable of reaching 60 mi/hr, you may request that we approve an alternative test cycle and cycle-validation criteria as described in 40 CFR 1066.425(b)(5). Note that hybrid engines rely on a specified transmission that is different for each duty cycle; the transmission's top gear ratio therefore depends on the duty cycle, which will in turn change the selection of the drive axle ratio and tire size. For example, § 1036.520 prescribes a different top gear ratio than this paragraph (b)(2).

* * * * *

(c) Measure emissions using the SET duty cycle shown in Table 1 of this section to determine whether engines meet the emission standards specified in subpart B of this part. Table 1 of this section specifies test settings, as follows:

* * * * *

(3) Table 2 follows:

TABLE 2 TO PARAGRAPH (c)(3) OF § 1036.510—SUPPLEMENTAL EMISSION TEST

SET mode	Engine testing			Hybrid powertrain testing								
	Time in mode (seconds)	Engine speed [a b]	Torque (percent) [b c]	Vehicle speed (mi/hr)	Road-grade coefficients							
					a	*b*	*c*	*d*	*e*	*f*	*g*	*h*
1a Steady-state	124	Warm Idle	0	0	0	0	0	0	0	0	0	0
1b Transition [d]	20	Linear Transition.	Linear Transition.	Linear Transition.	−1.898E−08	−5.895E−07	3.780E−05	4.706E−03	6.550E−04	−2.679E−02	−1.027E+00	1.542E+01
2a Steady-state	196	A	100	v_{refA}	−1.227E−08	−5.504E−07	3.946E−05	1.212E−03	5.289E−04	−3.116E−02	−3.227E−01	1.619E+01
2b Transition [d]	20	Linear Transition.	Linear Transition.	Linear Transition.	−2.305E−09	−4.873E−07	2.535E−05	8.156E−04	4.730E−04	−2.383E−02	−2.975E−01	1.277E+01
3a Steady-state	220	B	50	v_{refB}	8.296E−09	−4.752E−07	1.291E−05	2.880E−04	4.524E−04	−1.802E−02	−1.830E−01	8.810E+00
3b Transition	20	B	Linear Transition.	v_{refB}	4.642E−09	−5.143E−07	1.991E−05	3.556E−04	4.873E−04	−2.241E−02	−2.051E−01	1.068E+01
4a Steady-state	220	B	75	v_{refB}	1.818E−10	−5.229E−07	2.579E−05	5.575E−04	5.006E−04	−2.561E−02	−2.399E−01	1.287E+01
4b Transition [d]	20	Linear Transition.	Linear Transition.	Linear Transition.	5.842E−10	−4.992E−07	2.244E−05	4.700E−04	4.659E−04	−2.203E−02	−1.761E−01	1.072E+01
5a Steady-state	268	A	50	v_{refA}	3.973E−09	−4.362E−07	1.365E−05	4.846E−04	4.158E−04	−1.606E−02	−1.908E−01	8.206E+00
5b Transition	20	A	Linear Transition.	v_{refA}	−2.788E−10	−4.226E−07	1.812E−05	6.591E−04	4.158E−04	−1.846E−02	−2.201E−01	1.001E+01
6a Steady-state	268	A	75	v_{refA}	−4.216E−09	−4.891E−07	2.641E−05	8.796E−04	4.692E−04	−2.348E−02	−2.595E−01	1.226E+01
6b Transition	20	A	Linear Transition.	v_{refA}	3.979E−09	−4.392E−07	1.411E−05	2.079E−04	4.203E−04	−1.658E−02	−1.655E−01	7.705E+00
7a Steady-state	268	A	25	v_{refA}	1.211E−08	−3.772E−07	6.209E−07	1.202E−04	3.578E−04	−8.420E−03	−1.248E−01	4.189E+00
7b Transition [d]	20	Linear Transition.	Linear Transition.	Linear Transition.	1.659E−09	−4.954E−07	2.103E−05	4.849E−04	4.776E−04	−2.194E−02	−2.551E−01	1.075E+01
8a Steady-state	196	B	100	v_{refB}	−8.232E−09	−5.707E−07	3.900E−05	8.150E−04	5.477E−04	−3.325E−02	-2.956E−01	1.689E+01
8b Transition	20	B	Linear Transition.	v_{refB}	4.286E−09	−5.150E−07	2.070E−05	5.214E−04	4.882E−04	−2.291E−02	−2.271E−01	1.157E+01
9a Steady-state	196	B	25	v_{refB}	1.662E−08	−4.261E−07	−2.705E−07	2.098E−05	4.046E−04	−1.037E−02	−1.263E−01	4.751E+00
9b Transition [d]	20	Linear Transition.	Linear Transition.	Linear Transition.	7.492E−09	−5.451E−07	1.950E−05	2.243E−04	5.114E−04	−2.331E−02	−2.270E−01	1.062E+01
10a Steady-state.	28	C	100	v_{refC}	−1.073E−09	−5.904E−07	3.477E−05	5.069E−04	5.647E−04	−3.354E−02	−2.648E−01	1.651E+01
10b Transition	20	C	Linear Transition.	v_{refC}	9.957E−09	−5.477E−07	1.826E−05	2.399E−04	5.196E−04	−2.410E−02	−2.010E−01	1.128E+01
11a Steady-state.	4	C	25	v_{refC}	1.916E−08	−5.023E−07	3.715E−06	3.634E−05	4.706E−04	−1.539E−02	−1.485E−01	6.827E+00
11b Transition	20	C	Linear Transition.	v_{refC}	1.474E−08	−5.176E−07	1.027E−05	1.193E−04	4.911E−04	−1.937E−02	−1.713E−01	8.872E+00
12a Steady-state.	4	C	75	v_{refC}	6.167E−09	−5.577E−07	2.354E−05	3.524E−04	5.319E−04	−2.708E−02	−2.253E−01	1.313E+01
12b Transition	20	C	Linear Transition.	v_{refC}	1.039E−08	−5.451E−07	1.756E−05	2.257E−04	5.165E−04	−2.366E−02	−1.978E−01	1.106E+01
13a Steady-state.	4	C	50	v_{refC}	6.209E−09	−5.292E−07	2.126E−05	3.475E−04	5.132E−04	−2.552E−02	−2.212E−01	1.274E+01
13b Transition [d]	20	Linear Transition.	Linear Transition.	Linear Transition.	4.461E−09	−6.452E−07	1.301E−05	1.420E−03	5.779E−04	−1.564E−02	1.949E−01	7.998E+00
14 Steady-state	144	Warm Idle	0	0	0	0	0	0	0	0	0	0

[a] Engine speed terms are defined in 40 CFR part 1065.
[b] Advance from one mode to the next within a 20 second transition phase. During the transition phase, command a linear progression from the settings of the current mode to the settings of the next mode.
[c] The percent torque is relative to maximum torque at the commanded engine speed.
[d] Use the average vehicle speed during each transition for v_{ref} in Eq. 1036.510–7 for calculating road grade for all points during the transition.

(d) Determine criteria pollutant emissions for plug-in hybrid powertrains for charge-sustaining operation as described in paragraph (b)(2) of this section.

(e) Determine greenhouse gas pollutant emissions for plug-in hybrid powertrains using the emissions results for all the SET test intervals for both charge-depleting and charge-sustaining operation as follows:

(1) Carry out a charge-depleting test as described in paragraph (b)(2) of this section, except as follows:

(i) Fully charge the RESS after preconditioning.

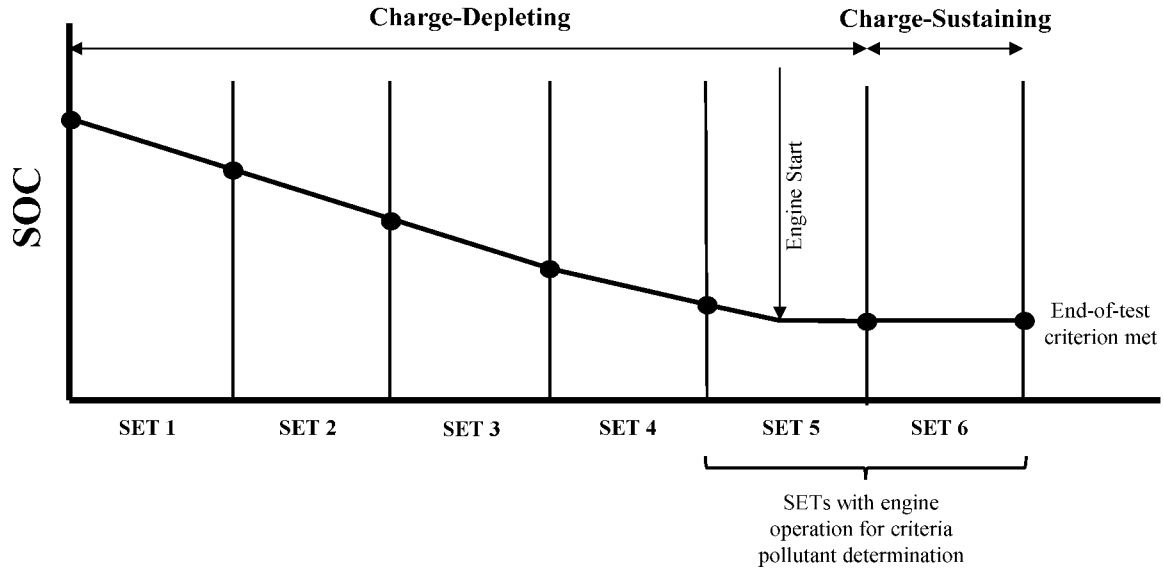
(ii) Operate the engine or powertrain continuously over repeated SET duty cycles until you reach the end-of-test criterion defined in 40 CFR 1066.501(a)(3).

(iii) Calculate emission results for each SET duty cycle. Figure 1 to paragraph (e)(3) of this section provides an example of a charge-depleting test sequence where there are two test intervals that contain engine operation.

(2) Report the highest emission result for each GHG pollutant from all tests in paragraph (e)(1) of this section, even if those individual results come from different test intervals.

(3) The following figure illustrates an example of an SET charge-depleting test sequence:

FIGURE 1 TO PARAGRAPH (e)(3) OF § 1036.510—SET CHARGE-DEPLETING GHG POLLUTANT TEST SEQUENCE



(4) Calculate the utility factor-weighted composite mass of emissions from the charge-depleting and charge-sustaining test results, $e_{UF[emission]comp}$, using the following equation:

$$e_{UF[emission]comp} = \sum_{i=1}^{N}\left[e_{[emission][int]CDi} \cdot \left(UF_{DCDi} - UF_{DCDi-1}\right)\right] + \sum_{j=1}^{M}\left[e_{[emission][int]CSj}\right] \cdot \frac{\left(1 - UF_{RCD}\right)}{M}$$

Eq. 1036.510-10

Where:

i = an indexing variable that represents one test interval.

N = total number of charge-depleting test intervals.

$e_{[emission][int]CDi}$ = total mass of emissions in the charge-depleting portion of the test for each test interval, i, starting from i = 1, including the test interval(s) from the transition phase.

UF_{DCDi} = utility factor fraction at distance D_{CDi} from Eq. 1036.510–11, as determined by interpolating the approved utility factor curve for each test interval, i, starting from i = 1. Let UF_{DCD0} = 0.

j = an indexing variable that represents one test interval.

M = total number of charge-sustaining test intervals.

$e_{[emission][int]CSj}$ = total mass of emissions in the charge-sustaining portion of the test for each test interval, j, starting from j = 1.

UF_{RCD} = utility factor fraction at the full charge-depleting distance, R_{CD}, as

determined by interpolating the approved utility factor curve. R_{CD} is the cumulative distance driven over N charge-depleting test intervals.

$$D_{CDi} = \sum_{k=1}^{Q} (v_k \cdot \Delta t)$$

Eq. 1036.510-11

Where:

k = an indexing variable that represents one recorded velocity value.

Q = total number of measurements over the test interval.

v = vehicle velocity at each time step, k, starting from $k = 1$. For tests completed under this section, v is the vehicle velocity from the vehicle model in § 1036.545. Note that this should include charge-depleting test intervals that start when the engine is not yet operating.

$\Delta t = 1/f_{record}$

f_{record} = the record rate.

Example using the charge-depletion test in figure 1 to paragraph (d)(4) of this section for the SET for CO_2 emission determination:

$Q = 24000$

$v_1 = 0$ mi/hr

$v_2 = 0.8$ mi/hr

$v_3 = 1.1$ mi/hr

$f_{record} = 10$ Hz

$\Delta t = 1/10$ Hz $= 0.1$ s

$D_{CD1} = \Sigma^{24000}{}_{k=1}\ (0 \cdot 0.1 + 0.8 \cdot 0.1 + 1.1 \cdot 0.1 + v_{24000} \cdot \Delta t)$

$D_{CD1} = 30.1$ mi

$D_{CD2} = 30.0$ mi

$D_{CD3} = 30.1$ mi

$D_{CD4} = 30.2$ mi

$D_{CD5} = 30.1$ mi

$N = 5$

$UF_{DCD1} = 0.11$

$UF_{DCD2} = 0.23$

$UF_{DCD3} = 0.34$

$UF_{DCD4} = 0.45$

$UF_{DCD5} = 0.53$

$e_{CO2SETCD1} = 0$ g/hp·hr

$e_{CO2SETCD2} = 0$ g/hp·hr

$e_{CO2SETCD3} = 0$ g/hp·hr

$e_{CO2SETCD4} = 0$ g/hp·hr

$e_{CO2SETCD5} = 174.4$ g/hp·hr

$M = 1$

$e_{CO2SETCS} = 428.1$ g/hp·hr

$UF_{RCD} = 0.53$

$$e_{UFCO2comp} = [0 \cdot (0.11 - 0) + 0 \cdot (0.23 - 0.11) + 0 \cdot (0.34 - 0.23) + 0 \cdot (0.45 - 0.34) + 174.4 \cdot (0.53 - 0.45)] + 428.1 \cdot \frac{(1 - 0.53)}{1}$$

$e_{UFCO2comp} = 215.2$ g/hp·hr

* * * * *

(g) Calculate the total emission mass of each constituent, *m,* over the test interval as described in 40 CFR 1065.650. Calculate the total work, *W,* over the test interval as described in 40 CFR 1065.650(d), with the following exceptions for testing hybrid powertrains:

(1) Determine shaft power at each point during the test interval using system power, P_{sys}, from § 1036.520(f) instead of calculating shaft power according to 40 CFR 1065.650(d)(2).

(2) Do not set power values to zero as described in 40 CFR 1065.650(d)(6).

(3) For criteria pollutant charge sustaining tests, where the net energy change tolerance is greater than 1 percent and less than or equal to 5 percent, subtract net energy change from the battery determined from 40 CFR 1066.501(a)(3) from the total work determined from this paragraph (g) and 40 CFR 1065.650(d).

■ 34. Amend § 1036.512 by revising paragraphs (c) and (d) to read as follows:

§ 1036.512 Federal Test Procedure.

* * * * *

(c) Except as specified in paragraph (d) of this section for plug-in hybrid powertrains, the FTP duty cycle consists of an initial run through the test interval from a cold start as described in 40 CFR part 1065, subpart F, followed by a (20 ± 1) minute hot soak with no engine operation, and then a final hot start run through the same transient test interval. Engine starting is part of both the cold-start and hot-start test intervals. Calculate the total emission mass of each constituent, m, and the total work, *W*, over the test interval as described in § 1036.510(g). For powertrains with automatic transmissions, account for and include the work produced by the engine from the CITT load. Calculate the official transient emission result from the cold-start and hot-start test intervals using the following equation:

$$Official\ transient\ emission\ result = \frac{cold\ start\ emissions\ (g) + 6 \cdot hot\ start\ emissions\ (g)}{cold\ start\ work\ (hp \cdot hr) + 6 \cdot hot\ start\ work\ (hp \cdot hr)}$$

Eq. 1036.512-1

(d) Determine criteria pollutant emissions for plug-in hybrid powertrains as follows:

(1) Carry out a charge-depleting test as described in paragraph (b)(2) of this section, except as follows:

(i) Precondition the engine or powertrain as described in 40 CFR 1065.518(c)(1).

(ii) Fully charge the RESS after preconditioning.

(iii) Operate it over one FTP duty cycle followed by alternating repeats of a 20-minute soak and a hot start test interval until you reach the end-of-test criteria defined in 40 CFR 1066.501(a)(3).

(iv) Calculate the composite emission result by treating the first test interval with engine operation and the subsequent test interval as the cold-start test intervals and the test interval that follows those two as the hot-start test interval. Figure 1 to paragraph (d)(4) of this section provides an example of a charge-depleting test sequence where the fifth and sixth test intervals are the cold-start test intervals while the seventh is the hot-start test interval. Calculate the official transient emission result from the cold-start and hot-start test intervals using the following equation:

$$= \frac{\left(\frac{\sum_{i=1}^{2} cold\ start\ emissions\ (g)_i}{2}\right) + 6 \cdot hot\ start\ emissions\ (g)}{\left(\frac{\sum_{i=1}^{2} cold\ start\ work\ (hp \cdot hr)_i}{2}\right) + 6 \cdot hot\ start\ work\ (hp \cdot hr)}$$

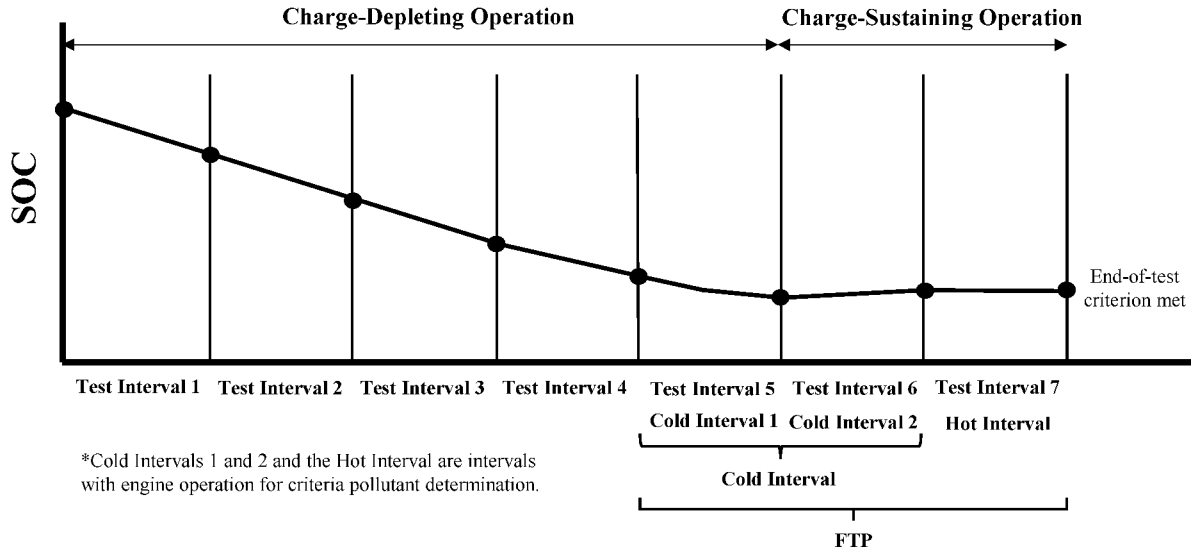
Eq. 1036.512-2

(2) Carry out a charge-sustaining test as described in paragraphs (b)(2) and (c) of this section.

(3) Report the highest composite emission result from all FTP duty-cycles for each criteria pollutant from all tests in paragraphs (d)(1) and (2) of this section, even if those individual results come from different test intervals.

(4) The following figure illustrates an example of an FTP charge-depleting test sequence:

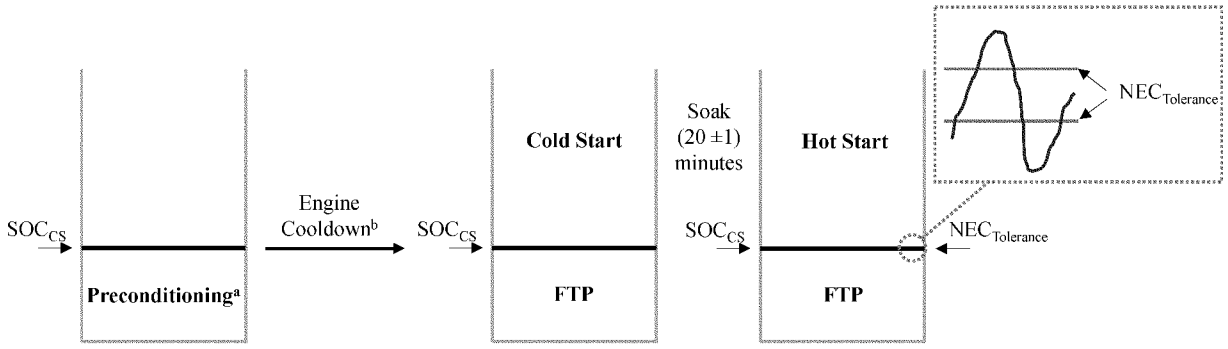
FIGURE 1 TO PARAGRAPH (d)(4) OF § 1036.512—FTP CHARGE-DEPLETING CRITERIA POLLUTANT TEST SEQUENCE DEPICTING THE END OF TEST WITH TWO COLD START AND ONE HOT START TEST INTERVALS



(5) The following figure illustrates an example of an FTP charge-sustaining test sequence:

FIGURE 1 TO PARAGRAPH (d)(5) OF § 1036.512—FTP CHARGE-SUSTAINING CRITERIA

POLLUTANT TEST SEQUENCE



[a] As described in 40 CFR 1065.518(c)(1).
[b] As described in 40 CFR 1065.530(a)(1).

* * * * *

■ 35. Amend § 1036.514 by revising paragraphs (a)(1)(i), (b), and (d) to read as follows:

§ 1036.514 Low Load Cycle.

* * * * *

(a) * * *

(1) * * *

(i) Apply the accessory load at idle in paragraph (c) of this section using declared idle power as described in 40 CFR 1065.510(f)(6). The option of declaring a nonzero torque under 40 CFR 1065.510(f)(5)(iii) does not apply.

* * * * *

(b) Test hybrid powertrains as described in § 1036.510(b)(2), with the following exceptions:

(1) Replace ''SET'' with ''LLC''.

(2) Replace $P_{contrated}$ with P_{rated}, which is the peak rated power determined in § 1036.520.

(3) Keep the transmission in drive for all idle segments 200 seconds or less. For idle segments more than 200 seconds, leave the transmission in drive for the first 3 seconds of the idle segment, then immediately place the transmission in park or neutral, and shift the transmission into drive again 3 seconds before the end of the idle segment. The end of the idle segment occurs at the first nonzero vehicle speed setpoint.

(4) For hybrid engines, you may request to change the GEM-generated engine reference torque at idle to better represent curb idle transmission torque (CITT).

(5) Calculate and evaluate cycle-validation criteria as specified in § 1036.545.

* * * * *

(d) Except as specified in paragraph (b)(4) of this section for plug-in hybrid powertrains, the test sequence consists of preconditioning the engine by running one or two FTPs with each FTP followed by (20 ±1) minutes with no engine operation and a hot start run through the LLC. You may start any preconditioning FTP with a hot engine. Perform testing as described in 40 CFR 1065.530 for a test interval that includes engine starting. Calculate the total emission mass of each constituent, *m*, and the total work, *W*, over the test interval as described in § 1036.510(g). Do not exclude accessory loads specified in paragraph (c) of this section when calculating *W*. For powertrains with automatic transmissions, account for and include the work produced by the engine from the CITT load.

* * * * *

■ 36. Amend § 1036.520 by

■ a. Revising paragraphs (d), (e), (f)(1), and (h) through (k); and

■ b. Adding a new paragraph (l); and

These revisions and addition read as follows:

§ 1036.520 Determining power and vehicle speed values for powertrain testing.

* * * * *

(d) Carry out the test as described in this paragraph (d). The state-of-charge of the RESS must be at a representative level to deliver maximum power.

(1) Warm up the powertrain with one FTP duty-cycle that you denormalized using the manufacturer declared $P_{contrated}$.

(2) Ramp the vehicle speed to 5 mi/hr with a grade of 0 percent over 5 seconds and dwell at this speed and grade for 5 seconds.

(3) Ramp to maximum driver demand for a full load acceleration within 3 seconds at 6.0 percent road grade, continuing for 268 seconds.

(4) Linearly ramp the grade from 6.0% down to 0.0% over 300 seconds. Stop the test after the acceleration is less than 0.02 m/s^2.

(e) Record the powertrain system angular speed and torque values measured at the dynamometer at 100 Hz and use these in conjunction with the vehicle model to calculate vehicle system power, $P_{sys,vehicle}$. Note that P_{sys}, is the corresponding value for system power at a location that represents the engine's primary output shaft on a conventional powertrain.

(f) * * *

(1) For testing with the speed and torque measurements at the engine's primary output shaft, P_{sys} is equal to the calculated vehicle system power, $P_{sys,vehicle}$, determined in paragraphs (d) and (e) of this section.

* * * * *

(h) Determine measured rated power, $P_{ratedmeas}$, as the maximum measured power from the data collected in paragraph (d)(2) of this section where the COV determined in paragraph (g) of this section is less than 0.5 percent.

(i) Determine rated power, P_{rated}, as follows:

(1) For nonhybrid powertrains P_{rated} equals $P_{ratedmeas}$.

(2) For hybrid powertrains, P_{rated} is the lower of $P_{ratedmeas}$ and the following values:

(i) 260 kW for Spark-ignition HDE and Light HDE.

(ii) 340 kW for Medium HDE.

(iii) 450 kW for Heavy HDE.

(j) Determine continuous rated power, $P_{contrated}$, as follows:

(1) For nonhybrid powertrains, $P_{contrated}$ equals P_{rated}.

(2) For hybrid powertrains, $P_{contrated}$ is the smaller of the following values:

(i) The maximum measured power from the data collected in paragraph (d)(4) of this section where the COV determined in paragraph (g) of this section is less than 0.5 percent.

(ii) P_{rated} from paragraph (i) of this section.

(k) Determine vehicle C speed, v_{refC}, as follows:

(1) If the maximum $P_{sys}(t)$ in the highest gear during the maneuver in paragraph (d)(4) of this section is greater than $0.98 \cdot P_{contrated}$, v_{refC} is the average of the minimum and maximum vehicle speeds where $P_{sys}(t)$ is equal to $0.98 \cdot P_{contrated}$ during the maneuver in paragraph (d)(4) where the transmission is in the highest gear, using linear interpolation, as appropriate. If $P_{sys}(t)$ at the lowest vehicle speed where the transmission is in the highest gear is greater than $0.98 \cdot P_{contrated}$, use the lowest vehicle speed where the transmission is in the highest gear as the minimum vehicle speed input for calculating v_{refC}.

(2) Otherwise, v_{refC} is the maximum vehicle speed during the maneuver in paragraph (d)(4) of this section where the transmission is in the highest gear.

(3) You may use a declared v_{refC} instead of measured v_{refC} if the declared v_{refC} is within (97.5 to 102.5) % of the corresponding measured value.

(4) Manufacturers may request approval to use an alternative vehicle C speed in place of the measured vehicle C speed determined in this paragraph (k) for series hybrid applications. Approval will be contingent upon justification that the measured vehicle C speed is not representative of the expected real-world cruise speed.

(l) If $P_{contrated}$ as determined in paragraph (j) of this section is within ±3 percent of the manufacturer-declared value, use the manufacturer-declared value. In addition, for nonhybrid powertrains set P_{rated} to declared $P_{contrated}$. Otherwise, repeat the procedure in paragraphs (b) through (k) of this section and use $P_{contrated}$ from paragraph (j) instead of the manufacturer-declared value.

■ 37. Amend § 1036.525 by revising paragraph (b)(3) to read as follows:

§ 1036.525 Clean Idle test.

* * * * *

(b) * * *

(3) Start sampling emissions 10 minutes after reaching the speed and torque setpoints and continue emission sampling and engine operation at those setpoints. Stop emission sampling after 1800 seconds to complete the test interval.

* * * * *

■ 38. Revise and republish § 1036.530 to read as follows:

§ 1036.530 Test procedures for off-cycle testing.

(a) *General.* This section describes the measurement and calculation procedures to perform field testing and determine whether tested engines and engine families meet emission standards under subpart E of this part. Calculate mass emission rates as specified in 40 CFR part 1065, subpart G. Use good engineering judgment to adapt these procedures for simulating vehicle operation in the laboratory.

(b) *Vehicle preparation and measurement procedures.* (1) Set up the vehicle for testing with a portable emissions measurement system (PEMS) as specified in 40 CFR part 1065, subpart J.

(2) Begin emission sampling and data collection as described in 40 CFR 1065.935(c)(3) before starting the engine at the beginning of the shift-day. Start the engine only after confirming that engine coolant temperature is at or below 40 °C.

(3) Measure emissions over one or more shift-days as specified in subpart E of this part.

(4) For engines subject to compression-ignition standards, record 1 Hz measurements of ambient temperature near the vehicle.

(c) *Drift verification.* Perform drift verification as described in 40 CFR 1065.935(g)(5)(ii) and (iii). For drift verification of CO and HC, determine a corrected value of the off-cycle emission quantity for bin 2 from Eq. 1036.530–3 for each interval between analyzer verifications. Compare that corrected value to the uncorrected value or to the bin 2 emission standard in § 1036.104(a)(3), whichever is greater, to determine whether drift is within the specified percentage limit.

(d) *Test Intervals.* Determine the test intervals as follows:

(1) *Spark-ignition.* Create a single test interval that covers the entire shift-day for engines subject to spark-ignition standards. The test interval starts with the first pair of consecutive data points with no exclusions as described in paragraph (d)(3) of this section after the start of the shift-day and ends with the last pair of consecutive data points with no exclusions before the end of the shift day.

(2) *Compression-ignition.* Create a series of 300 second test intervals for engines subject to compression-ignition standards (moving-average test intervals) as follows:

(i) Begin and end each test interval with a pair of consecutive data points with no exclusions as described in paragraph (d)(3) of this section. Select the last data point of each test interval such that the test interval includes 300 seconds of data with no exclusions, as described in paragraph (e) of this section. The test interval may be a fraction of a second more or less than 300 seconds to account for the precision of the time stamp in recording 1 Hz data. A test interval may include up to 599 seconds of data with continuous exclusions; invalidate any test interval that includes at least 600 seconds of continuous sampling with excluded data.

(ii) The first 300 second test interval starts with the first pair of consecutive data points with no exclusions. Determine the start of each subsequent 300 second test interval by finding the first pair of consecutive data points with no exclusions after the initial data point of the previous test interval.

(iii) The last 300 second test interval ends with the last pair of consecutive data points with no exclusions before the end of the shift day.

(3) *Excluded data.* Exclude data from test intervals for any period meeting one or more of the following conditions:

(i) An analyzer or flow meter is performing zero and span drift checks or zero and span calibrations, including any time needed for the analyzer to stabilize afterward, consistent with good engineering judgment.

(ii) The engine is off, except as specified in § 1036.415(g) and (h).

(iii) The engine is performing an infrequent regeneration. Do not exclude data related to any other AECDs, except as specified in paragraph (d)(3)(vi) of this section.

(iv) The recorded ambient air temperature is below 5 °C or above the temperature calculated using the following equation.

$$T_{max} = -0.0014 \cdot h + 37.78$$

Eq. 1036.530-1

Where:

h = recorded elevation of the vehicle in feet above sea level (h is negative for elevations below sea level).

Example:

h = 2679 ft

$T_{max} = -0.0014 \cdot 2679 + 37.78$

T_{max} = 34.0 °C

(v) The vehicle is operating at an elevation more than 5,500 feet above sea level.

(vi) An engine has one or more active AECDs for emergency vehicles under § 1036.115(h)(4).

(vii) A single data point does not meet any of the conditions specified in paragraphs (d)(3)(i) through (vi) of this section, but it is preceded and followed by data points that both meet one or more of the specified exclusion conditions.

(viii) Gas analyzer range validation failure according to 40 CFR 1065.935(g)(5)(i).

(ix) Any data not meeting the drift requirements in paragraph (c) of this section.

(e) *Assembling test intervals.* A test interval may include multiple subintervals separated by periods with one or more exclusions under paragraph (d)(3) of this section.

(1) Treat these test subintervals as continuous for calculating duration of the test interval for engines subject to compression-ignition standards.

(2) Calculate emission mass during each test subinterval and sum those subinterval emission masses to determine the emission mass over the test interval. Calculate emission mass as described in 40 CFR 1065.650(c)(2)(i), with the following exceptions and clarifications:

(i) Correct NO_X emissions for humidity as specified in 40 CFR 1065.670. Calculate corrections relative to ambient air humidity as measured by PEMS.

(ii) Disregard the provision in 40 CFR 1065.650(g) for setting negative emission mass to zero for test intervals and subintervals.

(iii) Calculation of emission mass in 40 CFR 1065.650 assumes a constant time interval, Δt. If it is not appropriate to assume Δt is constant for testing under this section, use good engineering judgment to record time at each data point and adjust the mass calculation from Eq. 1065.650–4 by treating Δt as a variable.

(f) *Normalized CO_2 emission mass over a 300 second test interval.* For engines subject to compression-ignition standards, determine the normalized CO_2 emission mass over each 300 second test interval, $m_{CO2,norm,testinterval}$, to the nearest 0.01% using the following equation:

$$m_{CO2,norm,testinterval} = \frac{m_{CO2,testinterval}}{e_{CO2FTPFCL} \cdot P_{max} \cdot t_{testinterval}}$$

Eq. 1036.530-2

Where:

$m_{CO2,testinterval}$ = total CO_2 emission mass over the test interval.

$e_{CO2FTPFCL}$ = the engine's FCL for CO_2 over the FTP duty cycle or, for plug-in hybrid powertrains, the charge-sustaining CO_2 emissions over the FTP duty cycle. If the engine family includes no FTP testing, use the engine's FCL for CO_2 over the SET duty cycle.

P_{max} = the highest value of rated power for all the configurations included in the engine family.

$t_{testinterval}$ = duration of the test interval. Note that the nominal value is 300 seconds.

Example:

$m_{CO2,testinterval}$ = 3948 g

$e_{CO2FTPFCL}$ = 428.2 g/hp·hr

P_{max} = 406.5 hp

$t_{testinterval}$ = 300.01 s = 0.08 hr

$$m_{CO2,norm,testinterval} = \frac{3948}{428.2 \cdot 406.5 \cdot 0.08}$$

$m_{CO2,norm,testinterval}$ = 0.2722 = 27.22%

(g) *Binning 300 second test intervals.* For engines subject to compression-ignition standards, identify the appropriate bin for each of the 300 second test intervals based on its normalized CO_2 emission mass, $m_{CO2,norm,testinterval}$, as follows:

TABLE 1 TO PARAGRAPH (g) OF § 1036.530—CRITERIA FOR OFF-CYCLE BINS

Bin	Normalized CO_2 emission mass over the 300 second test interval
Bin 1	$m_{CO2,norm,testinterval} \leq 6.00$ %.
Bin 2	$m_{CO2,norm,testinterval} > 6.00$ %.

(h) *Off-cycle emissions quantities.* Determine the off-cycle emissions quantities as follows:

(1) Spark-ignition. For engines subject to spark-ignition standards, the off-cycle emission quantity, $e_{[emission],offcycle}$, is the value for CO_2-specific emission mass for a given pollutant over the test interval representing the shift-day converted to a brake-specific value, as calculated for each measured pollutant using the following equation:

$$e_{[\text{emissions}],\text{offcycle}} = \frac{m_{[\text{emission}]}}{m_{CO2}} \cdot e_{CO2,FTP,FCL}$$

Eq. 1036.530-3

Where:

$m_{[emission]}$ = total emission mass for a given pollutant over the test interval as determined in paragraph (e)(2) of this section.

m_{CO2} = total drift-corrected CO_2 emission mass over the test interval as determined in paragraph (e)(2) of this section.

$e_{CO2,FTP,FCL}$ = the engine's FCL for CO_2 over the FTP duty cycle.

Example:

m_{NOx} = 1.337 g

m_{CO2} = 18778 g

$e_{CO2,FTP,FCL}$ = 505.1 g/hp · hr

$$e_{NOx,offcycle} = \frac{1.337}{18778} \cdot 505.1$$

$e_{NOx,offcycle}$ = 0.035 g/hp · hr

(2) Compression-ignition. For engines subject to compression-ignition standards, determine the off-cycle emission quantity for each bin. When calculating mean bin emissions from ten engines to apply the pass criteria for engine families in § 1036.425(c), set any negative off-cycle emissions quantity to zero before calculating mean bin emissions.

(i) Off-cycle emissions quantity for bin 1. The off-cycle emission quantity for bin 1, $\bar{\dot{m}}_{NOx,offcycle,bin1}$, is the mean NO_X mass emission rate from all test intervals associated with bin 1 as calculated using the following equation:

$$\bar{\dot{m}}_{NOx,offcycle,bin1} = \frac{\sum_{i=1}^{N} m_{NOx,testinterval,i}}{\sum_{i=1}^{N} t_{testinterval,i}}$$

Eq. 1036.530-4

Where:

i = an indexing variable that represents one 300 second test interval.

N = total number of 300 second test intervals in bin 1.

$m_{NOxtestinterval,i}$ = total NO_X emission mass over the test interval i in bin 1 as determined in paragraph (e)(2) of this section.

$t_{testinterval,i}$ = total time of test interval i in bin 1 as determined in paragraph (e)(1) of this section. Note that the nominal value is 300 seconds.

Example:

N = 10114

$m_{NOx,testinterval,1}$ = 0.021 g

$m_{NOx,testinterval,2}$ = 0.025 g

$m_{NOx,testinterval,3}$ = 0.031 g

$t_{testinterval,1}$ = 299.99 s

$t_{testinterval,2}$ = 299.98 s

$t_{testinterval,3}$ = 300.04 s

$$\bar{\dot{m}}_{NOx,offcycle,bin1} = \frac{\left(0.021 + 0.025 + 0.031\ldots + m_{NOx,testinterval,10114}\right)}{\left(299.99 + 299.98 + 300.04\ldots + t_{testinterval,10114}\right)}$$

$\bar{\dot{m}}_{NOx,offcycle,bin1}$ = 0.000285 g/s = 1.026 g/hr

(ii) *Off-cycle emissions quantity for bin 2.* The off-cycle emission quantity for bin 2, $e_{[emission],offcycle,bin2}$, is the value for CO_2-specific emission mass for a given pollutant of all the 300 second test intervals in bin 2 combined and converted to a brake-specific value, as calculated for each measured pollutant using the following equation:

$$e_{[\text{emissions}],\text{offcycle},\text{bin2}} = \frac{\sum_{i=1}^{N} m_{[\text{emission}],\text{testinterval},i}}{\sum_{i=1}^{N} m_{CO2,testinterval,i}} \cdot e_{CO2,FTP,FCL}$$

Eq. 1036.530-5

Where:

i = an indexing variable that represents one 300 second test interval.

N = total number of 300 second test intervals in bin 2.

$m_{[emission],testinterval,i}$ = total emission mass for a given pollutant over the test interval i in bin 2 as determined in paragraph (e)(2) of this section.

$m_{CO2,testinterval,i}$ = total CO_2 emission mass over the test interval i in bin 2 as determined in paragraph (e)(2) of this section.

$e_{CO2,FTP,FCL}$ = the engine's FCL for CO_2 over the FTP duty cycle.

Example:

N = 15439

m_{NOx1} = 0.546 g

m_{NOx2} = 0.549 g

m_{NOx3} = 0.556 g

$m_{CO2,1}$ = 10950.2 g

$m_{CO2,2}$ = 10961.3 g

$m_{CO2,3}$ = 10965.3 g

$e_{CO2,FTP,FCL}$ = 428.1 g/hp · hr

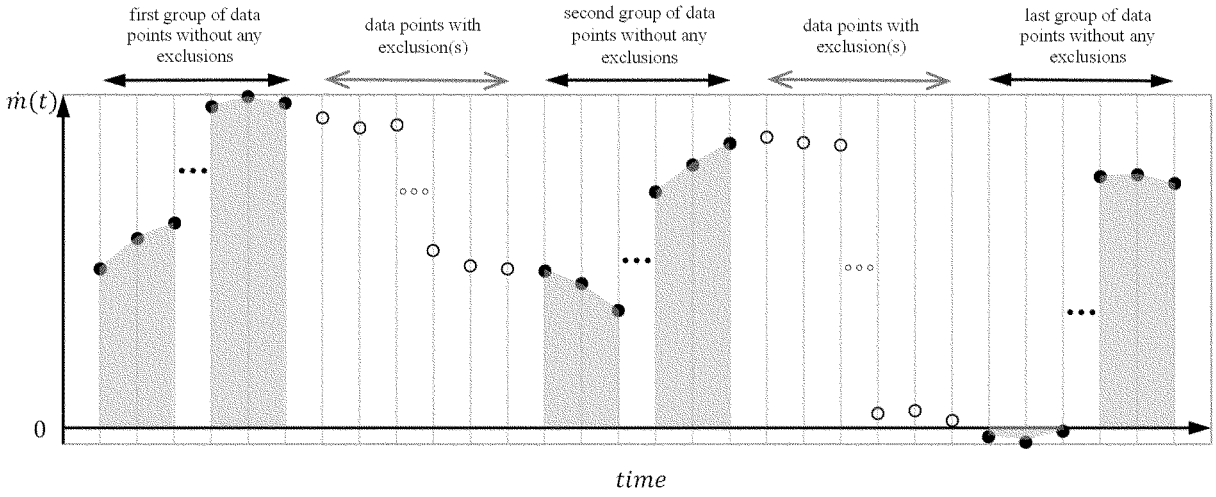
$$e_{NOx,offcycle,bin2} = \frac{\left(0.546 + 0.549 + 0.556\ldots + m_{NOx,testinterval,15439}\right)}{\left(10950.2 + 10961.3 + 10965.3\ldots + m_{CO2,testinterval,15439}\right)} \cdot 428.1$$

$e_{NOx,offcycle,bin2}$ = 0.026 g/hp·hr = 26 mg/hp · hr

(i) *Shift-day ambient temperature.* For engines subject to compression-ignition standards, determine the mean shift-day ambient temperature, $\overline{T}_{amb}$, considering only temperature readings corresponding to data with no exclusions under paragraph (d)(3) of this section.

(j) *Graphical illustration.* Figure 1 of this section illustrates a test interval with interruptions of one or more data points excluded under paragraph (d)(3) of this section. The x-axis is time and the y-axis is the mass emission rate at each data point, $\dot{m}(t)$. The data points coincident with any exclusion are illustrated with open circles. The shaded area corresponding to each group of closed circles represents the total emission mass over that test subinterval. Note that negative values of $\dot{m}(t)$ are retained and not set to zero in the numerical integration calculation. The first group of data points without any exclusions is referred to as the first test subinterval and so on.

FIGURE 1 TO PARAGRAPH (j) OF § 1036.530—ILLUSTRATION OF INTEGRATION OF MASS OF EMISSIONS OVER A TEST INTERVAL WITH EXCLUDE DATA POINTS



(k) *Fuel other than carbon-containing.* The following procedures apply for testing engines using at least one fuel that is not a carbon-containing fuel:

(1) Use the following equation to determine the normalized equivalent CO_2 emission mass over each 300 second test interval instead of Eq. 1036.530–2:

$$m_{CO2,norm,equiv,testinterval} = \frac{W_{testinterval}}{P_{max} \cdot t_{testinterval}}$$

Eq. 1036.530-6

Where:

$W_{testinterval}$ = total positive work over the test interval from both the engine and hybrid components, if applicable, as described in § 1036.510(g).

P_{max} = the highest value of rated power for all the configurations included in the engine family.

$t_{testinterval}$ = duration of the test interval. Note that the nominal value is 300 seconds.

Example:

$W_{testinterval}$ = 8.95 hp·hr

P_{max} = 406.5 hp

$t_{testinterval}$ = 300.01 s = 0.08 hr

$$m_{CO2,norm,testinterval} = \frac{8.95}{406.5 \cdot 0.08}$$

$m_{CO2,norm,testinterval} = 0.2722$
$m_{CO2,norm,testinterval} = 27.22\%$

(2) Determine off-cycle emissions quantities as follows:

(i) For engines subject to spark-ignition standards, use the following equation to determine the off-cycle emission quantity instead of Eq. 1036.530–3:

$$e_{[emissions],offcycle} = \frac{m_{[emission]}}{W_{testinterval}}$$

Eq. 1036.530-7

Where:

$m_{[emission]}$ = total emission mass for a given pollutant over the test interval as determined in paragraph (e)(2) of this section.

$W_{testinterval}$ = total positive work over the test interval as determined in 40 CFR 1065.650.

Example:

$m_{NOx} = 1.337$ g
$W_{testinterval} = 38.2$ hp·hr

$$e_{NOx,offcycle} = \frac{1.337}{38.2}$$

$e_{NOx,offcycle} = 0.035$ g/hp·hr = 35 mg/hp·hr

(ii) For engines subject to compression-ignition standards, use Eq. 1036.530–4 to determine the off-cycle emission quantity for bin 1.

(iii) For engines subject to compression-ignition standards, use the following equation to determine the off-cycle emission quantity for bin 2 instead of Eq. 1036.530–5:

$$e_{[emissions],offcycle,bin2} = \frac{\sum_{i=1}^{N} m_{[emission],testinterval,i}}{\sum_{i=1}^{N} W_{testinterval,i}}$$

Eq. 1036.530-8

Where:

i = an indexing variable that represents one 300 second test interval.

N = total number of 300 second test intervals in bin 2.

$m_{[emission],testinterval,i}$ = total emission mass for a given pollutant over the test interval i in bin 2 as determined in paragraph (e)(2) of this section.

$W_{testinterval,i}$ = total positive work over the test interval i in bin 2 as determined in 40 CFR 1065.650.

Example:

$N = 15439$
$m_{NOx1} = 0.546$ g
$m_{NOx2} = 0.549$ g
$m_{NOx3} = 0.556$ g
$W_{testinterval1} = 8.91$ hp·hr
$W_{testinterval2} = 8.94$ hp·hr
$W_{testinterval3} = 8.89$ hp·hr

$$e_{NOx,offcycle,bin2} = \frac{(0.546 + 0.549 + 0.556\ldots + m_{NOx,testinterval,15439})}{(8.91 + 8.94 + 8.89\ldots + W_{testinterval,15439})}$$

$e_{NOx,offcycle,bin2} = 0.026$ g/hp•hr = 26 mg/hp·hr

■ 39. Amend § 1036.545 by:
■ a. Revising paragraphs (a)(3)(i) and (ii) and (a)(6);
■ b. Adding and reserving paragraph (a)(12);
■ c. Redesignating paragraph (a)(11) as paragraph (a)(13);
■ d. Adding a new paragraph (a)(11);
■ e. Revising newly redesignated paragraph (a)(13); and
■ f. Revising paragraphs (f)(3), (j)(4), (j)(5), (j)(6), and (m).

The revisions and addition read as follows:

§ 1036.545 Powertrain testing.

* * * * *

(a) * * *

(3) * * *

(i) Create driveline and vehicle models that calculate the angular speed setpoint for the test cell dynamometer, $f_{nref,dyno}$, based on the torque measurement location. Use the detailed equations in paragraph (f) of this section, the GEM HIL model's driveline and vehicle submodels, or a combination of the equations and the submodels. You may use the GEM HIL model's transmission submodel in paragraph (f) to simulate a transmission only if testing hybrid engines. For hybrid engines intended for vehicles with automatic transmissions, update the driver_in_gear signal within the driver interface block in the GEM HIL model with the transmission state (in-gear or idle) as a function of time as defined by the duty cycles in this part.

(ii) Create a driver model or use the GEM HIL model's driver submodel to simulate a human driver modulating the vehicle speed to follow the test cycle as closely as possible. Alternatively, a human driver may modulate the vehicle speed to follow the test cycle as closely as possible.

* * * * *

(6) The following provisions apply to account for energy coming from RESS:

(i) For hybrid powertrains with no plug-in capability, correct for the net energy change of the energy storage device as described in 40 CFR 1066.501(a)(3).

(ii) For plug-in hybrid powertrains, follow 40 CFR 1066.501(a)(3) to determine End-of-Test for charge-depleting operation. You must get our approval in advance for your utility factor curve; we will approve it if you can show that you created it, using good engineering judgment, from sufficient in-use data of vehicles in the same application as the vehicles in which the plug-in hybrid electric powertrain will be installed. You may use methodologies described in SAE J2841 to develop the utility factor curve.

(iii) For all hybrid powertrains, apply the provisions of 40 CFR 1066.501(a)(3) for charge-sustaining operation during tests to measure criteria pollutant emissions, except that you must correct for net energy change as described in § 1036.510(g)(3) and the tolerance for End-of-Test is ± 5%.

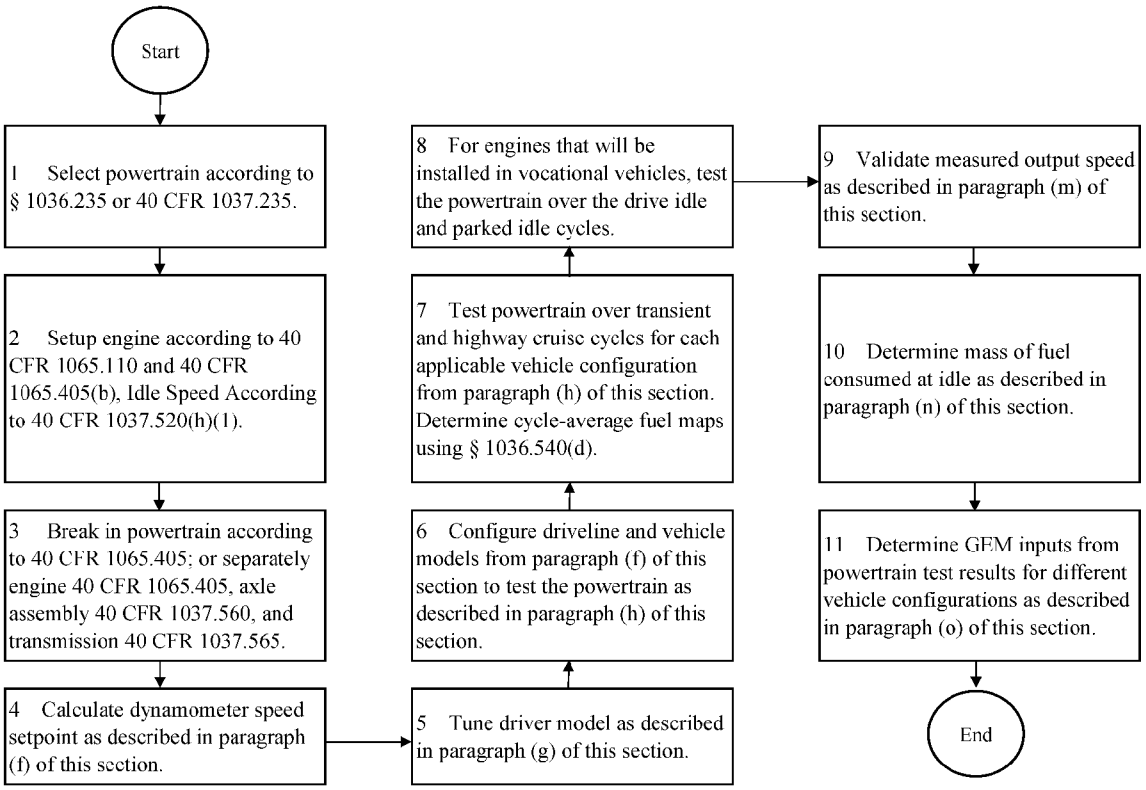
* * * * *

(11) The test must include all the components of the certified configuration.

(12) [Reserved]

(13) The following figure provides an overview of testing under this section:

FIGURE 1 TO PARAGRAPH (a)(13) OF § 1036.545—OVERVIEW OF POWERTRAIN TESTING



Duty Cycle Exceptions	Note
SET, FTP, LLC	1) Do not compensate the duty cycle for the distance driven in step 5. 2) Disregard duty cycles in step 7 and 8 and disregard steps 10 and 11 in their entirety. 3) For cycles that begin with idle, leave the transmission in neutral or park for the full initial idle segment. Place the transmission into drive no earlier than 5 seconds before the first nonzero vehicle speed setpoint. 4) Use the vehicle parameters in § 1036.505(b)(2)(i) to (viii) to define the vehicle model in § 1036.545(a)(3).
SET Specific	1) For SE1 testing only, place the transmission into park or neutral when the cycle reaches the final idle segment. 2) Select the transmission from Table 1 of § 1036.540.
FTP Specific	1) Replace $P_{contrated}$ with P_{rated}, which is the peak rated power determined in § 1036.520. 2) Keep the transmission in drive for all idle segments after the initial idle segment. 3) For hybrid engines, select the transmission from Table 1 of § 1036.540. 4) For hybrid engines, you may request to change the engine-commanded torque at idle to better represent curb idle transmission torque (CITT).
LLC Specific	1) Replace $P_{contrated}$ with P_{rated}, which is the peak rated power determined in § 1036.520. 2) Keep the transmission in drive for all idle segments 200 seconds or less. For idle segments more than 200 seconds, place the transmission in park or neutral at the start of the idle segment and place the transmission into drive again no earlier than 5 seconds before the first nonzero vehicle speed setpoint. 3) For hybrid engines, you may request to change the engine-commanded torque at idle to better represent curb idle transmission torque (CITT). 4) For plug-in hybrid engines and powertrains, determine criteria pollutant and greenhouse gas emissions as described in § 1036.510(d) and (e), replacing "SET" with "LLC".

* * * * *

(f) * * *

(3) *Vehicle model.* Calculate the simulated vehicle reference speed, v_{refi}, using the GEM HIL model's vehicle

submodel or the equations in this paragraph (f)(3):

$$v_{\text{ref}i} = \left(\frac{k_{\text{a}} \cdot T_{i\text{-}1}}{r} \cdot (Eff_{\text{axle}}) - \left(M \cdot g \cdot C_{\text{rr}} \cdot \cos(\text{atan}(G_{i\text{-}1})) + \frac{\rho \cdot C_{\text{d}}A}{2} \cdot v_{\text{ref},i\text{-}1}^2 \right) - F_{\text{brake},i\text{-}1} - F_{\text{grade},i\text{-}1} \right) \cdot \frac{\Delta t_{i\text{-}1}}{M + M_{\text{rotating}}} + v_{\text{ref},i\text{-}1}$$

Eq. 1036.545-3

Where:

i = a time-based counter corresponding to each measurement during the sampling period. Let $v_{\text{ref}1} = 0$; start calculations at $i = 2$. A 10-minute sampling period will generally involve 60,000 measurements.

T = instantaneous measured torque at the axle input, measured at the wheel hubs, or simulated by the GEM HIL model's transmission submodel. For configurations with multiple torque measurements, such as when measuring torque at the wheel hubs, T is the sum of all torque measurements.

Eff_{axle} = axle efficiency. Use $Eff_{\text{axle}} = 0.955$ for $T \geq 0$, and use $Eff_{\text{axle}} = 1/0.955$ for $T < 0$. Use $Eff_{\text{axle}} = 1.0$ if torque is measured at the wheel hubs.

M = vehicle mass for a vehicle class as determined in paragraph (h) of this section.

g = gravitational constant = 9.80665 m/s^2.

C_{rr} = coefficient of rolling resistance for a vehicle class as determined in paragraph (h) of this section.

$G_{\text{i-1}}$ = the percent grade interpolated at distance $D_{\text{i-1}}$ from the grade profile in 40 CFR part 1037, appendix D. $D_{\text{i-1}}$ is the cumulative distance driven over the test cycle at time = (i-1). Use the following equation to calculate $D_{\text{i-1}}$ starting at i = 2:

$$D_{i\text{-}1} = D_{i\text{-}2} + \left(v_{\text{ref},i\text{-}1} \cdot \Delta t_{i\text{-}1} \right)$$

Eq. 1036.545-4

ρ = air density at reference conditions. Use $\rho = 1.1845$ kg/m^3.

$C_{\text{d}}A$ = drag area for a vehicle class as determined in paragraph (h) of this section.

$F_{\text{brake,i-1}}$ = instantaneous braking force applied by the driver model.

$$F_{\text{grade},i\text{-}1} = M \cdot g \cdot \sin(\text{atan}(G_{i\text{-}1}))$$

Eq. 1036.545-5

Δt = the time interval between measurements. For example, at 100 Hz, $\Delta t = 0.0100$ seconds.

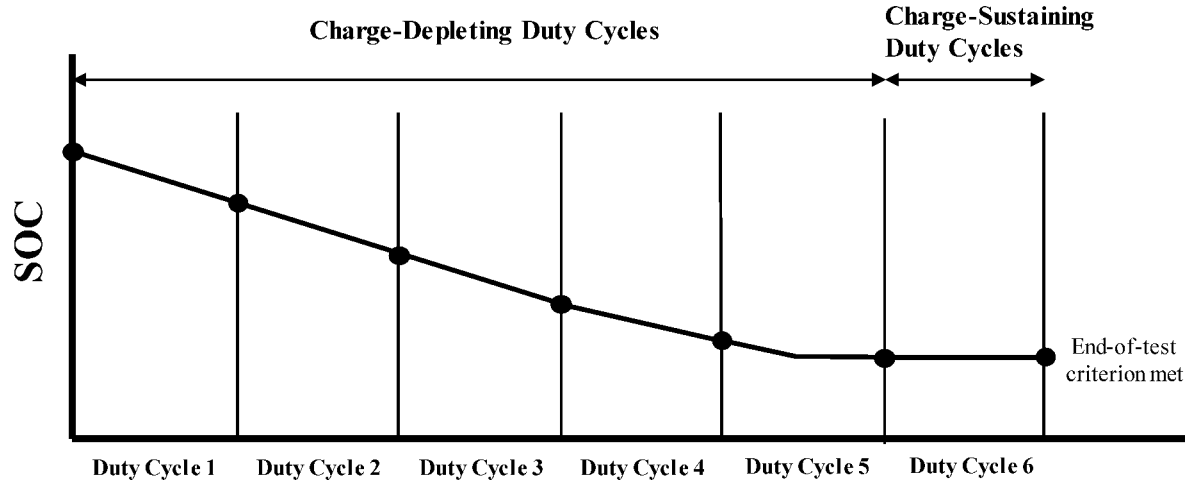
M_{rotating} = inertial mass of rotating components. Let M_{rotating} = 340 kg for vocational Light HDV or vocational Medium HDV. See paragraph (h) of this section for tractors and for vocational Heavy HDV.

* * * * *

(j) * * *

(4) For plug-in hybrid powertrains, precondition the battery and then complete all back-to-back tests for each vehicle configuration according to 40 CFR 1066.501(a)(3) before moving to the next vehicle configuration. Set the dynamometer target torque to zero when ramping to the target speed at 1 mi/hr/s. The following figure illustrates a charge-depleting test sequence with engine operation during two duty cycles, which are used for criteria pollutant determination:

FIGURE 2 TO PARAGRAPH (j)(4) OF § 1036.545— GENERIC CHARGE-DEPLETING TEST SEQUENCE



(5) For non-plug-in hybrid powertrains and plug-in hybrid powertrains tested as described in paragraph (j)(4) of this section, if the preceding duty cycle does not end at 0 mi/hr, transition between duty cycles by decelerating at a rate of 2 mi/hr/s at 0% grade until the vehicle reaches zero speed. Shut off the powertrain. Prepare the powertrain and test cell for the next duty cycle. For all other plug-in hybrid powertrain testing, transition directly to the next duty cycle without altering vehicle speed.

(6) For non-plug-in hybrid, conventional powertrains, and plug-in hybrid powertrains tested as described in paragraph (j)(4) of this section, start the next duty cycle within 60 to 180 seconds after shutting off the powertrain.

(i) To start the next duty cycle, for hybrid powertrains, key on the vehicle and then start the duty cycle. For conventional powertrains key on the vehicle, start the engine, wait for the engine to stabilize at idle speed, and then start the duty cycle.

(ii) If the duty cycle does not start at 0 mi/hr, transition to the next duty cycle by accelerating at a target rate of 1 mi/hr/s at 0% grade. Stabilize for 10 seconds at the initial duty cycle conditions and start the duty cycle.

* * * * *

(m) *Measured output speed validation.* For each test point, validate the measured output speed with the corresponding reference values. If speed is measured at more than one location, the measurements at each location must meet validation requirements. If the range of reference speed is less than 10 percent of the mean reference speed, you need to meet only the standard error of the estimate in table 4 to this paragraph (m). You may delete points when the vehicle is stopped or when a hybrid engine is at idle. If your speed measurement is not at the location of f_{nref}, correct your measured speed using the constant speed ratio between the two locations. You may apply the time-alignment provisions in 40 CFR 1065.514(c) for up to 0.5 seconds to the reference and measured output speed values. Apply cycle-validation criteria for each separate transient or highway cruise cycle based on the following parameters:

TABLE 4 TO PARAGRAPH (m) OF § 1036.545—CYCLE-VALIDATION CRITERIA

Parameter[a]	Speed control
Slope, a_1	0.990 ≤ a1 ≤ 1.010.
Absolute value of intercept, $\|a_0\|$.	≤2.0% of maximum f_{nref} speed.
Standard error of the estimate, *SEE*.	≤2.0% of maximum f_{nref} speed.
Coefficient of determination, r^2.	≥0.990.

[a] Determine values for specified parameters as described in 40 CFR 1065.514(e) by comparing measured and reference values for $f_{nref,dyno}$.

* * * * *

■ 40. Amend § 1036.555 by revising paragraph (a) to read as follows:

§ 1036.555 Test procedures to verify deterioration factors.

* * * * *

(a) Use PEMS to collect 1 Hz data throughout a shift-day of driving. Collect all the data elements needed to determine brake-specific emissions. Calculate emission results using moving average test intervals as described in § 1036.530.

* * * * *

■ 41. Add § 1036.560 to subpart F to read as follows:

§ 1036.560 DEF thawing procedure.

Use the following procedure to demonstrate that engines protect against DEF freezing as specified in § 1036.115(i)(3):

(a) Select a complete or partial vehicle for testing to represent in-use operation in cold weather.

(b) Start with a full DEF tank that is stabilized to a temperature at or below −5 °C.

(c) Soak the vehicle at temperatures at or below −17 °C for 72 hours or until the DEF is frozen solid.

(d) Operate the engine at temperatures at or below −17 °C as follows:

(1) Start the engine and let it idle with no engine load for 20 minutes.

(2) Operate the engine for up to 50 minutes at maximum test speed and up to 40 percent of the maximum torque available at maximum test speed.

(e) Determine the time from engine starting to the point at which the engine is able to consistently inject DEF into the exhaust for achieving proper catalyst performance.

■ 42. Amend § 1036.580 by revising paragraph (b) to read as follows:

§ 1036.580 Infrequently regenerating aftertreatment devices.

* * * * *

(b) You may ask us to approve an alternative methodology to account for regeneration events. We will generally limit approval to cases where your engines use aftertreatment technology with extremely infrequent regeneration and you are unable to apply the provisions of this section.

* * * * *

■ 43. Amend § 1036.601 by revising paragraphs (a) introductory text, (a)(3), and (b)(3) to read as follows:

§ 1036.601 Overview of compliance provisions.

(a) Engine and vehicle manufacturers, as well as owners, operators, and rebuilders of engines subject to the requirements of this part, and all other persons, must observe the provisions of this part, 40 CFR part 1068, and the Clean Air Act. The provisions of 40 CFR part 1068 apply for heavy-duty highway engines as specified in that part, subject to the following provisions:

* * * * *

(3) The warranty-related prohibitions in section 203(a)(4) of the Clean Air Act (42 U.S.C. 7522(a)(4)) apply to manufacturers of new heavy-duty highway engines in addition to the prohibitions described in 40 CFR 1068.101(b)(6). We may assess a civil penalty up to $44,539 for each engine or vehicle in violation. Penalties apply as described in 40 CFR 1068.101.

(b) * * *

(3) Provisions related to nonconformance penalties apply as described in 40 CFR part 1071. Note that nonconformance penalty provisions are not available for current or future emission standards unless we revise the regulation to specify how to apply those provisions.

* * * * *

■ 44. Amend § 1036.605 by revising the section heading, introductory text, and paragraphs (c) and (d) to read as follows:

§ 1036.605 Alternative emission standards for engines used in specialty vehicles.

Starting in model year 2027, compression-ignition engines at or above 56 kW and spark-ignition engines of any size that will be installed in specialty vehicles as allowed by 40 CFR 1037.605 are exempt from the standards of subpart B of this part if they are certified under this part to alternative emission standards as follows:

* * * * *

(c) Except as specified in this section, engines certified under this section must meet all the requirements that apply under 40 CFR part 1039 or 1048 instead of the comparable provisions in this part. Before shipping engines under this section, you must have written assurance from vehicle manufacturers that they need a certain number of exempted engines under this section. In your annual production report under 40

CFR 1039.250 or 1048.250, count these engines separately and identify the vehicle manufacturers that will be installing them. Treat these engines as part of the corresponding engine family under 40 CFR part 1039 or 1048 for compliance purposes such as testing production engines, in-use testing, defect reporting, and recall.

(d) The engines must be labeled as described in § 1036.135, with the following statement instead of the one specified in § 1036.135(c)(8): ''This engine conforms to alternative standards for specialty vehicles under 40 CFR 1036.605.'' Engines certified under this section may not have the label specified for nonroad engines in 40 CFR part 1039 or 1048 or any other label identifying them as nonroad engines.

* * * * *

■ 45. Amend § 1036.615 by revising paragraph (b) to read as follows:

§ 1036.615 Engines with Rankine cycle waste heat recovery and hybrid powertrains.

* * * * *

(b) *Rankine engines.* Test engines that include Rankine-cycle exhaust energy recovery systems according to the procedures specified in subpart F of this part unless we approve alternative procedures.

* * * * *

■ 46. Amend § 1036.701 by revising paragraph (k) to read as follows:

§ 1036.701 General provisions.

* * * * *

(k) Engine families you certify with a nonconformance penalty under 40 CFR part 1071, may not generate emission credits.

■ 47. Amend § 1036.705 by revising paragraph (b) to read as follows:

§ 1036.705 Generating and calculating emission credits.

* * * * *

(b) For each participating family, calculate positive or negative emission credits relative to the otherwise applicable emission standard. Calculate positive emission credits for a family that has an FEL below the standard. Calculate negative emission credits for a family that has an FEL above the standard. Sum your positive and negative credits for the model year before rounding. Calculate emission credits to the nearest megagram (Mg) for each family using the following equation:

$$Emission\ credits\ (\mathrm{Mg}) = (Std - FL) \cdot CF \cdot Volume \cdot UL \cdot c$$

Eq. 1036.705-1

Where:

Std = the emission standard, in (mg NO_X)/hp·hr that applies under subpart B of this part for engines not participating in the ABT program of this subpart (the ''otherwise applicable standard'').

FL = the engine family's FEL for NO_X, in mg/hp·hr rounded to the same number of decimal places as the emission standard.

CF = a transient cycle conversion factor (hp·hr/mile), calculated by dividing the total (integrated) horsepower-hour over the applicable duty cycle by 6.3 miles for engines subject to spark-ignition standards and 6.5 miles for engines subject to compression-ignition standards. This represents the average work performed over the duty cycle.

Volume = the number of engines eligible to participate in the averaging, banking, and trading program within the given engine family or subfamily during the model year, as described in paragraph (c) of this section.

UL = the useful life for the standard that applies for a given primary intended service class, in miles.

$c = 10 - 9$ for NO_X.

Example for model year 2030 Heavy HDE generating NO_X *credits:*

Std = 35 mg/hp·hr

FL = 20 mg/hp·hr

CF = 9.78 hp·hr/mile

Volume = 15,342

UL = 650,000 miles

c = 10 − 9

Emission credits = (35 − 20) · 9.78 · 15,342 · 650,000 · 10 − 9

Emission credits = 1,463 Mg

* * * * *

■ 48. Amend § 1036.801 by:

■ a. Revising the introductory text;

■ b. Removing the definition of ''Act'';

■ c. Adding definitions of ''Certified configuration'' and ''Clean Air Act'' in alphabetical order;

■ d. Revising the definitions of ''Designated Compliance Officer'', ''Hybrid'', ''Manufacture'', and ''New motor vehicle engine''; and

■ e. Adding a definition of ''Useful life'' in alphabetical order.

The additions and revisions read as follows:

§ 1036.801 Definitions.

The following definitions apply to this part. The definitions apply to all subparts unless we note otherwise. All undefined terms have the meaning the Clean Air Act gives to them. The definitions follow:

* * * * *

Certified configuration means a specific engine configuration that is named in the application for certification.

* * * * *

Clean Air Act means the Clean Air Act, as amended, 42 U.S.C. 7401–7671q.

* * * * *

Designated Compliance Officer means one of the following:

(1) For engines subject to compression-ignition standards, *Designated Compliance Officer* means Supervisor, Diesel Engine Compliance Branch, U.S. Environmental Protection Agency, 2000 Traverwood Drive, Ann Arbor, MI 48105; *complianceinfo@epa.gov;www.epa.gov/ve-certification.*

(2) For engines subject to spark-ignition standards, Designated Compliance Officer means Supervisor, Gasoline Engine Compliance Branch, U.S. Environmental Protection Agency, 2000 Traverwood Drive, Ann Arbor, MI 48105; *complianceinfo@epa.gov; www.epa.gov/ve-certification.*

* * * * *

Hybrid means relating to an engine or powertrain that includes a Rechargeable Energy Storage System. Hybrid engines store and recover energy in a way that is integral to the engine or otherwise upstream of the vehicle's transmission. Examples of hybrid engines include engines with hybrid components connected to the front end of the engine (P0), connected to the crankshaft before the clutch (P1), or connected between the clutch and the transmission where the clutch upstream of the hybrid feature is in addition to the transmission clutch or clutches (P2). Engine-based systems that recover kinetic energy to power an electric heater in the aftertreatment are themselves not sufficient to qualify as a hybrid engine. The provisions in this part that apply for hybrid powertrains apply equally for hybrid engines, except as specified. Note that certain provisions in this part treat hybrid powertrains intended for vehicles that include regenerative braking different than those intended for vehicles that do not include regenerative braking. The definition of

hybrid includes plug-in hybrid powertrains.

* * * * *

Manufacture means the physical and engineering process of designing, constructing, and assembling a heavy-duty engine or a heavy-duty vehicle.

* * * * *

New motor vehicle engine has the meaning given in the Clean Air Act. This generally means a motor vehicle engine meeting any of the following:

(1) A motor vehicle engine for which the ultimate purchaser has never received the equitable or legal title is a *new motor vehicle engine.* This kind of engine might commonly be thought of as ''brand new'' although a *new motor vehicle engine* may include previously used parts. Under this definition, the engine is new from the time it is produced until the ultimate purchaser receives the title or places it into service, whichever comes first.

(2) An imported motor vehicle engine is a *new motor vehicle engine* if it was originally built on or after January 1, 1970.

(3) Any motor vehicle engine installed in a new motor vehicle.

* * * * *

Useful life means the period during which a new engine is required to comply with all applicable emission standards.

* * * * *

■ 49. Amend § 1036.810 by revising introductory text and paragraphs (a) and (d)(4) to read as follows:

§ 1036.810 Incorporation by reference.

Certain material is incorporated by reference into this part with the approval of the Director of the Federal Register under 5 U.S.C. 552(a) and 1 CFR part 51. To enforce any edition other than that specified in this section, EPA must publish a document in the **Federal Register** and the material must be available to the public. All approved incorporation by reference (IBR) material is available for inspection at EPA and at the National Archives and Records Administration (NARA). Contact EPA at: U.S. EPA, Air and Radiation Docket Center, WJC West Building, Room 3334, 1301 Constitution Ave. NW, Washington, DC 20004; *www.epa.gov/dockets;* (202) 202–1744. For information on inspecting this material at NARA, visit *www.archives.gov/federal-register/cfr/ibr-locations* or email *fr.inspection@nara.gov.* The material may be obtained from the following sources:

(a) ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA, 19428–2959; (877) 909–2786; *www.astm.org.*

(1) ASTM D975–24a, Standard Specification for Diesel Fuel, approved August 1, 2024 (ASTM D975); IBR approved for § 1036.415(c).

(2) ASTM D3588–98 (Reapproved 2017)e1, Standard Practice for Calculating Heat Value, Compressibility Factor, and Relative Density of Gaseous Fuels, approved April 1, 2017 (ASTM D3588); IBR approved for § 1036.550(b).

(3) ASTM D4809–25, Standard Test Method for Heat of Combustion of Liquid Hydrocarbon Fuels by Bomb Calorimeter (Precision Method), approved November 1, 2025 (ASTM D4809); IBR approved for § 1036.550(b).

(4) ASTM D4814–25a, Standard Specification for Automotive Spark-Ignition Engine Fuel, approved December 15, 2025 (ASTM D4814); IBR approved for § 1036.415(c).

(5) ASTM D7467–23, Standard Specification for Diesel Fuel Oil, Biodiesel Blend (B6 to B20), approved October 1, 2023 (ASTM D7467); IBR approved for § 1036.415(c).

* * * * *

(d) * * *

(1) 2019 13 CCR 1968.2, Title 13. Motor Vehicles, Division 3. Air Resources Board, Chapter 1. Motor Vehicle Pollution Control Devices, Article 2. Approval of Motor Vehicle Pollution Control Devices (New Vehicles), § 1968.2. Malfunction and Diagnostic System Requirements—2004 and Subsequent Model-Year Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles and Engines, operative October 3, 2019 ''13 CCR 1968.2''; into §§ 1036.110(b); 1036.111(f).

(3) 2019 13 CCR 1971.1, Title 13. Motor Vehicles, Division 3. Air Resources Board, Chapter 1. Motor Vehicle Pollution Control Devices, Article 2. Approval of Motor Vehicle Pollution Control Devices (New Vehicles), § 1971.1. On-Board Diagnostic System Requirements—2010 and Subsequent Model-Year Heavy-Duty Engines, operative October 3, 2019 ''13 CCR 1971.1''; into §§ 1036.110(b); 1036.111(f); 1036.150(v).

* * * * *

(4) 2019 13 CCR 1971.5, 13 CA ADC 1971.5: 2019 CA REG TEXT 504962 (NS), 13 CA ADC 1971.5. Enforcement of Malfunction and Diagnostic System Requirements for 2010 and Subsequent Model-Year Heavy-Duty Engines, operative October 3, 2019 ''13 CCR 1971.5''; into § 1036.110(b), 1036.111(f).

* * * * *

■ 50. Amend appendix B of part 1036 by revising footnote a of Table 1 in paragraph (b) to read as follows:

Appendix B of Part 1036—Transient Duty Cycles

* * * * *

(b) * * *

TABLE 1 OF APPENDIX B—TRANSIENT TEST INTERVAL FOR SPARK-IGNITION ENGINES AND POWERTRAINS UNDER § 1036.512

Record (seconds)	Engine testing		Powertrain testing			
	Normalized revolutions per minute (percent)	Normalized torque (percent)	Vehicle speed (mi/hr)	Road grade coefficients		
				a	*b*	*c*
*	*	*	*	*	*	*

[a] Minimum operator demand.

■ 51. Amend appendix B of part 1036 by revising footnote a of Table 2 in paragraph (c) to read as follows:

(c) * * *

TABLE 2 OF APPENDIX B—TRANSIENT TEST INTERVAL FOR COMPRESSION-IGNITION ENGINES AND POWERTRAINS UNDER § 1036.512

Record (seconds)	Engine testing		Powertrain testing			
	Normalized revolutions per minute (percent)	Normalized torque (percent)	Vehicle speed (mi/hr)	Road grade coefficients		
				a	*b*	*c*
*	*	*	*	*	*	*

[a] Minimum operator demand.

■ 52. Amend appendix B of part 1036 by revising footnote a of Table 3 in paragraph (d) to read as follows:

(d) * * *

TABLE 3 OF APPENDIX B—TRANSIENT DUTY CYCLE FOR COMPRESSION-IGNITION ENGINES AND POWERTRAINS UNDER § 1036.514

Record (seconds)	Engine testing		Powertrain testing			
	Normalized revolutions per minute (percent)	Normalized torque (percent)	Vehicle speed (mi/hr)	Road grade coefficients		
				a	*b*	*c*
*	*	*	*	*	*	*

[a] Minimum operator demand.

PART 1037—CONTROL OF EMISSIONS FROM NEW HEAVY-DUTY MOTOR VEHICLES

■ 53. The authority citation for part 1037 continues to read as follows:

Authority: 42 U.S.C. 7401–7671q.

■ 54. Amend § 1037.135 by revising paragraph (e) to read as follows:

§ 1037.135 Labeling.

* * * * *

(e) You may ask us to approve modified labeling requirements in this part 1037 if you show that it is necessary or appropriate. We will approve your request if your alternative label is consistent with the requirements of this part.

■ 55. Amend § 1037.205 by revising paragraph (e) to read as follows:

§ 1037.205 What must I include in my application?

* * * * *

(e) Describe any test equipment and procedures that you used, including any special or alternative test procedures you used (see § 1037.501). Include information describing the procedures you used to determine C_dA values as specified in §§ 1037.525 and 1037.527. Describe which type of data you are using for engine fuel maps (see 40 CFR 1036.505).

* * * * *

■ 56. Amend § 1037.235 by revising paragraph (f) to read as follows:

§ 1037.235 Testing requirements for certification.

* * * * *

(f) If you use an alternative test procedure under 40 CFR 1065.10 and later testing shows that such testing does not produce results that are equivalent to the procedures specified in subpart F of this part, we may reject data you generated using the alternative procedure.

* * * * *

■ 57. Amend § 1037.501 by revising paragraph (e) to read as follows:

§ 1037.501 General testing and modeling provisions.

* * * * *

(e) You may use special or alternative procedures as specified in 40 CFR 1065.10.

* * * * *

■ 58. Amend § 1037.510 by revising paragraph (c)(3) to read as follows:

§ 1037.510 Duty-cycle exhaust testing.

* * * * *

(c) * * *

(3) Table 1 to this paragraph (c)(3) follows:

TABLE 1 TO PARAGRAPH (c)(3) OF § 1037.510—WEIGHTING FACTORS FOR DUTY CYCLES

	Distance-weighted			Time-weighted [a]			Average speed during non-idle cycles (mi/hr) [b]
	Transient (%)	55 mi/hr cruise (%)	65 mi/hr cruise (%)	Drive idle (%)	Parked idle (%)	Non-idle (%)	
Class 7 All Cabs	19	17	64				
Class 8 Day Cabs	19	17	64				
Class 8 Sleeper Cabs	5	9	86				
Heavy-haul Tractors	19	17	64				
Vocational—Regional	20	24	56	0	25	75	38.41
Vocational—Multi-Purpose (2b–7)	54	29	17	17	25	58	23.18

TABLE 1 TO PARAGRAPH (c)(3) OF § 1037.510—WEIGHTING FACTORS FOR DUTY CYCLES—Continued

	Distance-weighted			Time-weighted [a]			Average speed during non-idle cycles (mi/hr) [b]
	Transient (%)	55 mi/hr cruise (%)	65 mi/hr cruise (%)	Drive idle (%)	Parked idle (%)	Non-idle (%)	
Vocational—Multi-Purpose (8)	54	23	23	17	25	58	23.27
Vocational—Urban (2b–7)	92	8	0	15	25	60	16.25
Vocational—Urban (8)	90	10	0	15	25	60	16.51
Vocational with conventional powertrain (Phase 1 only)	42	21	37				
Vocational Hybrid Vehicles (Phase 1 only)	75	9	16				

[a] Note that these drive idle and non-idle weighting factors do not reflect additional drive idle that occurs during the transient cycle. The transient cycle does not include any parked idle.
[b] These values apply even for vehicles not following the specified speed traces.

* * * * *

■ 59. Amend § 1037.520 by revising paragraphs (e)(2) and (4) and (n) to read as follows:

§ 1037.520 Modeling CO_2 emissions to show that vehicles comply with fuel consumption standards.

* * * * *

(e) * * *

(2) Weight reduction inputs for tractor components other than wheels are specified in the following table:

TABLE 7 TO § 1037.520—NONWHEEL-RELATED WEIGHT REDUCTIONS FROM ALTERNATIVE MATERIALS FOR TRACTORS

[Pounds]

Weight reduction technologies	Aluminum	High-strength steel	Thermoplastic
Door	20	6	
Roof	60	18	
Cab rear wall	49	16	
Cab floor	56	18	
Hood Support Structure System	15	3	
Hood and Front Fender			65
Day Cab Roof Fairing			18
Sleeper Cab Roof Fairing	75	20	40
Aerodynamic Side Extender			10
Fairing Support Structure System	35	6	
Instrument Panel Support Structure	5	1	
Brake Drums—Drive (set of 4)	140	74	
Brake Drums—Non Drive (set of 2)	60	42	
Frame Rails	440	87	
Crossmember—Cab	15	5	
Crossmember—Suspension	25	6	
Crossmember—Non Suspension (set of 3)	15	5	
Fifth Wheel	100	25	
Radiator Support	20	6	
Fuel Tank Support Structure	40	12	
Steps	35	6	
Bumper	33	10	
Shackles	10	3	
Front Axle	60	15	
Suspension Brackets, Hangers	100	30	
Transmission Case	50	12	
Clutch Housing	40	10	
Fairing Support Structure System	35	6	
Drive Axle Hubs (set of 4)	80	20	
Non Drive Hubs (set of 2)	40	5	
Two-piece driveshaft	20	5	
Transmission/Clutch Shift Levers	20	4	

* * * * *

(4) Apply vehicle weight inputs for changing technology configurations as follows:

(i) For Class 8 tractors or for Class 8 vocational vehicles with a permanent 6 × 2 axle configuration, apply a weight reduction input of 300 pounds. However, apply no weight reduction for coach buses certified to custom-chassis standards under § 1037.105(h).

(ii) For Class 8 tractors with 4 × 2 axle configuration, apply a weight reduction input of 400 pounds.

(iii) For tractors with installed engines with displacement below 14.0 liters, apply a weight reduction of 300 pounds.

(iv) For tractors with single-piece driveshafts with a total length greater than 86 inches, apply a weight reduction of 43 pounds for steel driveshafts and 63 pounds for aluminum driveshafts.

* * * * *

(n) *Other fuels.* For fuels other than those identified in GEM, perform the simulation by identifying the vehicle as being diesel-fueled if the engine is subject to the compression-ignition standard, or as being gasoline-fueled if the engine is subject to the spark-ignition standards. Correct the engine or powertrain fuel map for mass-specific net energy content as described in 40 CFR 1036.535(b).

■ 60. Amend § 1037.601 by revising paragraphs (a)(5) and (e) to read as follows:

§ 1037.601 General compliance provisions.

(a) * * *

(5) The warranty-related prohibitions in section 203(a)(4) of the Act (42 U.S.C. 7522(a)(4)) apply to manufacturers of new heavy-duty highway vehicles in addition to the prohibitions described in 40 CFR 1068.101(b)(6). We may assess a civil penalty up to $44,539 for each engine or vehicle in violation. Penalties apply as described in 40 CFR 1068.101.

* * * * *

(e) Under § 1037.801, certain vehicles are considered to be new vehicles when they are imported into the United States, even if they have previously been used outside the country.

* * * * *

■ 61. Amend § 1037.605 by revising the section heading and paragraphs (a) introductory text, (a)(4), (c), and (d)(1) to read as follows:

§ 1037.605 Installing engines certified to alternative standards for specialty vehicles.

(a) *General provisions.* This section allows vehicle manufacturers to introduce into U.S. commerce certain new motor vehicles using engines certified to alternative emission standards specified in 40 CFR 1036.605 for motor vehicle engines used in specialty vehicles. You may not install an engine certified to these alternative standards if there is an engine certified to the full set of requirements of 40 CFR part 1036 that has the appropriate physical and performance characteristics to power the vehicle. Note that, although these alternative emission standards are mostly equivalent to standards that apply for nonroad engines under 40 CFR part 1039 or 1048, they are specific to motor vehicle engines. The provisions of this section apply for the following types of specialty vehicles:

* * * * *

(4) Through model year 2030, vehicles with a hybrid powertrain in which the engine provides energy only for the Rechargeable Energy Storage System.

* * * * *

(c) *Production limits.* You may produce up to 200 of each type of vehicle identified in paragraph (a) of this section in a given model year. This includes vehicles produced by affiliated companies. If you exceed this limit, the number of vehicles that exceed the limit for the model year will not be covered by a valid certificate of conformity. For the purpose of this paragraph (c), we will count all vehicles labeled or otherwise identified as exempt under this section.

(d) * * *

(1) Vehicles qualifying under this section are subject to evaporative and refueling emission standards as specified in § 1037.103, but are exempt from the other requirements of this part, except as specified in this section and in § 1037.601.

* * * * *

■ 62. Amend § 1037.631 by revising paragraph (a) introductory text to read as follows:

§ 1037.631 Exemption for vocational vehicles intended for off-road use.

* * * * *

(a) *Qualifying criteria.* Vocational vehicles intended for off-road use are exempt without request, subject to the provisions of this section, if they are primarily designed to perform work off-road (such as in oil fields, mining, forests, or construction sites), and they meet at least one of the criteria of paragraph (a)(1) of this section and at least one of the criteria of paragraph (a)(2) of this section. See § 1037.105(h) for alternative Phase 2 standards that apply for vehicles meeting only one of these sets of criteria.

* * * * *

■ 63. Amend § 1037.635 by revising paragraph (b)(4) to read as follows:

§ 1037.635 Glider kits and glider vehicles.

* * * * *

(b) * * *

(4) Note that alternative standards or requirements may apply under § 1037.150.

* * * * *

■ 64. Amend § 1037.660 by revising paragraph (c)(2) to read as follows:

§ 1037.660 Idle-reduction technologies.

* * * * *

(c) * * *

(2) For AES systems designed to limit idling to a specific number of hours less than 1,800 hours over any 12-month period, calculate an adjusted AES input using the following equation, rounded to the nearest 0.1 g/ton-mile: AES Input = 5 g CO_2/ton-mile × (1 − (maximum allowable number of idling hours per year/1,800 hours)). This is an annual allowance that starts when the vehicle is new and resets every 12 months after that. Manufacturers may propose an alternative method based on operating hours or miles instead of years.

* * * * *

■ 65. Amend § 1037.801 by revising the definitions of ''Date of manufacture'', ''Designated Compliance Officer'', ''Fuel system'', and ''Hydrocarbon (HC)'' to read as follows:

§ 1037.801 Definitions.

* * * * *

Date of manufacture means the date on which the certifying vehicle manufacturer completes its manufacturing operations, except as follows:

(1) Where the certificate holder is an engine manufacturer that does not manufacture the chassis, the date of manufacture of the vehicle is based on the date assembly of the vehicle is completed.

(2) We may approve an alternative date of manufacture based on the date on which the certifying (or primary) manufacturer completes assembly at the place of main assembly, consistent with the provisions of § 1037.601 and 49 CFR 567.4.

* * * * *

Designated Compliance Officer means one of the following:

(1) For compression-ignition engines, *Designated Compliance Officer* means Supervisor, Diesel Engine Compliance Branch, U.S. Environmental Protection Agency, 2000 Traverwood Drive, Ann Arbor, MI 48105; *complianceinfo@epa.gov; www.epa.gov/ve-certification.*

(2) For spark-ignition engines, *Designated Compliance Officer* means Supervisor, Gasoline Engine Compliance Branch, U.S. Environmental Protection Agency, 2000 Traverwood Drive, Ann Arbor, MI 48105; *complianceinfo@epa.gov; www.epa.gov/ve-certification.*

* * * * *

Fuel system means all components involved in transporting, metering, and mixing the fuel from the fuel tank to the combustion chamber(s), including the fuel tank, fuel pump, fuel filters, fuel lines, carburetor or fuel-injection components, and all fuel-system vents.

It also includes components for controlling evaporative and refueling emissions, such as fuel caps, purge valves, and carbon canisters.

* * * * *

Hydrocarbon (HC) means the hydrocarbon group on which the emission standards are based for each fuel type. For alcohol-fueled vehicles, HC means nonmethane hydrocarbon equivalent (NMHCE) for exhaust emissions and total hydrocarbon equivalent (THCE) for evaporative emissions. For all other vehicles, HC means nonmethane hydrocarbon (NMHC) for exhaust emissions and total hydrocarbon (THC) for evaporative and refueling emissions.

* * * * *

■ 66. Amend § 1037.810 by revising paragraph (c)(7) to read as follows:

§ 1037.810 Incorporation by reference.

* * * * *

(c) * * *

(7) SAE J2343 FEB2018, Recommended Practice for LNG Medium and Heavy-Duty Powered Vehicles, Stabilized February 2018, (''SAE J2343''); IBR approved for § 1037.103(e).

* * * * *

PART 1039—CONTROL OF EMISSIONS FROM NEW AND IN-USE NONROAD COMPRESSION-IGNITION ENGINES

■ 67. The authority citation for part 1039 continues to read as follows:

Authority: 42 U.S.C. 7401–7671q.

■ 68. Amend § 1039.110 by revising paragraph (a) to read as follows:

§ 1039.110 Recording reductant use and other diagnostic functions.

(a) Engines equipped with SCR systems using a reductant other than the engine's fuel must have a diagnostic system that monitors reductant quality and tank levels and alert operators to the need to refill the reductant tank before it is empty, or to replace the reductant if it does not meet your concentration specifications. The diagnostic system must include audible and visual signals as described in § 1039.111. You do not need to separately monitor reductant quality if your system uses input from an exhaust NO_X sensor (or other sensor) to alert operators when reductant quality is inadequate. However, tank level must be monitored in all cases.

* * * * *

■ 69. Add § 1039.111 to subpart B to read as follows:

§ 1039.111 Inducements related to SCR.

Engines using SCR to control emissions depend on a constant supply of diesel exhaust fluid (DEF). This section describes how manufacturers must design their engines to prompt operators to take appropriate actions to ensure the SCR system is working properly. The requirements of this section apply starting in model year 2029, though you may comply with the requirements of this section in earlier model years.

(a) [Reserved]

(b) *Inducement triggering conditions.* Create strategies that monitor for and trigger an inducement signal based on the following conditions:

(1) Engine operation with no DEF.

(2) DEF with a urea concentration below 20 mass percent. You may determine urea concentration based on direct measurement or based on a surrogate value such as exhaust NO_X concentration before and after an SCR catalyst. Measurement may be limited to one time for each occurrence of adding to the DEF tank. Use good engineering judgment to determine urea concentration as soon as possible.

(3) Any signal indicating that a catalyst is missing.

(4) Open circuit faults related to the following: DEF tank level sensor, DEF pump, DEF quality sensor, SCR wiring harness, NO_X sensors, DEF dosing valve, DEF tank heater, DEF tank temperature sensor, and aftertreatment control module.

(c) *Audible and visual signals.* Design engines with audible and visual signals corresponding to the inducement triggering conditions in paragraph (b) of this section, subject to our approval, as follows:

(1) Audible signals must be sufficient to alert the operator to the need for service. The tone must be active for 90 seconds with repeated tones on one of the following schedules:

(i) For DEF supply, the tone must occur when the system detects the triggering condition in paragraph (b)(1) of this section, when the engine detects an empty DEF tank, 30 minutes after detecting an empty DEF tank, 60 minutes after detecting an empty DEF tank, and then every 60 minutes until key-off.

(ii) For all conditions other than DEF supply, the tone must occur when the system detects a triggering condition in paragraph (b)(2) through (4) of this section, 30 minutes after detecting the triggering condition, 90 minutes after detecting the triggering condition, and then every 180 minutes until key-off.

(iii) If the triggering condition persists after keying off and on again, engines must repeat the audible signal after key-on and according to the time schedule described in paragraph (c)(1)(i) or (ii) of this section.

(2) You may design your engines to suspend the audible signals in paragraph (c)(1) of this section when ambient temperature is below −11 °C. If the triggering condition persists, restart audible signals at the same point in the schedule identified in paragraph (c)(1) of this section when ambient temperature is above 0 °C.

(3) Visual signals must be sufficient to alert the operator to the need for service. Visual signals must be displayed until deactivation as described in paragraph (e) of this section.

(d) *Performance derates.* You may rely on derating engine performance for protecting aftertreatment systems and other engine components from catastrophic damage, as long as derating is not based only on an assessment of emission control performance (such as evaluation of catalyst conversion efficiency).

(e) *Deactivating inducements.* Program the engine to deactivate inducements as follows:

(1) Evaluate whether the detected inducement triggering condition continues to apply. Deactivate inducements if the engine confirms that the detected inducement triggering condition is resolved.

(2) If your system allows for remotely deactivating inducement triggering codes, do not limit this capability to proprietary scantools.

■ 70. Amend § 1039.115 by revising paragraph (e) and adding paragraph (h) to read as follows:

§ 1039.115 What other requirements apply?

* * * * *

(e) *Adjustable parameters.* Engines that have adjustable parameters must meet all the requirements of this part for any adjustment in the practically adjustable range.

(1) We may require that you set adjustable parameters to any specification within the practically adjustable range during any testing, including certification testing, selective enforcement auditing, or in-use testing.

(2) General provisions for adjustable parameters apply as specified in 40 CFR 1068.50.

(3) DEF supply and DEF quality are adjustable parameters. The practically adjustable range includes any amount of DEF for which the engine's diagnostic system does not trigger inducement provisions under § 1036.111.

* * * * *

(h) The following additional requirements apply for engines with SCR:

(1) Diesel exhaust fluid tanks must be sized to require refilling no more frequently than the vehicle operator will need to refill the fuel tank, even for worst-case assumptions related to fuel efficiency and refueling volumes.

(2) Design engines to respond to varying DEF quality with compensation algorithms that varies DEF injection to maintain NO_X emission control that is comparable to operation with DEF conforming to the specifications referenced in the definition of ''diesel exhaust fluid'' in § 1039.801, subject to the limitations of the emission control hardware.

(3) Design engines for DEF freeze protection by including a warming system to thaw DEF to restore DEF flow into the exhaust system within 70 minutes after engine starting using the procedure described in 40 CFR 1036.560.

■ 71. Amend § 1039.125 by revising paragraph (a)(1) introductory text to read as follows:

§ 1039.125 What maintenance instructions must I give to buyers?

* * * * *

(a) * * *

(1) You demonstrate that the maintenance is reasonably likely to be done at the recommended intervals on in-use engines. We will accept DEF replenishment as reasonably likely to occur if your engine meets the specifications in § 1039.111. We will accept other scheduled maintenance as reasonably likely to occur if you satisfy any of the following conditions:

* * * * *

■ 72. Amend § 1039.130 by revising paragraph (b)(3) to read as follows:

§ 1039.130 What installation instructions must I give to equipment manufacturers?

* * * * *

(b) * * *

(3) Describe the instructions needed to properly install the exhaust system and any other components. Include instructions consistent with the requirements of § 1039.205(u). Also describe how equipment manufacturers must install diesel exhaust fluid tanks with sensors and equipment as needed to meet the requirements of §§ 1039.111 and 1039.115(h).

* * * * *

■ 73. Amend § 1039.205 by adding paragraph (b)(12) to read as follows:

§ 1039.205 What must I include in my application?

* * * * *

(b) * * *

(12) For engines using SCR, describe the following design features:

(i) Audible and visual signals required under § 1039.111(c).

(ii) Compensation algorithms required under § 1039.115(h)(2).

* * * * *

■ 74. Amend § 1039.501 by revising paragraph (d) to read as follows:

§ 1039.501 How do I run a valid emission test?

* * * * *

(d) Use the fuels and engine fluids specified in § 1039.104(e) and 40 CFR part 1065 to perform valid tests.

(1) For service accumulation, use the test fuel or any commercially available fuel that is representative of the fuel that in-use engines will use.

(2) For diesel-fueled engines, use the appropriate diesel fuel specified in 40 CFR part 1065 for emission testing. Unless we specify otherwise, the appropriate diesel test fuel is the ultra low-sulfur diesel fuel. If we allow you to use a test fuel with higher sulfur levels, identify the test fuel in your application for certification and ensure that the emission control information label is consistent with your selection of the test fuel (see § 1039.135(c)(9)). For example, do not test with ultra low-sulfur diesel fuel if you intend to label your engines to allow use of diesel fuel with sulfur concentrations up to 500 ppm.

(3) For engines using selective catalytic reduction, use diesel exhaust fluid that conforms to the specifications referenced in the definition of ''diesel exhaust fluid'' in § 1039.801.

* * * * *

PART 1065—ENGINE-TESTING PROCEDURES

■ 75. The authority citation for part 1065 continues to read as follows:

Authority: 42 U.S.C. 7401–7671q.

■ 76. Amend § 1065.1 by revising paragraph (e) to read as follows:

§ 1065.1 Applicability.

* * * * *

(e) Unless we specify otherwise, the terms ''procedures'' and ''test procedures'' in this part include all aspects of engine testing, including the equipment specifications, calibrations, calculations, and other protocols and procedural specifications needed to make required measurements.

* * * * *

■ 77. Amend § 1065.2 by revising paragraph (c) to read as follows:

§ 1065.2 Submitting information to EPA under this part.

* * * * *

(c) We may void any certificates or approvals associated with a submission of information if we find that you intentionally submitted false, incomplete, or misleading information. For example, if we find that you intentionally submitted incomplete information to mislead EPA when requesting approval to use alternative test procedures, we may void the certificates for all engine families certified based on emission data collected using the alternative procedures. This paragraph (c) would also apply if you ignore data from incomplete tests or from repeat tests with higher emission results.

* * * * *

■ 78. Amend § 1065.10 by revising paragraphs (c) introductory text, (c)(6), (c)(7) introductory text, and (c)(7)(iii); and removing paragraph (d) to read as follows:

§ 1065.10 Other procedures.

* * * * *

(c) *Exceptions.* We may allow or require you to use procedures other than those specified in this part in the following cases, which may apply to laboratory testing, field testing, or both. We intend to publicly announce when we allow or require such exceptions. If we require you to request approval to use other procedures under this paragraph (c), you may not use them until we approve your request. All the test procedures noted here as exceptions to the specified procedures are considered generically as ''other procedures.'' Note that the terms ''special procedures'' and ''alternative procedures'' have specific meanings; ''special procedures'' are those allowed by paragraph (c)(2) of this section and ''alternative procedures'' are those allowed by paragraph (c)(7).

* * * * *

(6) During the 12 months following the effective date of any change in the provisions of this part 1065 (and 40 CFR part 1066 for vehicle testing), you may use data collected using procedures specified in the previously applicable version of this part 1065 (and 40 CFR part 1066 for vehicle testing). This also applies for changes to test procedures specified in the standard-setting part to the extent that these changes are not related to new standards. This paragraph (c)(6) does not restrict the use of carryover certification data otherwise allowed by the standard-setting part. This paragraph (c)(6) also does not prevent us from identifying an earlier

starting date for certain changes to test procedures.

(7) You may request to use alternative procedures that are equivalent to the specified procedures, or procedures that are more accurate or more precise than the specified procedures. We may perform tests with your engines using either the approved alternative procedures or the specified procedures. We may reject data you generate using alternate procedures if later testing with the otherwise specified procedures shows contradictory emission data. The following provisions apply to requests for alternative procedures:

* * * * *

(iii) *Notification.* We may approve your request by telling you directly, or we may issue guidance announcing our approval of a specific alternative procedure, which would make additional requests for approval unnecessary.

* * * * *

■ 79. Revise § 1065.12 to read as follows:

§ 1065.12 Approval of alternative procedures.

(a) To get approval for an alternative procedure under § 1065.10(c), send the EPA Program Officer an initial written request describing the alternative procedure and why you believe it is equivalent to the specified procedure. Anyone may request alternative procedure approval. This means that an individual engine manufacturer may request to use an alternative procedure. This also means that an instrument manufacturer may request to have an instrument, equipment, or procedure approved as an alternative procedure to those specified in this part. We may approve your request based on this information alone, whether or not it includes all the information specified in this section. Where we determine that your original submission does not include enough information for us to determine that the alternative procedure is equivalent to the specified procedure, we may ask you to submit supplemental information showing that your alternative procedure is consistently and reliably at least as accurate and repeatable as the specified procedure.

(b) We may make our approval under this section conditional upon meeting other requirements or specifications. We may limit our approval, for example, to certain time frames, specific duty cycles, or specific emission standards. Based upon any supplemental information we receive after our initial approval, we may amend a previously approved alternative procedure to extend, limit, or discontinue its use. We intend to publicly announce alternative procedures that we approve.

(c) Although we will make every effort to approve only alternative procedures that completely meet our requirements, we may revoke our approval of an alternative procedure if new information shows that it is significantly not equivalent to the specified procedure. If we do this, we will grant time to switch to testing using an allowed procedure, considering the following factors:

(1) The cost, difficulty, and availability to switch to a procedure that we allow.

(2) The degree to which the alternative procedure affects your ability to show that your engines comply with all applicable emission standards.

(3) Any relevant factors considered in our initial approval.

(d) If we do not approve your proposed alternative procedure based on the information in your initial request, we may ask you to send additional information to fully evaluate your request. While we consider the information specified in this paragraph (d) and the statistical criteria of paragraph (e) of this section to be sufficient to demonstrate equivalence, it may not be necessary to include all the information or meet the specified statistical criteria. For example, systems that do not meet the statistical criteria in paragraph (e) of this section because they have a small bias toward high emission results could be approved since they would not adversely affect your ability to demonstrate compliance with applicable standards.

(1) *Theoretical basis.* Give a brief technical description explaining why you believe the proposed alternative procedure should result in emission measurements equivalent to those using the specified procedure. You may include equations, figures, and references. You should consider the full range of parameters that may affect equivalence. For example, for a request to use a different NO_X measurement procedure, you should theoretically relate the alternative detection principle to the specified detection principle over the expected concentration ranges for NO, NO_2, and interference species. For a request to use a different PM measurement procedure, you should explain the principles by which the alternative procedure quantifies particulate mass similarly to the specified procedures.

(2) *Technical description.* Describe briefly any hardware or software needed to perform the alternative procedure. You may include dimensioned drawings, flowcharts, schematics, and component specifications. Explain any necessary calculations or other data manipulation.

(3) *Procedure execution.* Describe briefly how to perform the alternative procedure and recommend a level of training an operator should have to achieve acceptable results. Summarize the installation, calibration, operation, and maintenance procedures in a step-by-step format. Describe how any calibration is performed using NIST-traceable standards or other similar standards we approve. Calibration must be specified by using known quantities and must not be specified as a comparison with other allowed procedures.

(4) *Data-collection techniques.* Compare measured emission results using the proposed alternative procedure and the specified procedure, as follows:

(i) Both procedures must be calibrated independently to NIST-traceable standards or to other similar standards we approve.

(ii) Include measured emission results from all applicable duty cycles. Measured emission results should show that the test engine meets all applicable emission standards according to specified procedures.

(iii) Use statistical methods to evaluate the emission measurements, such as those described in paragraph (e) of this section.

(e) Absent any other directions from us, use a *t*-test and an *F*-test calculated according to § 1065.602 to evaluate whether your proposed alternative procedure is equivalent to the specified procedure. We may give you specific directions regarding methods for statistical analysis, or we may approve other methods that you propose. Such alternative methods may be more or less stringent than those specified in this paragraph (e). In determining the appropriate statistical criteria, we will consider the repeatability of measurements made with the reference procedure. For example, less stringent statistical criteria may be appropriate for measuring emission levels being so low that they adversely affect the repeatability of reference measurements. We recommend that you consult a statistician if you are unfamiliar with these statistical tests. Perform the tests as follows:

(1) Repeat measurements for all applicable duty cycles at least seven times for each procedure. You may use laboratory duty cycles to evaluate field-testing procedures. Be sure to include all available results to evaluate the precision and accuracy of the proposed

alternative procedure, as described in § 1065.2.

(2) Demonstrate the accuracy of the proposed alternative procedure by showing that it passes a two-sided *t*-test. Use an unpaired *t*-test, unless you show that a paired *t*-test is appropriate under both of the following provisions:

(i) For paired data, the population of the paired differences from which you sampled paired differences must be independent. That is, the probability of any given value of one paired difference is unchanged by knowledge of the value of another paired difference. For example, your paired data would violate this requirement if your series of paired differences showed a distinct increase or decrease that was dependent on the time at which they were sampled.

(ii) For paired data, the population of paired differences from which you sampled the paired differences must have a normal (*i.e.,* Gaussian) distribution. If the population of paired difference is not normally distributed, consult a statistician for a more appropriate statistical test, which may include transforming the data with a mathematical function or using some kind of non-parametric test.

(3) Show that t is less than the critical t value, t_{crit}, tabulated in § 1065.602, for the following confidence intervals:

(i) 90% for a proposed alternative procedure for laboratory testing.

(ii) 95% for a proposed alternative procedure for field testing.

(4) Demonstrate the precision of the proposed alternative procedure by showing that it passes an *F*-test. Use a set of at least seven samples from the reference procedure and a set of at least seven samples from the alternative procedure to perform an *F*-test. The sets must meet the following requirements:

(i) Within each set, the values must be independent. That is, the probability of any given value in a set must be unchanged by knowledge of another value in that set. For example, your data would violate this requirement if a set showed a distinct increase or decrease that was dependent upon the time at which they were sampled.

(ii) For each set, the population of values from which you sampled must have a normal (*i.e.,* Gaussian) distribution. If the population of values is not normally distributed, consult a statistician for a more appropriate statistical test, which may include transforming the data with a mathematical function or using some kind of non-parametric test.

(iii) The two sets must be independent of each other. That is, the probability of any given value in one set must be unchanged by knowledge of another value in the other set. For example, your data would violate this requirement if one value in a set showed a distinct increase or decrease that was dependent upon a value in the other set. Note that a trend of emission changes from an engine would not violate this requirement.

(iv) If you collect paired data for the paired *t*-test in paragraph (e)(2) in this section, use caution when selecting sets from paired data for the *F*-test. If you do this, select sets that do not mask the precision of the measurement procedure. We recommend selecting such sets only from data collected using the same engine, measurement instruments, and test cycle.

(5) Show that F is less than the critical F value, F_{crit}, tabulated in § 1065.602. If you have several *F*-test results from several sets of data, show that the mean *F*-test value is less than the mean critical F value for all the sets. Evaluate F_{crit}, based on the following confidence intervals:

(i) 90% for a proposed alternative procedure for laboratory testing.

(ii) 95% for a proposed alternative procedure for field testing.

■ 80. Amend § 1065.140 by adding paragraph (b)(2)(vi) to read as follows:

§ 1065.140 Dilution for gaseous and PM constituents.

* * * * *

(b) * * *

(2) * * *

(vi) You may use the provisions in 40 CFR 1066.110(b)(2)(i).

* * * * *

■ 81. Amend § 1065.201 by revising paragraph (b) to read as follows:

§ 1065.201 Overview and general provisions.

* * * * *

(b) *Instrument types.* You may use any of the specified instruments as described in this subpart to perform emission tests. If you want to use one of these instruments in a way that is not specified in this subpart, or if you want to use a different instrument, you must first get us to approve your alternative procedure under § 1065.10. Where we specify more than one instrument for a particular measurement, we may identify which instrument serves as the reference for comparing with an alternative procedure. You may generally use instruments with compensation algorithms that are functions of other gaseous measurements and the known or assumed fuel properties for the test fuel. The target value for any compensation algorithm is 0% (that is, no bias high and no bias low), regardless of the uncompensated signal's bias.

* * * * *

■ 82. Amend § 1065.225 by revising paragraph (a) to read as follows:

§ 1065.225 Intake-air flow meter.

(a) *Application.* You may use intake-air flow meters in combination with a chemical balance of fuel, DEF, intake air, and raw exhaust to calculate raw exhaust flow as described in § 1065.655(f) and (g). You may also use intake-air flow meters to determine the amount of intake air input for performing carbon balance error verification in § 1065.543 and to calculate the measured amount of intake air, n_{int}, as described in § 1065.643. The following provisions apply for using intake-air flow meters:

(1) Use the actual value of calculated raw exhaust in the following cases:

(i) For multiplying raw exhaust flow rate with continuously sampled concentrations.

(ii) For multiplying total raw exhaust flow with batch-sampled concentrations.

(iii) For verifying minimum dilution ratio for PM batch sampling as described in § 1065.546.

(iv) For calculating the dilution air flow for background correction as described in § 1065.667.

(2) In the following cases, you may use an intake-air flow meter signal that does not give the actual value of raw exhaust, as long as it is linearly proportional to the exhaust flow rate's actual calculated value:

(i) For feedback control of a proportional sampling system, such as a partial-flow dilution system.

(ii) For multiplying with continuously sampled gas concentrations, if the same signal is used in a chemical-balance calculation to determine work from brake-specific fuel consumption and fuel consumed.

* * * * *

■ 83. Amend § 1065.248 by:

■ a. Adding an undesignated center heading ''CO AND CO_2 MEASUREMENTS'' immediately before § 1065.248 section heading; and

■ b. After paragraph (b), removing the undesignated text ''CO AND CO_2 MEASUREMENTS''.

■ 84. Amend § 1065.257 by revising paragraph (d) to read as follows:

§ 1065.257 H_2O measurement devices.

* * * * *

(d) *Interference verification.* Certain compounds can interfere with FTIR and laser infrared analyzers by causing a response similar to water. Perform

interference verification for the following interference species:

(1) Perform CO_2 interference verification for FTIR analyzers using the procedures of § 1065.357. Use good engineering judgment to determine other interference species for FTIR analyzers when performing interference verification. Consider at least CO, NO, C_2H_4, and C_7H_8. Perform interference verifications using the procedures of § 1065.357, replacing occurrences of CO_2 with each targeted interference species. Determine interference species under this paragraph (d)(1) that are appropriate for each H_2O infrared absorption band, or you may identify the interference species based on the instrument manufacturer's recommendations.

(2) Perform interference verification for laser infrared analyzers using the procedures of § 1065.358. Use good engineering judgment to determine interference species for laser infrared analyzers. Note that interference species are dependent on the H_2O infrared absorption band chosen by the instrument manufacturer. For each analyzer determine the H_2O infrared absorption band. Determine interference species under this paragraph (d)(2) that are appropriate for each H_2O infrared absorption band, or you may identify the interference species based on the instrument manufacturer's recommendations.

■ 85. Remove the undesignated center heading ''HYDROCARBON MEASUREMENTS'' immediately before § 1065.260 section heading.

■ 86. Amend § 1065.267 by revising paragraph (a) to read as follows:

§ 1065.267 Gas chromatograph with a flame ionization detector.

(a) *Application.* You may use a gas chromatograph with a flame ionization detector (GC–FID) to measure CH_4 and C_2H_6 concentrations of diluted exhaust for batch sampling. While you may also use a nonmethane cutter to measure CH_4, as described in § 1065.265, use a reference procedure based on a gas chromatograph for comparison with any proposed alternative measurement procedure under § 1065.10.

* * * * *

■ 87. Amend § 1065.270 by revising paragraph (a) to read as follows:

§ 1065.270 Chemiluminescent NO_X analyzer.

(a) *Application.* You may use a chemiluminescent detector (CLD) to measure NO_X concentration in raw or diluted exhaust for batch or continuous sampling. We generally accept a CLD for NO_X measurement, even though it measures only NO and NO_2, when coupled with an NO_2-to-NO converter, since conventional engines and aftertreatment systems do not emit significant amounts of NO_X species other than NO and NO_2. Measure other NO_X species if required by the standard-setting part. While you may also use other instruments to measure NO_X, as described in § 1065.272, use a reference procedure based on a chemiluminescent detector for comparison with any proposed alternative measurement procedure under § 1065.10.

* * * * *

■ 88. Amend § 1065.290 by revising paragraph (b) to read as follows:

§ 1065.290 PM gravimetric balance.

* * * * *

(b) *Component requirements.* We recommend that you use a balance that meets the specifications in Table 1 of § 1065.205. Note that your balance-based system must meet the linearity verification in § 1065.307. If the balance uses internal calibration weights for routine spanning and the weights do not meet the specifications in § 1065.790, the weights must be verified independently with external calibration weights meeting the requirements of § 1065.790. While you may also use an inertial balance to measure PM, as described in § 1065.295, use a reference procedure based on a gravimetric balance for comparison with any proposed alternative measurement procedure under § 1065.10.

* * * * *

■ 89. Revise and republish § 1065.303 to read as follows:

§ 1065.303 Summary of required calibration and verifications.

The following table summarizes the required and recommended calibrations and verifications described in this subpart and indicates when these have to be performed:

TABLE 1 OF § 1065.303—SUMMARY OF REQUIRED CALIBRATION AND VERIFICATIONS

Type of calibration or verification	Minimum frequency [a]
§ 1065.305: Accuracy, repeatability and noise	*Accuracy:* Not required, but recommended for initial installation. *Repeatability:* Not required, but recommended for initial installation. *Noise:* Not required, but recommended for initial installation.
§ 1065.307: Linearity verification	*Speed:* Upon initial installation, within 370 days before testing and after major maintenance. *Torque:* Upon initial installation, within 370 days before testing and after major maintenance. In the case of torque measurement transducers and systems that are shipped off-site for linearity verification, the linearity verification is required within 370 days before testing, plus up to an additional 185 days before testing to store and transport calibrated equipment that is stored in a controlled environment. *Electrical power, current, and voltage:* Upon initial installation, within 370 days before testing and after major maintenance.[b] *Fuel mass flow rate:* Upon initial installation, within 370 days before testing, and after major maintenance. *Fuel mass scale:* Upon initial installation, within 370 days before testing, and after major maintenance. *DEF mass flow rate:* Upon initial installation, within 370 days before testing, and after major maintenance.[c] *DEF mass scale:* Upon initial installation, within 370 days before testing, and after major maintenance. *Intake-air, dilution air, diluted exhaust, and batch sampler flow rates:* Upon initial installation, within 370 days before testing and after major maintenance.[d] *Raw exhaust flow rate:* Upon initial installation, within 185 days before testing and after major maintenance.[d] *Gas dividers:* Upon initial installation, within 370 days before testing, and after major maintenance.

TABLE 1 OF § 1065.303—SUMMARY OF REQUIRED CALIBRATION AND VERIFICATIONS—Continued

Type of calibration or verification	Minimum frequency [a]
	Gas analyzers (unless otherwise noted): Upon initial installation, within 35 days before testing and after major maintenance. *FTIR, H_2O laser infrared analyzers, and photoacoustic analyzers:* Upon initial installation, within 370 days before testing and after major maintenance. *GC–ECD:* Upon initial installation and after major maintenance. *PM balance:* Upon initial installation, within 370 days before testing and after major maintenance. *Pressure, temperature, and dewpoint:* Upon initial installation, within 370 days before testing and after major maintenance.
§ 1065.308: Continuous gas analyzer system response and updating-recording verification—for gas analyzers not continuously compensated for other gas species.	Upon initial installation or after system modification that would affect response.
§ 1065.309: Continuous gas analyzer system-response and updating-recording verification—for gas analyzers continuously compensated for other gas species.	Upon initial installation or after system modification that would affect response.
§ 1065.310: Torque	Upon initial installation and after major maintenance.
§ 1065.315: Pressure, temperature, dewpoint	Upon initial installation and after major maintenance.
§ 1065.320: Fuel flow	Upon initial installation and after major maintenance.
§ 1065.325: Intake flow	Upon initial installation and after major maintenance.
§ 1065.330: Exhaust flow	Upon initial installation and after major maintenance.
§ 1065.340: Diluted exhaust flow (CVS)	Upon initial installation and after major maintenance.
§ 1065.341: CVS and PFD flow verification (propane check).	Upon initial installation, within 35 days before testing, and after major maintenance.[e]
§ 1065.342 Sample dryer verification	For thermal chillers: upon installation and after major maintenance. For osmotic membranes; upon installation, within 35 days of testing, and after major maintenance.
§ 1065.345: Vacuum leak	For laboratory testing: upon initial installation of the sampling system, within 8 hours before the start of the first test interval of each duty-cycle sequence, and after maintenance such as pre-filter changes. For field testing: after each installation of the sampling system on the vehicle, prior to the start of the field test, and after maintenance such as pre-filter changes.
§ 1065.350: CO_2 NDIR H_2O interference	Upon initial installation and after major maintenance.
§ 1065.355: CO NDIR CO_2 and H_2O interference	Upon initial installation and after major maintenance.
§ 1065.357: H_2O FTIR interference	Upon initial installation and after major maintenance.
§ 1065.358: H_2O LIA interference	Upon initial installation and after major maintenance.
§ 1065.360: FID calibration	Calibrate all FID analyzers: upon initial installation and after major maintenance.
THC FID optimization, and THC FID verification	Optimize and determine CH_4 response for THC FID analyzers: upon initial installation and after major maintenance. Verify CH_4 response for THC FID analyzers: upon initial installation, within 185 days before testing, and after major maintenance. Verify C_2H_6 response for THC FID analyzers if used for NMNEHC determination: upon initial installation, within 185 days before testing, and after major maintenance.
§ 1065.362: Raw exhaust FID O_2 interference	For all FID analyzers: upon initial installation, and after major maintenance. For THC FID analyzers: upon initial installation, after major maintenance, and after FID optimization according to § 1065.360.
§ 1065.365: Nonmethane cutter penetration	Upon initial installation, within 185 days before testing, and after major maintenance.
§ 1065.366: Interference verification for FTIR analyzers	Upon initial installation and after major maintenance.
§ 1065.369: H_2O, CO, and CO_2 interference verification for ethanol photoacoustic analyzers.	Upon initial installation and after major maintenance.
§ 1065.370: CLD CO_2 and H_2O quench	Upon initial installation and after major maintenance.
§ 1065.372: NDUV HC and H_2O interference	Upon initial installation and after major maintenance.
§ 1065.375: N_2O analyzer interference	Upon initial installation and after major maintenance.
§ 1065.376: Chiller NO_2 penetration	Upon initial installation and after major maintenance.
§ 1065.377: Interference verification for NH3 analyzers	Upon initial installation and after major maintenance.
§ 1065.378: NO_2-to-NO converter conversion	Upon initial installation, within 35 days before testing, and after major maintenance.
§ 1065.390: PM balance and weighing	*Independent verification:* upon initial installation, within 370 days before testing, and after major maintenance. Zero, span, and reference sample verifications: within 12 hours of weighing, and after major maintenance.
§ 1065.395: Inertial PM balance and weighing	Independent verification: upon initial installation, within 370 days before testing, and after major maintenance. Other verifications: upon initial installation and after major maintenance.

[a] Perform calibrations and verifications more frequently than we specify, according to measurement system manufacturer instructions and good engineering judgment.

[b] Perform linearity verification either for electrical power or for current and voltage.

[c] Linearity verification is not required if DEF flow rate comes directly from the ECM signal as described in § 1065.247(b).

[d] Linearity verification is not required if the flow signal's accuracy is verified by carbon balance error verification as described in § 1065.307(e)(5) or a propane check as described in § 1065.341.

[e] CVS and PFD flow verification (propane check) is not required for measurement systems verified by linearity verification as described in § 1065.307 or carbon balance error verification as described in § 1065.341(h).

■ 90. Amend § 1065.308 by revising paragraphs (b) and (g) introductory text to read as follows:

§ 1065.308 Continuous gas analyzer system-response and updating-recording verification—for gas analyzers not continuously compensated for other gas species.

* * * * *

(b) *Measurement principles.* This test verifies that the updating and recording frequencies match the overall system response to a rapid change in the value of concentrations at the sample probe. Gas analyzers and their sampling systems must be optimized such that their overall response to a rapid change in concentration is updated and recorded at an appropriate frequency to prevent loss of information. This test also verifies that the measurement system meets a minimum response time. You may use the results of this test to determine transformation time, t_{50}, for the purposes of time alignment of continuous data in accordance with § 1065.650(c)(2)(i). You may also use an alternative procedure to determine t_{50} in accordance with good engineering judgment. Note that any such procedure for determining t_{50} must account for both transport delay and analyzer response time.

* * * * *

(g) *Optional procedure.* Instead of using a three-way valve to switch between zero and span gases, you may use a fast-acting two-way valve to switch sampling between ambient air and span gas at the probe inlet. For this alternative procedure, the following provisions apply:

* * * * *

■ 91. Amend § 1065.309 by revising paragraph (b) to read as follows:

§ 1065.309 Continuous gas analyzer system-response and updating-recording verification—for gas analyzers continuously compensated for other gas species.

* * * * *

(b) *Measurement principles.* This procedure verifies that the updating and recording frequencies match the overall system response to a rapid change in the value of concentrations at the sample probe. It indirectly verifies the time-alignment and uniform response of all the continuous gas detectors used to generate a continuously combined/compensated concentration measurement signal. Gas analyzer systems must be optimized such that their overall response to rapid change in concentration is updated and recorded at an appropriate frequency to prevent loss of information. This test also verifies that the measurement system meets a minimum response time. For this procedure, ensure that all compensation algorithms and humidity corrections are turned on. You may use the results of this test to determine transformation time, t_{50}, for the purposes of time alignment of continuous data in accordance with § 1065.650(c)(2)(i). You may also use an alternative procedure to determine t_{50} consistent with good engineering judgment. Note that any such procedure for determining t_{50} must account for both transport delay and analyzer response time.

* * * * *

■ 92. Amend § 1065.340 by revising paragraph (h)(5) to read as follows:

§ 1065.340 Diluted exhaust flow (CVS) calibration.

* * * * *

(h) * * *

(5) Set the variable restrictor to its wide-open position. Instead of a variable restrictor, you may alternatively vary the pressure downstream of the CFV by varying blower speed or by introducing a controlled leak. Note that some blowers have limitations on nonloaded conditions.

* * * * *

■ 93. Amend § 1065.342 by revising paragraph (e) to read as follows:

§ 1065.342 Sample dryer verification.

* * * * *

(e) *Alternative sample dryer verification procedure.* The following method may be used in place of the sample dryer verification procedure in (d) of this section. If you use a humidity sensor for continuous monitoring of dewpoint at the sample dryer outlet you may skip the performance check in § 1065.342(d), but you must make sure that the dryer outlet humidity is at or below the minimum value used for quench, interference, and compensation checks.

■ 94. Add § 1065.358 to subpart D immediately before the center heading ''Hydrocarbon Measurements'' to read as follows:

§ 1065.358 Interference verification for H_2O Laser Infrared Analyzer.

(a) *Scope and frequency.* If you measure H_2O using a laser infrared analyzer, verify the amount of interference after initial analyzer installation and after major maintenance.

(b) *Measurement principles.* Certain compounds can positively interfere with analyzers by causing a response similar to H_2O. If the analyzer uses compensation algorithms that rely on measurements of other gases to meet this interference verification, a correct result depends on simultaneously conducting these other measurements to test the compensation algorithms during the analyzer interference verification.

(c) *System requirements.* A H_2O laser infrared analyzer must have a combined interference that is within (0.0 ± 0.4) mmol/mol, though we strongly recommend a lower interference that is within (0.0 ± 0.2) mmol/mol.

(d) *Procedure.* Perform the interference verification as follows:

(1) Start, operate, zero, and span the H_2O laser infrared analyzer as you would before an emission test.

(2) Flow a multi-component span gas that incorporates the target interference species and meets the specifications in § 1065.750 at the analyzer inlet. Use interference span gas concentrations that are at least as high as the maximum expected during testing.

(3) Allow time for the analyzer response to stabilize. Stabilization time may include time to purge the transfer line and account for analyzer response.

(4) Record the analyzer output for 30 seconds while it measures the sample's concentration. Calculate the arithmetic mean of this data. When performed with all the gases simultaneously, this is the combined interference.

(5) The analyzer meets the interference verification if the result of paragraph (d)(4) of this section meets the tolerance in paragraph (c) of this section.

(6) You may instead perform interference verification procedures separately for individual interference species. The system requirement specified in paragraph (c) of this section applies based on the sum of the interference values from separate interference species. If the concentration of any interference species used is higher than the maximum levels expected during testing, you may scale down each observed interference value by multiplying the observed interference value by the ratio of the maximum expected concentration value to the concentration in the span gas. The sum of the scaled interference values must meet the tolerance for combined interference as specified in paragraph (c) of this section.

■ 95. Amend § 1065.360 by revising paragraph (b) to read as follows:

§ 1065.360 FID optimization and verification.

* * * * *

(b) *Calibration.* Use good engineering judgment to develop a calibration procedure, such as one based on the FID-analyzer manufacturer's instructions and recommended

frequency for calibrating the FID. Alternatively, you may remove system components for off-site calibration. For a FID that measures THC, calibrate using C_3H_8 calibration gases that meet the specifications of § 1065.750. For a FID that measures CH_4, calibrate using CH_4 calibration gases that meet the specifications of § 1065.750. We recommend FID analyzer zero and span gases that contain approximately the flow-weighted mean concentration of O_2 expected during testing. If you use a FID to measure CH_4 downstream of a nonmethane cutter (NMC), you may calibrate that FID using CH_4 calibration gases with the NMC. Regardless of the calibration gas composition, calibrate on a carbon number basis of one (C_1). For example, if you use a C_3H_8 span gas of concentration 200 µmol/mol, span the FID to respond with a value of 600 µmol/mol. As another example, if you use a CH_4 span gas with a concentration of 200 µmol/mol, span the FID to respond with a value of 200 µmol/mol.

* * * * *

■ 96. Amend § 1065.390 by revising paragraph (d) introductory text to read as follows:

§ 1065.390 PM balance verifications and weighing process verification.

* * * * *

(d) *Reference sample weighing.* Verify all mass readings during a weighing session by weighing reference PM sample media (*e.g.* filters) before and after a weighing session. A weighing session may be as short as desired, but no longer than 80 hours, and may include both pre-test and post-test mass readings. We recommend that weighing sessions be eight hours or less. Successive mass determinations of each reference PM sample media (*e.g.,* filter) must return the same value within ±5 µg or ±10% of the net PM mass expected at the standard (if known), whichever is higher. If successive reference PM sample media (*e.g.* filter) weighing events fail this criterion, invalidate all individual test media (*e.g.,* filter) mass readings occurring between the successive reference media (*e.g.,* filter) mass determinations. You may reweigh these media (*e.g.* filter) in another weighing session. If you invalidate a pre-test media (*e.g.* filter) mass determination, that test interval is void. Perform this verification as follows:

* * * * *

■ 97. Amend § 1065.510 by revising paragraphs (f)(3)(iii) and (h) to read as follows:

§ 1065.510 Engine mapping.

* * * * *

(f) * * *

(3) * * *

(iii) For electronically governed variable-speed engines, you may use a declared warm high-idle speed for calculating the alternative maximum test speed as specified in § 1065.610.

* * * * *

(h) *Other mapping procedures.* You may use other mapping procedures if you believe the procedures specified in this section are unsafe or unrepresentative for your engine. Any alternative techniques you use must satisfy the intent of the specified mapping procedures, which is to determine the maximum available torque at all engine speeds that occur during a duty cycle. Identify any deviations from this section's mapping procedures when you submit data to us.

■ 98. Amend § 1065.514 by revising paragraph (b) to read as follows:

§ 1065.514 Cycle-validation criteria for operation over specified duty cycles.

* * * * *

(b) *Testing performed by manufacturers.* Emission tests that meet the specifications of paragraph (f) of this section satisfy the standard-setting part's requirements for duty cycles. You may ask to use a dynamometer or other laboratory equipment that cannot meet those specifications. We will approve your request as long as using the alternative equipment does not adversely affect your ability to show compliance with the applicable emission standards.

* * * * *

■ 99. Amend § 1065.520 by revising paragraph (g)(9) to read as follows:

§ 1065.520 Pre-test verification procedures and pre-test data collection.

* * * * *

(g) * * *

(9) If corrective action does not resolve the deficiency, you may request to use the contaminated system as an alternative procedure under § 1065.10.

■ 100. Amend § 1065.530 by:

■ a. Removing paragraph (b)(8);

■ b. Redesignating paragraphs (b)(9)–(12) as paragraphs (b)(8)–(11), respectively; and

■ c. Revising paragraph (c).

The revision reads as follows:

§ 1065.530 Emission test sequence.

* * * * *

(c) Start and run each test interval as described in this paragraph (c). The procedure varies depending on whether the test interval is part of a discrete-mode cycle, and whether the test interval includes engine starting. Note that the standard-setting part may apply different requirements for running test intervals. For example, 40 CFR part 1033 specifies a different way to perform discrete-mode testing.

(1) For steady-state discrete-mode duty cycles, start the duty cycle with the engine warmed-up and running as described in § 1065.501(c)(2)(i). Run each mode in the sequence specified in the standard-setting part. This will require controlling engine speed, engine load, or other operator demand settings as specified in the standard-setting part. Simultaneously start continuous data recording and batch sampling. We recommend that you stabilize the engine for at least 5 minutes for each mode. Once sampling begins, sample continuously for at least 1 minute. Note that longer sample times may be needed for accurately measuring very low emission levels.

(2) For transient and steady-state ramped-modal duty cycles that do not include engine starting, start the test interval with the engine running as soon as practical after completing engine preconditioning. Simultaneously start continuous data recording, batch sampling, and execution of the duty cycle.

(3) If engine starting is part of the test interval, simultaneously start continuous data recording and batch sampling before attempting to start the engine. Initiate the sequence of points in the duty cycle when the engine starts.

(4) For batch sampling systems, you may advance or delay the start and end of sampling at the beginning and end of the test interval to improve the accuracy of the batch sample, consistent with good engineering judgment.

* * * * *

■ 101. Amend § 1065.550 by revising paragraphs (b)(2) introductory text and (b)(3) to read as follows:

§ 1065.550 Gas analyzer range verification and drift verification.

* * * * *

(b) * * *

(2) Drift verification requires two sets of emission calculations. For each set of calculations, include all the constituents in the drift verification. Calculate one set using the data before drift correction and calculate the other set after correcting all the data for drift according to § 1065.672. Note that for purposes of drift verification, you must leave unaltered any negative emission values over a given test interval (*i.e.,* do not set them to zero). These unaltered values are used when verifying either test interval values or composite emission values over the entire duty cycle for drift. For each constituent to be verified,

both sets of calculations must include the following:

* * * * *

(3) The duty cycle is verified for drift if you satisfy the following criteria:

(i) For each regulated gaseous exhaust constituent, you must satisfy one of the following:

(A) For each test interval of the duty cycle, the difference between the uncorrected and the corrected emission values of the regulated constituent must be within ±4% of the uncorrected value or the applicable emissions standard, whichever is greater. Alternatively, the difference between the uncorrected and the corrected emission mass (or mass rate) values of the regulated constituent must be within ±4% of the uncorrected value or the composite work (or power) multiplied by the applicable emissions standard, whichever is greater. For purposes of verifying each test interval, you may use either the reference or actual composite work (or power).

(B) For each test interval of the duty cycle and for each mass subcomponent of the regulated constituent, the difference between the uncorrected and the corrected emission values must be within ±4% of the uncorrected value. Alternatively, the difference between the uncorrected and the corrected emissions mass (or mass rate) values must be within ±4% of the uncorrected value.

(C) For the entire duty cycle, the difference between the uncorrected and the corrected composite emission values of the regulated constituent must be within ±4% of the uncorrected value or applicable emission standard, whichever is greater.

(D) For the entire duty cycle and for each subcomponent of the regulated constituent, the difference between the uncorrected and the corrected composite emission values must be within ±4% of the uncorrected value.

(ii) Where no emission standard applies for CO_2, H_2, O_2, H_2O, and NH_3, you must satisfy one of the following:

(A) For each test interval of the duty cycle, the difference between the uncorrected and the corrected CO_2, H_2, O_2, H_2O, or NH_3 values must be within ±4% of the uncorrected value; or the difference between the uncorrected and the corrected CO_2, H_2, O_2, H_2O, or NH_3 mass (or mass rate) values must be within ±4% of the uncorrected value.

(B) For the entire duty cycle, the difference between the uncorrected and the corrected composite CO_2, H_2, O_2, H_2O, or NH_3 values must be within ±4% of the uncorrected value.

* * * * *

■ 102. Amend § 1065.610 by revising paragraph (a)(2) to read as follows:

§ 1065.610 Duty cycle generation.

* * * * *

(a) * * *

(2) For engines with a high-speed governor that will be subject to a reference duty cycle that specifies normalized speeds greater than 100%, calculate an alternative maximum test speed, $f_{ntest,alt}$, as specified in this paragraph (a)(2). If $f_{ntest,alt}$ is less than the measured maximum test speed, f_{ntest}, determined in paragraph (a)(1) of this section, replace f_{ntest} with $f_{ntest,alt}$. In this case, $f_{ntest,alt}$ becomes the ''maximum test speed'' for that engine for all duty cycles. Note that § 1065.510 allows you to apply an optional declared maximum test speed to the final measured maximum test speed determined as an outcome of the comparison between fntest, and $f_{ntest,alt}$ in this paragraph (a)(2). Determine $f_{ntest,alt}$ as follows:

$$f_{ntest,alt} = \frac{f_{nhi,idle} - f_{nidle}}{\%\ speed_{max}} + f_{nidle}$$

Eq. 1065.610-2

Where:

$f_{ntest,alt}$ = alternative maximum test speed
$f_{nhi,idle}$ = warm high-idle speed
f_{nidle} = warm idle speed
$\%\ speed_{max}$ = maximum normalized speed from duty cycle

Example:

$f_{nhi,idle}$ = 2200 r/min
f_{nidle} = 800 r/min
$\%\ speed_{max}$ = 105% (Nonroad CI Transient Cycle) = 1.05

$$f_{ntest,alt} = \frac{2200 - 800}{1.05} + 800$$

$f_{ntest,alt}$ = 2133 r/min

* * * * *

■ 103. Amend § 1065.640 by revising paragraphs (a), (c)(5)(iv), and (d)(1) to read as follows:

§ 1065.640 Flow meter calibration calculations.

* * * * *

(a) *Reference meter conversions.* The calibration equations in this section use molar flow rate, $\dot{n}_{ref}$, as a reference quantity. If your reference meter outputs a flow rate in a different quantity, such as standard volume rate, $\dot{V}_{stdref}$, actual volume rate, $\dot{V}_{actref}$, or mass rate, $\dot{m}_{ref}$, convert your reference meter output to a molar flow rate using the following equations, noting that while values for volume rate, mass rate, pressure, temperature, and molar mass may change during an emission test, you should ensure that they are as constant as practical for each individual set point during a flow meter calibration:

$$\dot{n}_{ref} = \frac{\dot{V}_{stdref} \cdot p_{std}}{T_{std} \cdot R} = \frac{\dot{V}_{actref} \cdot p_{act}}{T_{act} \cdot R} = \frac{\dot{m}_{ref}}{M_{mix}}$$

Eq. 1065.640-1

Where:

$\dot{n}_{ref}$ = reference molar flow rate.
$\dot{V}_{stdref}$ = standard volume flow rate output by the reference flow meter at a standard pressure and standard temperature.
$\dot{V}_{actref}$ = actual volume flow rate output by the reference flow meter.
$\dot{m}_{ref}$ = mass flow rate output by the reference flow meter.
p_{std} = standard pressure used by the reference flow meter.
p_{act} = actual pressure of the flow rate.
T_{std} = standard temperature used by the reference flow meter.
R = molar gas constant.
M_{mix} = molar mass of the flow rate.

Example 1:

$\dot{V}_{stdref}$ = 1000.00 ft^3/min = 0.471948 m^3/s

p_{std} = 29.9213 in Hg @32 °F = 101.325 kPa = 101325 Pa = 101325 kg/(m·s^2)

T_{std} = 68.0 °F = 293.15 K

R = 8.314472 J/(mol·K) = 8.314472 (m^2·kg)/(s^2·mol·K)

$$\dot{n}_{ref} = \frac{0.471948 \cdot 101325}{293.15 \cdot 8.314472}$$

$\dot{n}_{ref}$ = 19.619 mol/s

Example 2:

$\dot{m}_{ref}$ = 17.2683 kg/min = 287.805 g/s
M_{mix} = 28.7805 g/mol

$$\dot{n}_{ref} = \frac{287.805}{28.7805}$$

$\dot{n}_{ref}$ = 10.0000 mol/s

* * * * *

(c) * * *

(5) * * *

(iv) For diluted exhaust and dilution air, you may assume the molar mass of the mixture, M_{mix}, is a function only of the amount of water in the dilution air or calibration air, as follows:

$$M_{mix} = M_{air} \cdot (1 - x_{H2O}) + M_{H2O} \cdot x_{H2O}$$

Eq. 1065.640-9

Where:

M_{air} = molar mass of dry air.

χ_{H2O} = amount of H_2O in the dilution air or calibration air, determined as described in § 1065.645.

M_{H2O} = molar mass of water.

Example:

M_{air} = 28.96623 g/mol

χ_{H2O} = 0.0169 mol/mol

M_{H2O} = 18.01528 g/mol

M_{mix} = 28.96623 · (1–0.0169) + 18.01528 · 0.0169

M_{mix} = 28.7812 g/mol

* * * * *

(d) * * *

(1) Calculate the Reynolds number, $Re^{\#}$, for each reference molar flow rate, $\dot{n}_{ref}$, using the throat diameter of the venturi, d_t. Because the dynamic viscosity, μ, is needed to compute $Re^{\#}$, you may use your own fluid viscosity model to determine μ for your calibration gas (usually air), using good engineering judgment. Alternatively, you may use the Sutherland three-coefficient viscosity model to approximate μ, as shown in the following sample calculation for $Re^{\#}$:

$$Re^{\#} = \frac{4 \cdot M_{mix} \cdot \dot{n}_{ref}}{\pi \cdot d_t \cdot \mu}$$

Eq. 1065.640-10

Where, using the Sutherland three-coefficient viscosity model as captured in Table 4 of this section:

$$\mu = \mu_0 \cdot \left(\frac{T_{in}}{T_0}\right)^{\frac{3}{2}} \cdot \left(\frac{T_0 + S}{T_{in} + S}\right)$$

Eq. 1065.640-11

Where:

μ_0 = Sutherland reference viscosity.

T_0 = Sutherland reference temperature.

S = Sutherland constant.

TABLE 4 OF § 1065.640—SUTHERLAND THREE-COEFFICIENT VISCOSITY MODEL PARAMETERS

Gas [a]	μ_0	T_0	S	Temperature range within ±2% error [b]	Pressure limit [b]
	kg/(m·s)	K	K	K	kPa
Air	$1.716 \cdot 10^{-5}$	273	111	170 to 1900	≤ 1800
CO_2	$1.370 \cdot 10^{-5}$	273	222	190 to 1700	≤ 3600
H_2O	$1.12 \cdot 10^{-5}$	350	1064	360 to 1500	≤ 10000
O_2	$1.919 \cdot 10^{-5}$	273	139	190 to 2000	≤ 2500
N_2	$1.663 \cdot 10^{-5}$	273	107	100 to 1500	≤ 1600

[a] Use tabulated parameters only for the pure gases, as listed. Do not combine parameters in calculations to calculate viscosities of gas mixtures.

[b] The model results are valid only for ambient conditions in the specified ranges.

Example:

$\mu_0 = 1.716 \cdot 10^{-5}$ kg/(m·s)

T_0 = 273 K

S = 111 K

$$\mu = 1.716 \cdot 10^{-5} \cdot \left(\frac{298.15}{273}\right)^{\frac{3}{2}} \cdot \left(\frac{273 + 111}{298.15 + 111}\right)$$

$\mu = 1.838 \cdot 10^{-5}$ kg/(m·s)

M_{mix} = 28.7812 g/mol = 0.0287812 kg/mol

$\dot{n}_{ref}$ = 57.625 mol/s

d_t = 152.4 mm = 0.1524 m

T_{in} = 298.15 K

$$Re^{\#} = \frac{4 \cdot 0.0287812 \cdot 57.625}{3.14159 \cdot 0.1524 \cdot 1.838 \cdot 10^{-5}}$$

Re # = $7.538 \cdot 10^5$

* * * * *

■ 104. Amend § 1065.642 by revising paragraphs (b) and (c) to read as follows:

§ 1065.642 PDP, SSV, and CFV molar flow rate calculations.

* * * * *

(b) *SSV molar flow rate.* Calculate SSV molar flow rate, $\dot{n}$, as follows:

$$\dot{n} = C_d \cdot C_f \cdot \frac{A_t \cdot p_{in}}{\sqrt{Z \cdot M_{mix} \cdot R \cdot T_{in}}}$$

Eq. 1065.642-3

Where:

C_d = discharge coefficient, as determined based on the C_d versus $Re^{\#}$ equation in § 1065.640(d)(2).

C_f = flow coefficient, as determined in § 1065.640(c)(3)(ii).

A_t = venturi throat cross-sectional area.

p_{in} = static absolute pressure at the venturi inlet.

Z = compressibility factor.

M_{mix} = molar mass of gas mixture.

R = molar gas constant.

T_{in} = absolute temperature at the venturi inlet.

Example:

A_t = 0.01824 m^2

p_{in} = 99.132 kPa = 99132 Pa = 99132 kg/($m \cdot s^2$)

Z = 1

M_{mix} = 28.7812 g/mol = 0.0287812 kg/mol

R = 8.314472 J/(mol·K) = 8.314472 (m^2·kg)/(s^2·mol·K)

T_{in} = 298.15 K

$Re^{\#} = 7.232 \cdot 10^5$

γ = 1.399

β = 0.8

Δp = 2.312 kPa

Using Eq. 1065.640–7:

r_{ssv} = 0.997

Using Eq. 1065.640–6:

C_f = 0.274

Using Eq. 1065.640–5:

C_d = 0.990

$$\dot{n} = 0.990 \cdot 0.274 \cdot \frac{0.01824 \cdot 99132}{\sqrt{1 \cdot 0.0287812 \cdot 8.314472 \cdot 298.15}}$$

$\dot{n}$ = 58.067 mol/s

(c) *CFV molar flow rate.* If you use multiple venturis and you calibrate each venturi independently to determine a separate discharge coefficient, C_d (or calibration coefficient, K_v), for each venturi, calculate the individual molar flow rates through each venturi and sum all their flow rates to determine CFV flow rate, $\dot{n}$. If you use multiple venturis and you calibrated venturis in combination, calculate $\dot{n}$ using the sum of the active venturi throat areas as A_t, the square root of the sum of the squares of the active venturi throat diameters as d_t, and the ratio of the venturi throat to inlet diameters as the ratio of the square root of the sum of the active venturi throat diameters (d_t) to the diameter of the common entrance to all the venturis (D).

(1) To calculate $\dot{n}$ through one venturi or one combination of venturis, use its respective mean C_d and other constants you determined according to § 1065.640 and calculate $\dot{n}$ as follows:

$$\dot{n} = C_d \cdot C_f \cdot \frac{A_t \cdot p_{in}}{\sqrt{Z \cdot M_{mix} \cdot R \cdot T_{in}}}$$

Eq. 1065.642-4

Where:

C_f = flow coefficient, as determined in § 1065.640(c)(3).

Example:

C_d = 0.985

C_f = 0.7219

A_t = 0.00456 m^2

p_{in} = 98.836 kPa = 98836 Pa = 98836 kg/($m \cdot s^2$)

Z = 1

M_{mix} = 28.7812 g/mol = 0.0287812 kg/mol

R = 8.314472 J/(mol·K) = 8.314472 (m^2·kg)/(s^2·mol·K)

T_{in} = 378.15 K

$$\dot{n} = 0.985 \cdot 0.7219 \cdot \frac{0.00456 \cdot 98836}{\sqrt{1 \cdot 0.0287805 \cdot 8.314472 \cdot 378.15}}$$

$\dot{n}$ = 33.689 mol/s

(2) To calculate the molar flow rate through one venturi or a combination of venturis, you may use its respective mean, K_v, and other constants you determined according to § 1065.640 and calculate its molar flow rate $\dot{n}$ during an emission test. Note that if you follow the permissible ranges of dilution air dewpoint versus calibration air dewpoint in Table 3 of § 1065.640, you may set $M_{mix\text{-}cal}$ and M_{mix} equal to 1. Calculate $\dot{n}$ as follows:

$$\dot{n} = \frac{K_v \cdot p_{in}}{\sqrt{T_{in}}} \cdot \frac{p_{std}}{T_{std} \cdot R} \cdot \frac{\sqrt{M_{mix\text{-}cal}}}{\sqrt{M_{mix}}}$$

Eq. 1065.642-5

Where:

$$K_v = \frac{\dot{V}_{stdref} \cdot \sqrt{T_{in\text{-}cal}}}{p_{in\text{-}cal}}$$

Eq. 1065.642-6

$\dot{V}_{stdref}$ = standard volume flow rate output by the CFV CVS flow meter at a standard pressure and standard temperature.

$T_{in\text{-}cal}$ = venturi inlet temperature during calibration.

$P_{in\text{-}cal}$ = venturi inlet pressure during calibration.

$M_{mix\text{-}cal}$ = molar mass of gas mixture used during calibration.

M_{mix} = molar mass of gas mixture during the emission test calculated using Eq. 1065.640–9.

Example:

$\dot{V}_{stdref}$ = 0.4895 m^3/s

$T_{in\text{-}cal}$ = 302.52 K

$P_{in\text{-}cal}$ = 99.654 kPa = 99654 Pa = 99654 kg/($m \cdot s^2$)

p_{in} = 98.836 kPa = 98836 Pa = 98836 kg/($m \cdot s^2$)

p_{std} = 101.325 kPa = 101325 Pa = 101325 kg/($m \cdot s^2$)

$M_{mix\text{-}cal}$ = 28.9656 g/mol = 0.0289656 kg/mol

M_{mix} = 28.7812 g/mol = 0.0287812 kg/mol

T_{in} = 353.15 K

T_{std} = 293.15 K

R = 8.314472 J/(mol·K) = 8.314472 (m^2·kg)/(s^2·mol·K)

$$K_V = \frac{0.4895 \cdot \sqrt{302.52}}{99654} = 0.000074954 \ \frac{m^4 \cdot s \cdot K^{0.5}}{kg}$$

$$\dot{n} = \frac{0.000074954 \cdot 98936}{\sqrt{353.15}} \cdot \frac{101325}{293.15 \cdot 8.314472} \cdot \frac{\sqrt{0.0289656}}{\sqrt{0.0287812}}$$

$\dot{n}$ = 16.456 mol/s

■ 105. Amend § 1065.643 by revising paragraph (b) introductory text to read as follows:

§ 1065.643 Carbon balance error verification calculations.

* * * * *

(b) *Intake air.* Calculate the mass of carbon in the intake air, m_{Cair}, for each test interval using one of the methods in this paragraph (b). The methods are listed in order of preference. Use the first method where all the inputs are available for your test configuration. For methods that calculate m_{Cair} based on the amount of CO_2 per mole of intake air, we recommend measuring intake air concentration, but you may calculate χ_{CO2int} using Eq. 1065.655–10 and letting $\chi_{CO2intdry}$ = 428 μmol/mol.

* * * * *

■ 106. Amend § 1065.650 by revising paragraphs (d)(6) and (e)(2) to read as follows:

§ 1065.650 Emission calculations.

* * * * *

(d) * * *

(6) Set all power values to zero during idle periods with a corresponding denormalized reference torque of 0 N·m.

* * * * *

(e) * * *

(2) To calculate an engine's mean steady-state total power, $\overline{P}$, add the mean steady-state power from all the work paths described in § 1065.210 that cross the system boundary including electrical power, mechanical shaft power, and fluid pumping power. For all work paths, except the engine's primary output shaft (crankshaft), the mean steady-state power over the test interval is the integration of the net work flow rate (power) out of the system boundary divided by the period of the test interval. When power flows into the system boundary, the power/work flow rate signal becomes negative; in this case, include these negative power/work rate values in the integration to calculate the mean power from that work path. Some work paths may result in a negative mean power. Include negative mean power values from any work path in the mean total power from the engine rather than setting these values to zero. The rest of this paragraph (e)(2) describes how to calculate the mean power from the engine's primary output shaft. Calculate $\overline{P}$ using Eq. 1065.650–14, noting that $\overline{P}$, $\bar{f}_n$, and $\overline{T}$ refer to mean power, mean rotational shaft frequency, and mean torque from the primary output shaft. Account for the power of simulated accessories according to § 1065.110 (reducing the mean primary output shaft power or torque by the accessory power or torque). Set the power to zero during actual motoring operation (negative feedback torques), unless the engine was connected to one or more energy storage devices. Examples of such energy storage devices include hybrid powertrain batteries and hydraulic accumulators, like the ones denoted ''Acc.'' and ''Batt.'' as illustrated in Figure 1 of § 1065.210. Set the power to zero for modes with a zero reference load (0 N·m reference torque or 0 kW reference power). Include power during idle modes with simulated minimum torque or power.

$$\bar{P} = \bar{f}_n \cdot \bar{T}$$

Eq. 1065.650-14

* * * * *

■ 107. Amend § 1065.655 by revising paragraphs (c)(3) and (e)(1)(i) to read as follows:

§ 1065.655 Carbon-based chemical balances of fuel, DEF, intake air, and exhaust.

* * * * *

(c) * * *

(3) Use the following symbols and subscripts in the equations for performing the chemical balance calculations in this paragraph (c):

TABLE 1 OF § 1065.655—SYMBOLS AND SUBSCRIPTS FOR CHEMICAL BALANCE EQUATIONS

$\chi_{dil/exh}$	amount of dilution gas or excess air per mole of exhaust.
χ_{H2Oexh}	amount of H_2O in exhaust per mole of exhaust.
$\chi_{Ccombdry}$	amount of carbon from fuel and any injected fluids in the exhaust per mole of dry exhaust.
χ_{H2dry}	amount of H_2 in exhaust per amount of dry exhaust.
K_{H2Ogas}	water-gas reaction equilibrium coefficient; you may use 3.5 or calculate your own value using good engineering judgment.
$\chi_{H2Oexhdry}$	amount of H_2O in exhaust per dry mole of dry exhaust.
$\chi_{prod/intdry}$	amount of dry stoichiometric products per dry mole of intake air.
$\chi_{dil/exhdry}$	amount of dilution gas and/or excess air per mole of dry exhaust.
$\chi_{int/exhdry}$	amount of intake air required to produce actual combustion products per mole of dry (raw or diluted) exhaust.
$\chi_{raw/exhdry}$	amount of undiluted exhaust, without excess air, per mole of dry (raw or diluted) exhaust.
χ_{O2int}	amount of intake air O_2 per mole of intake air.
$\chi_{CO2intdry}$	amount of intake air CO_2 per mole of dry intake air; you may use $\chi_{CO2intdry}$ = 428 μmol/mol, but we recommend measuring the actual concentration in the intake air.
$\chi_{H2Ointdry}$	amount of intake air H_2O per mole of dry intake air.
χ_{CO2int}	amount of intake air CO_2 per mole of intake air.
χ_{CO2dil}	amount of dilution gas CO_2 per mole of dilution gas.
$\chi_{CO2dildry}$	amount of dilution gas CO_2 per mole of dry dilution gas; if you use air as diluent, you may use $\chi_{CO2dildry}$ = 428 μmol/mol, but we recommend measuring the actual concentration in the intake air.
$\chi_{H2Odildry}$	amount of dilution gas H_2O per mole of dry dilution gas.
χ_{H2Odil}	amount of dilution gas H_2O per mole of dilution gas.
$\chi_{[emission]meas}$	amount of measured emission in the sample at the respective gas analyzer.
$\chi_{[emission]dry}$	amount of emission per dry mole of dry sample.

TABLE 1 OF § 1065.655—SYMBOLS AND SUBSCRIPTS FOR CHEMICAL BALANCE EQUATIONS—Continued

$\chi_{H2O[emission]meas}$	amount of H_2O in sample at emission-detection location; measure or estimate these values according to § 1065.145(e)(2).
χ_{H2Oint}	amount of H_2O in the intake air, based on a humidity measurement of intake air.
α	atomic hydrogen-to-carbon ratio of the fuel (or mixture of test fuels) and any injected fluids.
β	atomic oxygen-to-carbon ratio of the fuel (or mixture of test fuels) and any injected fluids.
γ	atomic sulfur-to-carbon ratio of the fuel (or mixture of test fuels) and any injected fluids.
δ	atomic nitrogen-to-carbon ratio of the fuel (or mixture of test fuels) and any injected fluids.

* * * * *

(e) * * *

(1) * * *

(i) Determine the carbon and hydrogen mass fractions according to ASTM D5291 (incorporated by reference, see § 1065.1010). When using ASTM D5291 to determine carbon and hydrogen mass fractions of gasoline (with or without blended ethanol), use good engineering judgment to adapt the method as appropriate. This may include consulting with the instrument manufacturer on how to test high-volatility fuels. Allow the weight of volatile fuel samples to stabilize for 20 minutes before starting the analysis; if the weight still drifts after 20 minutes, prepare a new sample). Retest the sample if the carbon, hydrogen, oxygen, sulfur, and nitrogen mass fractions do not add up to a total mass of 100 ±0.5%; you may assume oxygen has a zero mass contribution for this specification for diesel fuel and neat (E0) gasoline. You may not normalize your mass fraction results to total 100%. You may also assume that sulfur and nitrogen have a zero mass contribution for this specification for all fuels except residual fuel blends.

* * * * *

■ 108. Amend § 1065.656 by revising entries for ''$x_{CO2intdry}$'' and ''$_{xCO2dildry}$'' in Table 1 to paragraph (c)(3) to read as follows:

§ 1065.656 Hydrogen-based chemical balances of fuel, DEF, intake air, and exhaust.

* * * * *

(c) * * *

(3) * * *

TABLE 1 TO PARAGRAPH (c)(3) OF § 1065.656—SYMBOLS AND SUBSCRIPTS FOR CHEMICAL BALANCE EQUATIONS

* * * * * * *	
$\chi_{CO2intdry}$	amount of intake air CO_2 per mole of dry intake air; you may use $\chi_{CO2intdry}$ = 428 μmol/mol, but we recommend measuring the actual concentration in the intake air.
* * * * * * *	
$\chi_{CO2dildry}$	Amount of dilution gas CO_2 per mole of dry dilution gas; if you use air as diluent, you may use $\chi_{CO2dildry}$ = 428 μmol/mol, but we recommend measuring the actual concentration in the dilution gas.
* * * * * * *	

* * * * *

■ 109. Amend § 1065.672 by revising paragraph (d)(7) to read as follows:

§ 1065.672 Drift correction.

* * * * *

(d) * * *

(7) Usually the reference concentration of the zero gas, $\chi_{refzero}$, is zero: $\chi_{refzero}$ = 0 μmol/mol. However, in some cases you might know that $\chi_{refzero}$ has a non-zero concentration. For example, if you zero a CO_2 analyzer using ambient air, you may use the default ambient air concentration of CO_2, which is 428 μmol/mol. In this case, $\chi_{refzero}$ = 428 μmol/mol. Note that when you zero an analyzer using a non-zero $\chi_{refzero}$, you must set the analyzer to output the actual $\chi_{refzero}$ concentration. For example, if $\chi_{refzero}$ = 428 μmol/mol, set the analyzer to output a value of 428 μmol/mol when the zero gas is flowing to the analyzer.

■ 110. Amend § 1065.695 by revising paragraphs (a), (c)(1) introductory text, and (c)(11)(ii) to read as follows:

§ 1065.695 Data requirements.

(a) To determine the information we require from engine tests, refer to the standard-setting part and request from your EPA Program Officer the format used to apply for certification or demonstrate compliance. We may require different information for different purposes, such as for certification applications, approval requests for alternative procedures, selective enforcement audits, laboratory audits, production-line test reports, and field-test reports.

* * * * *

(c) * * *

(1) What approved alternative procedures did you use? For example:

* * * * *

(11) * * *

(ii) Alternative fuel.

* * * * *

■ 111. Amend § 1065.701 by revising paragraphs (b) and (f) to read as follows:

§ 1065.701 General requirements for test fuels.

* * * * *

(b) *Fuels meeting alternative specifications.* We may allow you to use a different test fuel (such as California LEV III gasoline) if it does not affect your ability to show that your engines would comply with all applicable emission standards in this chapter using the test fuel specified in this subpart.

* * * * *

(f) *Service accumulation and field testing fuels.* If we do not specify a service-accumulation or field-testing fuel in the standard-setting part, use an appropriate commercially available fuel such as those meeting minimum specifications from the following table:

TABLE 1 OF § 1065.701—EXAMPLES OF SERVICE-ACCUMULATION AND FIELD-TESTING FUELS

Fuel category	Subcategory	Reference procedure
Diesel	Light distillate and light blends with residual	ASTM D975.
	Middle distillate	ASTM D6985.
	Biodiesel (B100)	ASTM D6751.
Intermediate and residual fuel	All	See § 1065.705.
Gasoline	Automotive gasoline	ASTM D4814.
	Automotive gasoline with ethanol concentration up to 10 volume %.	ASTM D4814.
Alcohol	Ethanol (E51–83)	ASTM D5798.
	Methanol (M70–M85)	ASTM D5797.
Aviation fuel	Aviation gasoline	ASTM D910.
	Gas turbine	ASTM D1655.
	Jet B wide cut	ASTM D6615.
Gas turbine fuel	General	ASTM D2880.

* * * * *

■ 112. Amend § 1065.715 by revising paragraph (b)(2) to read as follows:

§ 1065.715 Natural gas.

* * * * *

(b) * * *

(2) You may use fuel meeting alternative specifications if the standard-setting part allows it.

* * * * *

■ 113. Amend § 1065.720 by revising paragraph (b)(2) to read as follows:

§ 1065.720 Liquefied petroleum gas.

* * * * *

(b) * * *

(2) You may use fuel meeting alternative specifications if the standard-setting part allows it.

* * * * *

■ 114. Amend § 1065.750 by revising paragraph (a)(6) introductory text to read as follows:

§ 1065.750 Analytical gases.

* * * * *

(a) * * *

(6) If you measure H_2O using an FTIR or laser infrared analyzer, generate H_2O calibration gases with a humidity generator using one of the options in this paragraph (a)(6). Use good engineering judgment to prevent condensation in the transfer lines, fittings, or valves from the humidity generator to the analyzer. Design your system so the wall temperatures in the transfer lines, fittings, and valves from the point where the mole fraction of H_2O in the humidified calibration gas, x_{H2Oref}, is measured to the analyzer are at a temperature of (110 to 202) °C. Calibrate the humidity generator upon initial installation, within 370 days before verifying the H2O measurement of the analyzer, and after major maintenance. Use the uncertainties from the calibration of the humidity generator's measurements and follow NIST Technical Note 1297 (incorporated by reference, see § 1065.1010) to verify that the amount of H_2O in the calibration gas, x_{H2Oref}, is determined within ±3% uncertainty, U_{xH2O}. If the humidity generator requires assembly before use, after assembly follow the instrument manufacturer's instructions to check for leaks. You may generate the H_2O calibration gas using one of the following options:

* * * * *

■ 157. Amend § 1065.920 by revising paragraph (b)(6)(ii) to read as follows:

§ 1065.920 PEMS calibrations and verifications.

* * * * *

(b) * * *

(6) * * *

(ii) The entire set of test-interval results passes the 95% confidence alternative-procedure statistics for field testing (*t*-test and *F*-test) specified in § 1065.12.

■ 116. Amend § 1065.935 by revising paragraphs (c), (d)(2), and (g)(4)(ii) and (5) to read as follows:

§ 1065.935 Emission test sequence for field testing.

* * * * *

(c) Start testing as follows:

(1) If the engine is already running and warmed up and starting is not part of field testing, start the field test by simultaneously starting to sample exhaust, record engine and ambient data, and integrate measured values using a PEMS.

(2) If engine starting is part of field testing, start field testing by simultaneously starting to sample from the exhaust system, record engine and ambient data, and integrate measured values using a PEMS. Then start the engine.

(d) * * *

(2) Between each test interval, reset batch storage media as needed.

* * * * *

(g) * * *

(4) * * *

(ii) Invalidate any data that does not meet the drift criterion in § 1065.550. For HC, invalidate any data if the difference between the uncorrected and the corrected brake-specific HC emission values are not within ±10% of the uncorrected results or the applicable standard, whichever is greater.

(5) Verify PEMS gas analyzers used to determine bin emission values as follows:

(i) For analyzer outputs exceeding 100% of the selected gas analyzer range, calculate emission results using the reported value. Invalidate data if more than 1% of recorded 1 Hz data used to determine bin emission values exceeds 100% of the selected gas analyzer range. For NO_X or CO_2, invalidate data from the entire shift-day for all pollutants, and retest the engine. For other pollutants, invalidate data from the entire shift-day, but only for the affected gas analyzer. Retest the engine if the standard-setting part requires it.

(ii) Verify drift for CO and HC as described in § 1065.550(b)(3)(i)(A) and verify drift for CO_2 as described in § 1065.550(b)(3)(ii)(A). Verify drift for CO, CO_2, and HC bin testing based on the interval between analyzer verifications. For CO and CO_2, invalidate data for periods in which the respective analyzer does not meet the drift criterion in § 1065.550. For HC, invalidate data if the difference between the uncorrected and the corrected HC emission values are not within ±10% of the uncorrected results or the applicable standard, whichever is greater.

(iii) For PEMS NO_X analyzers used to determine bin emission values, do not apply the drift verification criteria specified in § 1065.550. Invalidate data for all pollutants over the entire shift-day if the NO_X analyzer does not meet the following drift limits:

(A) The allowable analyzer zero-drift between successive zero verifications is

±2.5 ppm. The analyzer zero-drift limit over the shift-day is ±10 ppm.

(B) The allowable analyzer span-drift limit between successive span verifications is ±4% of the measured span gas value preceding the interval.

* * * * *

■ 117. Amend § 1065.940 by revising paragraph (a) to read as follows:

§ 1065.940 Emission calculations.

(a) Perform emission calculations as described in § 1065.650 to calculate emissions for each test interval using any applicable information and instructions in the standard-setting part.

* * * * *

■ 118. Amend § 1065.1001 by:

■ a. Removing the definition of ''Alternate procedures'';

■ b. Adding the definitions of ''Alternative procedures'' and ''Gas analyzer range'' in alphabetical order; and

■ c. Revising the definitions of ''Oxygenated fuels'' and ''Span''.

The additions and revisions read as follows:

§ 1065.1001 Definitions.

* * * * *

Alternative procedures means procedures allowed under § 1065.10(c)(7).

* * * * *

Gas analyzer range means the lesser of the following values:

(1) 103% of the highest point on the linearity verification.

(2) Span gas value divided by 0.75.

* * * * *

Oxygenated fuels means fuels composed of at least 25% oxygen-containing compounds by volume, such as ethanol or methanol. Testing engines that use oxygenated fuels generally requires the use of the sampling methods in subpart I of this part. However, you should read the standard-setting part and subpart I of this part to determine appropriate sampling methods.

* * * * *

Span means to adjust an instrument so that it gives a proper response to a calibration standard that represents between 75% and 100% of the range of the instrument or expected range of use.

* * * * *

■ 119. Amend § 1065.1005 by revising the entry for ''test,alt'' in Table 5 in paragraph (e) to read as follows:

§ 1065.1005 Symbols, abbreviations, acronyms, and units of measure.

* * * * *

(e) * * *

TABLE 5 OF § 1065.1005—SUBSCRIPTS

Subscript	Meaning
* * * * * * *	
test,alt	alternative test quantity.
* * * * * * *	

* * * * *

■ 120. Amend § 1065.1010 by revising paragraphs (a) and (b) to read as follows:

§ 1065.1010 Incorporation by reference.

Certain material is incorporated by reference into this part with the approval of the Director of the Federal Register under 5 U.S.C. 552(a) and 1 CFR part 51. To enforce any edition other than that specified in this section, EPA must publish a document in the **Federal Register** and the material must be available to the public. All approved incorporation by reference (IBR) material is available for inspection at EPA and at the National Archives and Records Administration (NARA). Contact EPA at: U.S. EPA, Air and Radiation Docket Center, WJC West Building, Room 3334, 1301 Constitution Ave. NW, Washington, DC 20004; *www.epa.gov/dockets;* (202) 202–1744. For information on inspecting this material at NARA, visit *www.archives.gov/federal-register/cfr/ibr-locations* or email *fr.inspection@nara.gov.* The material may be obtained from the following sources:

(a) *ASTM International (ASTM).* ASTM International, 100 Barr Harbor Dr., P.O. Box C700, West Conshohocken, PA 19428–2959; (610) 832–9585; *www.astm.org.*

(1) ASTM D86–23ae2, Standard Test Method for Distillation of Petroleum Products and Liquid Fuels at Atmospheric Pressure, approved December 1, 2023 (ASTM D86); IBR approved for §§ 1065.703(b); 1065.710(b) and (c).

(2) ASTM D93–26, Standard Test Methods for Flash Point by Pensky-Martens Closed Cup Tester, approved March 1, 2026 (ASTM D93); IBR approved for § 1065.703(b).

(3) ASTM D130–26, Standard Test Method for Corrosiveness to Copper from Petroleum Products by Copper Strip Test, approved March 1, 2026 (ASTM D130); IBR approved for § 1065.710(b).

(4) ASTM D381–25, Standard Test Method for Gum Content in Fuels by Jet Evaporation, approved April 1, 2025 (ASTM D381); IBR approved for § 1065.710(b).

(5) ASTM D445–24, Standard Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and Calculation of Dynamic Viscosity); approved April 1, 2024 (ASTM D445); IBR approved for § 1065.703(b).

(6) ASTM D525–12a (Reapproved 2025), Standard Test Method for Oxidation Stability of Gasoline (Induction Period Method); approved December 1, 2025 (ASTM D525); IBR approved for § 1065.710(b).

(7) ASTM D613–25a, Standard Test Method for Cetane Number of Diesel Fuel Oil, approved November 1, 2025 (ASTM D613); IBR approved for § 1065.703(b).

(8) ASTM D1267–23, Standard Test Method for Gage Vapor Pressure of Liquefied Petroleum (LP) Gases (LP-Gas Method), approved March 1, 2023 (ASTM D1267); IBR approved for § 1065.720(a).

(9) ASTM D1319–20a, Standard Test Method for Hydrocarbon Types in Liquid Petroleum Products by Fluorescent Indicator Adsorption, approved August 1, 2020 (ASTM D1319); IBR approved for § 1065.710(c).

(10) ASTM D1838–21, Standard Test Method for Copper Strip Corrosion by Liquefied Petroleum (LP) Gases, approved July 1, 2021 (ASTM D1838); IBR approved for § 1065.720(a).

(11) ASTM D1945–25, Standard Test Method for Analysis of Natural Gas by Gas Chromatography, approved August 1, 2025 (ASTM D1945); IBR approved for § 1065.715(a).

(12) ASTM D2158–21, Standard Test Method for Residues in Liquefied

Petroleum (LP) Gases, approved July 1, 2021 (ASTM D2158); IBR approved for § 1065.720(a).

(13) ASTM D2163–23e1, Standard Test Method for Determination of Hydrocarbons in Liquefied Petroleum (LP) Gases and Propane/Propene Mixtures by Gas Chromatography, approved March 1, 2023 (ASTM D2163); IBR approved for § 1065.720(a).

(14) ASTM D2598–21, Standard Practice for Calculation of Certain Physical Properties of Liquefied Petroleum (LP) Gases from Compositional Analysis, approved April 1, 2021 (ASTM D2598); IBR approved for § 1065.720(a).

(15) ASTM D2622–24, Standard Test Method for Sulfur in Petroleum Products by Wavelength Dispersive X-ray Fluorescence Spectrometry, approved July 1, 2024 (ASTM D2622); IBR approved for §§ 1065.703(b); 1065.710(b) and (c).

(16) ASTM D2699–25, Standard Test Method for Research Octane Number of Spark-Ignition Engine Fuel, approved November 1, 2025 (ASTM D2699); IBR approved for § 1065.710(b).

(17) ASTM D2700–26, Standard Test Method for Motor Octane Number of Spark-Ignition Engine Fuel, approved May 1, 2026 (ASTM D2700); IBR approved for § 1065.710(b).

(18) ASTM D2713–24, Standard Test Method for Dryness of Propane (Valve Freeze Method), approved October 1, 2024 (ASTM D2713); IBR approved for § 1065.720(a).

(19) ASTM D2986–95a (Reapproved 1999), Standard Practice for Evaluation of Air Assay Media by the Monodisperse DOP (Dioctyl Phthalate) Smoke Test, approved September 10, 1995 (ASTM D2986); IBR approved for § 1065.170(c). (Note: This standard was withdrawn by ASTM.)

(20) ASTM D3231–25, Standard Test Method for Phosphorus in Gasoline, approved March 1, 2024 (ASTM D3231); IBR approved for § 1065.710(b) and (c).

(21) ASTM D3237–22, Standard Test Method for Lead in Gasoline By Atomic Absorption Spectroscopy, approved May 1, 2025 (ASTM D3237); IBR approved for § 1065.710(b) and (c).

(22) ASTM D4052–22, Standard Test Method for Density, Relative Density, and API Gravity of Liquids by Digital Density Meter, approved May 1, 2022 (ASTM D4052); IBR approved for § 1065.703(b).

(23) ASTM D4629–24, Standard Test Method for Trace Nitrogen in Liquid Petroleum Hydrocarbons by Syringe/Inlet Oxidative Combustion and Chemiluminescence Detection, approved October 1, 2024 (ASTM D4629); IBR approved for § 1065.655(e).

(24) ASTM D4815–22, Standard Test Method for Determination of MTBE, ETBE, TAME, DIPE, tertiary-Amyl Alcohol and C1 to C4 Alcohols in Gasoline by Gas Chromatography, approved April 1, 2022 (ASTM D4815); IBR approved for § 1065.710(b).

(25) ASTM D5186–24, Standard Test Method for Determination of the Aromatic Content and Polynuclear Aromatic Content of Diesel Fuels By Supercritical Fluid Chromatography, approved July 1, 2024 (ASTM D5186); IBR approved for § 1065.703(b).

(26) ASTM D5191–22, Standard Test Method for Vapor Pressure of Petroleum Products and Liquid Fuels (Mini Method), approved July 1, 2022 (ASTM D5191); IBR approved for § 1065.710(b) and (c).

(27) ASTM D5291–26, Standard Test Methods for Instrumental Determination of Carbon, Hydrogen, and Nitrogen in Petroleum Products and Lubricants, approved March 1, 2026 (ASTM D5291); IBR approved for § 1065.655(e).

(28) ASTM D5453–25, Standard Test Method for Determination of Total Sulfur in Light Hydrocarbons, Spark Ignition Engine Fuel, Diesel Engine Fuel, and Engine Oil by Ultraviolet Fluorescence, approved July 1, 2025 (ASTM D5453); IBR approved for §§ 1065.703(b); 1065.710(b).

(29) ASTM D5599–22, Standard Test Method for Determination of Oxygenates in Gasoline by Gas Chromatography and Oxygen Selective Flame Ionization Detection, approved April 1, 2022 (ASTM D5599); IBR approved for §§ 1065.655(e); 1065.710(b).

(30) ASTM D5762–24 Standard Test Method for Nitrogen in Petroleum and Petroleum Products by Boat-Inlet Chemiluminescence, approved July 1, 2024 (ASTM D5762); IBR approved for § 1065.655(e).

(31) ASTM D5769–25, Standard Test Method for Determination of Benzene, Toluene, and Total Aromatics in Finished Gasolines by Gas Chromatography/Mass Spectrometry, approved October 1, 2025 (ASTM D5769); IBR approved for § 1065.710(b).

(32) ASTM D6348–12 (Reapproved 2020), Standard Test Method for Determination of Gaseous Compounds by Extractive Direct Interface Fourier Transform Infrared (FTIR) Spectroscopy, approved December 1, 2020 (ASTM D6348); IBR approved for §§ 1065.257(b); 1065.266(c); 1065.275(b); 1065.277(b).

(33) ASTM D6550–25, Standard Test Method for Determination of Olefin Content of Gasolines by Supercritical-Fluid Chromatography, approved October 1, 2025 (ASTM D6550); IBR approved for § 1065.710(b).

(34) ASTM D6667–21, Standard Test Method for Determination of Total Volatile Sulfur in Gaseous Hydrocarbons and Liquefied Petroleum Gases by Ultraviolet Fluorescence, approved April 1, 2021 (ASTM D6667); IBR approved for § 1065.720(a).

(35) ASTM D7039–24, Standard Test Method for Sulfur in Gasoline, Diesel Fuel, Jet Fuel, Kerosine, Biodiesel, Biodiesel Blends, and Gasoline-Ethanol Blends by Monochromatic Wavelength Dispersive X-ray Fluorescence Spectrometry, approved December 1, 2024 (ASTM D7039); IBR approved for §§ 1065.703(b); 1065.710(b).

(36) ASTM E178–21, Standard Practice for Dealing With Outlying Observations, approved June 1, 2021 (ASTM E178); IBR approved for § 1065.1121(d).

(37) ASTM F1471–09, Standard Test Method for Air Cleaning Performance of a High-Efficiency Particulate Air Filter System, approved March 1, 2009 (ASTM F1471); IBR approved for § 1065.1001. (Note: This standard was withdrawn by ASTM.)

(b) *California Air Resources Board.* California Air Resources Board, Southern California Headquarters—Mary D. Nichols Campus, 4001 Iowa Avenue, Riverside, CA 92507; (800) 242–4450; *www.arb.ca.gov.*

(1) California Non-Methane Organic Gas Test Procedures, Amended July 30, 2002, Mobile Source Division, California Air Resources Board; IBR approved for § 1065.805(f).

(2) [Reserved]

* * * * *

■ 121. Add § 1065.1102 to subpart L before the center header ''Semi-Volatile Organic Compounds'' to read as follows:

§ 1065.1102 Calibrations and verifications.

(a) *Subsystem calibrations and verifications.* Use all the applicable calibrations and verifications in subpart D of this part, including the linearity verifications in § 1065.307, to calibrate and verify each measurement system listed in Table 1 of this section, for the procedures in this subpart L. This section does not apply to systems used to gather data to inform accelerated aftertreatment aging processes.

(b) *Performance criteria for measurement systems.* Table 1 follows:

TABLE 1 OF § 1065.1102—SUBPART L MEASUREMENT SYSTEMS THAT REQUIRE LINEARITY VERIFICATION

	Measurement system	Applicable section	Recommended method	Use
Vanadium Sublimation				
Catalyst inlet gas temperature.	§ 1065.1117(b)	Thermocouple	Catalyst aging temperature.	[a]
Catalyst bed temperature	§ 1065.1117(b)	Thermocouple	Catalyst aging temperature.	[a]
Individual gas flow rates	§ 1065.1117(a)(1)	Mass flow meter	Control of inlet gas mixture.	[a]
Total flow rate	§ 1065.1117(a)(2)	Mass flow meter	Verification of catalyst space velocity.	±5% of target.
Gas analyzer performance	§ 1065.1117(a)(2)	Gas analytical system	Verification of inlet conditions.	[a]
Sample weights	§ 1065.1121(a)(1)	Balance	ICP sample mass determination.	[a]
Thermal Reactivity Coefficient Gas Stand				
Catalyst inlet gas temperature.	§ 1065.1137(c)(2)	Thermocouple	Catalyst aging temperature.	[a]
Catalyst bed temperature	§ 1065.1137(c)(2)	Thermocouple	Catalyst aging temperature.	[a]
Individual gas flow rates	§ 1065.1137(c)(2)	Mass flow meter	Control of inlet gas mixture.	[a]
Total flow rate	§ 1065.1137(c)(2)	Mass flow meter	Verification of catalyst space velocity.	±5% of target.
Gas analyzer performance	§ 1065.1137(c)(2)	Gas analytical system	Verification of inlet conditions.	[a]
Engine-Based Aging Stand				
Exhaust flow rate to aftertreatment.	§ 1065.1141 § 1065.1145(a)(1)(i)	Air flow + fuel flow	Initial Cycle Development	[a]
	§ 1065.1141 § 1065.1145(a)(1)	Direct measurement	Initial Cycle Development	[a]
Bulk Oil Consumption	§ 1065.1141(f) § 1065.1145(a)(1)(i) § 1065.1145(e)(2)	Good engineering judgement	Initial Cycle Development and Cycle Validation.	[a]
Volatile Oil Consumption	§ 1065.1141(i) § 1065.1145(a)(1)(i) § 1065.1145(e)(2)	Mass flow meter	Initial Cycle Development and. Cycle Validation	[a]
Secondary Oil Exposure	§ 1065.1141(h) § 1065.1145(e)(2)(ii)	DPF weights	Cycle Validation	[a]
Sulfur Exposure (choose one method).	§ 1065.1141(j) § 1065.1145(e)(2)(iii)	Mass flow meter	Cycle Validation	[a]
	§ 1065.1141(k) § 1065.1145(e)(2)(iii)	Mass flow meter	Cycle Validation	[a]
Burner-Based Aging Stand				
Exhaust flow rate to aftertreatment.	§ 1065.1143 § 1065.1145(a)(2)(i)	Direct measurement	Initial Cycle Development	[a]
Bulk Oil Consumption	§ 1065.1143(d) § 1065.1145(a)(2)(i) § 1065.1145(e)(2)	DPF weights	Initial Cycle Development and Cycle Validation.	[a]
Volatile Oil Consumption	§ 1065.1143(e) § 1065.1145(a)(2)(i) § 1065.1145(e)(2)	DPF weights	Initial Cycle Development and Cycle Validation.	[a]
Secondary Oil Exposure	§ 1065.1143(d) § 1065.1145(e)(2)(ii)	DPF weights	Cycle Validation	[a]
Sulfur Exposure (choose one method).	§ 1065.1143(i) § 1065.1145(e)(2)(iii)	Mass flow meter	Cycle Validation	[a]
	§ 1065.1143(j) § 1065.1145(e)(2)(iii)	Mass flow meter	Cycle Validation	[a]
Aging Bench				
Catalyst inlet gas temperature.	§ 1065.1153(a)	Thermocouple	Catalyst aging temperature.	[a]
Catalyst bed temperature	§ 1065.1153(c) § 1065.1155(f)	Thermocouple	Catalyst aging temperature.	[a]
Individual gas flow rates	§ 1065.1153(a) § 1065.1153(b)	Mass flow meter	Control of inlet gas mixture.	[a]

TABLE 1 OF § 1065.1102—SUBPART L MEASUREMENT SYSTEMS THAT REQUIRE LINEARITY VERIFICATION—Continued

	Measurement system	Applicable section	Recommended method	Use
Total flow rate	§ 1065.1153(b) § 1065.1155(h)	Mass flow meter	Verification of catalyst space velocity.	±5% of target.

[a] See Table 1 of § 1065.307 for linearity criteria.

■ 122. Revise and republish § 1065.1115 to read as follows:

§ 1065.1115 Reactor design and setup.

Vanadium measurements rely on a reactor that adsorbs sublimation vapors of vanadium onto an alumina capture bed with high surface area.

(a) Configure the reactor with the alumina capture bed downstream of the catalyst in the reactor's hot zone to adsorb vanadium vapors at high temperature. You may use quartz beads upstream of the catalyst to help stabilize reactor gas temperatures. Select an alumina material and design the reactor to minimize sintering of the alumina. For a 1-inch diameter reactor, use 4 to 5 g of ⅛ inch extrudates or −14/+24 mesh (approximately 0.7 to 1.4 mm) gamma alumina (such as Alfa Aesar, aluminum oxide, gamma, catalyst support, high surface area, bimodal). Position the alumina downstream from either an equivalent amount of −14/+24 mesh catalyst sample or an approximately 1-inch diameter by 1-inch to 3-inch-long catalyst-coated monolith sample cored from the production-intent vanadium catalyst substrate. Separate the alumina from the catalyst with a 0.2 to 0.4 g plug of quartz wool. Place a short 4 g plug of quartz wool downstream of the alumina to maintain the position of that bed. Use good engineering judgment to adjust as appropriate for reactors of different sizes.

(b) Include the quartz wool with the capture bed to measure vanadium content. We recommend analyzing the downstream quartz wool separately from the alumina to see if the alumina fails to capture some residual vanadium.

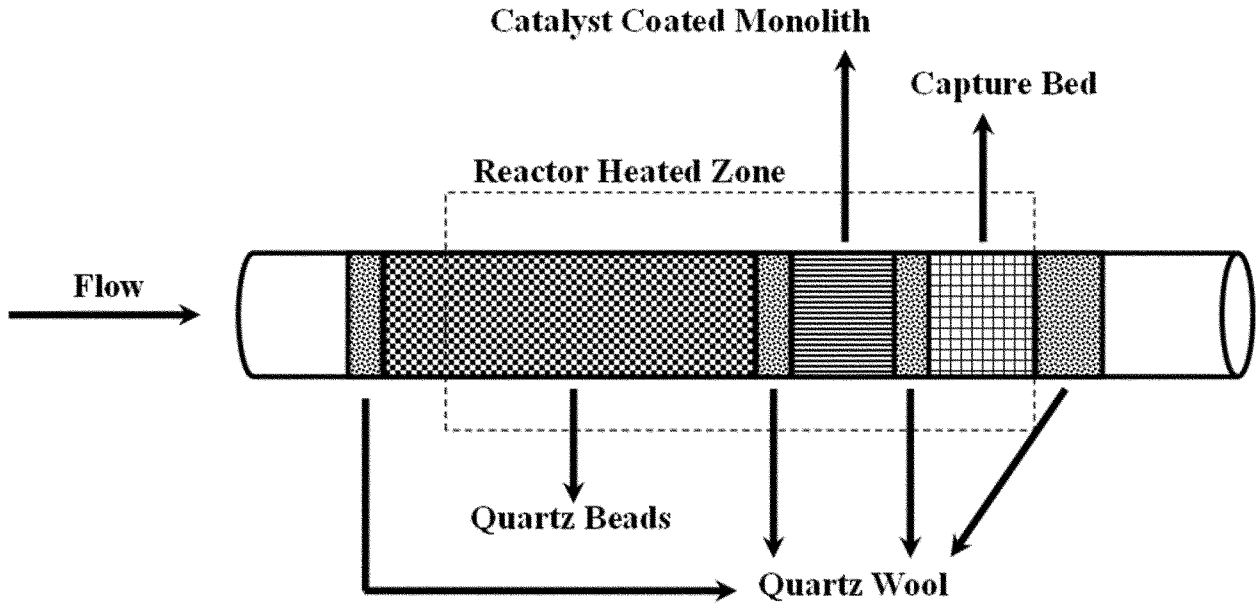
(c) Configure the reactor such that both the sample and capture beds are in the reactor's hot zone. Design the reactor to maintain similar temperatures in the capture bed and catalyst. Monitor the catalyst and alumina temperatures with Type K thermocouples inserted into a thermocouple well that is in contact with the catalyst sample bed.

(d) You may include an ammonia slip catalyst as part of the catalyst-coated monolith sample if it is part of the production aftertreatment system. Size the ammonia slip catalyst based on its volume ratio to the vanadium catalyst and locate it in the reactor heated zone. Ensure that the ratio of the vanadium catalyst core volume to ammonia slip catalyst core volume is consistent with the highest production system volume ratio of vanadium to ammonia slip catalyst you expect. You may use a small amount of quartz wool between the vanadium and ammonia slip catalysts to address catalyst core alignment. You may exceed the 3-inch maximum core length in paragraph (a) of this section by up to 3 inches.

(e) If there is a risk that the quartz wool and capture bed are not able to collect all the vanadium, configure the reactor with an additional capture bed and quartz wool plug just outside the hot zone and analyze the additional capture bed and quartz wool separately.

(f) An example of a catalyst-coated monolith and capture bed arrangement in the reactor tube are shown in the following figure:

FIGURE 1 TO PARAGRAPH (f) OF § 1065.1115– EXAMPLE OF REACTOR SETUP



(g) You may need to account for vanadium-loaded particles contaminating catalyst-coated monoliths as a result of physical abrasion. To do this correction, your sample must show levels of vanadium, titanium, and either

tungsten, antimony, or other metals contained in the catalyst-coated monolith above their respective method detection limits. Using these values and available information about the ratio of vanadium to titanium in the catalyst, subtract the mass of vanadium catalyst material associated with the catalyst particles from the total measured vanadium on the capture bed to determine the vanadium recovered due to sublimation as described in § 1065.1121(e).

■ 123. Revise and republish § 1065.1117 to read as follows:

§ 1065.1117 Reactor aging cycle for determination of vanadium sublimation temperature.

This section describes the conditions and process required to operate the reactor described in § 1065.1115 for collection of the vanadium sublimation samples for determination of vanadium sublimation temperature. The reactor aging cycle constitutes the process of testing the catalyst sample over all the test conditions described in paragraph (b) of this section.

(a) Set up the reactor to flow gases with a space velocity of at least 35,000/hr over the catalyst-coated monolith system with a pressure drop across the catalyst and capture bed less than 35 kPa.

(1) Calculate space velocity as follows:

$$SV = \frac{\bar{\dot{V}}_{\text{stdreactor}}}{V_{\text{monolith}}}$$

Eq. 1065.1117-1

Where:

$\bar{\dot{V}}_{\text{stdreactor}}$ = the mean volume flow rate through the reactor at conditions of 293.15 K and 101.325 kPa.

V_{monolith} = the total volume of the catalyst-coated monolith system. When determining space velocity for a reactor blank test, use the volume for a 1-inch diameter by 1-inch-long monolith.

Example:

$\bar{\dot{V}}_{\text{stdreactor}}$ = 0.4502 m^3/hr

V_{monolith} = 0.0000128638 m^3

$$SV = \frac{0.4502}{0.0000128638}$$

SV = 34,997/hr

(2) Use test gases meeting the following specifications, noting that not all gases will be used at the same time:

(i) 5 vol% O_2, balance N_2.

(ii) NO, balance N_2. Use an NO concentration of (200 to 500) ppm.

(iii) NH_3, balance N_2. Use an NH_3 concentration of (200 to 500) ppm.

(b) Perform testing as follows:

(1) Add a new catalyst sample and capture bed into the reactor as described in § 1065.1113. Heat the reactor to 550 °C while flowing the oxygen blend specified in paragraph (a)(2) of this section as a pretest gas mixture. Ensure that no H_2O is added to the pretest gas mixture to reduce the risk of sintering and vanadium sublimation.

(2) Start testing at a temperature that is lower than the point at which vanadium starts to sublime. Start testing when the reactor reaches 550 °C unless testing supports a lower starting temperature. Once the reactor reaches the starting temperature and the catalyst has been equilibrated to the reactor temperature, flow NO and NH_3 test gases for 18 hours with a nominal H_2O content of 10 volume percent. This volume percentage of H_2O is appropriate and must be used for diesel fueled compression-ignition engines. If you perform this testing for engines that use a different fuel than diesel, use good engineering judgment to select an H_2O volume percentage consistent with the maximum expected exhaust H_2O content for that fuel. For example, you might test at an H_2O content of 20 volume percent for a lean-burn, spark-ignition hydrogen-fueled engine. If an initial starting temperature of 550 °C results in vanadium sublimation, you may retest using a new catalyst sample and a lower initial starting temperature.

(3) After 18 hours of exposure, flow the pretest oxygen blend as specified in paragraph (b)(1) of this section and allow the reactor to cool down to room temperature.

(4) Analyze the sample as described in § 1065.1121.

(5) Repeat the testing in paragraphs (b)(1) through (4) of this section by raising the reactor temperature in increments of up to 25 °C, until you reach the temperature at which vanadium sublimation begins above the method detection limit threshold determined in § 1065.1121.

(7) You may optionally test in a manner other than testing a single catalyst formulation in series across all test temperatures. For example, you may test additional samples at the same reactor temperature before moving on to the next temperature.

(c) Determine the effective sublimation temperature as follows:

(1) Select the data from the lowest temperature where you detected a vanadium level above the method detection limit threshold and the next lowest temperature where vanadium sublimation was not detected above the threshold.

(2) Use linear interpolation between the two data points to determine the temperature at which the vanadium level crosses the method detection limit threshold.

(3) Calculate the sublimation temperature, $T_{\text{sublimation}}$, as follows:

$$T_{\text{sublimation}} = \frac{MDL_{\text{threshold}} - V_{\text{L}}}{V_{\text{H}} - V_{\text{L}}} \cdot (T_{\text{H}} - T_{\text{L}}) + T_{\text{L}}$$

Eq. 1065.1117-2

Where:

$MDL_{\text{threshold}}$ = the vanadium method detection limit threshold in § 1065.1121(d)(3). This value of 10 μg/m^3 is based on the total volume that flowed through the catalyst core at a space velocity of 35,000/hr for 18 hours, for a standard 1-inch diameter by 1-inch-long catalyst core. If you test a different size catalyst core, you must scale the method detection limit threshold value as described in § 1065.1121(d)(4).

V_{L} = the vanadium result from the highest test point where vanadium sublimation was below the method detection limit threshold.

V_{H} = the vanadium result from the lowest test point where vanadium sublimation was at or above the method detection limit threshold.

T_{H} = the temperature at which VH was determined.

T_{L} = the temperature at which VL was determined.

Example:

$MDL_{\text{threshold}}$ = 10 μg/m^3

V_{L} = 5.1 μg/m^3

V_{H} = 12.5 μg/m^3

T_{H} = 585 °C

T_{L} = 560 °C

$$T_{\text{sublimation}} = \frac{10 - 5.1}{12.5 - 5.1} \cdot (585 - 560) + 560$$

$T_{\text{sublimation}}$ = 577 °C

■ 124. Revise and republish § 1065.1119 to read as follows:

§ 1065.1119 Blank testing.

This section describes the process for analyzing blanks. Use blanks to determine the background effects and the potential for contamination from the sampling process.

(a) Take blanks from the same batch of alumina used for the capture bed.

(b) Media blanks are used to determine if there is any contamination in the sample media. Analyze at least one media blank for each reactor aging cycle or round of testing performed under § 1065.1117. If your sample media is taken from the same lot, you may analyze media blanks less frequently consistent with good engineering judgment.

(c) Reactor blanks are used to determine the method detection limit and can be used to determine if there is any contamination from the sampling system. Analyze at least one reactor blank for each reactor aging cycle or round of testing performed under § 1065.1117.

(1) Test reactor blanks with the reactor on and operated identically to that of a catalyst test in § 1065.1117 with the exception that when loading the reactor, only the alumina capture bed will be loaded (no catalyst sample is loaded for the reactor blank). We recommend acquiring reactor blanks with the reactor operating at a 750 °C test temperature. If your reactor cannot maintain 750 °C, acquire the reactor blanks at the highest temperature your reactor can maintain.

(2) You must run at least three reactor blanks if the result from the initial blank analysis is above the detection limit of the method, with additional blank runs based on the uncertainty of the reactor blank measurements, consistent with good engineering judgment.

(3) If the volumetric flow during the vanadium sublimation test is higher than what was flowed during the reactor blank test, scale the method detection limit and method detection limit threshold to account for the volumetric flow differences. This will typically occur in instances where a catalyst coated monolith is tested that has a volume that is greater than the standard 1″ diameter by 1″ long catalyst core, as the volumetric flow rate through the catalyst core is increased to maintain the target space velocity of 35,000/hr. Adjust the method detection limit as described in § 1065.1121(d)(4).

■ 125. Revise § 1065.1121 to read as follows:

§ 1065.1121 Vanadium sample dissolution and analysis in alumina capture beds.

This section describes the process for dissolution of vanadium from the vanadium sublimation samples collected in § 1065.1117 and any blanks collected in § 1065.1119 as well as the analysis of the digestates to determine the mass of vanadium (as well as titanium, tungsten and antimony if you are testing for those elements) emitted during the reactor aging cycle.

(a) Digest the samples using the following procedure, or an equivalent procedure:

(1) Place the recovered alumina, a portion of the ground quartz tube from the reactor, and the quartz wool in a Teflon pressure vessel with a mixture made from 1.5 mL of 16 N HNO_3, 0.5 mL of 28 N HF, and 0.2 mL of 12 N HCl. Note that you must weigh all the sample materials submitted to the digestion process (including alumina, quartz wool, and quartz tube). Note that the amount of ground quartz tube from the reactor included in the digestion can influence the vanadium concentration of both the volatilized vanadium from the sample and the method detection limit. You must be consistent with the amount ground quartz tube included in the sample analysis for your testing. You must limit the amount of quartz tube to include only portions of the tube that would be likely to encounter volatilized vanadium.

(2) Program a microwave oven to heat the sample to 180 °C over 9 minutes, followed by a 10-minute hold at that temperature, and 1 hour of ventilation/cooling.

(3) After cooling, dilute the digests to 30 mL with high purity 18MΩ water prior to ICP–MS (or ICP–OES) analysis. Note that this digestion technique requires adequate safety measures when working with HF at high temperature and pressure. To avoid ''carry-over'' contamination, rigorously clean the vessels between samples as described in ''Microwave digestion procedures for environmental matrixes'' (Lough, G.C. *et al,* Analyst. 1998, 123 (7), 103R–133R).

(b) Analyze the digestates for vanadium as follows:

(1) Perform the analysis using ICP–OES (or ICP–MS) using standard plasma conditions (1350 W forward power) and a desolvating microconcentric nebulizer, which will significantly reduce oxide- and chloride-based interferences.

(2) We recommend that you digest and analyze a minimum of three solid vanadium NIST Standard Reference Materials in duplicate with every batch of 25 vanadium alumina capture bed samples that you analyze in this section, as described in ''Emissions of metals associated with motor vehicle roadways'' (Herner, J.D. *et al.,* Environmental Science and Technology. 2005, 39, 826–836). This will serve as a quality assurance check to help gauge the relative uncertainties in each measurement, specifically if the measurement errors are normally distributed and independent.

(c) Calculate your vanadium result, V_{meas}, in μg/m³ using the following equation:

$$V_{\text{meas}} = \frac{x_{\text{ICP}} \cdot m_{\text{sample}}}{V_{\text{reactor}}}$$

Eq. 1065.1121-1

Where:

x_{ICP} = the ICP measured mass concentration of vanadium. If the mass concentration is below the instrument detection limit, use the instrument detection limit in place of the measured value.

m_{sample} = total sample mass determined in paragraph (a)(1) of this section.

V_{reactor} = the total gas volume flowed through the reactor during the catalyst-coated monolith test.

Example:

x_{ICP} = 0.74 mg/m³
m_{sample} = 114.839 g
V_{reactor} = 8.104223 m³

$$V_{\text{meas}} = \frac{0.74 \cdot 114.839}{8.104223}$$

V_{meas} = 10.5 μg/m³

(d) Use the 3-sigma approach to determine the analytical method detection limits for vanadium. This process involves analyzing at least seven replicates of a reactor blank using the analytical method described in paragraphs (a) and (b)(1) of this section, converting the responses into concentration units, and calculating the standard deviation. Determine the detection limit by multiplying the standard deviation by 3 and adding it to the median. Determine the following analytical method detection limits:

(1) Determine the ICP–MS (or ICP–OES) instrumental detection limit (mg/

kg) by measuring at least seven blank samples made up of the reagents from paragraph (a) of this section.

(2) Determine the method detection limit (μg/m³ of flow) by measuring at least seven reactor blank samples taken as described in § 1065.1119(d). You may check for and remove any outliers using Section 7 of ASTM E178 (incorporated by reference, see § 1065.1010). Maintain a rolling method detection limit, updating it by removing the oldest reactor blank results as new reactor blank samples are taken. Repeat the outlier analysis each time you generate a new reactor blank and update the data set. Maintain at least seven blanks in the data set. Use good engineering judgment to add new blanks and remove old blanks from the data set as needed. For example, if the lot of capture blank material changes or if your testing involves submission of multiple groups of samples that are submitted for ICP analysis at different times.

(3) Your method detection limit determined under paragraph (d)(2) of this section must be at or below a threshold of 10 μg/m³. Note that this method detection limit threshold is based on the total volume that flowed through the catalyst core at a space velocity of 35,000/hr for 18 hours, for a standard 1-inch diameter by 1-inch-long catalyst core. If you test at a different size catalyst core, you must scale both your calculated method detection limit and the threshold value as described in paragraph (d)(4) of this section. You must report your method detection limit determined in this paragraph (d)(3) with your test results. Report your method detection limit at a precision of two significant figures. Report your results and calculated method detection limit at the same level of precision as the threshold.

(4) When your catalyst core volume dictates a total volume flowed through the catalyst core that is greater than the total volume flowed during the reactor blank test, scale the method detection limit threshold from paragraph (d)(3) of this section and the lab determined method detection limit as follows:

$$MDL_{[\text{type}]\text{cor}} = MDL_{[\text{type}]} \cdot \frac{V_{\text{stdblank}}}{V_{\text{reactor}}}$$

Eq. 1065.1121-2

Where:

$MDL_{[\text{type}]}$ = method detection limit threshold from paragraph (d)(3) of this section or lab determined method detection limit from paragraph (d)(2) of this section.

V_{stdblank} = the total gas volume flowed through the reactor during a standard lab reactor blank test (assuming a 1-inch diameter and 1-inch-long core).

V_{reactor} = the total gas volume flowed through the reactor during the catalyst coated monolith test.

Example for a catalyst coated monolith system that contains a 1″ diameter by 1″ long vanadium SCR catalyst core and a 1″ diameter by 0.5″ long ammonia slip catalyst core that yields a vanadium test result of 7.9 μg/m³:

$MDL_{\text{threshold}}$ = 10 μg/m³ threshold, from paragraph (d)(3) of this section.

$MDL_{\text{reactorblank}}$ = 4.5 μg/m³, actual determined method detection limit from paragraph (d)(2) of this section.

V_{stdblank} = 8.4 m³

V_{reactor} = 12.2 m³

$$MDL_{\text{thresholdcor}} = 10 \cdot \frac{8.4}{12.2} = 6.9\ \mu\text{g/m}^3$$

$$MDL_{\text{reactorblankcor}} = 4.5 \cdot \frac{8.4}{12.2} = 3.1\ \mu\text{g/m}^3$$

(5) In the example given in paragraph (d)(4) of this section, the corrected reactor blank derived method detection limit is below the adjusted method detection limit threshold of 4.8 μg/m³, indicating that the reactor blank derived method detection limit meets the requirements of paragraph (d)(3) of this section. The threshold corrected value becomes the new method detection limit threshold, replacing the value from paragraph (d)(3) of this section, which is compared to the reactor blank corrected method detection limit. The corrected method detection limit threshold of 6.9 μg/m³ indicates that the catalyst coated monolith vanadium test result of 7.9 μg/m³ is above the adjusted method detection limit threshold and that vanadium has been emitted by the monolith.

(e) You may account for vanadium-loaded particles contaminating the catalyst-coated monoliths as a result of physical abrasion as allowed in § 1065.1115(g). This process requires that you determine the analytical method detection limits for titanium and either tungsten, antimony or other metals contained in the catalyst-coated monolith using the same method as described in paragraph (d) of this section for vanadium. You may perform this correction using either the ratio provided by the catalyst supplier or the measured mass ratio of vanadium to titanium.

(1) If you use the ratio provided by the catalyst supplier, determine the corrected vanadium level, V_{cor}, using the following equation:

$$V_{\text{cor}} = V_{\text{meas}} - Ratio \cdot Ti_{\text{meas}}$$

Eq. 1065.1121-3

Where:

V_{meas} = the vanadium result determined in paragraph (c) of this section.

Ratio = the mass ratio of V to Ti from the catalyst supplier or the experimentally determined ratio, $Ratio_{\text{meas}}$, as determined in paragraph (e)(2) of this section.

Ti_{meas} = the titanium result determined in paragraph (c) of this section.

Example:

V_{meas} = 6.8 μg/m³
$Ratio_{meas}$ = 0.025
Ti_{meas} = 223.5 μg/m³
V_{cor} = 1.2 μg/m³

(2) If you have multiple tests where you detect vanadium, titanium, and either tungsten or antimony, you may substitute the ratio measured during the experiments, $Ratio_{meas}$, in place of the catalyst supplier ratio in Eq. 1065.1121–3. You may use this option only if the measured ratios of vanadium to titanium for the test you are correcting are within 20% of the average calculated ratio for all of the tests in the data set that are being corrected. If you use the measured ratio from the experiment, calculate that ratio using the following equation:

$$Ratio_{meas} = \frac{V_{meas} - MDL_V}{Ti_{meas} - MDL_{Ti}}$$

Eq. 1065.1121-4

Where:

MDL_V = the method detection limit for vanadium.
MDL_{Ti} = the method detection limit for vanadium.

Example:

V_{meas} = 6.8 μg/m³
MDL_V = 3.1 μg/m³
Ti_{meas} = 223.5 μg/m³
MDL_{Ti} = 76.2 μg/m³

$$Ratio_{meas} = \frac{6.8 - 3.1}{223.5 - 76.2}$$

Ratio = 0.025

■ 126. Amend § 1065.1125 by revising paragraph (d)(2) to read as follows:

§ 1065.1125 Exhaust opacity measurement system.

* * * * *

(d) * * *

(2) You may use smokemeters that rely on partial flow sampling. Follow the instrument manufacturer's installation, calibration, operation, and maintenance procedures and correct for any difference in the path length of the exhaust plume relative to the diameter of the engine's exhaust outlet.

■ 127. Amend § 1065.1127 by revising paragraphs (c)(4) and (5) to read as follows:

§ 1065.1127 Test procedure for determining percent opacity.

* * * * *

(c) * * *

(4) Determine the dynamometer load needed to meet the cycle requirements in paragraphs (d)(4)(ii) and (iv) of this section.

(5) You may program the dynamometer to apply motoring assist with negative flywheel torque, but only during the first 0.5 seconds of the acceleration events identified in paragraph (d)(4) of this section. Negative flywheel torque may not exceed 13.6 N·m.

* * * * *

■ 128. Amend subpart L by revising the center header ''ACCELERATED AFTERTREATMENT AGING'' to read as follows: ACCELERATED AFTERTREATMENT AGING—COMPRESSION-IGNITION AFTERTREATMENT

■ 129. Amend § 1065.1133 by revising paragraph (a)(3) to read as follows:

§ 1065.1133 Application selection, data gathering, and analysis.

* * * * *

(a) * * *

(3) *Sulfur exposure.* The total sulfur exposure is the sum of fuel- and oil-related sulfur. Oil-related sulfur will be accounted for in the acceleration of oil exposure directly. We recommend that you determine fuel-related sulfur exposure by selecting an application that represents the 90th percentile of fuel consumption. Use good engineering judgment to determine that average rate of fuel consumption for the target application. You may use a combination of field and laboratory measurements to make this determination. Calculate the average rate of fuel-related sulfur exposure in grams per hour from the average rate of fuel consumption assuming a fuel sulfur level of 10 ppm by weight. You may adjust the 10-ppm fuel sulfur level if the fuel your engine operates on is shown to have a sulfur level that differs from diesel fuel.

* * * * *

■ 130. Amend § 1065.1137 by revising paragraphs (d)(1)(ii)(B)(1), (d)(2), and (d)(4)(iii)(A) to read as follows:

§ 1065.1137 Determination of thermal reactivity coefficient.

* * * * *

(d) * * *

(1) * * *

(ii) * * *

(B) * * *

(*1*) Generate a fit of the deactivation data in paragraph (d)(1)(i) of this section at each aging temperature using the following linear expression:

$$\frac{1}{\Omega} = k_D \cdot t + 1$$

Eq. 1065.1137-9

Where:

Ω = N_2/N_1 or N_2 (Ω is to be normalized to the degreened Ω value for each new catalyst component prior to aging, *i.e.,* Ω = 1 at t = 0 for each aging temperature).
k_D = the thermal aging rate constant from paragraph (d)(1)(ii)(A) of this section.

* * * * *

(2) *Iron-based zeolite or vanadium SCR.* Process all NH_3 TPD data from each aging condition using a GPLE to fit the NH_3 desorption data (or BTE surface area data for vanadium SCR). Note that this expression is different from the one used in paragraph (d)(1)(ii)(A) of this section because the model order m is allowed to vary. This general expression takes the following form:

$$-\frac{d\Omega}{dt} = k_D \cdot \left(\Omega - \Omega_{eq}\right)^m$$

Eq. 1065.1137-11

Where:

Ω = total NH_3 (or BET surface area) normalized to the degreened value for each new catalyst component prior to aging (*i.e.,* Ω = 1 at t = 0 for each aging temperature).
k_D = the thermal aging rate constant from paragraph (d)(1)(ii)(A) of this section.
t = time.
Ω_{eq} = aging metric at equilibrium (set to 0 unless there is a known activity minimum).
m = model order.

* * * * *

(4) * * *

(iii) * * *

(A) Use the GPLE to fit the NO to NO_2 conversion data, X, at each aging temperature. The GPLE takes the following form:

$$-\frac{d\Omega}{dt} = k_D \cdot \left(\Omega - \Omega_{eq}\right)^m$$

Eq. 1065.1137-16

Where:

Ω = aging metric for diesel oxidation catalysts.
k_D = the thermal aging rate constant from paragraph (d)(4)(i) of this section.
t = aging time.
Ω_{eq} = aging metric at equilibrium (set to 0 unless there is a known activity minimum).
m = model order.

* * * * *

■ 131. Amend § 1065.1139 by revising paragraphs (a), (b)(1)(iii) and (iv), (b)(2)(i), (b)(2)(v)(C), (d)(1), (e)(3), (g)(1) introductory text, (g)(1)(iv), (g)(2)(ii), and (h) to read as follows:

§ 1065.1139 Aging cycle generation.

* * * * *

(a) *Cycle generation process overview.* The process of cycle generation begins by determining the number of bench aging hours. The input into this

calculation is the useful life in engine operating hours for the target application. If the standard-setting part does not establish useful life based on engine operating hours, use good engineering judgment to determine the appropriate number of hours corresponding to the regulatory useful life based on field data, including average vehicle speed. Subtract service accumulation hours on an engine dynamometer before the start of accelerated aging from the value representing the useful life in hours. Also subtract the engine operating hours needed to stabilize the engine before accelerated aging, and subtract 100 hours to account for stabilization after accelerated aging. The total number of accelerated aging hours is generally equal to the useful life in hours divided by 10 to account for the 10-fold acceleration of the aging process; however, a different acceleration factor may apply as specified in paragraph (e)(6)(v) of this section. As an example of the 10-fold acceleration based on the sample calculation in 40 CFR 1036.245(c)(6), if the total service accumulation representing hours of engine operation over the useful life is 18,567 hours, engine stabilization involved 250 hours of engine operation before initial emission testing, and service accumulation on the dynamometer included 1,525 hours of engine operation, the target for bench-aging hours would be 1,669 hours ((18,567 − 250 − 1,525 − 100)/10). Arrange the different operating modes for repetitive temperature cycling and divide the 1669 hours over those operating modes, as outlined in paragraph (g) of this section. In the case of periodic regeneration, split the bench-aging hours between regeneration and normal (non-regeneration) operation. The analysis of normal operation data is given in paragraph (b) of this section. The analysis of regeneration data is given in paragraph (d) of this section.

(b) * * *

(1) * * *

(iii) Check each solution, starting with the one with the highest CCC to determine if it satisfies the following requirements:

(A) No more than one cluster contains fewer than 3% of the data points.

(B) If that solution does not satisfy these requirements move to the solution with the next highest CCC.

(iv) The process described in paragraph (c)(1)(iii) of this section generally works well for most data sets, but if you have difficulty with the CCC metric in a particular data set, use good engineering judgment to leverage additional criteria to help the down-selection process. Examples of alternative clustering metrics include a Davies-Bouldin Index (optimizing on the minimum value) or a Calinski-Harabasz Index (optimize on the maximum value).

* * * * *

(2) * * *

(i) Perform k-means clustering as described in paragraph (b)(1) of this section but using data sets containing the two parameters recorded in the field data sets. For example, you might use speed and torque, as recorded both in the field and the laboratory for Method 2 clustering.

* * * * *

(v) * * *

(C) Calculate subsequent w_i values after calculating w_1 as follows:

$$w_i = w_1 \cdot \frac{d_1}{d_i}$$

Eq. 1065.1139-5

(D) Calculate the sum of the weighting factors to verify that they are equal to one.

$$w_1 + \ldots w_n = 1$$

Eq. 1065.1139-6

Where:

n = number of regulatory cycles for the application.

* * * * *

(d) * * *

(1) The total number of regenerations that will be run during the accelerated aging process will be the same as the total number of regenerations over useful life. Calculate this number by dividing the total number of useful life hours by the interval between regenerations as determined in § 1065.1133(b)(3) and subtract the number of regenerations that occurred during service accumulation on an engine dynamometer.

* * * * *

(e) * * *

(3) Calculate the cumulative deactivation, D_t, for the input field data set. The time step for the calculations should be 1 second for 1-Hz input data.

(i) First calculate D_t for the non-regeneration portion of the field data set. For Method 2 use the 1-Hz data from the regulatory cycles as the field data set.

(ii) Divide the calculate field D_t by the number of hours represented in the field data set.

(iii) Multiply the hourly D_t by the number of hours required to reach useful life. This is the target $D_{t,field\text{-}norm\,i}$.

(iv) Multiply the total number of regenerations for useful life by the cumulative deactivation D_t for the target regeneration profile determined in paragraph (d)(4) of this section. This is the target $D_{t,field\text{-}regen}$.

(v) The total target cumulative deactivation for the field data, $D_{t,field}$, is the sum of $D_{t,field\text{-}norm\,i}$ and $D_{t,field\text{-}regen}$.

* * * * *

(g) * * *

(1) *Cycle assembly with infrequent regenerations.* For systems that use infrequent regenerations, the number of cycle repeats is equal to the number of regeneration events that happen over useful life. The total cycle duration of the aging cycle is calculated as the total aging duration in hours divided by the number of infrequent regeneration events. In the case of systems with multiple types of infrequent regenerations, use the regeneration with the lowest frequency to calculate the cycle duration.

* * * * *

(iv) Place the mode with the lowest temperature first, then move to the highest temperature mode, followed by the next lowest temperature mode, and then the next highest mode, continuing in this alternating pattern until all modes are included. You may also place the mode with the highest temperature first, then move to the lowest temperature mode, followed by the next highest temperature mode, and then the next lowest temperature mode, continuing in this alternating pattern until all modes are included.

* * * * *

(2) * * *

(ii) Place the mode with the lowest temperature first, then move to the highest temperature mode, followed by the next lowest temperature mode, and then the next highest mode, continuing in this alternating pattern until all modes are included. You may also place the mode with the highest temperature first, then move to the lowest temperature mode, followed by the next highest temperature mode, and then the next lowest temperature mode, continuing in this alternating pattern until all modes are included.

* * * * *

(h) *Chemical exposure targets.* Determine targets for accelerated oil and fuel sulfur exposure as follows:

(1) *Oil exposure targets.* The target oil exposure rate during accelerated aging is 10 times the field average oil consumption rate determined in § 1065.1133(a)(2). You must achieve this

target exposure rate on a cycle average basis during aging. Use good engineering judgment to determine the oil exposure rates for individual operating modes that will achieve this cycle average target. For engine-based aging stands you will likely have different oil consumption rates for different modes depending on the speed and load conditions you set. For burner-based aging stands, you may find that you have to limit oil exposure rates at low exhaust flow or low temperature modes to ensure good atomization of injected oil. On a cycle average basis, the portion of oil exposure from the volatile introduction pathway (*i.e.,* oil doped in the burner or engine fuel) must be between (10 to 30) % of the total. The remainder of oil exposure must be introduced through bulk pathway. We recommend that you adjust your oil exposure to account for exposure that occurred during service accumulation on the dynamometer.

(i) We recommend that you minimize (in the case of an engine-bench aging stand) or turn off (in the case of a burner-based aging stand) oil exposure during infrequent regeneration modes. If you do, you must increase the target oil exposure rates by the ratio of total aging time to total normal (non-regeneration) aging time. Determine this ratio, $O_{acc,rate}$, using the following equation:

$$O_{\mathrm{acc,rate}} = \frac{t_{\mathrm{ul}}}{t_{\mathrm{acc,aging}} - t_{\mathrm{regen}}}$$

Eq. 1065.1139-9

Where:

t_{ul} = total time required for remainder of useful life in hours.

$t_{acc,aging}$ = total time of accelerated aging in hours.

t_{regen} = required total time of infrequent regeneration events during accelerated aging in hours.

Example:

t_{ul} = 16,692 hours

$t_{acc,aging}$ = 1,669 hours

t_{regen} = 300 hours

$$O_{\mathrm{acc,rate}} = \frac{16692}{1669 - 300} = 12.19$$

(ii) This example is for a burner-based aging bench and assumes that oil exposure is completely turned off during infrequent regeneration modes. Therefore, you would need to increase the oil consumption rates in all non-regeneration modes by 12.19 times.

(iii) If $O_{acc,rate}$ exceeds 15.0, you must increase $t_{acc,aging}$ until the calculated oil exposure acceleration rate falls below 15.0. We recommend targeting an acceleration rate of 13 or less to provide a sufficient operating window during actual aging. You may not lower the required total time of infrequent regeneration events during accelerated aging, t_{regen}; therefore, the overall time acceleration will decrease from the original target of ten times.

(2) *Fuel sulfur exposure targets.* The target sulfur exposure rate for fuel-related sulfur is determined by utilizing the field mean fuel rate data for the engine determined in § 1065.1133(a)(3). Calculate the total sulfur exposure mass using this mean fuel rate, the total number of non-accelerated hours to reach useful life, and a fuel sulfur level of 10 ppmw. You may adjust the 10-ppm fuel sulfur level if the fuel your engine operates on is shown to have a sulfur level that differs from diesel fuel. We recommend that you adjust your sulfur exposure to account for exposure that occurred during service accumulation on the dynamometer.

(i) For an engine-based aging stand, if you perform accelerated sulfur exposure by additizing engine fuel to a higher sulfur level, determine the accelerated aging target additized fuel sulfur mass fraction, w_S, as follows:

$$w_{\mathrm{S,target}} = \frac{\bar{\dot{m}}_{\mathrm{fuel,field}}}{\bar{\dot{m}}_{\mathrm{fuel,cyle}}} \cdot m_{\mathrm{Sfuel,ref}} \cdot S_{\mathrm{acc,rate}}$$

Eq. 1065.1139-10

Where:

$\bar{\dot{m}}_{fuel,field}$ = field mean fuel flow rate.

$\bar{\dot{m}}_{fuel,cycle}$ = accelerated aging cycle mean fuel flow rate.

$m_{Sfuel,ref}$ = reference mass of sulfur per mass of fuel = 0.00001 kg/kg.

$S_{acc,rate}$ = sulfur acceleration rate = 10.

Example:

$\bar{\dot{m}}_{fuel,field}$ = 54.3 kg/hr

$\bar{\dot{m}}_{fuel,cycle}$ = 34.1 kg/hr

$m_{Sfuel,ref}$ = 0.00001 kg/kg.

$S_{acc,rate}$ = 10

$$w_{\mathrm{S,target}} = \frac{54.3}{34.1} \cdot 0.00001 \cdot 10$$

$w_{S,target}$ = 0.000159

(ii) If you use gaseous SO_2 to perform accelerated sulfur exposure, such as on a burner-based stand, calculate the target SO_2 concentration to be introduced, $x_{SO2,target}$, as follows:

$$x_{\mathrm{SO2,target}} = \frac{\bar{\dot{m}}_{\mathrm{fuel,field}}}{\bar{\dot{m}}_{\mathrm{exhaust,cycle}}} \cdot \left(\frac{x_{\mathrm{Sfuel,ref}} \cdot S_{\mathrm{acc,rate}} \cdot M_{\mathrm{exh}}}{M_{\mathrm{S}}} \right)$$

Eq. 1065.1139-11

Where:

$\bar{\dot{m}}_{fuel,field}$ = field mean fuel flow rate.

$\bar{\dot{m}}_{exhaust,cycle}$ = time weighted average exhaust flow rate during the burner aging cycle.

$x_{Sfuel,ref}$ = reference mol fraction of sulfur in fuel = 10 µmol/mol.

$S_{acc,rate}$ = sulfur acceleration rate = 10.

M_{exh} = molar mass of exhaust = molar mass of air.

M_S = molar mass of sulfur.

Example:

$\bar{\dot{m}}_{fuel,field}$ = 54.3 kg/hr

$\bar{\dot{m}}_{exhaust,cycle}$ = 1000.8 kg/hr

$x_{Sfuel,ref}$ = 10 µmol/mol

$S_{acc,rate}$ = 10

M_{exh} = 28.96559 g/mol

M_S = 32.065 g/mol

$$x_{SO2,target} = \frac{54.3}{1000.8} \cdot \left(\frac{10 \cdot 10 \cdot 28.96559}{32.065}\right)$$

$x_{SO2,target}$ = 4.90 µmol/mol

(iii) We recommend that you turn off gaseous sulfur injection during infrequent regeneration modes;, if you do this, you must increase the target SO_2 concentration by the ratio of total aging time to total normal (non-regeneration) aging time. Determine this ratio, $S_{acc,rate}$, using the following equation:

$$S_{acc,rate} = \frac{t_{ul}}{t_{acc,aging} - t_{regen}}$$

Eq. 1065.1139-12

Where:

t_{ul} = total time required for remainder of useful life in hours.

$t_{acc,aging}$ = total time of accelerated aging in hours.

t_{regen} = required total time of infrequent regeneration events during accelerated aging in hours.

Example:

t_{ul} = 16,692 hours
$t_{acc,aging}$ = 1,669 hours
t_{regen} = 300 hours

$$S_{acc,rate} = \frac{16692}{1669 - 300} = 12.19$$

(iv) If the updated $S_{acc,rate}$ exceeds 15.0, you must increase $t_{acc,aging}$ until the calculated sulfur exposure acceleration rate falls below 15.0. We recommend targeting an acceleration rate of 13 or less to provide a sufficient operating window during actual aging. You may not lower the required total time of infrequent regeneration events during accelerated aging, t_{regen}; therefore, the overall time acceleration will decrease from the original target of ten times.

■ 132. Amend § 1065.1141 by revising paragraphs (h) and (j) to read as follows:

§ 1065.1141 Facility requirements for engine-based aging stands.

* * * * *

(h) If the engine-aging stand will be used for aging of systems that incorporate a diesel particulate filter (DPF), we recommend you perform secondary tracking of oil exposure by using clean (soot free) DPF weights to track ash loading and compare this mass of ash to the amount predicted using the measured oil consumption mass and the oil ash concentration. The ratio of the mass of ash found by DPF weight over the predicted mass of ash based on oil consumption measurements should fall within a range of 0.55 to 0.7.

* * * * *

(j) If you perform sulfur acceleration by increasing the sulfur level of the engine fuel, you must meet the target sulfur level within ±5 ppmw. Increase the sulfur level by adding sulfur to the entire batch of fuel or adding sulfur to the fuel line that feeds the engine. Verify the sulfur level of the fuel prior to the start of aging, or whenever a new batch of aging fuel is acquired.

* * * * *

■ 133. Amend § 1065.1143 by revising paragraph (h) and adding a new paragraph (j) to read as follows:

§ 1065.1143 Requirements for burner-based aging stands.

* * * * *

(h) If the burner-based aging stand will be used for aging of systems that incorporate a diesel particulate filter (DPF), we recommend you perform secondary tracking of oil exposure by using clean (soot free) DPF weights to track ash loading and compare this mass of ash to the amount predicted using the measured oil consumption mass and the oil ash concentration. The ratio of the mass of ash found by DPF weight over the predicted mass of ash based on oil consumption measurements should fall within a range of 0.55 to 0.7.

* * * * *

(j) If you perform sulfur acceleration by increasing the sulfur level of the burner fuel, you must meet the target sulfur level within ±5 ppmw. Increase the sulfur level by adding sulfur to the entire batch of fuel or adding sulfur to the fuel line that feeds the burner. Verify the sulfur level of the fuel prior to the start of aging, or whenever a new batch of aging fuel is acquired.

* * * * *

■ 134. Amend § 1065.1145 by revising the introductory text and paragraphs (a), (c), and (d) to read as follows:

§ 1065.1145 Execution of accelerated aging, cycle tracking, and cycle validation criteria.

The aging cycle generally consists first of practice runs to validate and tune the final cycle, followed by the actual running of the repeat cycles needed to accumulate field equivalent hours to reach useful life. During the course of the aging run, various aging parameters are tracked to allow verification of proper cycle execution, as well as to allow for correction of the aging parameters to stay within the target limits.

(a) *Preliminary cycle validation runs.* Prior to the start of aging, conduct a number of practice runs to tune the cycle parameters. It is recommended that initial practice runs be conducted without the aftertreatment installed, but with the backpressure of the aftertreatment simulated to help ensure that the tuned cycle is representative. For final cycle tuning, including regenerations, it is recommended to use a duplicate or spare aftertreatment system of similar design to the target system, to avoid damage or excessive initial aging during the tuning. However, it is permissible to conduct final tuning using the target system being aged, but you must limit the total duration to no more than 100 field equivalent hours (10 hours of accelerated aging), including both thermal and chemical components. The process followed for these initial runs will vary depending on whether you are using an engine-based platform or a burner-based platform.

(1) *Engine-based platform.* (i) *Initial cycle development.* It will be necessary to determine a set of engine modes that will generate the required combinations of temperature, exhaust flow, oil consumption, and NO_X to meet the target aging requirements. The development of these modes will be an iterative process using the engine and independent temperature control features of the aging stand. This process assumes that you have already implemented the oil consumption increase modifications, and that these have already been stabilized and validated to reach the necessary levels of bulk oil exposure. In general, we

recommend the use of higher engine speeds and loads to generate the desired oil consumption, leveraging the temperature controls as needed to lower temperature to the targets. Several iterations will likely be needed to reach all targets. Exhaust flow must be within ±25 % of targets for individual cycle modes, and the weighted cycle average exhaust flow (considering non-regeneration modes) must be within ±10 % of the target value. Note that during transitions you may utilize any combination of conditions necessary to help primary component catalysts reach the target temperature and flow conditions within no more than 5 minutes. For example, you may use a higher exhaust flow rate and lower temperature to rapidly cool the aftertreatment system to the next temperature. Use good engineering judgement to select NO_X targets such that the cycle-average NO_X mass rate is consistent with the application if you used Method 1 to develop the accelerated aging cycle, and consistent with the weighted lab cycle NO_X measurements if you used Method 2. NO_X targets do not need to be met during transitions. It is permissible to deviate from engine-out NO_X emission targets if needed to reach the temperature, exhaust flow, and oil consumption targets. We recommend that you maintain a weighted cycle average NO_X level (considering non-regeneration modes) that is within ±25 % of the target. Note that validation of oil consumption requires at least 72 hours of operation. Tune the parameters for infrequent regeneration towards then end of this initial development process (such as hydrocarbon injection schedules and temperature ramp rates).

(ii) *Final cycle validation.* Once the cycle is tuned, conduct a final run using the target aftertreatment system to verify conditions and log temperatures for heat load calculation. Using the recorded cycle data, calculate D_t for all primary component catalysts to ensure that you are matching the desired $D_{t,cycle}$ targets. If you are not within ±3% of the target $D_{t,cycle}$, adjust the cycle accordingly. Calculate D_t for any secondary catalyst components to verify that they are within ±3% of either the target D_t or the target aging metric. Note that the accelerated aging methodology assumes that the relationship between the temperature of the primary and secondary catalyst components will be the same as the field observations. If this relationship deviates in the lab by having more or less heat transfer through the system, it may be necessary to modify that relationship on the aging stand. You may need to take measures such as adding or removing insulation or utilize external cooling fans to help these parameters match more closely.

(2) *Burner-based platform.* (i) *Cycle development.* The burner-based platform should be able to meet the exhaust flow, temperature, and oil consumption targets directly without the need for additional cycle development. This process assumes that you have already implemented and validated your oil consumption exposure methods to reach the necessary levels of bulk oil exposure. Exhaust flow must be within ±25% of targets for individual cycle modes, and the weighted cycle average exhaust flow (considering non-regeneration modes) must be within ±10% of the target value. For diesel-fueled engines, we recommend maintaining oxygen setpoints between (7 and 17) volume percent and water setpoints between (5 and 11) volume percent. For other fuels, use good engineering judgment to select appropriate ranges. Use good engineering judgement to select NO_X targets such that the cycle-average NO_X mass rate is consistent with the application if you used Method 1 to develop the accelerated aging cycle, and consistent with the weighted lab cycle NO_X measurements if you used Method 2. We recommend maintaining a weighted cycle-average NO_X level (considering non-regeneration modes) that is within ±25% of the target level. Note that during transitions you may utilize any combination of conditions necessary to help primary component catalysts reach the target temperature and flow conditions within no more than 5 minutes. For example, you may use a higher exhaust flow rate and lower temperature to rapidly cool the aftertreatment system to the next temperature. NO_X targets do not need to be met during transitions.

(ii) *Final cycle validation.* Once the cycle is tuned, conduct a final run using the target aftertreatment system to verify conditions and log temperatures for heat load calculation. Using the recorded cycle data, calculate D_t for all primary components catalysts to ensure that you are matching the desired $D_{t,cycle}$ targets. If you are not within ±3% of the target $D_{t,cycle}$, adjust the cycle accordingly. Calculate D_t for any secondary catalyst components to check that they are within ±3% of either the target D_t or the target aging metric. Note that the accelerated aging methodology assumes that the relationship between the temperature of the primary and secondary catalyst components will be the same as that observed in the field. If this relationship deviates in the lab by having more or less heat transfer through the system, it may be necessary to modify that relationship on the aging stand. You may need to take measures such as adding or removing insulation or utilize external cooling fans to help these parameters match more closely.

* * * * *

(c) *Initial emission testing.* Prior to the start of accelerated aging conduct the initial zero-hour emission test and any required engine dynamometer aging following the requirements of the standard setting part for your engine. Dynamometer aging hours count toward the total aging hours.

(d) *Accelerated aging.* Following zero-hour emission testing and any engine dynamometer aging, perform accelerated aging using the cycle validated in either paragraph (a)(1) or (2) of this section. Repeat the cycle the number of times required to reach useful life equivalent aging. Interrupt the aging cycle as needed to conduct any scheduled intermediate emission tests, clean the DPF of accumulated ash, and for any facility-related reasons. We recommend you interrupt aging at the end of a given aging cycle, following the completion of any scheduled infrequent regeneration event. If an aging cycle is paused for any reason, we recommend that you resume the aging cycle at the same point in the cycle where it stopped to ensure consistent thermal and chemical exposure of the aftertreatment system.

* * * * *

■ 135. Amend subpart L by adding a new center header following § 1065.1145 and adding §§ 1065.1147, 1065.1149, 1065.1151, 1065.1153, and 1065.1155 under that center header to read as follows:

Accelerated Aftertreatment Aging—Spark-Ignition Aftertreatment

§ 1065.1147 General provisions related to accelerated aging of spark-ignition aftertreatment for deterioration factor determination.

Sections 1065.1147 through 1065.1155 specify procedures for spark-ignition engine aftertreatment systems to produce an aged aftertreatment system, in an accelerated fashion, for durability demonstration. Determine the target number of hours that represents useful life for an engine family as described in the standard setting part. The method described is a procedure for translating field data that represents a given application into an accelerated aging cycle for that specific application, as well as methods for carrying out aging using that cycle. The procedure is intended to be representative of field

aging and includes exposure to elements of both thermal and chemical aging.

§ 1065.1149 Standard catalyst bench-aging procedure.

This section provides a means to accelerate aging of the catalyst-plus-oxygen-sensor system on a catalyst aging bench. Accelerated aging is performed by testing the system over the standard bench cycle (SBC) based on the calculated bench aging time, *BAT,* which uses catalyst time-at-temperature data measured from field data over a cycle you develop or over the standard road cycle (SRC) provided in Table 1 and Figure 1 of this section. You may develop your own method to calculate bench aging with our approval. Demonstrate that your bench aging calculations provide the same or larger amount of emission deterioration as the standard bench aging procedure.

TABLE 1 OF § 1065.1149—STANDARD ROAD CYCLE (SRC) [a] [b]

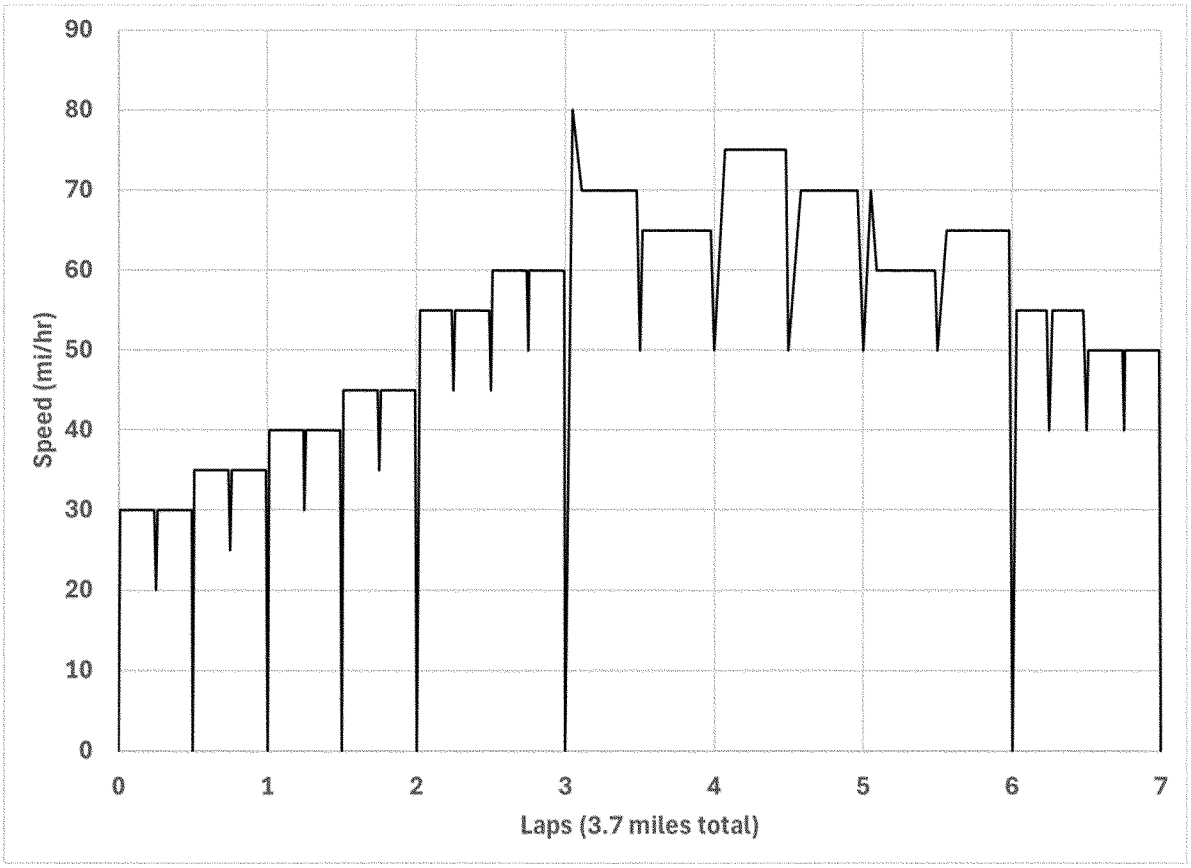
Lap	Description	Typical accel rate (mi/hr/s)
1	(start engine) Idle 10 sec	0
1	Moderate acceleration to 30 mi/hr	4
1	Cruise at 30 mi/hr for ¼ lap	0
1	Moderate deceleration to 20 mi/hr	−5
1	Moderate acceleration to 30 mi/hr	4
1	Cruise at 30 mi/hr for ¼ lap	0
1	Moderate deceleration to stop	−5
1	Idle for 5 seconds	0
1	Moderate acceleration to 35 mi/hr	4
1	Cruise at 35 mi/hr for ¼ lap	0
1	Moderate deceleration to 25 mi/hr	−5
1	Moderate acceleration to 35 mi/hr	4
1	Cruise at 35 mi/hr for ¼ lap	0
1	Moderate deceleration to stop	−5
2	Idle 10 sec	0
2	Moderate acceleration to 40 mi/hr	3
2	Cruise at 40 mi/hr for ¼ lap	0
2	Moderate deceleration to 30 mi/hr	−5
2	Moderate acceleration to 40 mi/hr	3
2	Cruise at 40 mi/hr for ¼ lap	0
2	Moderate deceleration to stop	−5
2	Idle for 5 seconds	0
2	Moderate acceleration to 45 mi/hr	3
2	Cruise at 45 mi/hr for ¼ lap	0
2	Moderate deceleration to 35 mi/hr	−5
2	Moderate acceleration to 45 mi/hr	3
2	Cruise at 45 mi/hr for ¼ lap	0
2	Moderate deceleration to stop	−5
3	Idle 10 sec	0
3	Hard acceleration to 55 mi/hr	4
3	Cruise at 55 mi/hr for ¼ lap	0
3	Moderate deceleration to 45 mi/hr	−5
3	Moderate acceleration to 55 mi/hr	2
3	Cruise at 55 mi/hr for ¼ lap	0
3	Moderate deceleration to 45 mi/hr	−5
3	Moderate acceleration to 60 mi/hr	2
3	Cruise at 60 mi/hr for ¼ lap	0
3	Moderate deceleration to 50 mi/hr	−5
3	Moderate acceleration to 60 mi/hr	2
3	Cruise at 60 mi/hr for ¼ lap	0
3	Moderate deceleration to stop	−4
4	Idle 10 sec	0
4	Hard acceleration to 80 mi/hr	3
4	Coastdown to 70 mi/hr	−1
4	Cruise at 70 mi/hr for ½ lap	0
4	Moderate deceleration to 50 mi/hr	−3
4	Moderate acceleration to 65 mi/hr	2
4	Cruise at 65 mi/hr for ½ lap	0
4	Moderate deceleration to 50 mi/hr	−3
5	Moderate acceleration to 75 mi/hr	1
5	Cruise at 75 mi/hr for ½ lap	0
5	Moderate deceleration to 50 mi/hr	−3
5	Light acceleration to 70 mi/hr	1
5	Cruise at 70 mi/hr for ½ lap	0
5	Moderate deceleration to 50 mi/hr	−3
6	Moderate acceleration to 70 mi/hr	2
6	Coastdown to 60 mi/hr	−1
6	Cruise at 60 mi/hr for ½ lap	0
6	Moderate deceleration to 50 mi/hr	−4
6	Moderate acceleration to 65 mi/hr	1
6	Cruise at 65 mi/hr for ½ lap	0

TABLE 1 OF § 1065.1149—STANDARD ROAD CYCLE (SRC) [a] [b]—Continued

Lap	Description	Typical accel rate (mi/hr/s)
6	Moderate deceleration to stop	−4
7	Idle 45 sec	0
7	Hard acceleration to 55 mi/hr	4
7	Cruise at 55 mi/hr for ¼ lap	0
7	Moderate deceleration to 40 mi/hr	−5
7	Moderate acceleration to 55 mi/hr	2
7	Cruise at 55 mi/hr for ¼ lap	0
7	Moderate deceleration to 40 mi/hr	−5
7	Moderate acceleration to 50 mi/hr	2
7	Cruise at 50 mi/hr for ¼ lap	0
7	Moderate deceleration to 40 mi/hr	−5
7	Moderate acceleration to 50 mi/hr	2
7	Cruise at 50 mi/hr for ¼ lap	0
7	Moderate deceleration to stop	−5

[a] The engine may be run in a vehicle on a track or on a mileage accumulation dynamometer.
[b] The cycle consists of 7 laps of a 3.7-mile course. The length of the lap may be changed to accommodate the length of the service-accumulation track.

FIGURE 1 OF § 1065.1149–STANDARD ROAD CYCLE (SRC)



(a) *Standard bench cycle (SBC).* Perform standard catalyst bench aging by following the SBC, as described in § 1065.1153.

(b) *Catalyst time-at-temperature data.* (1) Measure the catalyst temperature over at least two full cycles of the SRC or use temperature data acquired in the field to obtain your catalyst time-at-temperature.

(2) Measure the catalyst bed temperature at the highest peak temperature location in the hottest catalyst on the vehicle or engine as described in § 1065.1155(f). We recommend using thermocouples that are 1.6 mm in diameter to ensure fast response to temperature changes. Alternatively, the temperature may be measured at another location providing that it is adjusted to represent the temperature measured at the hottest location using good engineering judgement.

(3) Measure the catalyst temperature at a minimum of 1 Hz.

(4) Use the measured catalyst temperature results to generate a histogram with temperature bins of no larger than 25 °C.

(c) *Bench-aging time.* Determine bench aging time, *BAT,* using the following series of equations:

(1) Determine the equivalent catalyst aging time, $t_{e,bin,}$ at the effective reference temperature, T_r, on the catalyst aging bench using the catalyst aging cycle to produce the same amount of deterioration experienced by the catalyst due to thermal deactivation at the temperature bin, T_v, over the vehicle's useful life.

$$t_{e,bin} = t_h \cdot e^{\left(\left(\frac{R}{T_r}\right)-\left(\frac{R}{T_v}\right)\right)}$$

Eq. 1065.1149-1

Where:

t_h = time measured within the prescribed temperature bin of the vehicle's catalyst temperature histogram adjusted to a full useful life basis, in hours. For example, if the histogram represented 400 miles, and full useful life was 100,000 miles; all histogram time entries would be multiplied by 250 (100,000/400).

R = catalyst thermal reactivity coefficient = 17,500 for the SBC. You may optionally develop your own coefficient using the procedure described in § 1065.1151.

T_r = the effective reference temperature of the catalyst on the catalyst bench run on the bench aging cycle, in °K. The effective temperature is the constant temperature that would result in the same amount of aging as the various temperatures experienced during the bench aging cycle.

T_v = the mid-point temperature of the temperature bin of the vehicle or engine catalyst temperature histogram, in °K.

(2) Determine the equivalent time to age the catalyst at the temperature of T_r on the catalyst aging bench using the catalyst aging cycle, $t_{e,total}$. This equivalent time is determined by summing the time for all temperature bin results from Eq. 1065.1149–1 which will result in the same amount of deterioration experienced by the catalyst due to thermal deactivation over the vehicle's full useful life.

$$t_{e,total} = \sum_{i=0}^{n} t_{e,bin i}$$

Eq. 1065.1149-2

Where:

n = total number of temperature bins.

i = an indexing variable that represents one temperature bin.

(3) Determine *BAT.*

$$BAT = A \cdot t_{e,total}$$

Eq. 1065.1149-3

Where:

A = catalyst aging adjustment time to account for deterioration from sources other than thermal aging of the catalyst = 1.1. You may develop your own adjustment factor using good engineering judgement, without prior EPA approval, to ensure that the durability process will achieve the durability objective of § 1065.1147. You may account for chemical aging using fuel with additional compounds that may lead to catalyst poisoning, such as phosphorus, sulfur or lead. If you choose this option, you must calculate a new, *A,* and ensure that the durability objective of this section is achieved.

(d) *Effective reference temperature on the SBC.* Determine the effective reference temperature of the standard bench cycle (SBC) for the actual catalyst system design and actual aging bench used, using the following procedures:

(1) Measure the catalyst system time-at-temperature while being tested on the catalyst aging bench over the SBC.

(i) Measure catalyst temperature at the highest peak temperature location of the hottest catalyst in the system. Alternatively, the temperature may be measured at another location providing that it is adjusted to represent the temperature measured at the hottest location using good engineering judgement.

(ii) Measure catalyst temperature at 1 Hz for at least 20 minutes of bench aging cycle.

(iii) Use the measured catalyst temperature results to generate a histogram with temperature bins of no larger than 10 °C.

(2) Use Eq. 1065.1149–1 to iteratively calculate the effective reference temperature by changing the reference temperature, T_r, until the calculated aging time equals the actual time represented in the catalyst temperature histogram. The resulting temperature is the effective reference temperature on the SBC for that catalyst system and aging bench.

(e) *Catalyst aging bench.* Use good engineering judgement to design a catalyst aging bench that follows the SBC and delivers the appropriate exhaust constituents and exhaust temperature to the face of the catalyst. Use good engineering judgment to select an appropriate exhaust flow. Good engineering judgment would include selecting an exhaust flow equal to the average exhaust flow over the road cycle, within ±10%.

(1) Design your catalyst aging bench as described in § 1065.1155. You may use another design that results in equivalent or superior results with our prior approval.

(2) Design your catalyst aging bench to record appropriate information such as lambda and catalyst time-at-temperature to ensure that sufficient aging has occurred.

§ 1065.1151 Experimentally determining the catalyst thermal reactivity coefficient (R) for bench aging durability procedures.

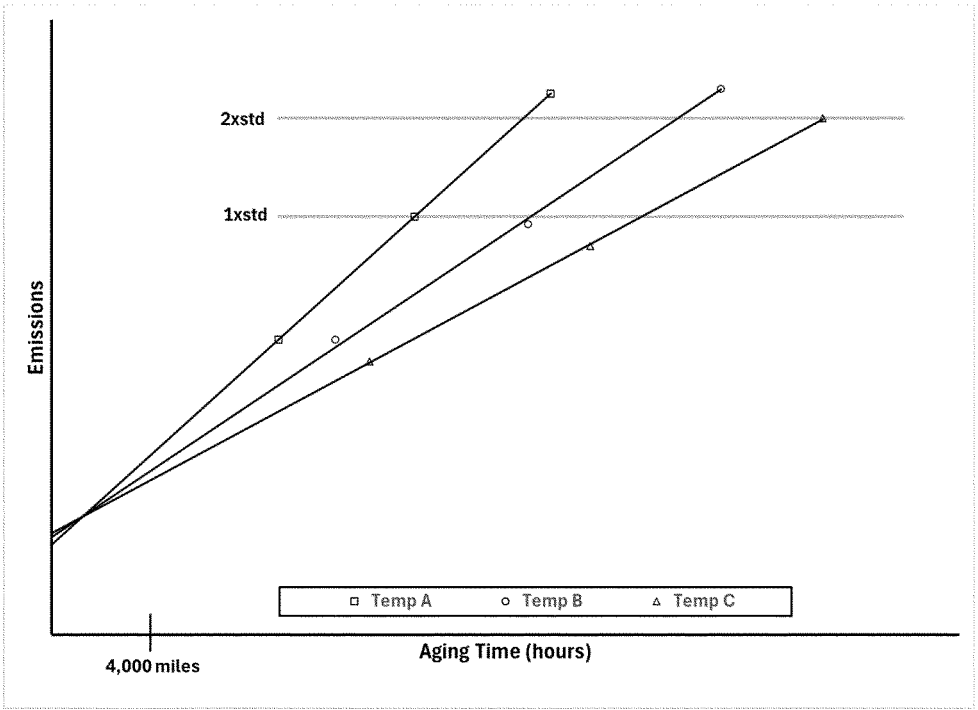
If you choose not to use the default catalyst thermal reactivity coefficient that follows in Eq. 1065.1149–1, experimentally determine the coefficient using the following procedure:

(a) Use the applicable bench cycle and aging bench hardware to age at least three catalysts at different control temperatures ranging between the normal operating temperature and the damage limit temperature. Measure emissions during this aging for all regulated pollutants. Ensure that the final testing yields emission data between one- and two-times the standard.

(b) Estimate the catalyst thermal reactivity coefficient and calculate the effective reference temperature, T_r, for the bench aging cycle for each control temperature according to the procedure described in § 1065.1149(d).

(c) Generate a plot of emissions (or catalyst inefficiency) versus aging time for each catalyst. Calculate the least-squared best-fit line through the data. The data should have a common intercept between 0 and 4000 miles. The following figure provides an example of the plot:

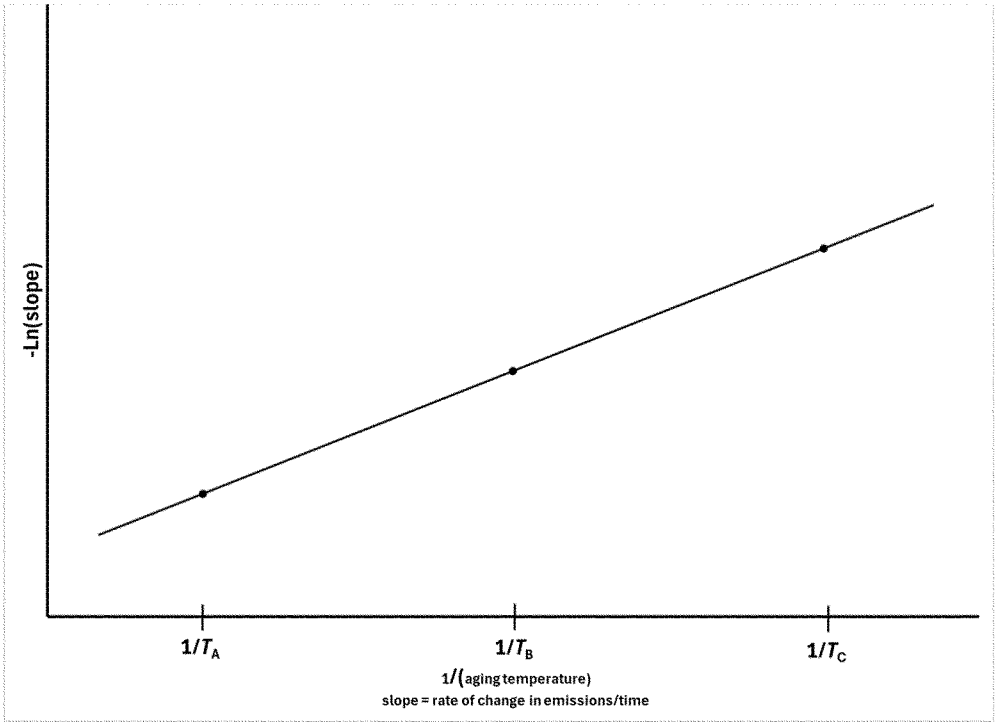
FIGURE 1 OF § 1065.1151—CATALYST INEFFICIENCY VERSUS AGING TIME



(d) Calculate the slope of the best-fit line for each aging temperature.

(e) Plot the natural log (ln) of the slope of each best-fit line determined in paragraph (d) of this section along the vertical axis, versus the inverse of aging temperature (1/(aging temperature, °K)) along the horizontal axis. Calculate the least-squared best-fit lines through the data. The slope of the line is the catalyst thermal reactivity coefficient. The following figure provides an example of the plot:

FIGURE 2 OF § 1065.1151—LEAST-SQUARED BEST-FIT OF LINES DETERMINED IN PARAGRAPH (D) OF THIS SECTION VERSUS THE INVERSE OF AGING TEMPERATURE.



(f) Compare the catalyst thermal reactivity coefficient to the initial value that was used in paragraph (b) of this section. If the calculated catalyst thermal reactivity coefficient differs from the initial value by more than 5%, choose a new coefficient that is between the initial and calculated values, then repeat the steps in paragraphs (b) through (f) of this section to derive a new coefficient. Repeat this process until the calculated catalyst thermal reactivity coefficient is within 5% of the initially assumed coefficient.

(g) Compare the catalyst thermal reactivity coefficient determined separately for each constituent. Use the lowest catalyst thermal reactivity coefficient for calculating BAT.

§ 1065.1153 Standard bench cycle (SBC).

The standard bench aging durability procedure consists of aging a catalyst-oxygen-sensor system on an aging bench that follows the SBC.

(a) The SBC requires use of an aging bench (exhaust gas generator) with an engine or burner as the source of feed gas for the catalyst.

(b) The SBC is a 60-second cycle which is repeated on the aging bench for the duration of the procedure. The SBC is defined based on the duration of a given operating mode and associated catalyst bed temperature, exhaust lambda, and the amount of secondary air injection added upstream of the catalyst. Maintain the exhaust flow rate as described in § 1065.1149(e). You may develop and use your own bench cycle with our approval. Demonstrate that your bench cycle provides the same or a larger amount of emission deterioration as the standard bench cycle.

(c) Instrument the catalyst to measure the bed temperature at the location where the highest peak bed temperature occurs in the hottest catalyst. Alternatively, measure the feed gas temperature and convert it to catalyst bed temperature using a linear transform calculated from correlation data collected on the catalyst design and aging bench used in the aging process.

(d) Control the catalyst bed temperature at stoichiometric conditions (Mode 1), $T_{lambda1}$, to a minimum of 800 °C (±10 °C) by selecting the appropriate operating conditions (fueling and air flow) for the aging bench. Note that the catalyst bed temperature might be out of tolerance in Mode 1 initially after the transition from Mode 4. Control the maximum catalyst temperature that occurs during the cycle, $T_{lambdarich}$, to 890 °C (±10 °C) by selecting the appropriate aging bench lambda during the ''rich'' phase described in the table below. Note that the temperatures given in this paragraph are based on neat (E0) gasoline and the temperatures will change with fuel type.

(e) If a Mode 1 target catalyst bed temperature other than 800 °C is utilized, set the high control temperature to 90 °C greater than the Mode 1 catalyst bed temperature.

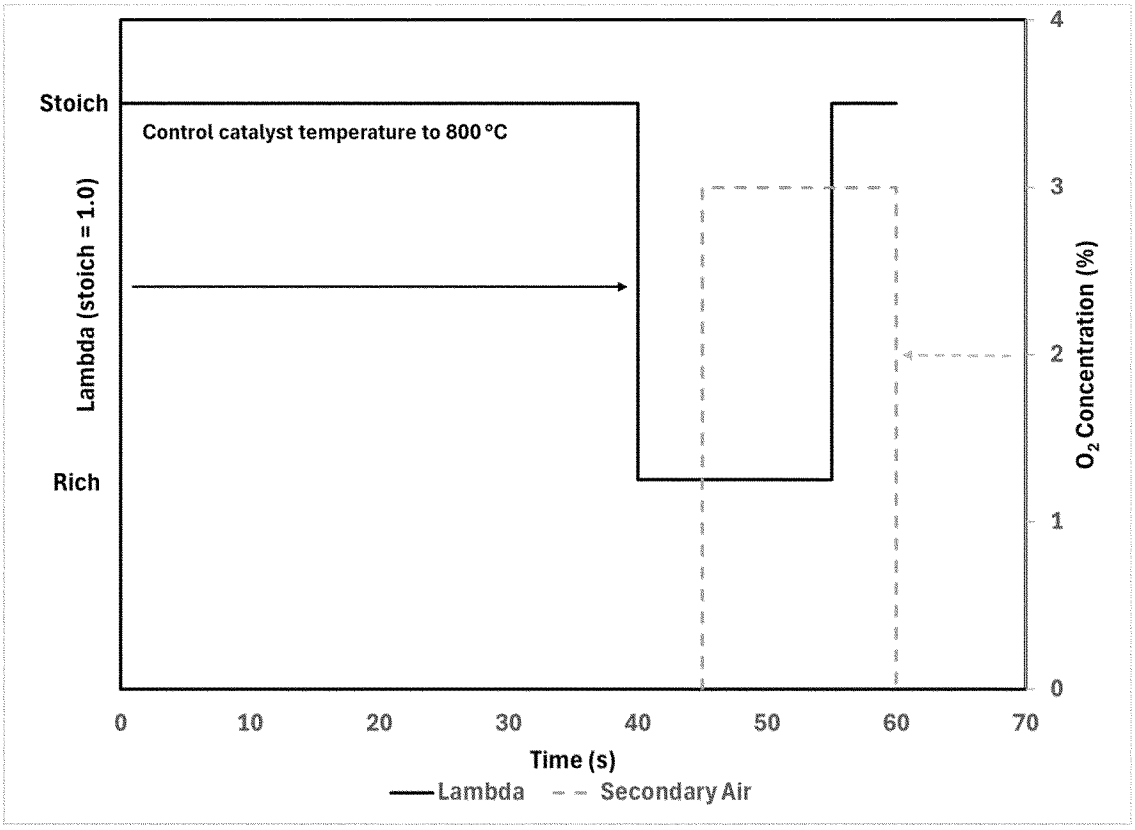
TABLE 1 OF § 1065.1153—STANDARD BENCH CYCLE (SBC)

Mode	Time (seconds)	Aging bench operating conditions	Secondary air injection
1	1–40	Lambda = 1 with operating conditions set to achieve the targeted catalyst bed temperature (typically a minimum of 800 °C) and exhaust flow rate.	None.

TABLE 1 OF § 1065.1153—STANDARD BENCH CYCLE (SBC)—Continued

Mode	Time (seconds)	Aging bench operating conditions	Secondary air injection
2	41–45	Same as Mode 3	None.
3	46–55	"Rich" (lambda selected to achieve a maximum catalyst temperature over the entire cycle of 890 °C, or 90 °C higher than low control temperature).	3% (±0.1%).
4	56–60	Same as Mode 1	3% (±0.1%).

FIGURE 1 OF § 1065.1153—STANDARD BENCH CYCLE



§ 1065.1155 Aging bench equipment and procedures.

This section provides specifications for the standard aging bench equipment and aging procedures used to conduct catalyst bench aging under the provisions of § 1065.1147.

(a) Design the aging bench to provide the appropriate temperature, lambda, exhaust constituents and secondary air injection at the inlet face of the catalyst. Maintain the exhaust flow rate as described in § 1065.1149(e).

(b) The standard aging bench consists of an engine, engine controller, and engine dynamometer. You may use other configurations, such as a burner that provides the correct exhaust conditions, as long as the catalyst inlet conditions and control features specified in this section are met. You may split the exhaust flow into multiple streams to simultaneously age multiple catalyst systems.

(c) Use the appropriate fuel specified in §§ 1065.710(b), 1065.715, or 1065.720. Use good engineering judgment to select a representative commercial oil to use in the engine.

(d) Install the entire catalyst(s)-plus-oxygen-sensor(s) system, together with all exhaust piping which connects these components, on the bench. Install each bank of the exhaust system separately on the bench for engines with multiple exhaust streams. You may request approval to age the oxygen sensor system separately.

(e) Install the entire catalyst system as a unit for aging; including all catalysts, all oxygen sensors (if not aged separately) and the associated exhaust piping for exhaust systems that contain multiple in-line catalysts. You may shorten the distance between the emission source and catalyst as needed to accommodate installation. Alternatively, each individual catalyst may be separately aged for the appropriate period of time.

(f) Measure catalyst temperature using a thermocouple placed in the catalyst bed at the location where the highest peak temperature occurs in the hottest catalyst. We recommend using thermocouples that are 1.6 mm in diameter to ensure fast response to temperature changes. Record catalyst temperature at 1 Hz during the aging procedure.

(g) Measure lambda as close as possible to the catalyst inlet flange at 1 Hz during the aging procedure.

(h) Maintain exhaust flow rate as described in § 1065.1149(e). Determine proper flow rate based upon the exhaust flow that would occur at the engine's steady state speed and load selected for

the bench aging in paragraph (i) of this section.

(i) Set the engine speed, load, and spark timing to achieve a catalyst bed temperature of 800 ±10 °C at steady-state stoichiometric operation.

(j) Set the air injection system to produce 3.0 ±0.3% oxygen in the steady-state stoichiometric exhaust stream. Use good engineering judgment to locate the secondary air injection point at a position upstream of the catalyst to ensure well mixed exhaust. A typical reading at the upstream measurement point is lambda 1.16, which equates to approximately 3% oxygen. Measure the oxygen concentration resulting from the secondary air injection (10 to 20) mm downstream of the secondary air injection point.

(k) Set the ''Rich'' lambda, with the air injection on, to produce a catalyst bed temperature of 890 ±10 °C. A typical lambda value for this step is 0.94, which equates to approximately 2% CO.

(l) The standard bench aging procedure uses the SBC in § 1065.1153. Repeat the SBC until the amount of aging calculated from Eq. 1065.1149–3 is achieved.

(m) Periodically verify the temperature, lambda, and exhaust flow rate values from paragraphs (f), (g), and (h) of this section at least every 50 hours during aging. Make adjustments as necessary to ensure that the SBC is properly followed throughout the aging process.

(n) Once the aging cycle is complete, generate a histogram of the catalyst time-at-temperature from the data collected during the aging process with temperature bins of no larger than 10 °C. Verify that the appropriate amount of thermal aging of the catalyst occurred using the *BAT* value from Eq. 1065.1149–3 and the calculated effective reference temperature for the aging cycle from § 1065.1149(d). Extend the bench aging if the thermal effect of the calculated aging time is not at least 95% of the target thermal aging.

(o) Use special low temperature startup and shutdown procedures to ensure that the maximum catalyst temperature for rapid deterioration (*e.g.,* 1050 °C) does not occur.

■ 136. A new part 1071 is added to subchapter U of chapter I to read as follows:

PART 1071—NONCONFORMANCE PENALTIES

Subpart A—Program Overview

1071.1 Applicability and general provisions.
1071.5 Criteria for adopting nonconformance penalties.
1071.10 Establishing Upper Limits.
1071.15 Qualifying for nonconformance penalties.

Subpart B—Compliance Provisions

1071.30 General provisions for Production Compliance Audits.
1071.35 Maintenance and testing procedures for Production Compliance Audits.
1071.40 Determining the Compliance Level.
1071.45 Fail thresholds.
1071.50 Test reporting.
1071.55 Recordkeeping.
1071.60 EPA testing.
1071.65 Labeling.

Subpart C—Penalty Provisions

1071.80 Penalty parameters for specific standards.
1071.85 Calculating the nonconformance penalty.
1071.90 Making payments.

Subpart D—Administrative Provisions

1071.100 Entry and access.
1071.105 Suspending and voiding certificates of conformity.
1071.110 Hearing procedures.
1071.115 Confidential information.
1071.120 List of acronyms.

Appendix A to Part 1071—Penalty Parameter Values for Historical Standards

Authority: 42 U.S.C. 7401–7671q.

Subpart A—Program Overview

§ 1071.1 Applicability and general provisions.

(a) This part describes how nonconformance penalties apply for qualifying motor vehicles and motor vehicle engines. Nonconformance penalties allow manufacturers to produce vehicles or engines that do not meet new emission standards, with the penalty designed to avoid a competitive advantage from producing higher-emitting vehicles or engines.

(b) Nonconformance penalties may apply relative to new standards that apply for motor vehicles above 6,000 pounds GVWR and for engines that will be installed in such vehicles. Nonconformance penalties apply for specific emission standards and for specific classes of vehicles and engines as specified in this part. We may establish nonconformance penalties by dividing vehicles into classes based on any relevant parameters.

(c) Participating manufacturers determine a Compliance Level to characterize the level of emission control as described in subpart B of this part. The amount of the penalty is calculated by comparing the Compliance Level to the published emission standard as described in subpart C of this part. The Compliance Level also serves as the emission standard for compliance testing with individual vehicles or engines.

(d) Unless we specify otherwise, send all reports and requests for approval to the Designated Compliance Officer (see 40 CFR 1068.30). See §§ 1071.50 and 1071.55 for specific reporting and recordkeeping provisions.

(e) All terms in this part have the meaning given in the Clean Air Act (42 U.S.C. 7401–7671q). The following conventions and definitions apply for this part:

(1) The term ''you'' means the manufacturer certifying vehicles or engines with nonconformance penalties as specified in this part.

(2) References to ''NCP families'' are understood to include engine families for engine-based exhaust emission standards for vehicle-based evaporative and refueling emission standards. References to ''NCP families'' are also understood to include test groups and durability groups for vehicle-based exhaust emission standards.

(3) *Good engineering judgment* has the meaning given in 40 CFR 1068.30.

(4) *Round* has the meaning given in 40 CFR 1065.1001.

(5) *Configuration* has one of the following meanings:

(i) For vehicle-based standards, configuration has the meaning given for ''vehicle configuration'' in 40 CFR 86.1803–01.

(ii) For engine-based standards, configuration has the meaning given for ''engine configuration'' in 40 CFR 1036.801.

§ 1071.5 Criteria for adopting nonconformance penalties.

We will determine whether nonconformance penalties are appropriate for a given emission standard for a given class of vehicles or engines as described in this section based on our evaluation of criteria designed to assess the likelihood that a manufacturer will be technologically unable to meet the emission standard on time.

(a) *Criteria.* We will establish a nonconformance penalty if the following three criteria apply:

(1) There is a new emission standard. The new emission standard may result from adopting a standard that is more stringent than what we adopted previously. An existing emission standard might also be considered new if meeting that standard becomes more difficult because of a new or revised standard for a different pollutant. An emission standard is no longer new under this paragraph (a)(1) when all manufacturers already producing U.S.-directed vehicles or engines within the

class comply with the standard without using emission credits.

(2) Meeting the relevant standard requires (or required) application of new technology or significant modification of existing technology, as evaluated from the point at which we adopted the new standard (or from the point at which we adopted an emission standard for a different pollutant that made it more difficult to meet the relevant standard).

(3) There is a manufacturer that is unable, or will likely be unable, for technological reasons to meet the emission standard for one or more vehicle or engine models within the class.

(b) *Evaluation.* We will evaluate the criteria in paragraph (a) of this section based on any available information. We will not establish a nonconformance penalty if we determine that any of the specified criteria do not apply. We may establish a nonconformance penalty if we determine that the criterion in paragraph (a)(3) applies even if we are uncertain whether one or both criteria in paragraphs (a)(1) and (2) apply. If we determine that a manufacturer will fail to meet a standard, we may establish a nonconformance penalty even if we are not certain that the failure is for technological reasons.

§ 1071.10 Establishing Upper Limits.

A vehicle or engine you certify with a nonconformance penalty must have a Compliance Level that is at or below an Upper Limit that we establish by rulemaking. This section describes how we establish the Upper Limit.

(a) The Upper Limit will generally be the previous emission standard. We may select a more stringent Upper Limit if we determine that all the vehicles or engines in the class can meet the more stringent Upper Limit. Conversely, we may select an appropriately less stringent Upper Limit if we determine that not all the vehicles or engines in the class can meet the previous standard.

(b) The following provisions apply for carryover NCP families certified to the relevant emission standard with a Family Emission Limit:

(1) Except as specified in paragraph (b)(2) of this section, if the Family Emission Limit is above the previous emission standard, we may set the Upper Limit for that NCP family to be equal to the Family Emission Limit.

(2) If the Upper Limit under paragraph (a) of this section is more stringent than the previous emission standard, the Upper Limit for the carryover NCP family is the previous emission standard.

(c) We will set an appropriate Upper Limit if there is no previous standard, or if the nonconformance penalty is based on an existing standard becoming more difficult because of a new or revised standard for a different pollutant.

§ 1071.15 Qualifying for nonconformance penalties.

This section describes how you may produce vehicles or engines that comply using nonconformance penalties under this part in spite of exceeding an emission standard.

(a) Nonconformance penalties are available for the following standards and classes of vehicles or engines:

(1) Medium HDE subject to the 35 mg/hp·hr NO_X standard in 40 CFR 1036.104.

(2) Heavy HDE subject to the 35 mg/hp·hr NO_X standard in 40 CFR 1036.104.

(b) Vehicles and engines you certify using nonconformance penalties must be in their own engine family or test group. We refer to these separately certified groups of vehicles and engines as NCP families. Vehicles and engines you certify using emission credits are not eligible for nonconformance penalties.

(c) You are eligible to produce vehicles or engines with a Compliance Level up to the Upper Limit as described in this section in either of the following circumstances:

(1) Your application for certification has a certified emission level that exceeds an emission standard identified in paragraph (a) of this section, but it is at or below the associated Upper Limit. Note that this may occur if you otherwise would need to amend an existing application for certification to include a new or modified configuration that has a certified emission level that exceeds an emission standard identified in paragraph (a) of this section.

(2) One of your test groups or engine families fails a Selective Enforcement Audit under 40 CFR part 86, subpart G, or part 1068, subpart E, with respect to a standard identified in paragraph (a) of this section.

(d) The following requirements apply with respect to vehicles and engines qualifying for nonconformance penalties under this part:

(1) You must establish a Compliance Level as described in subpart B of this part that is at or below the Upper Limit. You must also send us test results and keep records associated with Production Compliance Audits, as applicable.

(3) You must label vehicles or engines as described in § 1071.65.

(4) You must make timely payments as described in §§ 1071.85 and 1071.90.

Subpart B—Compliance Provisions

§ 1071.30 General provisions for Production Compliance Audits.

Unless otherwise specified in § 1071.80, the Compliance Level for establishing a per-vehicle or per-engine nonconformance penalty under this part is based on test results from Production Compliance Audits. Paragraphs (a) and (b) of this section describe administrative and procedural provisions that apply for two different scenarios.

(a) You may start to produce vehicles or engines with a certified emission level exceeding an emission standard as described in § 1071.15(c)(1) under a certificate of conformity that is subject to the following conditions:

(1) You must agree to conduct a Performance Compliance Audit as described in § 1071.35. The Compliance Level from the tested configurations applies for the whole NCP family unless we approve your proposed approach to test additional configurations and divide different configurations across the NCP family into subfamilies based on similar emission characteristics for establishing different Compliance Levels.

(2) You must agree to pay the nonconformance penalty resulting from the Production Compliance Audit for each affected vehicle or engine you produce, subject to the hearing provisions in § 1071.110.

(3) You must agree to meet recall requirements for all affected configurations with a Compliance Level that exceeds the Upper Limit. Recall requirements are in 40 CFR part 85, subpart S, for vehicles and in 40 CFR part 1068, subpart F, for engines. Recall requirements apply without a separate EPA determination under 40 CFR 85.1802(a) or 1068.505(a).

(4) You must start to select and test vehicles or engines within five days after you start to produce affected vehicles or engines, unless we agree to allow additional time.

(5) If the Production Compliance Audit results in a Compliance Level at or below the emission standard, you may produce vehicles or engines for all affected configurations under the existing certificate of conformity and the conditions in paragraph (a)(2) and (3) of this section do not apply.

(6) You may add a configuration to an NCP family certified with nonconformance penalties or change a configuration already included in the NCP family by amending your application for certification as described in 40 CFR 86.1842–01 for vehicles and for engines as described in 40 CFR

1036.225 for engines, subject to the following conditions:

(i) If the existing Compliance Level continues to be appropriate for the new or changed configuration, you may treat those vehicles or engines like the others in the NCP family.

(ii) If your new or changed configuration fully complies with current emission standards, you may certify those vehicles or engines in a separate family that is not subject to nonconformance penalties.

(iii) You may perform a Production Compliance Audit as described in § 1071.35 with vehicles or engines in the new or changed configuration (or configurations) to establish a Compliance Level. If the Compliance Level for the new or changed configuration is lower than the earlier Compliance Level but still does not meet current emission standards, you may include affected vehicles or engines in a new subfamily that uses the new Compliance Level.

(b) If a vehicle or engine family fails a Selective Enforcement Audit as described in § 1071.15(c)(2), you may establish an NCP family and continue to produce vehicles or engines from the NCP family, subject to the following conditions:

(1) Within five days after you conclude the Selective Enforcement Audit, send us a written report describing your plan to conduct a Production Compliance Audit, including the date you will start testing. If the Selective Enforcement Audit was conducted on an engine family with a certified emission level at or below emission standards, state that you intend to continue production without making changes to remedy the nonconformity while you conduct a Production Compliance Audit.

(2) You must agree to pay the Nonconformance Penalty resulting from the Production Compliance Audit for each affected vehicle or engine you produce, subject to the hearing provisions in § 1071.110.

(3) You must agree to meet recall requirements as described in paragraph (a)(3) of this section.

(4) You must select vehicles or engines for the Production Compliance Audit that you produced with the same configuration (or configurations) as you tested in the Selective Enforcement Audit. Unless we instruct otherwise, the provisions of the test order for the Selective Enforcement Audit apply equally for the Production Compliance Audit.

(5) You must start to select and test vehicles or engines within ten days after you conclude the Selective Enforcement Audit, unless we agree to allow additional time.

(6) Include measured values from the Selective Enforcement Audit along with test results from the Production Compliance Audit to determine the Compliance Level under § 1071.40.

(7) If the Selective Enforcement Audit was conducted on a vehicle family or engine family already subject to a Nonconformance Penalty and the Production Compliance Audit results in a Compliance Level at or below the emission standard, you no longer need to pay Nonconformance Penalties for vehicles or engines demonstrated to meet emission standards.

(c) You are disqualified from pursuing nonconformance penalties under this part if you fail to meet a deadline to start testing or if you fail to meet a deadline to send us a report after concluding a Selective Enforcement Audit, unless you convince us that the delay was justified. You are similarly disqualified from establishing a reduced Compliance Level under paragraph (b) of this section if you fail to meet a deadline to start testing or if you fail to meet a deadline to send us a report after concluding a Selective Enforcement Audit.

§ 1071.35 Maintenance and testing procedures for Production Compliance Audits.

(a) If you perform a Production Compliance Audit, we will send you instructions that are analogous to a test order for a Selective Enforcement Audit under 40 CFR part 1068, subpart E. Testing will generally require that you measure emissions of all regulated pollutants.

(b) Select and prepare vehicles or engines for testing as described in 40 CFR 1068.410. Our test order will address selection criteria for establishing a test sample that properly represents the NCP family.

(c) Test vehicles or engines as described in 40 CFR 1068.415; however, for vehicle testing, the default minimum testing rate is four vehicles per day. Measurements generally involve testing vehicles as described in 40 CFR part 86, subpart S, and 40 CFR part 1066, and testing engines as described in 40 CFR part 1036, subpart F, and 40 CFR part 1065.

(d) You must take all necessary steps to complete the audit without delay.

(e) You may ship a tested vehicle or engine before establishing the Compliance Level under § 1071.40 only if it has deteriorated emission results at or below applicable emission standards. You may not retest any vehicle or engine after you ship it.

§ 1071.40 Determining the Compliance Level.

Determine the Compliance Level for the NCP family based on test results from a sample of vehicles or engines as described in this section. You may select a Compliance Level above the value you determine from testing under this section, as long as it is below the Upper Limit.

(a) Establish final deteriorated test results for each tested vehicle or engine as follows:

(1) The initial test result is the measured value from testing for comparing to the standard as described in § 1071.35. Determine the final test result by summing the initial test results from all the tests for a given vehicle or engine, dividing by the number of tests, and rounding to one more decimal place than the applicable standard.

(2) Apply the NCP family's multiplicative or additive deterioration factor to the final test result, along with any infrequent regeneration adjustment factors from your application for certification, to determine the final deteriorated test result. Round the final deteriorated test results to the same number of decimal places as the applicable standard.

(b) The Compliance Level is intended to represent the 60th percentile deteriorated emission level for a population. Except as specified in paragraph (c) of this section, determine the Compliance Level using the following primary sampling and calculation method:

(1) Determine final deteriorated test results for at least 24 vehicles or engines. If the Production Compliance Audit follows an NCP family failing a Selective Enforcement Audit, consider all the tests from the Selective Enforcement Audit to be part of the Production Compliance Audit under this paragraph (b); you must conduct additional testing for the Production Compliance Audit only as needed to test 24 vehicles or engines.

(2) Arrange the final deteriorated test results from all test vehicles or engines from the lowest to the highest value. Determine the Compliance Level based on the 60th percentile deteriorated emission level as follows:

(i) If there were exactly 24 test vehicles or engines, the Compliance Level is the final deteriorated test result for vehicle or engine number 15 in the sequence (where engine number 1 has the lowest final deteriorated test result).

(ii) If there were more than 24 test vehicles or engines, multiply the total number of test vehicles or engines by 0.6 and express the result as a ceiling function to the nearest whole number.

For example, the Compliance Level is the final deteriorated test result for vehicle or engine number 17 in the sequence if the total number of test vehicles or engines is either 27 ($27 \times 0.6 = 16.2$) or 28 ($28 \times 0.6 = 16.8$).

(c) You may determine the Compliance Level based on either of the alternative sampling methods for reduced testing in paragraph (c)(1) or (2) of this section. You may start with an alternative sampling method and expand your testing to instead determine the Compliance Level based on testing at least 24 vehicles or engines as described in paragraph (b) of this section. If the Production Compliance Audit follows an NCP family failing a Selective Enforcement Audit, consider all the tests from the Selective Enforcement Audit to be part of the Production Compliance Audit under this paragraph (c).

(1) The fixed reduced sampling plan applies as follows:

(i) Select at least three and up to 23 vehicles or engines for testing.

(ii) Calculate the Compliance Level, CL, based on the cumulative sample of tested vehicles or engines using the following equation, rounding the result to the same number of decimal places as the emission standard:

$$CL = \bar{e} + k \cdot \sigma$$

Eq. 1071.40-1

Where:

$\bar{e}$ = The arithmetic mean of final deteriorated test results from the set of tested vehicles or engines. See 40 CFR 1065.602(b).

k = A constant based on the size of the test sample, as shown in paragraph (c)(4) of this section for fixed reduced sampling.

σ = The standard deviation of the final deteriorated test results from the set of tested vehicles or engines. See 40 CFR 1065.602(c).

(iii) You may increase the sample size by any number of vehicles or engines, up to the maximum of 23, to recalculate the Compliance Level.

(2) The sequential reduced sampling plan applies as follows:

(i) Select a sample size of 4, 8, 12, 16 or 20 vehicles or engines for testing.

(ii) Calculate the Compliance Level as described in paragraph (c)(1)(ii) of this section but use the value of k from paragraph (c)(4) of this section for sequential reduced sampling.

(iii) You may increase the sample size by one or more sets of four vehicles or engines, up to the maximum of 20, to recalculate the Compliance Level.

(3) The Compliance Level for the cumulative sample of tested vehicles or engines always replaces previously calculated values.

(4) Calculate the Compliance level for alternative sampling plans in this paragraph (c) based on the values of k from the following table:

TABLE 1 OF § 1071.40(C)(4) VALUES OF k FOR ALTERNATIVE SAMPLING PLANS

Sample size	Fixed reduced sampling under paragraph (c)(1)	Sequential reduced sampling under paragraph (c)(2)
3	1.602	
4	1.114	1.671
5	0.895	
6	0.764	
7	0.674	
8	0.608	0.912
9	0.555	
10	0.513	
11	0.478	
12	0.448	0.672
13	0.422	
14	0.399	
15	0.379	
16	0.360	0.540
17	0.343	
18	0.328	
19	0.314	
20	0.301	0.451
21	0.289	
22	0.277	
23	0.266	

§ 1071.45 Fail thresholds.

(a) A vehicle or engine you test under this subpart fails if its final deteriorated test result exceeds the final value of the Compliance Level under this subpart. For any other regulated pollutant, a vehicle or engine fails if its final deteriorated test result exceeds the applicable standard.

(b) An NCP family fails if the Compliance Level exceeds the Upper Limit.

(c) Section 1071.105 describes the consequences of failing under this section.

§ 1071.50 Test reporting.

(a) Within 30 days after completing the audit, send us a report with the following information:

(1) Describe any facility used for testing under this subpart and state its location.

(2) Identify the standards that apply for tested vehicles or engines.

(3) Identify the deterioration factors you used to certify the NCP family.

(4) Describe each tested vehicle or engine, including the NCP family name, model year, build date, vehicle or engine configuration, model number, identification number, and number of hours of operation before testing.

(5) Identify where you accumulated hours of operation on the vehicles or engines and describe the procedure and schedule you used.

(6) Provide the test number and identify the test procedure and the date, time, and duration of testing. Also provide initial test results, final test results, and final deteriorated test results as described in § 1071.40(a) for all tests. Provide emission figures for all measured pollutants. Include information for both valid and invalid

tests and the reason for any invalidation.

(7) Identify the Compliance Level, consistent with § 1071.40.

(8) Describe completely and justify any nonroutine adjustment, modification, repair, preparation, maintenance, or test for the test vehicle if you did not report it separately under this subpart. Include the results of any emission measurements, regardless of the procedure or type of equipment.

(b) We may ask you to add information to your written report, so we can determine whether your new vehicles or engines conform to the requirements of this part.

(c) An authorized representative of your company must sign the following statement: ''We submit this report under Clean Air Act section 206. Our testing conformed completely with the requirements of 40 CFR part 1071. All the information in this report is true and accurate to the best of my knowledge. I know of the penalties for violating the Clean Air Act and the regulations.'' (Authorized Company Representative)

(d) Send reports to the Designated Compliance Officer using an approved information format. If you want to use a different format, send us a written request with justification for a waiver.

(e) We may post test results on publicly accessible databases and we will send copies of your reports to anyone from the public who asks for them, consistent with 40 CFR 1068.11.

§ 1071.55 Recordkeeping.

(a) We may review your records at any time so it is important to keep required information readily available. Organize and maintain your records as described in this section.

(b) Keep records for testing under this subpart for six years after you complete all the testing required for the Production Compliance Audit. You may use any format and on any media, as long as you can promptly send us organized, written records in English if we ask for them.

(c) Keep a copy of reports you submit to us.

(d) Keep the following additional records:

(1) A description of all equipment identified in 40 CFR part 1065, subparts B and C, and 40 CFR part 1066, subpart B, that you used to test vehicles or engines under this part.

(2) A complete record of each test, including the information identified in 40 CFR part 1065.695 or 1066.695.

(3) The names of supervisors involved in each test.

(4) The name of anyone who authorizes adjusting, repairing, preparing, or modifying a test vehicle or engine and the names of all supervisors who oversee this work.

(5) If you shipped the vehicle or engine for testing, the date you shipped it, the assembly plant or associated storage or port facility, and the date the vehicle or engine arrived at the testing facility.

(6) Any records related to your audit that are not in the written report.

(7) A brief description of any significant events during testing not otherwise described in submitted reports or in this section, such as engine damage during shipment.

(e) We may ask you to keep or send other information necessary to implement this subpart.

§ 1071.60 EPA testing.

We may perform testing as described in this subpart by measuring emissions from any of your production vehicles or engines. If you certify engines using powertrain testing as specified in 40 CFR 1036.501(h), this section also applies for the powertrain test results.

(a) We may decide to do the testing at your plant or any other facility. If we do this, you must deliver the engine to a test facility we designate. The engine you provide must include appropriate manifolds, aftertreatment devices, ECMs, and other emission-related components not normally attached directly to the engine block. If we do the testing at your plant, you must schedule it as soon as possible and make available the instruments, personnel, and equipment we need.

(b) If we measure emissions on your engine, the results of that testing become the official emission results for the engine as specified in this paragraph (c). We will generally consider your data in determining if your NCP family meets applicable requirements in this part only if we later invalidate our data.

(c) Before we test one of your engines, we may set its adjustable parameters to any point within the practically adjustable ranges.

(d) Before we test one of your engines, we may calibrate it within normal production tolerances for anything we do not consider an adjustable parameter. For example, we may calibrate it within normal production tolerances for an engine parameter that is subject to production variability because it is adjustable during production but is not considered an adjustable parameter because it is permanently sealed. For parameters that relate to a level of performance that is itself subject to a specified range (such as maximum power output), we will generally perform any calibration under this paragraph (d) in a way that keeps performance within the specified range.

§ 1071.65 Labeling.

(a) Vehicles or engines you certify with a nonconformance penalty must have an emission control information label as described in the standard-setting part, with the following exceptions and clarifications:

(1) Within 10 days after you establish the Compliance Level, you must include the following statement on the emission control label or on a supplemental label:

The manufacturer of this [vehicle or engine, as applicable] pays a nonconformance penalty allowing it to be introduced into U.S. commerce at an emission level higher than the applicable emission standard. The Compliance Level is [identify the applicable Compliance Level and pollutant].

(2) Amend the compliance statement to say that the vehicle or engine complies with current standards using nonconformance penalties. For example, include the following compliance statement for heavy-duty engines certified under 40 CFR part 86 or part 1036: THIS ENGINE USES NONCONFORMANCE PENALTIES TO COMPLY WITH U.S. EPA REGULATIONS FOR [MODEL YEAR] HEAVY-DUTY HIGHWAY ENGINES.''

(3) If you produce vehicles or engines subject to a nonconformance penalty and you introduce them into U.S. commerce without the label statement described in paragraph (a)(1) of this section, you or your agent must apply a supplemental label to all affected vehicles or engines with the statement in paragraph (a)(1) of this section within 30 days after completing the Production Compliance Audit.

(4) Apply supplemental labels close to the emission control information label, consistent with good engineering judgment.

(b) You may ask us to approve modified labeling requirements in this section if you show that it is necessary or appropriate. We will approve your request if your alternative label is consistent with the intent of the labeling requirements of this section.

Subpart C—Penalty Provisions

§ 1071.80 Penalty parameters for specific standards.

(a) Implementing penalty provisions for a given standard depends on establishing values for the following parameters, most of which are illustrated in Figure 1 of § 1071.85:

(1) *S* is the published standard that is the basis for calculating nonconformance penalties.

(2) *UL* is the Upper Limit, which is the highest allowable emission level for certifying vehicles or engines with nonconformance penalties. See § 1071.10.

(3) COC_{50} is an estimate for the 50th percentile cost of compliance. This represents the average compliance cost to meet the published standard by modifying a vehicle or engine starting with emissions at the Upper Limit.

(4) COC_{90} is an estimate for the 90th percentile cost of compliance. This represents the incremental compliance cost to meet the published standard by modifying a vehicle or engine starting with emissions at the Upper Limit.

(5) *MC* is an estimate of the marginal cost of compliance, expressed in dollars per delta g/mile for vehicle standards and in dollars per delta g/hp·hr for engine standards. Penalty calculations in § 1071.85 use the following values for marginal cost of compliance:

(i) MC_{50} is an estimate of the 50th percentile marginal cost of compliance.

(ii) MC_{90} is a calculated value representing the 90th percentile marginal cost of compliance. MC_{90} is the slope of the line on the penalty curve in Figure 1 of § 1071.85 as the Compliance Level increases from *S*. The value of *F* is the ratio of MC_{90} to MC_{50}, which is generally between 1.1 and 1.3.

(6) χ is the emission level corresponding to COC_{50}. The equation for calculating nonconformance penalties depends on the slope of the curve representing the marginal cost of compliance, so the penalty calculation is different if the Compliance Level, *CL*, from subpart B of this part is above or below χ. We calculate χ for a specific emission standard from the following equation:

$$X = S + \frac{COC_{50}}{F \cdot MC_{50}}$$

Eq. 1071.80-1

(7) $F_{E\&D}$ is a fractional value representing the portion of the estimated compliance costs attributed to engineering and development. Section 1071.90 describes how there may be a refund for a portion of the nonconformance penalty based on $F_{E\&D}$.

(b) We will determine appropriate values for the cost parameters in paragraph (a) of this section. These estimates will generally be based on the analysis used to adopt the relevant standard, including the date associated with that analysis, though we may augment the data with additional information if we adopt the penalty provisions in a later rulemaking. We may adjust costs to account for inflation based on changes to the Consumer Price Index between the date of the analysis and January of the calendar year preceding the model year in which a nonconformance penalty is first available.

(c) Values for calculating nonconformance penalties for historical standards are in appendix A of this part.

(d) Nonconformance penalties are available for diesel-fueled Medium HDE and diesel-fueled Heavy HDE subject to the 35 mg/hp·hr NO_X standard in 40 CFR 1036.104, subject to the following provisions:

(1) For engines subject to nonconformance penalties, you may certify the NCP family under 40 CFR part 86 or part 1036, as follows:

(i) Engines certified under 40 CFR part 86 are subject to all standards, testing and compliance requirements, and other regulatory provisions as described for model year 2026 in 40 CFR part 86, subpart A. Such engines are not subject to Production Compliance Audits and are instead assigned a Compliance Level of 200 mg/hp-hr.

(ii) Engines certified under 40 CFR part 1036 are subject to all standards, testing and compliance requirements, and other regulatory provisions as described in 40 CFR part 1036 for the current model year, except for the NO_X standards. Such engines are subject to Production Compliance Audits to establish a Compliance Level as described in subpart B of this part.

(2) The following parameter values apply:

Engine class	*S* (mg/hp-hr)	*UL* (mg/hp-hr)	COC_{50}	COC_{90}	MC_{50} ($ per mg/hp-hr)	*F*	$F_{E\&D}$
Diesel-fueled Medium HDE	35	200	$3,683	$4330	$72	1.176	0.032
Diesel-fueled Heavy HDE	35	200	6,202	6781	82	1.1	0.025

(3) Determine the Compliance Level for the NCP family based on engine testing over the FTP duty cycle.

(4) The Compliance Level also serves as the emission standard for in-use testing and other compliance testing for individual engines over the FTP and SET duty cycles. Determine adjusted values for the Compliance Level as described for Family Emission Limits in 40 CFR 1036.104(c)(3) for the Low Load Cycle, idle testing, and off-cycle testing, as applicable. Note that these adjusted values for the Compliance Level apply only for determining whether an individual engine complies with emission standards; those adjusted values do not apply for qualifying NCP families under this part or for calculating penalty values under § 1071.85.

(5) The cost values in paragraph (d)(2) of this section are expressed in 2024 dollars. We will calculate the Annual Adjustment Factor in § 1071.85(c) using $I_0 = 0.03$ to represent the Consumer Price Index as of January 2026. Section 1071.85 describes how to calculate penalty values to account for inflation.

§ 1071.85 Calculating the nonconformance penalty.

(a) This section describes how to calculate the nonconformance penalty for a specific NCP family based on the following parameters:

(1) Section 1071.80 describes several parameters that are specific to the published standard, mostly to characterize the estimated cost of meeting the standard.

(2) *CL* is the Compliance Level for the NCP family, which is generally based on testing as described in subpart B of this part. The penalty provisions of this part apply only if the value of the Compliance Level is above the standard and at or below the Upper Limit.

(3) *AAF* is an Annual Adjustment Factor. Paragraph (c) of this section describes how the Annual Adjustment Factor serves to increase the penalty over time to account for inflation and continued use of the penalty provisions.

(b) Calculate a per-vehicle or per-engine nonconformance penalty for an NCP family, rounded to the nearest dollar, using one of the following equations:

(1) Use the following equation if the Compliance Level is at or below χ:

$$NCP_{\mathrm{i}} = F \cdot MC_{50} \cdot (CL - S) \cdot \prod_{i=1}^{n} AAF_{\mathrm{i}}$$

Eq. 1071.85-1

Where:

i is a counting variable to represent the current year based on the number of years you have certified vehicles or engines from a class with nonconformance penalties.

$\Pi^{n}_{i=1}$ AAF_{i} is the product of consecutive Annual Adjustment Factors for *n* years. For example, in the third year of certifying with nonconformance penalties, $\Pi^{n}_{i=3}$ AAF_{i} $AAF_1 \cdot AAF_2 \cdot AAF_3$.

(2) Use the following equation if the Compliance Level is above χ:

$$NCP_{\mathrm{i}} = \left(COC_{50} + \frac{(COC_{90} - COC_{50})}{(UL - X)} \cdot (CL - X) \right) \cdot \prod_{i=1}^{n} AAF_{\mathrm{i}}$$

Eq. 1071.85-2

(c) Calculate the Annual Adjustment Factor for year *i* using the following equation:

$$AAF_{\mathrm{i}} = 1 + I_{i-1} + A_i \cdot \left(\frac{1}{1 - frac_{i-1}} \right)^{i}$$

Eq. 1071.85-3

Where:

$I_{\mathrm{i\text{-}1}}$ = The fractional value representing the increase in overall consumer price index in year (*i*-1), as described in paragraph (d) of this section.

A_{i} = Usage adjustment factor in year *i*: Let A_{i} = 0.08, except that A_1 = 0 and A_2 = 0.10.

$frac_{\mathrm{i\text{-}1}}$ = Fraction of vehicles or engines in a class that are certified using nonconformance penalties in the year before the current year *i*, as described in paragraph (d) of this section. If $frac_{\mathrm{i\text{-}1}}$ is above 0.50, then calculate AAF_{i} using $frac_{\mathrm{i\text{-}1}}$ = 0.50.

(d) We will calculate your Annual Adjustment Factor based on the following information and procedures:

(1) Send us the following information by April 30 of each year that nonconformance penalties are available:

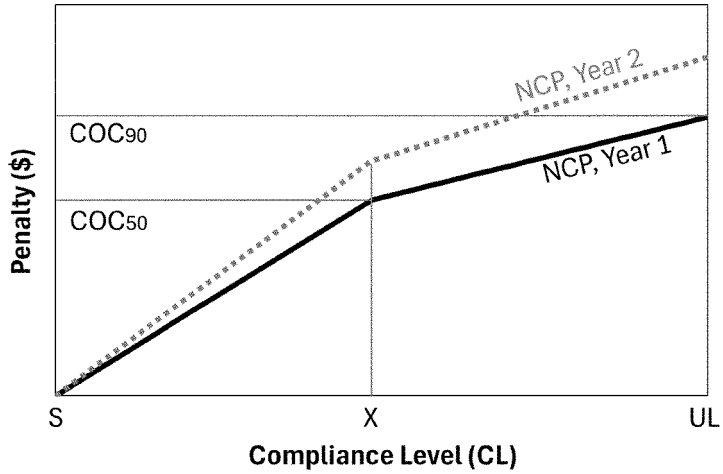
(i) The number of vehicles or engines from each class that you produced through March 31 in the current model year. Identify separate numbers of vehicles or engines certified with and without a nonconformance penalty. If your current model year involves production of additional vehicles or engines after March 31, also send us estimated values for those additional vehicles or engines.

(ii) If your report from the previous year included estimated production numbers, send us actual production numbers to replace your estimated values.

(2) We will determine the value of $frac_{\mathrm{i\text{-}1}}$ for calculating the Annual Adjustment Factor starting with the second year that nonconformance penalties are available based the information you send us, combined with nationwide production values aggregated from all manufacturers. We will estimate production volumes from manufacturers not using nonconformance penalties based on production reports, projected volumes from applications for certification, and any other relevant information. As an example, shortly after April 30, 2027, we will use actual and estimated production volumes for each class from all manufacturers to determine $frac_{2027}$, which is needed to determine nonconformance penalties for model year 2028. In that example, if we receive updated information for model year 2027 with actual production volumes in April 2028, we will use that information to create updated values of $frac_{2027}$ and AAF_{2027} to determine nonconformance penalties for model year 2029. We will use updated values accounting for actual production volumes to calculate nonconformance penalties prospectively; we will not use those updated values to revise nonconformance penalties from an earlier model year.

(3) We will determine the value of $I_{\mathrm{i\text{-}1}}$ based on the Consumer Price Index for All Urban Consumers published by the Bureau of Labor Statistics at *www.bls.gov/data/inflation_calculator.htm*. We will determine the value of I0 based on the change in prices between the date associated with establishing cost parameters and January of the calendar year preceding the model year in which a nonconformance penalty is first available; see § 1071.80. For later model years, we will determine the value of $I_{\mathrm{n\text{-}1}}$ based on the change in prices each January.

(e) The following figure illustrates how the various parameters support calculating nonconformance penalties:



§ 1071.90 Making payments.

This section describes procedures for paying penalties under this part.

(a) We will notify you in writing once we establish a specific nonconformance penalty based on the Compliance Levels that apply for affected vehicles or engines.

(b) The penalty applies for all nonconforming vehicles or engines you produce from any assembly plant for the following production periods:

(1) Penalties start to apply ten days after you conclude that an NCP family has failed a Selective Enforcement Audit. In all other cases, penalties apply starting with the beginning of the model year.

(2) Penalties continue to apply for the rest of the model year unless or until you demonstrate under § 1071.30(c) or (d) that vehicles or engines meet emission standards. Penalties continue to apply for any configurations not covered by the compliance demonstration.

(3) Penalties may carry over to future model years indefinitely. Section 1071.85 describes how the penalty increases for each model year.

(c) A penalty assessment applies for each calendar quarter based on the number of vehicles or engines you produce. Payment is due for each quarter in the month following the end of the quarter, on April 30, July 30, October 30, and January 30. We may approve your request for an alternative payment schedule, but any delay from the default schedule is subject to interest payments as described in paragraph (e) of this section. For each quarterly due date, send us the following information about vehicles and engines that are subject to nonconformance penalties, even if total production was zero in the preceding quarter:

(1) Identify the NCP family for all affected vehicles or engines.

(2) Identify quarterly production totals. Identify production totals separately by subfamily, if applicable.

(3) Show your calculations to determine the total payment penalty for the preceding quarter, including any interest payments.

(4) An authorized representative of your company must sign the following statement: ''We submit this report under Clean Air Act section 206. All the information in this report is true and accurate to the best of my knowledge. I know of the penalties for violating the Clean Air Act and the regulations.'' (Authorized Company Representative)

(d) We may ask you to demonstrate the accuracy of your quarterly production numbers, or any other information in reports you submit under paragraph (c) of this section.

(e) Calculate interest charges starting with the due date for any missed or partial payments, including payments on an approved alternative schedule and payments that are withheld during hearing deliberations. Interest charges continue to apply for each quarter with an outstanding balance due. Calculate the total interest payment based on the outstanding balance for the number of quarters that any penalty payment is overdue by applying the interest rate for the applicable payment due date from *www.fiscal.treasury.gov/reports-statements/cvfr/index.html.*

(f) Send payments to *www.pay.gov.*

(g) Credits and refunds apply as follows:

(1) If you overpay your penalty for any reason, you may subtract the overpayment from future payments. We may alternatively approve your request for a refund.

(2) You can claim a refund for a portion of the nonconformance penalty associated with your engineering and development costs to meet the new standards if you demonstrate that modified vehicles or engines to be fully compliant, including an updated Compliance Level under § 1071.30(c) or (d) that meets the applicable standard. Calculate the refund of payments you made to us, R_{EPA}, as follows:

$$R_{\mathrm{EPA}} = (D_{\mathrm{n}} \cdot F_{\mathrm{E\&D}} \cdot NCP_1 \cdot Prod_{\mathrm{tot}}) \cdot \left(1 - \frac{Prod_{Cal}}{Prod_{tot}}\right)$$

Eq. 1071.90-1

Where:

D_n = discount factor corresponding to the number of model years, *n*, nonconformance penalties have been available for a given class of vehicles or engines before completing certification that fully complies with applicable standards, where *n*=1 for the first year nonconformance penalties were available. Use the following values for D_n:

D_1 = 0.90.

D_2 = 0.79.

D_3 = 0.67.

D_4 = 0.54.
D_5 = 0.39.
D_6 = 0.23.
D_7 = 0.05.
D_n = 0.00 for n = 8 or more.

$F_{E\&D}$ = a fractional value representing the manufacturer's engineering and development costs relative to the total compliance costs as specified in § 1071.80.

NCP_1 = the nonconformance penalty identified in paragraph (a) of this section for the first model year.

$Prod_{Cal}$ = number of vehicles or engines from the same class you demonstrate have been titled, registered, or principally used in California and for which you paid nonconformance penalties to the State of California.

$Prod_{tot}$ = total number of vehicles or engines from the same class for which you paid nonconformance penalties to EPA or the State of California.

(3) We will not pay interest on any money we owe you.

Subpart D—Administrative Provisions

§ 1071.100 Entry and access.

Provisions related to EPA inspections apply as specified in 40 CFR 1068.20.

§ 1071.105 Suspending and voiding certificates of conformity.

(a) The certificate of conformity is automatically suspended for a vehicle or engine if it fails as described in § 1071.45(a). Notify us within five days after you make this determination. You must take the following actions before your certificate of conformity can cover that vehicle or engine:

(1) Correct the problem and retest the vehicle or engine to show it complies with all emission standards.

(2) Send us a written report describing your test results and the remedy for each vehicle or engine before introducing the vehicle or engine into U.S. commerce. You may include this information in the report you submit under § 1071.50.

(b) We may suspend the certificate of conformity if you do not meet the requirements and deadlines in this part.

(c) We may suspend the certificate of conformity if the Compliance Level as determined in § 1071.45(b) is above the Upper Limit. We may void the certificate of conformity if you fail to recall any vehicles or engines whose Compliance Level is found to be above the Upper Limit.

(d) We may void your certificate of conformity if you fail to fully pay the nonconformance penalty.

(e) Except as described in paragraph (a) of this section, we will tell you in writing if we suspend, revoke, or void your certificate of conformity in whole or in part. The suspension is effective when you receive our notice.

(f) You may request that we reinstate a suspended, revoked, or voided certificate of conformity by sending us a written report that identifies the reason for the failure and demonstrates that you comply with the requirements of this part. Include in the proposed remedy any quality control measures you propose to keep the problem from happening again. If the failure is related to measured emission levels, give us test data from production vehicles or engines showing that vehicles or engines in the remedied family comply with all the emission standards that apply. We may include any reasonable conditions when reinstating a certificate.

§ 1071.110 Hearing procedures.

(a) The provisions of 40 CFR part 1068, subpart G, apply if you request a hearing regarding nonconformance penalties or suspending, revoking, or voiding a certificate of conformity under this subpart.

(b) If we establish penalties under § 1071.90(a) and we agree to your request for a hearing related to the nonconformance penalty under 40 CFR 1068.625, you may produce affected vehicles or engines before the hearing deliberations conclude. However, if the hearing results in a final decision requiring a penalty, the payment is due, with interest, ten days after the Presiding Officer's final decision.

§ 1071.115 Confidential information.

The provisions of 40 CFR 1068.10 and 1068.11 apply for information you submit under this part.

§ 1071.120 List of acronyms.

The following acronyms and abbreviations apply to this part:

GVWR	gross vehicle weight rating, as defined in 40 CFR 1036.801.
HDE	heavy-duty engine, as defined in 40 CFR 1036.801.
HDGE ...	heavy-duty gasoline engine.
HDDE ...	heavy-duty diesel engine.
LDT3	Light-duty truck 3, as defined in 40 CFR 86.1803–01.
NCP	nonconformance penalty.

Appendix A to Part 1071—Penalty Parameter Values for Historical Standards

This appendix describes the values for the parameters identified in § 1071.80 to support penalty calculations for historical standards.

(a) The following parameter values applied for vehicle-based standards:

TABLE 1 TO PARAGRAPH (a) OF APPENDIX A TO PART 1071—PENALTY PARAMETERS FOR VEHICLE-BASED STANDARDS

Model year for new standard	Vehicle class	Pollutant	S (g/mi)	COC_{50}	COC_{90}	MC_{50} ($ per g/mi)	F	$F_{E\&D}$	Dollar basis
1987	Diesel vehicles ≤14,000 lb GVWR.	PM	0.26	$368	$541	$3,200	1.2	0.11	Dec. 1984.
1991	Diesel vehicles ≤14,000 lb GVWR.	PM	0.13	711	1,396	2,960	1.2	0.01	Dec. 1989.
1996	Diesel LDT3	PM	0.10	441	1,471	14,700	1.2	0.093	Dec. 1994.
1996	Diesel LDT3	NO_X	0.98	654	779	908	1.2	0.082	Dec. 1994.

(b) The following parameter values applied for engine-based standards:

TABLE 1 TO PARAGRAPH (b) OF APPENDIX A TO PART 1071—PENALTY PARAMETERS FOR ENGINE-BASED STANDARDS

Model year for new standard	Engine class	Pollutant	S (g/hp-hr)	COC_{50}	COC_{90}	MC_{50} ($ per g/hp-hr)	F	$F_{E\&D}$	Dollar basis
1987	HDGE for vehicles ≤14,000 lb GVWR.	HC	1.1	$45	$95	$83	1.2	0.06	Dec. 1984.
1987	HDGE for vehicles ≤14,000 lb GVWR.	CO	14.4	45	95	4	1.2	0.06	Dec. 1984.
1988	Light HDDE	PM	0.60	71	83	340	1.2	0.64	Dec. 1984.

TABLE 1 TO PARAGRAPH (b) OF APPENDIX A TO PART 1071—PENALTY PARAMETERS FOR ENGINE-BASED STANDARDS—Continued

Model year for new standard	Engine class	Pollutant	S (g/hp-hr)	COC_{50}	COC_{90}	MC_{50} ($ per g/hp-hr)	F	$F_{E\&D}$	Dollar basis
1988	Medium HDDE	PM	0.60	84	97	382	1.2	0.62	Dec. 1984.
1988	Heavy HDDE	PM	0.60	87	101	725	1.2	0.60	Dec. 1984.
1990	Light HDDE	NO_X	6.0	18	41	49	1.2	0.36	Dec. 1984.
1990	Medium HDDE	NO_X	6.0	1,125	1,540	883	1.2	0.02	Dec. 1984.
1990	Heavy HDDE	NO_X	6.0	1,278	1,980	1,733	1.2	0.02	Dec. 1984.
1991	Light HDDE	NO_X	5.0	830	946	1,167	1.2	0.12	Dec. 1989.
1991	Medium HDDE	NO_X	5.0	905	1,453	1,417	1.2	0.11	Dec. 1989.
1991	Heavy HDDE	NO_X	5.0	930	1,590	2,250	1.2	0.11	Dec. 1989.
1993	Urban bus HDE	PM	0.10	4,020	4,535	22,971	1.2	0.02	Dec. 1989.
1994	Urban bus HDE	PM	0.07	3,292	10,014	109,733	1.2	0.38	Dec. 1991.
1994	Light HDDE	PM	0.10	772	1,325	8,178	1.2	0.081	Dec. 1991.
1994	Medium HDDE	PM	0.10	1,276	3,298	15,370	1.2	0.098	Dec. 1991.
1994	Heavy HDDE	PM	0.10	2,105	6,978	30,070	1.2	0.083	Dec. 1991.
1996	Urban bus HDE	PM	0.05	576	6,569	28,800	1.2	0.500	Dec. 1994.
1998	Light HDDE	NO_X	4.0	833	1,513	833	1.2	0.039	Dec. 1994.
1998	Medium HDDE	NO_X	4.0	444	1,368	444	1.2	0.043	Dec. 1994.
1998	Heavy HDDE	NO_X	4.0	1,086	2,540	1,086	1.2	0.039	Dec. 1994.
2004	Light HDDE	NO_X+NMHC	2.4	1,240	2,710	2,000	1.3	0.403	Dec. 2001.
2004	Medium HDDE	NO_X+NMHC	2.4	2,740	4,930	1,400	1.3	0.197	Dec. 2001.
2004	Heavy HDDE	NO_X+NMHC	2.4	6,810	12,210	5,600	1.3	0.090	Dec. 2001.
2004	Urban bus HDE	NO_X+NMHC	2.4	3,930	6,660	3,800	1.3	0.155	Dec. 2001.
2012	Heavy HDDE	NO_X	0.20	3,219	3,775	10,729	1.173	0.005	Dec. 2011.

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