

Performance Standard Modeling for New and Existing Vehicle Inspection and Maintenance (I/M) Programs Using the MOVES Mobile Source Emissions Model

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Transportation and Climate Division
Office of Transportation and Air Quality
U.S. Environmental Protection Agency

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Section 1: Introduction

1.1 Purpose of This Guidance

This document describes when and how to conduct performance standard modeling (PSM) to demonstrate that a vehicle emission inspection and maintenance (I/M) program meets the applicable performance standard, as defined within the I/M regulations (40 CFR Part 51, subpart S) and the Clean Air Act (CAA). This guidance provides updates and procedures relevant to meeting the PSM requirements for developing I/M state implementation plans (SIPs) for CAA-required programs. This guidance is also intended to help state and local governments conduct PSM with EPA's Motor Vehicle Emission Simulator (MOVES) model and for the 2015 ozone national ambient air quality standard (NAAQS). In October 2022, EPA's final rule to reclassify certain ozone nonattainment areas from Marginal to Moderate for the 2015 ozone NAAQS was published, and those areas will need to develop Basic I/M SIPs.¹ Performance standard modeling is also required for I/M SIPs in other areas not attaining the 2015 ozone NAAQS, including Enhanced I/M programs in Serious and higher ozone nonattainment areas for that NAAQS.² EPA committed to providing technical assistance and updated guidance for I/M programs in affected ozone nonattainment areas. State and local agencies should contact their EPA Regional Office with specific questions concerning PSM for a particular ozone area.

This guidance describes how to do I/M PSM using the latest version of MOVES including setting up the model and preparing inputs, and post-processing model results to determine whether the applicable performance standard has been met.³ This guidance updates and supersedes the January 2014 guidance, *Performance Standard Modeling for New and Existing Vehicle Inspection and Maintenance (I/M) Programs Using the MOVES Mobile Source Emissions Model* (EPA-420-B-14-006).

1.2 Overview of Vehicle Inspection and Maintenance Requirements

I/M is the periodic inspection of the emissions control systems of motor vehicles. The goal of I/M programs across the country is the same: identify and repair high-emitting vehicles to improve air quality in areas that are not attaining the NAAQS.⁴ EPA sets new vehicle emission

¹ For more information, see *Determinations of Attainment by the Attainment Date, Extensions of the Attainment Date, and Reclassification of Areas Classified as Marginal for the 2015 Ozone National Ambient Air Quality Standards*, 87 FR 60897, October 7, 2022.

² See the I/M regulations and the Notice of Proposed Rulemaking for *Determinations of Attainment by the Attainment Date, Extensions of the Attainment Date, and Reclassification of Areas Classified as Marginal for the 2015 Ozone National Ambient Air Quality Standards*, 87 FR 21842, April 13, 2022.

³ EPA's MOVES model is a state-of-the-science emission modeling system for mobile sources. Currently, MOVES3 is the latest version of MOVES available. This guidance assumes familiarity with the MOVES model, its use in SIP development, and supporting technical documentation. For more information about MOVES, see www.epa.gov/moves.

⁴ Some areas that were once in violation of the ozone NAAQS have chosen to retain their I/M programs as a part of a maintenance plan to continue to meet the NAAQS.

standards to protect public health, but those regulations do not guarantee proper operation and maintenance of the vehicle's emission controls over its lifetime.

The CAA requires I/M programs for areas across the country that meet certain criteria, such as air quality status, population, and/or geographic location. The CAA established two performance levels for I/M programs:

1. Basic I/M for ozone nonattainment areas classified as Moderate per CAA section 182;⁵ and,
2. Enhanced I/M pursuant to CAA sections 182, 184 and 187. Enhanced I/M programs are mandated in the following areas:
 - All Serious or higher ozone nonattainment areas that had a 1980 urban population of 200,000 or more;
 - Metropolitan statistical areas with a 1990 population of 100,000 or more in the Ozone Transport Region (OTR), regardless of their air quality classification; and,
 - All Moderate or higher carbon monoxide (CO) nonattainment areas with a design value greater than 12.7 parts per million at the time of classification that had a 1980 urban population of 200,000 or more.

States that are required to implement Basic or Enhanced I/M programs include these programs in their I/M SIPs. The I/M regulations allow states flexibility in designing these programs. However, the programs must meet I/M requirements including the respective performance standards.

For the 2015 ozone NAAQS, states with urbanized ozone nonattainment areas classified (or reclassified) as Moderate or higher are required to submit an I/M SIP. Some areas may already be operating I/M programs for a variety of reasons, including being or having been designated nonattainment and classified as Moderate or higher under a prior ozone standard, or due to their location in the OTR. However, some areas may never have been subject to this requirement and will be starting new I/M programs as a result of reclassification to Moderate. Consistent with the I/M regulations, areas that are required to have an I/M program must submit to EPA a SIP revision that includes a PSM analysis. For those areas for which there is already an approved I/M SIP, states may need to revise their I/M programs to ensure that their I/M programs meet all applicable I/M requirements and operate at or above the applicable performance standard level for the corresponding ozone NAAQS.

1.3 Introduction to Performance Standard Modeling and the I/M Performance Standards

The purpose of a PSM analysis is to evaluate whether a proposed I/M program meets the applicable performance standard. The performance standards establish the level of emission reductions that mandatory I/M programs must meet or exceed. To conduct a PSM analysis, it is necessary to model two scenarios:

⁵ Per the I/M regulations at 40 CFR 51.350(a)(4), only Moderate ozone nonattainment areas with a 1990 Census-defined urbanized area population of 200,000 or more are required to implement Basic I/M.

1. Proposed/existing program scenario – this scenario represents the I/M program that is covered by the new or revised SIP, which includes all the local area parameters and control measures as well as the inputs required to define the proposed or existing I/M program; and,
2. Performance standard benchmark scenario – this scenario represents the applicable EPA defined benchmark program, which includes all the local area parameters and control measures and an I/M program with the elements of the required I/M performance standard.

The results of these scenario runs are compared to determine whether the proposed/existing program scenario emissions, or emissions rates depending on the applicable performance standard, are the same or lower than the performance standard benchmark scenario.

An I/M performance standard is a collection of program design elements which defines a benchmark program to which a state's proposed program is compared in terms of its potential to reduce emissions of relevant pollutants and precursors (*e.g.*, in ozone areas, namely volatile organic compounds (VOC) and oxides of nitrogen (NO_x)) by certain comparison dates. I/M program design elements include test frequency (annual or biennial), waiver/compliance rate, vehicle type coverage, model year (MY) coverage, network type (centralized or decentralized), and test type (*e.g.*, idle, onboard diagnostic (OBD)).

EPA first promulgated performance standards for Basic and Enhanced I/M programs in November 1992 as part of the I/M regulations (40 CFR Part 51, subpart S). The I/M performance standards are defined in the I/M regulations at 40 CFR 51.352 for Basic I/M programs and at 40 CFR 51.351 for Enhanced I/M programs. One of the main distinctions between Basic and Enhanced I/M performance standards is that the Basic performance standard includes the testing of passenger cars while the Enhanced performance standard includes the testing of passenger cars and light-duty trucks.⁶ The I/M program design elements are detailed in the respective program performance standards as discussed later in this document.

In addition to I/M program design elements, the performance standards also contain some provisions that are requirements for all applicable I/M programs. For example, with most of the in-use fleet now consisting of vehicles equipped with OBD emissions control technology, both Basic and Enhanced programs are required to conduct OBD testing.⁷ Similarly, pursuant to 40 CFR 51.351(b), Enhanced I/M programs must contain an on-road testing element.⁸

The I/M performance standards have been revised several times to provide states greater flexibility to design I/M programs that meet local needs and to address the change from the

⁶ This is an important difference, especially considering the significant growth in the light-duty truck and Sport Utility Vehicle markets since passage of the Clean Air Act Amendments of 1990.

⁷ See 40 CFR 51.352(c) and 40 CFR 51.351(c) for Basic and Enhanced I/M programs, respectively.

⁸ For more information, See *Guidance for On-Road Testing Requirements for Enhanced Vehicle Inspection and Maintenance (I/M) Programs* (EPA-420-B-20-020, March 2020) which can be found at nepis.epa.gov/Exe/ZyPDF.cgi?Dockkey=P100YQX8.pdf.

original 1-hour ozone NAAQS to an 8-hour ozone standard. I/M performance standards were last revised in April 2006 to address I/M programs required under an 8-hour ozone NAAQS.⁹

EPA notes that PSM must be conducted on the I/M program that is being implemented pursuant to the state regulations in the SIP. PSM is just one of the elements of an I/M SIP. A proposed or revised Basic or Enhanced I/M program must satisfy all the applicable requirements of the I/M regulations. The required elements for an I/M SIP submission are listed at 40 CFR 51.372.

1.4 When Is Performance Standard Modeling Required for an I/M SIP?

A PSM analysis (showing that the proposed/existing I/M program meets the applicable I/M performance standard) is required to be included in an I/M SIP submission whenever an I/M program is mandated pursuant to the CAA and I/M regulations. In general, there are four cases in which an I/M SIP and PSM analysis are required for the ozone NAAQS:

- 1) For an area meeting the criteria for a Basic or Enhanced I/M program upon its initial nonattainment designation and classification of Moderate or higher for a newly revised ozone NAAQS regardless of whether the area already operates an existing I/M program.
- 2) For an area meeting the criteria for a Basic I/M program upon its reclassification from Marginal to Moderate for the 2015 or subsequent ozone NAAQS regardless of whether the area already operates an existing I/M program under a prior NAAQS.
- 3) For an area meeting the criteria for an Enhanced I/M program upon its reclassification as Serious or higher for the 2015 or subsequent ozone NAAQS regardless of whether the area already operates an existing I/M program under a prior NAAQS. However, such an area need only demonstrate that it is operating at or above the Enhanced I/M performance standard once for any given NAAQS.¹⁰
- 4) For an area with an existing CAA-mandated I/M program that is revising its I/M SIP with changes to the I/M program.¹¹

As noted in Section 1.2, CAA-mandated I/M programs must have an approved I/M SIP for the applicable NAAQS. To be approved, the I/M SIP must address all applicable I/M requirements of the CAA and the I/M regulations, including a PSM analysis. The I/M regulations at 40 CFR 51.372 address I/M SIP submissions with paragraphs (a)(1)-(8) outlining the required elements. For example, the first required element is a schedule for the I/M program implementation and

⁹ 71 FR 17705; April 7, 2006.

¹⁰ For example, an area that was required to submit an I/M SIP (including a PSM analysis) for the Enhanced performance standard when it was reclassified from Moderate to Serious need not submit an I/M SIP (or conduct another PSM analysis) if it is reclassified again from Serious to Severe for the same ozone NAAQS.

¹¹ For these I/M SIP revisions, states that seek to reduce the requirements of their I/M programs, such as by dropping model years from their program, might need to either strengthen the program in some other way (for example, by changing the test frequency from biennial to annual, or covering more of the newer model years) to be able to demonstrate the applicable performance standard is being met. The provisions of CAA section 110(l) will also need to be met to ensure that any revisions to the SIP do not interfere with attaining any NAAQS or other CAA requirements.

interim milestones leading to mandatory testing which in practice would be most relevant for brand new I/M programs. This list of milestones in the SIP includes:

- passage of enabling statutory or other legal authority;
- proposal of draft regulations and promulgation of final regulations;
- issuance of final specifications and procedures;
- issuance of final Request for Proposals (if applicable);
- licensing or certifications of stations and inspectors;
- the date mandatory testing will begin for each model year to be covered by the program; etc.¹²

The other seven elements that the I/M SIP will need to address include:

- a PSM analysis of the proposed I/M program;
- the geographic applicability of the I/M program;
- a detailed discussion of each of the required design elements;
- legal authority requiring or allowing implementation of the I/M program and providing either broad or specific authority to perform all required elements of the program;
- legal authority for I/M program operation until such time as it is no longer necessary;
- implementing regulations, interagency agreements, and memoranda of understanding; and,
- evidence of adequate funding and resources to implement all aspects of the program.¹³

Per CFR 51.372(a)(2), the required PSM analysis element is –

An analysis of emission level targets for the program using the most current EPA mobile source emission model or an alternative approved by the Administrator showing that the program meets the performance standard described in § 51.351 or § 51.352 of this subpart, as applicable;

For example, a Basic I/M program is required for all urbanized Moderate areas under the 2015 ozone NAAQS, including for areas with and without an existing I/M program that may have been implemented to meet the CAA requirements for a previous ozone NAAQS. EPA clarified in its October 2022 rulemaking that, consistent with the I/M regulations, states with existing I/M programs would need to conduct and submit a PSM analysis as well as make any necessary program revisions as part of their Moderate area SIP submissions to ensure that I/M programs are operating at or above the Basic I/M performance standard level for the 2015 ozone NAAQS. States may determine through the PSM analysis that an existing SIP-approved program would meet the performance standard for purposes of the 2015 ozone NAAQS without modification. In this case, the state could submit a SIP revision with the associated PSM and a written statement certifying their determination in lieu of submitting new revised regulations.¹⁴

There are several practical and other reasons why an evaluation using PSM is necessary for areas to confirm that the applicable performance standard is met. Areas may have attained a previous

¹² See 40 CFR 51.372(a)(1).

¹³ See 40 CFR 51.372(a)(2)-(8).

¹⁴ See *Implementation of the 2015 National Ambient Air Quality Standards for Ozone: Nonattainment Area Classifications and State Implementation Plan Requirements*, 83 FR 63001-63002.

ozone standard and are operating their I/M program under a maintenance plan, where such existing programs could have been revised to cause them to operate below the required performance standard level. Many states with existing I/M programs have not conducted performance standard analyses for many years, and the results of those previous analyses may no longer be representative due to the updating of mobile source emissions models. Finally, some I/M SIPs were last approved because of their CO NAAQS status and thus have never conducted PSM for an ozone NAAQS. With the passage of time and changes in fleet mix, it is therefore appropriate and necessary for states to confirm existing programs' compliance with the performance standard for the 2015 ozone NAAQS, and to do so for any revised ozone NAAQS in the future.

EPA maintains that PSM need not consume considerable time, effort, or resources. Ozone nonattainment areas already use MOVES to develop mobile source emission inventories for SIP and other regulatory purposes. The model runs necessary to conduct an I/M performance standard evaluation are simpler than the ones necessary for developing the mobile source emissions inventory for a baseline, reasonable further progress (RFP), or attainment SIP submission. For more information on how to conduct modeling for PSM purposes, see Section 3 of this guidance.

1.5 When Is Performance Standard Modeling Not Required?

There are cases in which a state can revise their I/M SIP without conducting PSM such as when the I/M program area in question has been redesignated to attainment for the NAAQS that triggered the I/M requirement and is not otherwise required to operate an I/M program.¹⁵ In this case, a state can decide to retain or revise the I/M program as part of the area's maintenance plan since in this case the CAA nonattainment area requirement to have a Basic or Enhanced I/M program that meets the applicable performance standard no longer applies. In these cases, a state must demonstrate that the revisions to the I/M program will not interfere with the area's ability to attain or maintain any NAAQS, or with any other applicable CAA requirement. This type of demonstration is known as a CAA section 110(l) noninterference demonstration.

Another example would be a nonattainment area that has decided to implement an I/M program as a SIP control strategy, even though a Basic or Enhanced I/M program is not specifically required by the CAA. In this case, a PSM analysis would not be required to be performed to include this program as part of an RFP or attainment SIP. In addition, states or cities implementing I/M programs outside of the SIP as a voluntary control program are not required to conduct PSM.

1.6 Guidance and Existing Requirements

This guidance is based on CAA requirements, existing associated regulations, and does not create any new requirements. The CAA and EPA's I/M regulations at 40 CFR Part 51, subpart S contain legally binding requirements. This document is not a substitute for those provisions or

¹⁵ For example, an ozone area that is located in the OTR must continue to implement its I/M program after redesignation, pursuant to CAA section 184.

regulations, nor is it a regulation itself. Thus, it does not impose legally binding requirements on EPA, states, or the regulated community, and may not apply to a particular situation based upon the circumstances. EPA retains the discretion to consider and adopt approaches on a case-by-case basis that may differ from this guidance but still comply with the statute and applicable regulations. This guidance may be revised periodically without an opportunity for public comment.

1.7 Additional Information and Resources

For specific questions concerning I/M PSM for a particular area, please contact the appropriate EPA Regional Office. A list of the EPA Regional mobile source contacts can be found at www.epa.gov/transportation-air-pollution-and-climate-change/office-transportation-and-air-quality-contacts in Section 16.2, last page.

For general questions about this guidance, please see the *Office of Transportation and Air Quality Contacts by Topic* document available at www.epa.gov/transportation-air-pollution-and-climate-change/office-transportation-and-air-quality-contacts. A contact person is listed under “I/M Performance Standard Modeling”.

Additional information regarding I/M programs can be found on EPA’s Office of Transportation and Air Quality website at: www.epa.gov/state-and-local-transportation/vehicle-emissions-inspection-and-maintenance.

For general questions about MOVES, including downloadable code, guidance, training, FAQs, and background information, please visit EPA’s MOVES site at www.epa.gov/moves.

Section 2: Planning a Performance Standard Modeling Analysis

This section discusses some of the important factors to consider when planning a PSM analysis. Many of the elements described below would benefit from early consultation between a state and its EPA Regional Office. For example, a state could decide to develop a modeling protocol for its PSM analysis for EPA consultation prior to beginning the modeling process.

2.1 Overview of Performance Standard Modeling

The general modeling requirements for Basic I/M programs may be found at 40 CFR 51.352(d) and for Enhanced I/M programs at 40 CFR 51.351(d). Modeling must be performed using the most recent version of the MOVES emissions model available as further described in Section 2.5 below. Modeling should also reflect the latest planning assumptions available when the modeling is completed, such as the local fleet age distribution, vehicle miles traveled (VMT), etc. If there is an existing I/M program, model inputs should be based on the most recent available test data. See additional information about data inputs and the use of local data in Section 3.2.

The modeling results of the proposed/existing program scenario and performance standard benchmark scenario must then be compared for each analysis year. Meeting the applicable performance standard for an ozone NAAQS is different depending on the program type as described below:

- For a Basic I/M program, if the proposed/existing program achieves the same or lower emissions levels for VOC and NO_x as the performance standard benchmark program, then the proposed/existing program is considered to have met the Basic performance standard.
- For an Enhanced I/M program, if the proposed/existing program obtains the same or lower emissions levels for VOC and NO_x as the performance standard benchmark program to within 0.02 grams-per-mile (gpm), then it is considered to have met the Enhanced performance standard.

In ozone areas, the pollutant precursors that need to be considered in PSM analyses are VOC and NO_x.^{16, 17} The applicable performance standard must be met for each precursor separately, not cumulatively. In addition, “NO_x substitution” cannot be used to pass the applicable standard. In other words, PSM analyses cannot rely upon NO_x reductions to pass the applicable performance standard for VOC emissions. For example, if a proposed/existing Basic I/M program was at or below the emissions levels for VOC and at or below the emissions levels for NO_x, it would be

¹⁶ This guidance is primarily focused on ozone areas, rather than the CO NAAQS since all CO areas are in maintenance and would not need to conduct PSM.

¹⁷ Within the I/M regulations, in addition to NO_x, hydrocarbons (HC), and VOC are listed as pollutants and precursors of concern for ozone areas. The terms HC and VOC are used interchangeably within the various performance standards. Since VOC are an aggregate gaseous species of organic gases that include HC, VOC emissions are the more encompassing pollutant of concern for ozone PSM analyses. See Section 3.1 for additional information.

considered to meet the performance standard, but one which was at or below the performance standard for VOC while exceeding the emissions for NO_x would not meet the standard.

If after conducting the PSM analysis, the area's I/M program does not meet the corresponding performance standard, then the state would conduct a new PSM analysis based on new I/M program revisions to meet the appropriate I/M performance level.

2.2 Identifying the Performance Standard

The I/M regulations codify the Basic and Enhanced performance standards. There are four variations of the performance standards for Enhanced I/M programs although this guidance focuses on the use of the performance standards for the 2015 and subsequent 8-hour ozone NAAQS.

In general, the selection of the appropriate performance standard is as follows:

- Areas required to operate the I/M program as the result of being classified (or reclassified) as Moderate for an 8-hour ozone NAAQS must use the Basic performance standard, using the program design elements at 40 CFR 51.352(e). These are also listed in Appendix A.2. of this guidance.
- Areas required to operate an I/M program as the result of being classified (or reclassified) as Serious or higher for an 8-hour ozone NAAQS must use the Enhanced performance standard for areas designated and classified under the 8-hour ozone standard at 40 CFR 51.351(i). Any such nonattainment area needing to conduct a PSM analysis for the 2015 ozone NAAQS would not use any of the other Enhanced performance standard variations of 40 CFR 51.351(f)-(h), even if the area has an existing I/M program or if one of the other Enhanced variations might otherwise appear to be applicable.¹⁸ The program design elements for areas designated and classified under the 8-hour ozone standard are listed in Appendix A.4.
- States interested in revising an Enhanced I/M program required solely for another reason (such as an area's OTR status) should consult with their EPA Regional Office regarding which Enhanced performance standard variation applies: 40 CFR 51.351(f), (g) or (h). Although this guidance focuses on PSM for an 8-hour ozone NAAQS, the procedures contained within this document generally apply across all PSM analyses.

The general provisions of 40 CFR 51.351(a)-(e) apply to all CAA-mandated Enhanced I/M programs regardless of the performance standard variation. With future potential revisions of the 8-hour ozone NAAQS and reclassifications of areas for an ozone NAAQS, the unique and unusual situation could occur in which the same I/M program area may need to develop I/M PSM analyses for two NAAQS at the same time. Additionally, in a few of these cases, an area might need to demonstrate that their current I/M program satisfies the Basic I/M SIP requirement

¹⁸ Per 40 CFR 51.351(i) (emphasis added): "Areas required to implement an enhanced I/M program as a result of being designated and classified under the 8-hour ozone standard, **must** meet or exceed the HC and NO_x emission reductions achieved by the model program defined as follows...."

for one 8-hour NAAQS while also demonstrating that the area meets the Enhanced I/M SIP requirement for another 8-hour ozone NAAQS. Considering these possibilities, EPA would allow an area to use only the 8-hour ozone Enhanced performance standard when both the Basic and Enhanced I/M programs under the two ozone standards are involved, if the PSM demonstration contains “evaluation dates” (referred to as “analysis years” in this guidance) for both I/M SIPs and ozone NAAQS (see Section 2.3, below). In other words, it is reasonable to presume that if an I/M program meets the Enhanced performance standard, then it would also meet the Basic performance standard so long as the analysis years are appropriate for the two 8-hour ozone standards in question. States should consult with their EPA Regional Office when completing PSM for multiple ozone NAAQS at the same time.

2.3 Determining Analysis Year(s)

Selection of the analysis year(s) is a critical element of PSM, and it depends on the area’s ozone classification. The analysis year(s) shown below cover the most common cases where PSM is needed, including when the area has been reclassified.

Table 1: Analysis Years for PSM for an 8-hour Ozone NAAQS

Nonattainment Classification	Performance Standard	Analysis Year(s)	Regulatory Reference
Moderate	Basic	6 years after the effective date of designation and classification (i.e., the attainment date)	40 CFR 51.352(e)(13)
Serious and higher	Enhanced	6 years after the effective date of designation and classification, AND the attainment date	40 CFR 51.351(i)(13)
All Reclassifications	Basic or Enhanced	Attainment date OR program implementation date, whichever is later	In the case of reclassifications, an accelerated timeframe may apply as described in this guidance.

For revisions to an I/M program currently approved into the SIP, the PSM analysis year would be the evaluation date used in the approved SIP or the date of implementation of the revised I/M program, whichever is later.

For cases in which the attainment date has passed, PSM should be performed for an analysis year contemporary to when the corresponding I/M SIP will be submitted. If the attainment date is in the future, use the attainment date as the analysis year.

Please consult with your EPA Regional Office to establish the analysis year(s) (e.g., through a modeling protocol) prior to beginning the modeling process.

2.4 Determining Geographic Coverage and Representative Counties

Generally, a PSM analysis should be performed for each county in which an I/M program is required to operate to capture the programmatic and operational differences within those counties. It is important to note, geographic coverage is not a design element of an I/M program and since the purpose of PSM is to evaluate the effectiveness of a program, the geographic coverage should remain the same between the proposed/existing program scenario and performance standard benchmark scenario.¹⁹

However, if the regional characteristics and I/M program are similar among the counties within the nonattainment area, a single county can be used as a representative county for a PSM analysis. Whether or not a single county can represent the I/M program for the whole area depends on factors such as:

- The similarity of the I/M program implementation such as subject vehicle coverage (e.g., vehicle type, gross vehicle weight rating, model year coverage, etc.), types of tests administered, inspection frequency, and performance (e.g., waiver rate, compliance rate, etc.);
- The similarity of road type distribution, meteorology, and fuels used in the representative county compared to the whole nonattainment area; and
- The similarity of the local vehicle fleets (e.g., vehicle ages, vehicle type distribution, fuel mix, etc.) to that of the overall I/M program geographic coverage.

To conduct a PSM analysis with MOVES using a representative county, the areawide vehicle population and VMT can be applied to the single county for the model run. All other MOVES input database data should be entered as discussed in Section 3.2 and as directed by the most recent version of the *MOVES Technical Guidance*.²⁰ If the representative county approach is used, please consult with your EPA Regional Office to select the representative county, such as through a modeling protocol to document how the county is representative of the overall nonattainment area prior to beginning the modeling process.

2.5 Selecting an Emissions Model

Performance standard modeling must be demonstrated using the most current version of EPA's mobile source emission model.^{21,22} MOVES is EPA's latest motor vehicle emissions model for state and local agencies to estimate NO_x, VOC, and other pollutants/precursors from cars, trucks, buses, and motorcycles. EPA has developed performance standard templates for use in MOVES that capture the required program elements from the I/M regulations for performance standard benchmark scenarios, as discussed further in Section 3 and included in the Appendix of this guidance.

¹⁹ See 40 CFR 51.350(b)(3).

²⁰ For the latest version of the *MOVES Technical Guidance* go to www.epa.gov/moves/latest-version-motor-vehicle-emission-simulator-moves#guidance. Also see Sections 3 and 4 of this guidance for more on how to apply MOVES for PSM purposes.

²¹ See 40 CFR 51.351(d).

²² See 40 CFR 51.352(d).

Generally, California uses the EMFAC emissions model for onroad mobile emissions modeling. Due to the nature of PSM analysis and design of EMFAC, however, MOVES is an appropriate model for PSM applications within California - with inputs and assumptions consistent with the state's vehicle regulations and I/M program. EPA would address the use MOVES for I/M PSM in California in any related action on an I/M SIP.

2.6 Characterizing the Proposed/Existing Program

I/M programs are specifically characterized in MOVES through an input called the IMCoverage Table. Some of the design elements of an I/M program are:

- Vehicle coverage expressed through the Source Type ID, Fuel Type ID, and Beginning and Ending Model Years;
- Inspection frequency; and
- Tests performed expressed as the Test Standard ID.

More about these inputs is discussed in Section 3.2.1 of this guidance. The user will need to ensure that the inputs in the IMCoverage Table for the proposed/existing program scenario are consistent with the I/M program as proposed or currently in place and approved in the SIP.

2.7 Documenting the PSM Analysis

A PSM analysis should include sufficient documentation to support the conclusion that the I/M program meets the applicable performance standard. Documenting the analysis will provide transparency to the public and to other agencies reviewing the analysis, help the state and local agencies implement the program described in the SIP, and be a reference for future analyses. This SIP documentation should be provided to EPA to support the conclusions of the analysis, including:

- A description of the I/M program that includes the geographic scope, tests performed and inspection frequency, vehicles covered including model years, weight classes, fuel types, etc. and other coverage information such as waiver programs, and what performance standard applies;
- A description of the analysis year(s) examined, and the considerations in determining the year(s);
- Emissions modeling, including the emissions model used (e.g., MOVES version and database). In addition to documenting the model version used, also include the following MOVES files and/or databases in the SIP submission to EPA:
 - MOVES Run Specification (RunSpec) files – these files define the scope of the MOVES run by defining elements such as time period(s), geographical area, source types, etc. included in the modeling.
 - MOVES Input Databases – input databases provide vehicle characteristics, vehicle activity, and other local conditions.
 - MOVES Output Databases – output databases contain the results of the MOVES analysis.
- Post-processing calculations that demonstrate how the I/M program meets the applicable performance standard in the I/M regulations, including spreadsheets or scripts used to process model results.

Documentation should also describe the sources of data used in developing the modeling inputs such as sources of projected vehicle activity and fleet characteristic data. This documentation should also describe any critical assumptions that have the potential to impact the I/M programs meeting the performance standard such as the compliance factor elements (discussed further in Section 3 of this guidance). This documentation should be made available for review as part of the SIP development process.

Section 3: Running MOVES for Performance Standard Modeling Analysis

This section provides an overview on how to use MOVES to conduct a PSM analysis for an I/M SIP. This section assumes the user has familiarity with MOVES, such as generating a RunSpec and creating and modifying an input database using the County Data Manager (CDM).

As discussed in Section 1, to conduct a PSM analysis, it is necessary to model two scenarios:

1. Proposed/existing program scenario – this scenario represents the I/M program that is covered by the new or revised SIP, which includes all the local area parameters and control measures as well as the inputs that define the proposed or existing I/M program; and,
2. Performance standard benchmark scenario – this scenario represents the applicable EPA defined benchmark program, which includes all the local area parameters and control measures and an I/M program with the elements of the required I/M performance standard.

Since the purpose of a PSM analysis is to evaluate whether a proposed/existing program scenario meets the performance standard benchmark scenario, the only difference between MOVES runs is the data supplied to the I/M Programs Input Tab (or IMCoverage Table).^{23,24} Therefore, the RunSpec and all other input data should be the same between the MOVES runs for each scenario and analysis year. The emissions calculated in MOVES will be based on the input data supplied by the user.

The remainder of this section provides further details on how to conduct PSM analysis with MOVES by:

- Developing a MOVES RunSpec that will be used for both scenarios;
- Creating a separate input database for each scenario; and
- Executing the MOVES runs for each scenario.

In addition, Section 4 of this guidance covers processing the model output from MOVES to determine if the applicable performance standard is met.

Some information in Section 3.2 is repeated from the *MOVES Technical Guidance* to aid in the usefulness of the document however, Section 3.2 also contains unique tips and suggestions specific to PSM. Users should continue to consult with *MOVES Technical Guidance* when appropriate for other aspects of using MOVES and preparing inputs.²⁵

²³ The order in which the runs are conducted does not matter as long as the user keeps track of which run represents each scenario.

²⁴ If using the representative county approach, modeling only for a single county is needed. In cases when the representative county approach is not appropriate, modeling will need to be conducted for each county or grouping of counties within the nonattainment area. See Section 2.4 for more information on selecting a representative county.

²⁵ For the latest version of the *MOVES Technical Guidance*, go to www.epa.gov/moves/latest-version-motor-vehicle-emission-simulator-moves#guidance.

3.1 RunSpec Selections

For PSM analysis using MOVES, users would start by developing the RunSpec to define elements such as analysis year(s), geographical area, source types, etc. to be included in the modeling. These elements are defined in a series of panels in the MOVES Graphical User Interface (GUI). For each analysis year, the RunSpec created will be used for both the proposed/existing program scenario and performance standard benchmark scenario.

When setting up a RunSpec for a PSM analyses, the following selection should be made:

1. Description Panel: Use this panel to provide a short description of the run purpose. This is a good place to indicate the county name, calendar year and run scenario, (i.e., proposed/existing program scenario or the performance standard benchmark scenario).
2. Scale Panel: Select “Onroad” model and “County” for domain/scale. Calculation type should be specified as “Inventory”.
3. Time Spans Panel: Select the analysis year (see Section 2.3 Determining Analysis Year(s) for more information), *July* for month²⁶, *weekday* for day types, and *all hours*. Note, only a single year can be selected in a County Scale run so separate runs will be needed for additional analysis years.
4. Geographic Bounds Panel: Select the county or counties for which the PSM is being performed. Note, if the I/M program spans multiple counties, users may select the representative county approach discussed in Section 2.4 Determining Geographic Coverage and Representative Counties.
5. Onroad Vehicle Equipment Panel: Add all fuel type/source type combinations. For fuels, select all fuel types available for each source type.
6. Road Type Panel: Select all road types. Always select Off-Network to include calculation of emissions from engine starts, off-network idling, and evaporative emissions from parked gasoline vehicles.
7. Pollutants and Processes Panel: Select all processes for precursors and pollutants of concern. For ozone PSM analyses, under the column heading *Selected*, check the boxes to the left of *Volatile Organic Compounds* and *Oxides of Nitrogen (NOx)*. This automatically selects all emission processes to the right in this panel. Checking the *Volatile Organic Compounds* pollutant also adds messages into the white box in the lower right corner of screen listing all the prerequisites for VOC.²⁷ Click *Select*

²⁶ July is selected to represent the area’s ozone season (typically June, July, and August; or July, August, and September). July is also referenced in the I/M regulations for both the Enhanced and Basic performance standards in the evaluation date sections. Users need to enter the local average temperature profile for the period chosen to represent the area’s ozone season in the CDM.

²⁷ Though HC is listed as the pollutants of concern within the certain portions of the performance standards section in the I/M regulations, for ozone PSM modeling purposes for both the Basic and Enhanced standards, selecting VOCs and prerequisites in MOVES will capture the total HC emissions. EPA defines VOC as any compound of carbon, excluding CO, carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate, which participates in atmospheric photochemical reactions, except those designated by EPA as having negligible photochemical reactivity.

Prerequisites to remove these messages and automatically add checks to boxes for the pollutants and emission processes that MOVES needs to calculate VOC.

8. General Output Panel: For the “Database” field, specify an output database. This can be a unique output database for each run or multiple runs can be written to a single output database.²⁸ Choose units for emissions and distance. EPA recommends choosing “grams” and “miles” for these units. EPA also recommends selecting “Distance Traveled” under the “Activity” heading. “Distance Traveled” is required to use the post-processing script developed to determine the gram per mile rate used for Enhanced PSM purposes. Additionally, these results can be used as a quality assurance check when reviewing the run’s output.
9. Output Emissions Detail Panel: Select the level of detail needed in the model output. For PSM analysis, choosing “24-Hour Day” for the time output aggregation is appropriate to compare the various scenarios discussed above.²⁹ Making the “24-Hour Day” selection will generate a single emission quantity for each pollutant selected in the Pollutants and Processes Panel for each MOVES run (if writing multiple runs to a single output database). Selecting more detail in this panel results in larger output files and creates confusing results when using the supplied post-processing script. If more detail is desired, the user must manually post-process model outputs.
10. Create Input Database Panel: See Section 3.2 below.
11. Advanced Performance Features Panel: This panel is not needed and should be skipped.

3.2 Input Databases

The user must develop unique input databases for both the proposed/existing scenario MOVES run and for the performance standard benchmark scenario MOVES run. However, the input databases for these runs should be identical for a given analysis year except for the data supplied to the I/M Programs Input Tab (with the IMCoverage Table). To aid in PSM analyses, EPA has developed performance standard templates that capture the required program elements from the I/M regulations for both the Basic and Enhanced I/M performance standards for use in the performance standard benchmark scenario runs (discussed in Section 3.2.2).³⁰ Users must develop their own IMCoverage Tables to reflect the proposed or existing program for the proposed/existing scenario runs. Section 3.2.1 discusses the components of the IMCoverage

²⁸ Writing multiple MOVES runs to a single output database is an easy way to simplify post-processing of results. The different runs will be denoted with individual RunIDs within the “movesoutput” table. The “movestableused” contains information on the input tables. This is where a user can verify if the correct IMCoverage Table was used for the appropriate scenario RunID.

²⁹ Because PSM analysis is a simple comparison of the proposed/existing scenario and performance standard benchmark scenario for both Basic and Enhanced programs, a “24-Hour Day” provides adequate temporal resolution to determine if a program is meeting the applicable standard. “24-Hour Day” aggregates hourly output to estimate total emissions for a typical day type for the month selected.

³⁰ These templates can be found as tables in the Appendix of this document and are also available as fillable Excel spreadsheets on the EPA *Vehicle Emissions Inspection and Maintenance (I/M): Policy and Technical Guidance* website at www.epa.gov/state-and-local-transportation/vehicle-emissions-inspection-and-maintenance-im-policy-and-technical.

Table further and provides suggestions to aid in developing one for a proposed/existing scenario run.

Once the RunSpec is completed the user must specify an input database in the Create Input Database Panel of the MOVES GUI. In general, state and local agencies should use the latest available information at the time the PSM analysis and I/M SIP are developed when constructing input databases. If creating a new input database, users should consult the *MOVES Technical Guidance* for more information on the various data tab inputs in the CDM. Once an input database has been developed for one of the scenarios, copying the database and pasting it with a new name within Windows File Manager is the easiest way to prepare the starting point for the other scenario input database. The general process for this is described below:

1. Before copying and pasting, first open and flush the tables in the user's preferred SQL client by executing a "FLUSH TABLES" query.^{31,32}
2. After flushing tables, use the Windows File Manager to navigate to the user's data folder.
3. Create a copy (Ctrl-C) of the completed scenario input database and paste (Ctrl-V) it in the same data folder.
4. Rename the pasted input database folder with a descriptive name to indicate which scenario, analysis year, etc. that it represents.
5. Then using the MOVES GUI, in the Create Input Database Panel, click *Refresh* to renew the MOVES model's connection to the data folder and select the newly pasted and renamed database in the *Database* field, click *Enter/Edit Data* to open the MOVES CDM.
6. In the CDM, navigate to the I/M Programs tab and modify the database by clearing and importing the appropriate IMCoverage Table to represent desired scenario.

After this, the user will have developed a RunSpec for the PSM analysis and two input databases; one that represent proposed/existing program scenario and another that represents the performance standard benchmark scenario. The next section discusses the components of the IMCoverage Table for areas needing to develop an I/M Coverage Table to represent their proposed/existing program.

³¹ The current MOVES installer includes the "HeidiSQL" interface, which is the MariaDB equivalent of MySQL Workbench.

³² Flushing tables takes any data from memory and writes it to disk. Without performing a table flush, the copy function may not work properly.

3.2.1 I/M Programs Input Tab (IMCoverage Table)

I/M programs are characterized in MOVES through an input called the IMCoverage Table (depicted in Figure 1). The IMCoverage Table consists of 13 columns (and as depicted in Figure 1):

- polProcessID
- stateID
- countyID
- yearID
- sourceTypeID
- fuelTypeID
- IMProgramID
- inspectFreq
- testStandardsID
- begModelYearID
- endModelYearID
- useIMyn
- complianceFactor

Figure 1: Sample IMCoverage Table (Viewed in Microsoft Excel)

polProcessID	stateID	countyID	yearID	sourceTypeID	fuelTypeID	IMProgramID	inspectFreq	testStandardsID	begModelYearID	endModelYearID	useIMyn	complianceFactor
101	18	18089	2015	21	1	1	2	11	1976	1980 Y		95
101	18	18089	2015	21	1	6	2	33	1981	1995 Y		95
101	18	18089	2015	21	1	10	2	51	1996	2013 Y		95
101	18	18089	2015	21	5	201	2	11	1976	1980 Y		95
101	18	18089	2015	21	5	206	2	33	1981	1995 Y		95
101	18	18089	2015	21	5	210	2	51	1996	2013 Y		95
101	18	18089	2015	31	1	1	2	11	1976	1980 Y		95
101	18	18089	2015	31	1	6	2	33	1981	1995 Y		95
101	18	18089	2015	31	1	10	2	51	1996	2013 Y		95
101	18	18089	2015	31	5	201	2	11	1976	1980 Y		95
101	18	18089	2015	31	5	206	2	33	1981	1995 Y		95
101	18	18089	2015	31	5	210	2	51	1996	2013 Y		95
101	18	18089	2015	32	1	1	2	11	1976	1980 Y		95
101	18	18089	2015	32	1	6	2	33	1981	1995 Y		95
101	18	18089	2015	32	1	10	2	51	1996	2013 Y		95
101	18	18089	2015	32	5	201	2	11	1976	1980 Y		95
101	18	18089	2015	32	5	206	2	33	1981	1995 Y		95
101	18	18089	2015	32	5	210	2	51	1996	2013 Y		95

EPA recommends that users modeling an existing I/M program in MOVES begin by examining the default I/M program description included in MOVES for the county in question. The default I/M coverage data (e.g., the geographic coverage of a current program and the model years addressed) are updated when new versions of MOVES are released but may not contain the most up-to-date or accurate information for an area. The default I/M data can be reviewed by selecting the Export Default Data button in the I/M Tab of the CDM. Users should review the details of the default I/M program and make any necessary changes to reflect the actual local program. Users should note that any grace periods or exemption ages in an I/M program need to be included in the beginning and ending model years based on the calendar year of evaluation as discussed in Section 3.2.1.9 of this document.

3.2.1.1 Pollutant Process ID (*polProcessID*)

MOVES estimates emission reductions from I/M programs. For PSM in ozone areas, the analysis is completed for VOCs and NO_x and associated pollutant processes. For exhaust emissions, I/M programs can affect both running and start emissions. For evaporative emissions, I/M programs affect HC emissions from fuel vapor venting and fuel leaks. The table below shows the association between pollutants and processes for PSM in ozone areas.

Table 2: Pollutant Process Identifier Decoder

polProcessID	processID	processName	pollutantID	pollutantName
101	1	Running Exhaust	1	Total Gaseous Hydrocarbons
102	2	Start Exhaust	1	Total Gaseous Hydrocarbons
112	12	Evap Fuel Vapor Venting	1	Total Gaseous Hydrocarbons
113	13	Evap Fuel Leaks	1	Total Gaseous Hydrocarbons
301	1	Running Exhaust	3	Oxides of Nitrogen (NO _x)
302	2	Start Exhaust	3	Oxides of Nitrogen (NO _x)

3.2.1.2 State Identifier (*stateID*)

This value defines the state in which the analysis is being conducted. This is the 2-digit, state-level Federal Information Processing Standard (FIPS) code for the state. If exporting a blank I/M Program template using the CDM, this value will be populated based on information selected in the MOVES RunSpec.

3.2.1.3 County Identifier (*countyID*)

This value defines the county for which the analysis is being conducted. This is the 5-digit FIPS code for the county. If exporting a blank I/M Program template using the CDM, this value will be populated based on information selected in the MOVES RunSpec.

3.2.1.4 Year Identifier (*yearID*)

The analysis year, discussed in Section 2.3 Determining Analysis Year(s), for which the I/M program is being evaluated is entered as a four-digit year for the yearID column. If exporting a blank I/M Program template using the CDM, this value will be populated based on information selected in the MOVES RunSpec.

3.2.1.5 Vehicle Type (*sourceTypeID*) and Fuel Type (*fuelTypeID*) Identifiers

These entries are used to describe the source types (vehicles) and fuel types included in the I/M program. MOVES calculates I/M program benefits only for gasoline-fueled vehicles which include both dedicated vehicles and flex fuel vehicles that run on a combination of gasoline (fuelTypeID =1) and ethanol (fuelTypeID =5). For the proposed/existing program scenario, users should check to make sure that the vehicle and fuel types match the I/M program design elements for the vehicles included in the local program and SIP.

3.2.1.6 I/M Program Identifier (IMProgramID)

In MOVES, the IMProgramID is a numeric identifier used to differentiate between different parts of an I/M program such as different combinations of emission tests and vehicle coverage. For example, OBD I/M programs that have both exhaust and evaporative inspection components, should be modeled as two separate, simultaneous programs identified using different I/M program ID numbers in the I/M program ID column. Likewise, an I/M program that applies different tests to different vehicles (e.g., an IM240 program that applies to older model years and an OBD program that applies to newer model years) is also modeled as two separate, simultaneous programs identified using different I/M program ID numbers in the I/M program ID column and using the beginning and ending model year columns to differentiate what model years are covered by each program.³³ For the proposed/existing program scenario, the IMProgramID column within the IMCoverage Table is assigned by the user.

3.2.1.7 Inspection Frequency (inspectFreq)

MOVES allows users to enter either annual (inspectFreq = 1) or biennial (inspectFreq = 2) inspection frequency. MOVES also allows an entry for continuous I/M, however, there are currently no emission benefits assigned to this option in MOVES, and it should not be selected. MOVES assigns slightly lower emissions benefit for biennial inspections than it does for annual inspections. Since the performance standard benchmark programs for both the Basic and Enhanced performance standards employ annual testing, users should consider how to address any possible emissions benefit shortfall if biennial inspection frequency is selected for the proposed/existing program scenario.

3.2.1.8 Emission Test Type and Emission Standards (testStandardsID)

In MOVES, users need to select the appropriate test type and the model will automatically apply the relevant test standard. MOVES allows users to choose among 12 exhaust emissions tests (testStandardsID = 11-33, 51) and 7 evaporative emissions tests (testStandardsID = 41-47). In general, there are three types of I/M testing: visual inspections, tailpipe testing and OBD testing. I/M programs may use all or a combination of these. The inputs for emission test type are entered under the column headed testStandardsID and are defined in Table 3.

³³ Please note that there are no additional emission reductions (in either the performance standard benchmark or proposed/existing I/M program modeling scenarios) for tailpipe testing on OBD-tested vehicles. Pursuant to 40 CFR 51.356(a)(6):

States may also exempt MY 1996 and newer OBD-equipped vehicles that receive an OBD-I/M inspection from the tailpipe, purge, and fill-neck pressure tests (where applicable) without any loss of emission reduction credit.

Table 3: Test Standard Identifiers and Descriptions

Test Standards ID	Test Standards Description	Description
11	Unloaded Idle Test	Test performed while vehicle idles in Park or Neutral.
12	Two-mode, 2500 RPM/Idle Test	Test performed while vehicle idles and at 2500 rpm.
13	Loaded / Idle Test	Test performed while vehicle operates on a chassis dynamometer at constant load.
21	ASM 2525 Phase-in Cutpoints	Test performed on a dynamometer, under load, through a defined steady state driving cycle at 25 mph and 25% load, at phase-in cutpoints.
22	ASM 5015 Phase-in Cutpoints	Test performed on a dynamometer, under load, through two defined steady state driving cycles at 25 mph and 25% load, and 15 mph and 50% load, at phase-in cutpoints.
23	ASM 2525/5015 Phase-in Cutpoints	Test performed on a dynamometer, under load, through two defined steady state driving cycles at 25 mph and 25% load, and 15 mph and 50% load, at phase-in cutpoints.
24	ASM 2525 Final Cutpoints	Test performed on a dynamometer, under load, through a defined steady state driving cycle at 25 mph and 25% load, at final cutpoints.
25	ASM 5015 Final Cutpoints	Test performed on a dynamometer, under load, through a defined steady state driving cycle at 15 mph and 50% load, at final cutpoints.
26	ASM 2525/5015 Final Cutpoints	Test performed on an inertia-weighted dynamometer through two defined steady state driving cycles at 25 mph and 25% load, and 15 mph and 50% load, at final cutpoints.
31	IM240 Phase-in Cutpoints	Test performed on a dynamometer, under load, through a pre-defined transient driving cycle of up to 240 seconds at phase-in cutpoints.
33	IM240 Final Cutpoints	Test performed on a dynamometer, under load, through a pre-defined transient driving cycle of up to 240 seconds.
41	Evaporative Gas Cap Check	A test conducted by pressurizing the gas cap for the purpose of identifying leaks in the gas cap.

Test Standards ID	Test Standards Description	Description
42	Evaporative System Pressure Check	A test conducted by pressuring the evaporative system by way of the fuel tank's fillneck and sometimes referred to as the fillneck pressure (FP) test.
43	Evaporative System OBD Check	Test of the evaporative emission related systems and components performed by visual check of the MIL and scan of the OBD computer system for readiness, MIL status, and stored trouble codes, on 1996 and newer, OBD-equipped vehicles.
44	Evaporative Gas Cap and Pressure Check	A pair of tests to identify leaks in the gas cap and the rest of the vehicle's evaporative system. The latter test is conducted by pressuring the evaporative system by way of the fuel tank's fillneck and is referred to as the FP test.
45	Evaporative Gas Cap and OBD Check	The evaporative OBD test performed in conjunction with a separate check of the gas cap for the purpose of identifying leaks in the gas cap not otherwise identified by the evaporative OBD check. This combination of tests can only be conducted on 1996 and newer, OBD-equipped vehicles.
46	Evaporative Pressure and OBD Check	The evaporative OBD test performed in conjunction with a separate FP test.
47	Evaporative Gas Cap, Pressure and OBD Check	The evaporative OBD test performed in conjunction with a separate FP test and gas cap test.
51	Exhaust OBD Check	Test of exhaust-related systems and components performed by visual check of Malfunction Indicator Light (MIL) and scan of on-board (OBD) computer for system readiness, MIL status and stored trouble codes, on 1996 and newer OBD-equipped vehicles only.

Most current I/M programs are OBD-based, therefore, EPA anticipates that the testStandardsIDs used for most proposed/existing program scenarios would be testStandardsID 43 and 51.

3.2.1.9 Model Year Coverage (begModelYearID and endModelYearID)

MOVES uses these two columns (i.e., begModelYearID and endModelYearID) to specify the beginning and ending model years affected by a particular portion of the I/M program. This

section of the IMCoverage Table is important for capturing various types of vehicle exemptions such as model year-based vehicle exemptions.

For I/M programs with a grace period for new vehicles or an exemption period for older vehicles, this entry should reflect the actual model years covered by the program in the calendar year of evaluation. As a result, the beginning and ending model years for an I/M program may vary depending on the calendar year of the analysis. A typical OBD I/M program might apply to all model years beginning with 1996. However, if that program also includes a grace period during which newer vehicles are exempt from the program, the ending model year of the program should reflect the most recent model year included in the program based on the calendar year of analysis. For example, if in calendar year 2025, the most recent model year being tested in a program with a three-year grace period is the 2022 model year, a MOVES run for calendar year 2025 would have an ending model year of 2022. An analysis of the same program for calendar year 2030 would have an ending model year of 2027.

Similar adjustments to the beginning model year should be made to account for exemptions of older model years as well. In that case, the beginning model year of the program should reflect the earliest model year still being tested. For example, some programs include a 20-year rolling exemption meaning that the newest 25 model years are tested. Therefore, if the analysis year is 2025, the oldest model year still being tested in a program with this type of exemptions would be the 2005 model year, so the IMCoverage Table for analysis year 2025 would have a beginning model year of 2005 and ending model year of 2025. An analysis of the same program for calendar year 2030 would have a beginning model year of 2010.

Note that because of this treatment of beginning and end years, a unique set of I/M inputs would be needed for each analysis year modeled for I/M programs with grace periods or exemption periods.

Another vehicle exemption is mileage-based vehicle exemption. There are two types of mileage-based exemptions that a few states have chosen to grant to motorists. The first type is similar to the grace period for newer vehicles mentioned above. For this type of mileage-exemption, an “initial grace distance”, a vehicle is exempted from its regular inspection until it has clocked a set number of miles on its odometer since the vehicle was new, for example, 40,000 miles. The second type of mileage exemption is based on the quantity of miles traveled since the vehicle’s last required inspection cycle (annual or biennial period). For example, some I/M programs may allow vehicles to be exempt from I/M testing if they traveled less than 5,000 miles since their last annual registration renewal cycle.

Any area considering mileage-based exemptions should also consider how the odometer readings are to be tracked and verified for quality assurance purposes, especially if these exempt vehicles might not need to visit an emission inspection station. I/M programs with this type of exemption often also have a vehicle safety inspection program so that the odometer reading can be coordinated with the safety-portion of the vehicle’s inspection and registration process.

Neither of these types of mileage-based exemptions can be directly input in the MOVES model since the model does not account for an individual vehicle’s annual or accumulated VMT. As a

result of this and since these vehicles receive no I/M benefit, both types of mileage-based exemptions should be treated like waived vehicles and as such should be included in the estimation of waiver rate.

For areas considering the first type of mileage-based exemption (an initial grace distance), it may be prudent and advantageous to consider model year exemptions (a grace period) instead as discussed above, as this can be directly input into MOVES.

3.2.1.10 Compliance Factor

MOVES uses the compliance factor input (complianceFactor) to account for I/M program compliance rates, waiver rates, and adjustments needed to account for the fraction of vehicles within a source type that are covered by the I/M program. The last component is referred to as the regulatory class coverage adjustment (RCCA). The compliance factor is entered as a number from 0 to 100 and represents the percentage of vehicles within a source type that receive the benefits of the program. A unique compliance factor should be calculated for each IMProgramID. The compliance factor entered in MOVES is calculated as:

$$CF = CR \times (1 - WR \times FR) \times RCCA$$

Where CF = Compliance factor
 CR = Compliance rate
 WR = Waiver rate
 FR = Failure rate
 $RCCA$ = Regulatory class coverage adjustment

The terms compliance rate, waiver rate, and vehicle type adjustment are discussed in more detail below. An example of the compliance factor calculation is available in Section 4.9.6.5 of the *MOVES Technical Guidance*. The following sections go into greater detail on the component pieces that make up the compliance factor.

Compliance Rate

The compliance rate is the percentage of vehicles in the fleet covered by the I/M program that completes the I/M program and receives either a certificate of compliance (i.e., vehicles that pass inspection) or a waiver (i.e., vehicles that do not pass a retest but still receive a certificate). This is calculated by adding the number of vehicles that receive a certificate of compliance with the number of vehicles that receive a waiver, and dividing the sum by the number of total vehicles that are subject to I/M testing:

$$Compliance\ Rate = \frac{Compliant\ Vehicles + Waived\ Vehicles}{Subject\ Vehicles} \times 100$$

Historical compliance should be determined by sticker surveys, license plate surveys, or a comparison of the number of final tests to the number of vehicles subject to the I/M requirement.

Note, “Subject Vehicles” includes all vehicles registered in the county that meet the I/M program’s vehicle type, fuel type, model year, and weight class requirements. Additionally, note that the compliance rate is a percentage between 0 and 100. Sources of this data are discussed in greater detail in the next section.

An area planning to implement an I/M program using a registration denial system that automatically generates compliance documents that uniquely identify the complying vehicle and that are serially numbered, accounted for, and subject to centralized processing by government clerks with management oversight may assume a 96% compliance rate for modeling purposes prior to program implementation. Once the program begins implementation, however, the compliance rate should be based on actual operating program data.

Waiver Rate

For each IMProgramID, the waiver rate is the fraction of vehicles that fail an initial I/M test and do not pass a retest, but still receive a certificate. This is calculated as the number of vehicles that do not pass a retest but receive a certificate divided by the number of vehicles that fail an initial I/M test:

$$\text{Waiver Rate} = \frac{\text{Waived Vehicles}}{\text{Initially Failing Vehicles}}$$

The waiver rate is incorporated into the compliance factor calculation as a decimal fraction between 0 and 1. Sources of this data are discussed in greater detail in the next section.

Failure Rate

For each IMProgramID, the failure rate is the fraction of all tested vehicles that fail an initial I/M test (regardless of the vehicle’s outcome). This is calculated as the number of vehicles that fail an initial I/M test divided by the number of unique vehicles that were tested:

$$\text{Failure Rate} = \frac{\text{Initially Failing Vehicles}}{\text{Unique Vehicles Tested}}^{34}$$

The failure rate is incorporated into the compliance factor calculation as a decimal fraction between 0 and 1. Sources of this data are discussed in greater detail in the next section.

Regulatory Class Coverage Adjustment (RCCA)

I/M programs entered in MOVES are applied to source types. However, as discussed in Section 3.2.1.5, this association of I/M programs and source type may be inconsistent with state I/M program regulations that define I/M programs by the vehicle weight classes. MOVES source types are composed of several vehicle weight classes and, therefore, applying I/M benefits to the

³⁴ Note that “Unique Vehicles Tested” is not the same as the total number of I/M tests because it does not include vehicle retests.

entire MOVES source type may be inappropriate. A table of RCCA values is provided in the *MOVES Technical Guidance* for use in the compliance factor to account for this discrepancy. Be sure to consult the most recent version of the *MOVES Technical Guidance* for the most up to date RCCA values. The adjustments are population fractions of vehicles by the various regulatory weight classes within a source type. After reviewing the table, users should sum the adjustments for weight classes within a source type that are covered by an I/M program. This sum provides users with a multiplicative factor that can be applied when calculating the compliance factor, as described above. An example of this process is provided in the next section. Note that the adjustment factor is a decimal fraction between 0 and 1.

Users who believe a local set of regulatory class coverage adjustments are more appropriate than what is provided in the most recent version of the *MOVES Technical Guidance* should provide documentation of the local data and methods used to derive those adjustments.

Sources of Data for Compliance Factor Calculation

Actual program data should serve as the basis of the compliance factor calculation for areas with existing I/M programs that are being implemented. States with existing Basic and/or Enhanced I/M programs are required to submit reports every July to their EPA Regional Office to satisfy the I/M regulations at 40 CFR 51.366, “Data analysis and reporting.” As part of satisfying these requirements, states must collect summary statistics and evaluations of the effectiveness of the enforcement mechanism, the quality assurance system, the quality control program, and the testing elements. These summary statistics capture the data needed to calculate the compliance factor components (i.e., compliance rate, waiver rate, and failure rate for each program ID), and subsequently, the compliance factor itself.³⁵ Therefore, actual program data should be available to be used for compliance factor calculation for areas with existing I/M programs.

Areas developing brand new I/M programs will have to make some estimates and assumptions to calculate the compliance factor for the proposed/existing program scenario run. For the performance standard benchmark scenario, EPA developed performance standard templates, available in the Appendix of this document, and that contain calculated compliance factors in the complianceFactor column. These values were calculated using the values defined within the I/M regulations for the applicable performance standard, 40 CFR 51.351(i) for Enhanced and 40 CFR 51.352(e) for Basic, and an 8% failure rate derived from national historical values reported to EPA as summary statistics for data analysis and reporting purposes, as required for annual reporting under 40 CFR 51.366. A state enacting a new I/M program should provide additional documentation in its SIP submission if a different failure rate than this EPA supplied value is used.

³⁵ For more information on I/M test data statistics, please see the *Guidance on Vehicle Inspection and Maintenance (I/M) Test Data Statistics as Part of Annual I/M Reporting Requirements* (EPA-420-B-20-033) available at nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100ZBX7.pdf.

3.2.1.11 UseIMyn

The MOVES I/M input parameters include a column labeled useIMyn which allows the user to turn off (“N”) or on (“Y”) the portion of the I/M program described in that row of the table.

3.2.2 IMCoverage Tables for Different Performance Standard Runs

To aid in PSM analyses, EPA has developed performance standard templates that capture the required program elements from the I/M regulations for both the Basic and Enhanced I/M performance standards for use in the performance standard benchmark scenario runs.³⁶

- The Basic Performance Standard template (available in Appendix A.2) reflects the I/M program design elements as specified in 40 CFR 51.352(e).
- The Enhanced Performance Standard template (available in Appendix A.4) reflects the I/M program design elements as specified in 40 CFR 51.351(i).

Please see Section 2.2 for more information on applicability. As noted earlier, these templates contain some pre-filled information to reflect the required test standards, vehicle coverage, and compliance factors, however, values like state ID, county ID, YearID and endModelYearID must be supplied by the user. Additional information on completing the templates can be found in the respective Appendix sections.

3.3 Executing MOVES Runs

Once the RunSpec file and input databases are complete, be sure to specify an input database in the Create Input Database Panel of the MOVES GUI that represents a scenario of analysis (whether the proposed/existing scenario input database or the performance standard benchmark scenario input database). Then run MOVES by clicking *Action > Execute* in the menu of the MOVES GUI. After the first run completes, select the input database that represents the other scenario in the Create Input Database Panel and execute the MOVES run a second time. By using the same RunSpec, MOVES will write the output of the multiple runs to a single output database. This is an easy way to simplify post-processing of results. The different runs will be denoted with individual RunIDs within the “movesoutput” table. The “movestableused” contains information on the input tables. This is where a user can verify if the correct IMCoverage Table was used for the appropriate scenario RunID.

The steps described in Section 3 should be repeated for each analysis year and county within a nonattainment area, if not using the representative county approach, for a given I/M program.

³⁶ These templates can be found as tables in the Appendix of this document and are also available as fillable Excel spreadsheets on the EPA *Vehicle Emissions Inspection and Maintenance (I/M): Policy and Technical Guidance* website at www.epa.gov/state-and-local-transportation/vehicle-emissions-inspection-and-maintenance-im-policy-and-technical.

Section 4: Processing Model Output for Performance Standard Modeling Analysis and Meeting the Performance Standard

This section covers how to process MOVES model output, which varies depending on which I/M performance standard is being evaluated. For analyses using the Basic performance standard, see Section 4.1. For analyses using the Enhanced performance standard, see Section 4.2.

4.1 Processing Model Output for the Basic Performance Standard

Evaluating whether a proposed/existing program meets the Basic performance standard requires showing that the proposed/existing program obtains the same or lower emission levels for each applicable pollutant/precursor as the model program within the allowable tolerance.³⁷ As discussed in Section 3.1 of this guidance, “24-Hour Day” is recommended as the selection in the Output Emissions Detail Panel, and as a result, MOVES emissions output is expressed as a daily amount of emissions (in the emissionsQuant column) for the day type selected in the RunSpec.

Below in Table 4 is an abbreviated example of what MOVES will produce for a single county if selections were made following the suggestions in Section 3.1 where MOVESRunID=1 represents the proposed/existing program, and MOVESRunID=2 represents the performance standard benchmark program.³⁸ Modelers unfamiliar with MOVES identifiers should consult the MOVES onroad decoder available on the MOVES Github page.³⁹

Table 4: Abbreviated Example MOVES Output Table

MOVESRunID	iterationID	yearID	monthID	dayID	...	pollutantID	...	emissionQuant	...
1	1	2030	7	5	...	87	...	1147522.87	...
1	1	2030	7	5	...	79	...	1088286.76	...
1	1	2030	7	5	...	3	...	2448113.17	...
1	1	2030	7	5	...	1	...	1300707.66	...
2	1	2030	7	5	...	87	...	1158959.97	...
2	1	2030	7	5	...	79	...	1098635.99	...
2	1	2030	7	5	...	3	...	2442861.25	...
2	1	2030	7	5	...	1	...	1309823.59	...

The process of determining the emissions quantity, by pollutant, for the two scenarios is a simple process. Emissions quantities can be calculated by reviewing the emissionQuant value in the column by pollutant, where pollutantID=3 is NO_x and pollutantID = 87 is VOC, and runID, where different runIDs can represent different counties, years, or different run types (i.e., proposed/existing run or performance standard benchmark run). Note that in Table 4, above,

³⁷ See 40 CFR 51.352(e)(13).

³⁸ Note the “...” are used to indicate where anonymizing (stateID or countyID) or null quantity columns were omitted for simplicity.

³⁹ EPA provides “cheat sheets” to help decode MOVES identifiers available within the “docs” folder of model revisions. At the time of the development of this guidance, the MOVES onroad cheat sheet is available at: github.com/USEPA/EPA_MOVES_Model/blob/dev/v3.0.1/docs/MOVES3CheatsheetOnroad.pdf.

emissionQuant values are also given for pollutantID=1, total gaseous hydrocarbons, and pollutantID=79, non-methane hydrocarbons. MOVES reports these values because they were selected as prerequisites in the RunSpec, but these results are not used for PSM purposes. **Be sure to not sum results across scenarios, pollutants, or years.** Agencies can prepare summary tables like the table below using HeidiSQL or by exporting the MOVES output tables to a program like Excel and performing the calculations. States may find it easier to use one method over the other depending on staff skills. Modelers without SQL background knowledge who wish to create the summary table in HeidiSQL could refer to the SQL tip sheet for help.⁴⁰ Table 5, below, shows an example of emission summaries converting the emissionQuant values in Table 4 from grams per day to tons per day.⁴¹

Table 5. Summary of July Weekday Emissions for the Example Nonattainment Area (Tons Per Day⁴²)

Scenario	NO _x	VOC
Proposed/existing Program	2.698	1.265
Performance Standard Benchmark	2.692	1.277

Next, compare the proposed/existing scenario to the performance standard scenario for NO_x and VOC.⁴³ In Table 5, the total NO_x and VOC emissions are lower in the proposed/existing scenario than in the performance standard benchmark scenario, therefore, the proposed/existing scenario program is said to have met the performance standard.

4.2 Processing Model Output for the Enhanced Performance Standard

Evaluating whether a proposed program meets the Enhanced performance standard requires showing that the proposed program area-wide emission rates for NO_x and VOC must be not more than 0.02 gpm higher than the area-wide emission rates of the benchmark program.⁴⁴ To perform this evaluation, users must convert MOVES output emissions in mass-over-time units to the equivalent gpm rate. If selections were made following the suggestions in Section 3.1, processing MOVES output can be done by using SQL scripts. EPA has provided a script within MOVES called “EmissionRates.sql” that computes emissions in gpm. If other selections were made in the RunSpec, outputs can be processed manually using data available in specific MOVES output tables.

After the run has completed, to access the “EmissionRates.sql” script, first, an output database must be specified in the General Output panel of the MOVES GUI. Once the output database is specified, scroll to the “Post Processing” tab on the MOVES menu and click “Run MySQL

⁴⁰ GitHub, SQL Tip Sheet, github.com/USEPA/EPA_MOVES_Model/blob/master/docs/SQLTipSheet.pdf, February 2022.

⁴¹ For PSM, it is not necessary to convert values to tons per day, but this unit is a useful value when evaluating the benefit of an I/M program for SIP purposes.

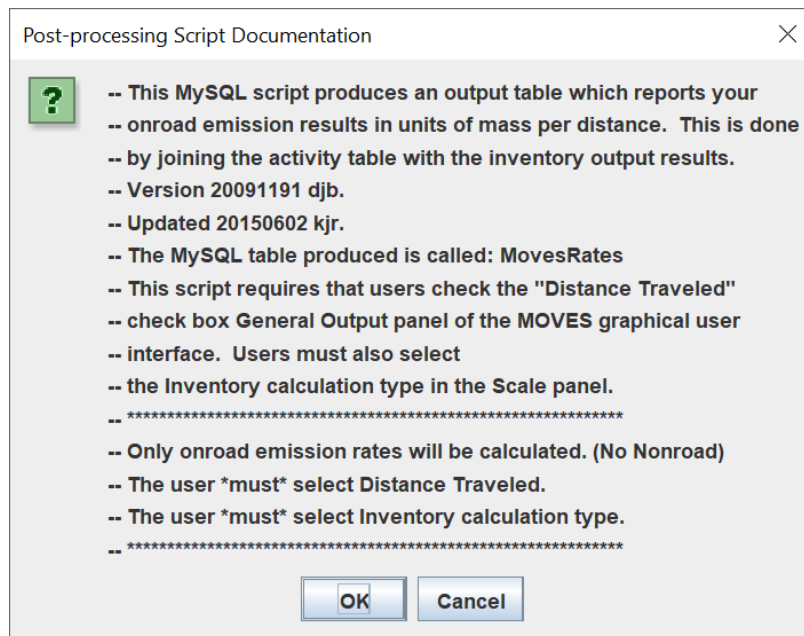
⁴² Note, in the RunSpec selections discussed in Section 4.1, output was specified in grams. The grams value can be directly reported or converted to other units as appropriate for the purpose of comparing results across the scenarios.

⁴³ As mentioned in Section 3.1, VOC are an aggregate gaseous species of organic gases that include HC, therefore VOC emissions are the useful pollutant of concern for PSM analyses with MOVES.

⁴⁴ See 40 CFR 51.352(i)(13).

Script on Output Database” option in the Post Processing menu in MOVES, the select the “EmissionRates.sql” script. This will open the MOVES Emission Rates Script dialogue box as shown below in Figure 2.

Figure 2: MOVES Emission Rates Script Dialogue Box



Note that in the dialogue box screenshot above, certain RunSpec selections must have been made to produce the emissions inventory to produce output compatible with the script.⁴⁵ These same RunSpec selections were specified in Section 3.1 above. The “EmissionRates.sql” script takes information from the “movesactivityoutput” table and the “movesoutput” table in the output database and produces a new table in the output database called “movesrates”. The movesrates table contains emissions and activity information and produces emission rates for each combination of vehicle type, fuel type, etc. The information in this table is helpful for quickly deriving total nonattainment area emissions and deriving emission rates for the area-wide onroad fleet.

Figure 3, below, provides an example of an abbreviated movesrates table where MOVESRunID=1 represents the proposed/existing program, and MOVESRunID=2 represents the performance standard benchmark program.⁴⁶ Modelers unfamiliar with MOVES identifiers should consult the MOVES onroad decoder available on the MOVES Github page.⁴⁷ The first column contains a “MasterKey” that serves as a row identifier. The column titled emissionQuant values which are the emissions for that row combination of pollutant, vehicle type, fuel type, etc.

⁴⁵ MOVES emission rates output cannot be used for this purpose because there is no simple way to convert grams-per-vehicle output for starts and evaporative emissions to grams per mile.

⁴⁶ Note the “...” are used to indicate where anonymizing (stateID or countyID) or null quantity columns were omitted for simplicity.

⁴⁷ EPA provides “cheat sheets” to help decode MOVES identifiers available within the “docs” folder of model revisions. At the time of the development of this document, the MOVES onroad cheat sheet is available at: github.com/USEPA/EPA_MOVES_Model/blob/dev/v3.0.1/docs/MOVES3CheatsheetOnroad.pdf.

The massUnits column indicates that the values in the emissionQuant column are in grams confirming the selection made in the MOVES GUI General Output panel. The activityTypeID column indicate that the values represent “distance traveled” (activityTypeID = 1) or, in this case, the distance traveled in miles per the RunSpec selections in the General Output panel. Finally, the emissionRate column provides the gram-per-mile rate for each pollutant row.

Figure 3: Example Abbreviated "movesrates" Table⁴⁸

... MOVESRunID	...	pollutantID	emissionQuant	...	activity	emissionRate	massUnits	distanceUnits	
...	1	...	87	1147522.87	...	5381341	0.213241081	g	mi
...	1	...	79	1088286.76	...	5381341	0.202233394	g	mi
...	1	...	3	2448113.17	...	5381341	0.454926269	g	mi
...	1	...	1	1300707.66	...	5381341	0.241706996	g	mi
...	2	...	87	1158959.97	...	5381341	0.215366406	g	mi
...	2	...	79	1098635.98	...	5381341	0.204156563	g	mi
...	2	...	3	244861.24	...	5381341	0.455251109	g	mi
...	2	...	1	1309823.59	...	5381341	0.243400986	g	mi

In this case, MOVESRunID = 1 represents the proposed/existing program and MOVESRunID = 2 represents the performance standard benchmark program and pollutantID = 3 is NO_x and pollutantID = 87 is VOC. Again, note that in Table 5, above, emissionRate values are also given for pollutantID = 1, total gaseous hydrocarbons, and pollutantID = 79, non-methane hydrocarbons. MOVES reports these values because they were selected as prerequisites in the RunSpec and appear in the MOVES output table, but these results are not used for PSM purposes. Therefore, to compare results for the pollutants and precursors of concern, simply look at the respective rates in the table for the applicable pollutants. A simplified results table could look something like the table below.

Table 6. Summary of July Weekday Emission Rates (in grams per mile) for the Example Nonattainment Area

Scenario	NO _x	VOC
Proposed/existing Program	0.4549	0.2132
Performance Standard Benchmark	0.4552	0.2153
Performance Standard Benchmark with 0.02 gpm Buffer	0.4752	0.2353

Based on the results in Table 6, the results for each pollutant in the proposed/existing program are less than the performance standard benchmark program with 0.02 gpm buffer and, therefore, meets the performance standard.

⁴⁸ Note, some columns removed to fit space constraints. Removed columns are indicated with “...” headers.

4.3 Analysis Wrap-Up

If after conducting the PSM analysis, the area's I/M program does not meet the corresponding performance standard, then the state would conduct a new PSM analysis based on new I/M program revisions to meet the appropriate I/M performance level.

When the proposed/existing program is shown to meet the applicable performance standard, the PSM analysis should be sufficiently documented in the SIP submission following the suggestions within Section 2.7. This documentation should be made available for review as part of the SIP development process.

Appendix

A.1 Basic Performance Standard (excerpted from 40 CFR 51.352(e))

- (e) **Basic performance standard for areas designated nonattainment for the 8-hour ozone standard.** Areas required to implement a Basic I/M program as a result of being designated and classified under the 8-hour ozone standard, must meet or exceed the emission reductions achieved by the model program defined for the applicable ozone precursor(s):
- (1) **Network type.** Centralized testing.
 - (2) **Start date.** 4 years after the effective date of designation and classification under the 8-hour ozone standard.
 - (3) **Test frequency.** Annual testing.
 - (4) **Model year coverage.** Testing of 1968 and newer vehicles.
 - (5) **Vehicle type coverage.** Light duty vehicles.
 - (6) **Emission test type.** Idle testing (as described in appendix B of this subpart) for 1968-2000 vehicles; onboard diagnostic checks on 2001 and newer vehicles.
 - (7) **Emission standards.** Those specified in 40 CFR part 85, subpart W.
 - (8) **Emission control device inspections.** None.
 - (9) **Evaporative system function checks.** None, with the exception of those performed by the OBD system on vehicles so-equipped and only for model year 2001 and newer vehicles.
 - (10) **Stringency.** A 20% emission test failure rate among pre-1981 model year vehicles.
 - (11) **Waiver rate.** A 0% waiver rate, as a percentage of failed vehicles.
 - (12) **Compliance rate.** A 100% compliance rate.
 - (13) **Evaluation date.** Basic I/M program areas subject to the provisions of this paragraph (e) shall be shown to obtain the same or lower emission levels as the model program described in this paragraph by an evaluation date set 6 years after the effective date of designation and classification under the 8-hour ozone standard (rounded to the nearest July) for the applicable ozone precursor(s).

A.2 Basic Performance Standard Template

EPA has developed performance standard templates that capture the required program elements from the I/M regulations. The template below is the Basic performance standard template that reflects the I/M program design elements as specified in 40 CFR 51.352(e). This is to be used in PSM analyses with MOVES for areas needing to meet the Basic performance standard. Values like stateID, countyID, YearID and endModelYearID must be supplied by the user in the table below. The stateID is the 2-digit state-level FIPS code for the state. The countyID is the 5-digit FIPS code for the county of the analysis. The yearID is the analysis year being examined. Lastly, the endModelYearID rows equal the analysis year minus 1. Once this table is filled out, it is to be used as the Basic Performance Standard Benchmark program imported into the CDM. A digital, fillable form is available on the EPA *Vehicle Emissions Inspection and Maintenance (I/M): Policy and Technical Guidance* website at www.epa.gov/state-and-local-transportation/vehicle-emissions-inspection-and-maintenance-im-policy-and-technical.

Table 7: Basic Performance Standard Template

polProcessID	stateID	countyID	yearID	sourceTypeID	fuelTypeID	IMProgramID	inspectFreq	testStandardsID	begModelYearID	endModelYearID	useIMyn	complianceFactor
101				21	1	111	1	11	1968	2000	y	100
102				21	1	111	1	11	1968	2000	y	100
301				21	1	111	1	11	1968	2000	y	100
302				21	1	111	1	11	1968	2000	y	100
101				21	1	151	1	51	2001		y	100
102				21	1	151	1	51	2001		y	100
301				21	1	151	1	51	2001		y	100
302				21	1	151	1	51	2001		y	100
112				21	1	143	1	43	2001		y	100
101				21	5	111	1	11	1968	2000	y	100
102				21	5	111	1	11	1968	2000	y	100
301				21	5	111	1	11	1968	2000	y	100
302				21	5	111	1	11	1968	2000	y	100
101				21	5	151	1	51	2001		y	100
102				21	5	151	1	51	2001		y	100
301				21	5	151	1	51	2001		y	100
302				21	5	151	1	51	2001		y	100
112				21	5	143	1	43	2001		y	100

A.3 Enhanced Performance Standard (excerpted from 40 CFR 51.351(i))

- (i) **Enhanced performance standard for areas designated and classified under the 8-hour ozone standard.** Areas required to implement an enhanced I/M program as a result of being designated and classified under the 8-hour ozone standard, must meet or exceed the HC and NO_x emission reductions achieved by the model program defined as follows:
- (1) **Network type.** Centralized testing.
 - (2) **Start date.** 4 years after the effective date of designation and classification under the 8-hour ozone standard.
 - (3) **Test frequency.** Annual testing.
 - (4) **Model year coverage.** Testing of 1968 and newer vehicles.
 - (5) **Vehicle type coverage.** Light duty vehicles, and light duty trucks, rated up to 8,500 pounds GVWR.
 - (6) **Emission test type.** Idle testing (as described in appendix B of this subpart) for 1968-2000 vehicles; onboard diagnostic checks on 2001 and newer vehicles.
 - (7) **Emission standards.** Those specified in 40 CFR part 85, subpart W.
 - (8) **Emission control device inspections.** Visual inspection of the positive crankcase ventilation valve on all 1968 through 1971 model year vehicles, inclusive, and of the exhaust gas recirculation valve on all 1972 and newer model year vehicles.
 - (9) **Evaporative system function checks.** None, with the exception of those performed by the OBD system on vehicles so-equipped and only for model year 2001 and newer vehicles.
 - (10) **Stringency.** A 20% emission test failure rate among pre-1981 model year vehicles.
 - (11) **Waiver rate.** A 3% waiver rate, as a percentage of failed vehicles.
 - (12) **Compliance rate.** A 96% compliance rate.
 - (13) **Evaluation date.** Enhanced I/M program areas subject to the provisions of this paragraph (i) shall be shown to obtain the same or lower emission levels for HC and NO_x as the model program described in this paragraph assuming an evaluation date set 6 years after the effective date of designation and classification under the 8-hour ozone standard (rounded to the nearest July) to within ± 0.02 gpm. Subject programs shall demonstrate through modeling the ability to maintain this percent level of emission reduction (or better) through their applicable attainment date for the 8-hour ozone standard, also rounded to the nearest July.

A.4 Enhanced Performance Standard Template

EPA has developed performance standard templates that capture the required program elements from the I/M regulations. The template below is the Enhanced performance standard template that reflects the I/M program design elements as specified in 40 CFR 51.351(i). This is to be used in PSM with MOVES for areas needing to meet the Enhanced performance standard. Values like stateID, countyID, YearID and endModelYearID must be supplied by the user in the table below. The stateID is the 2-digit state-level FIPS code for the state. The countyID is the 5-digit FIPS code for the county of the analysis. The yearID is the analysis year being examined. Lastly, the endModelYearID rows equal the analysis year minus 1. Once this table is filled out, it is to be used as the Enhanced Performance Standard Benchmark program imported into the CDM. A digital, fillable form is available on the EPA *Vehicle Emissions Inspection and Maintenance (I/M): Policy and Technical Guidance* website at www.epa.gov/state-and-local-transportation/vehicle-emissions-inspection-and-maintenance-im-policy-and-technical.

Table 8: Enhanced Performance Standard Template

polProcessID	stateID	countyID	yearID	sourceTypeID	fuelTypeID	IMProgramID	inspectFreq	testStandardsID	begModelYearID	endModelYearID	useIMyn	complianceFactor
101				21	1	111	1	11	1968	2000	y	95.77
101				31	1	111	1	11	1968	2000	y	92.05
101				32	1	111	1	11	1968	2000	y	72.08
102				21	1	111	1	11	1968	2000	y	95.77
102				31	1	111	1	11	1968	2000	y	92.05
102				32	1	111	1	11	1968	2000	y	72.08
301				21	1	111	1	11	1968	2000	y	95.77
301				31	1	111	1	11	1968	2000	y	92.05
301				32	1	111	1	11	1968	2000	y	72.08
302				21	1	111	1	11	1968	2000	y	95.77
302				31	1	111	1	11	1968	2000	y	92.05
302				32	1	111	1	11	1968	2000	y	72.08
101				21	1	151	1	51	2001		y	95.77
101				31	1	151	1	51	2001		y	92.05
101				32	1	151	1	51	2001		y	72.08
102				21	1	151	1	51	2001		y	95.77
102				31	1	151	1	51	2001		y	92.05
102				32	1	151	1	51	2001		y	72.08
301				21	1	151	1	51	2001		y	95.77
301				31	1	151	1	51	2001		y	92.05

polProcessID	stateID	countyID	yearID	sourceTypeID	fuelTypeID	IMProgramID	inspectFreq	testStandardsID	begModelYearID	endModelYearID	useIMyn	complianceFactor
301				32	1	151	1	51	2001		y	72.08
302				21	1	151	1	51	2001		y	95.77
302				31	1	151	1	51	2001		y	92.05
302				32	1	151	1	51	2001		y	72.08
112				21	1	143	1	43	2001		y	95.77
112				31	1	143	1	43	2001		y	92.05
112				32	1	143	1	43	2001		y	72.08
101				21	5	111	1	11	1968	2000	y	95.77
101				31	5	111	1	11	1968	2000	y	95.77
101				32	5	111	1	11	1968	2000	y	95.77
102				21	5	111	1	11	1968	2000	y	95.77
102				31	5	111	1	11	1968	2000	y	95.77
102				32	5	111	1	11	1968	2000	y	95.77
301				21	5	111	1	11	1968	2000	y	95.77
301				31	5	111	1	11	1968	2000	y	95.77
301				32	5	111	1	11	1968	2000	y	95.77
302				21	5	111	1	11	1968	2000	y	95.77
302				31	5	111	1	11	1968	2000	y	95.77
302				32	5	111	1	11	1968	2000	y	95.77
101				21	5	151	1	51	2001		y	95.77
101				31	5	151	1	51	2001		y	95.77
101				32	5	151	1	51	2001		y	95.77
102				21	5	151	1	51	2001		y	95.77
102				31	5	151	1	51	2001		y	95.77
102				32	5	151	1	51	2001		y	95.77
301				21	5	151	1	51	2001		y	95.77
301				31	5	151	1	51	2001		y	95.77
301				32	5	151	1	51	2001		y	95.77
302				21	5	151	1	51	2001		y	95.77
302				31	5	151	1	51	2001		y	95.77
302				32	5	151	1	51	2001		y	95.77
112				21	5	143	1	43	2001		y	95.77
112				31	5	143	1	43	2001		y	95.77
112				32	5	143	1	43	2001		y	95.77