PUBLIC HEARING TO CONSIDER THE PROPOSED AMENDMENTS TO CALIFORNIA SPECIFICATIONS FOR FILL PIPES AND OPENINGS OF MOTOR VEHICLE FUEL TANKS

STAFF REPORT: INITIAL STATEMENT OF REASONS

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<td>Above Ground Storage Tanks</td>
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<td>Board</td>
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<td>California Air Pollution Control Officer’s Association</td>
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<td>California Air Resources Board</td>
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<td>CCR</td>
<td>California Code of Regulations</td>
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<td>CEQA</td>
<td>California Environmental Quality Act</td>
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<td>ECARS</td>
<td>CARB Emissions Compliance, Automotive Regulations and Science Division</td>
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<td>ECO nozzle</td>
<td>Enhanced conventional nozzle</td>
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<td>CARB’s Emission Factors emission model</td>
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<td>GDF</td>
<td>Gasoline Dispensing Facility</td>
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<td>MLD</td>
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<td>ORVR</td>
<td>On-board Refueling Vapor Recovery</td>
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<tr>
<td>ROG</td>
<td>reactive organic gas</td>
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<tr>
<td>SAE</td>
<td>Society of Automotive Engineers</td>
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<tr>
<td>SLPM</td>
<td>Standard Liters Per Minute</td>
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<tr>
<td>TPD</td>
<td>Tons per day</td>
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<tr>
<td>US EPA</td>
<td>United States Environmental Protection Agency</td>
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<tr>
<td>UST</td>
<td>Underground Storage Tanks</td>
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<tr>
<td>V/L</td>
<td>Vapor to Liquid ratio. During refueling with a vapor recovery nozzle, this is the volume of vapor returned divide by the volume of liquid gasoline dispensed.</td>
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<tr>
<td>VR</td>
<td>Vapor Recovery</td>
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EXECUTIVE SUMMARY

The California Air Resources Board (CARB or Board) is proposing amendments to the Fill Pipes Specifications to help ensure new motor vehicle fill pipes form a good seal with Phase II vapor recovery nozzles. The original fill pipe specifications were adopted in 1976. Subsequent changes were made to introduce performance specifications to better ensure problem-free refueling. The new amendments being proposed through this rulemaking add a new performance leak standard, a bench test procedure, and new dimensional requirements for any planned fill pipe redesign beginning in model year 2024. Minimizing leaks between the motor vehicle fill pipe and nozzle helps ensure vehicles equipped with On-board Refueling Vapor Recovery (ORVR) are properly identified during refueling and reduces air ingestion at the nozzle, which helps reduce pressure-driven emissions caused by evaporation of gasoline within the gasoline storage tank during winter months.

Since the Fill Pipe Specifications were first adopted, there have been changes to both vehicles and the nozzles. Newer vehicles capture vapor from refueling through an ORVR system. CARB also implemented Phase II Enhanced Vapor Recovery (EVR) systems at the gasoline stations starting in 2001 for underground storage tanks (UST). The Phase II EVR systems are certified to capture at least 95 percent of available vapor generated during refueling. These actions were expected to reduce emissions concurrently.

The first indication that these systems were not fully compatible was an occurrence of overpressure alarms at gasoline stations during winter. These overpressure alarms happened because fuel vapor was pushed out of the UST. CARB staff has determined the primary causes of overpressure are excess air ingestion from a poor seal at the nozzle and vehicle fill pipe interface and winter blend of gasoline, causing a greater than 0.5 vapor/liquid (V/L) ratio at the gasoline station. CARB thus is proposing changes to both the vehicle fill pipe and vapor recovery nozzle regulations to help address the overpressurization problem by ensuring a better seal is achieved during refueling events.

CARB is proposing a performance leak standard to quantify an allowable leak rate between the fill pipe face and the nozzle boot as well as a bench test procedure to measure the leak rate. This is necessary as new capless fill pipe designs continue to be introduced in California by multiple manufacturers. A zero leak rate would be ideal; however, this would be difficult and costly to achieve with some of the designs available on the market today. A performance leak standard also preserves manufacturers’ flexibility in the designing fill pipes. The leak standard will phase in starting model year 2022 and be fully phased in model year 2024.

In addition, to prevent future increases in overpressure at California gasoline stations, this proposal modifies existing fill pipe dimensional requirements. These design changes only apply when an auto manufacturer is changing the fill pipe head design on model year 2024 and subsequent vehicles. From talks with manufacturers and staff’s
observations of vehicles, fill pipe head designs do not change often. Some designs have been around for decades. Tying fill pipe dimensional changes to already-planned fill pipe design changes provides flexibility, since the cost of redesigning and testing the fill pipe would already be incurred by the manufacturer during a planned redesign.

This rulemaking is being done in conjunction with the proposed amendments to Enhanced Vapor Recovery Regulations to Standardize Gas Station Nozzle Spout Dimensions to Help Address Storage Tank Overpressure regulation (EVR amendments) by the CARB Monitoring and Laboratory Division (MLD). These parallel rulemakings ensure a better seal between the nozzle’s vapor collection bellows and the vehicle fill pipe. The fill pipe amendments will reduce misidentification rates with ORVR vehicles, and the EVR amendments address loose latching and ensure compatibility with newer EVR and Enhanced Conventional (ECO) nozzle spout. A better seal will reduce excess air ingestion gasoline dispensing facilities (GDFs) with vacuum assist VR systems.

Both rulemakings together will result in a beneficial impact to air quality by reducing gasoline vapor (reactive organic gas, or ROG) emissions, which also contain benzene, an air toxic contaminant. The purpose of both rulemaking is to provide emission reductions that help attain federal health-based air quality standards for ozone in 2023 and 2031 in the South Coast and San Joaquin Valley air basins. Ozone (created by the photochemical reaction of ROGs and oxides of nitrogen) leads to harmful respiratory effects including lung damage, chest pain, coughing, and shortness of breath, especially affecting children and persons with compromised respiratory systems. Benzene is an air toxic contaminant, and reducing benzene emissions is critical for protecting the health of the people who live and work near gasoline dispensing facilities.

The emission reductions projected for the fill pipe and nozzle proposals are up to 0.63 tons per day (TPD) in 2030 on a day with average vapor concentration and up to 2.2 TPD in 2030 on a day with maximum vapor concentration. The proposed fill pipe and nozzle amendments are projected to reach the maximum potential emission reductions that can result from improving the fill pipe and nozzle interface. Therefore, further fill pipe improvements at this time are not expected to yield additional reductions in emissions.

**Recommendation:** Staff recommends that the Board approve for adoption amendments to the title 13, California Code of Regulations, section 2235, which incorporates by reference “Specifications for Fill Pipes and Openings of 2015 and Subsequent Model Motor Vehicle Fuel Tanks” (Fill Pipe Specifications), by adding requirements to the fill pipe specifications for a new performance leak standard and bench test procedure as well as changes to the fill pipe dimensional specifications (Appendix B).
I. INTRODUCTION AND BACKGROUND

The California Air Resources Board (CARB or Board) established necessary specifications for vehicle fill pipes in the “Specifications for Fill Pipes and Openings of 2015 and Subsequent Model Motor Vehicle Fuel Tanks" (Fill Pipe Specifications), which is incorporated by reference in section 2235 of Title 13, California Code of Regulations. As vehicles changed over time, the California’s fill pipe specifications have been amended in 1977, 1988, 1990, and 2012 to ensure continuing compatibility between vehicle fill pipes and gasoline-dispensing nozzles that provide gasoline vapor control at Phase II vapor recovery systems.

The amendments being proposed through this rulemaking will clarify fill pipe design and performance requirements to help ensure that the fill pipe minimizes air leakage and forms a good seal with the nozzle boot. This proposal will in turn assist in addressing overpressure at California’s gasoline dispensing facilities (GDFs).

A. Vehicle Fill Pipe Design

California’s current Fill Pipe Specifications
Since 1976, California has had fill pipe specifications to ensure fill pipes are shaped to interface properly with vapor recovery (VR) nozzles, which, in California, have a boot intended to seal with the fill pipe face. The first specification contained mostly dimensions and was adopted before Phase II vapor recovery was implemented in California. Early amendments in the 1980s and 1990s included adding performance testing for spitback and premature shutoff and ensuring nozzle retention in the fill pipe. In 2012, the California specification adopted ISO 13331-1995(E)¹ for dimensions, which mostly matches the original California specification from the 1970s.

On-board Refueling Vapor Recovery vehicles
On-board Refueling Vapor Recovery (ORVR) was introduced starting in 1998 and fully phased in by 2006 for on-road light duty vehicles. A vehicle with ORVR will capture vapors from the vehicle’s fuel tank that are displaced during refueling. These vapors are routed to a carbon canister and are later purged back to the engine and burned in the combustion process.

Table 1: ORVR Phase-In Schedule

<table>
<thead>
<tr>
<th>Vehicle Class</th>
<th>40% of Vehicles</th>
<th>80% of Vehicles</th>
<th>100% of Vehicles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passenger Cars</td>
<td>1998</td>
<td>1999</td>
<td>2000</td>
</tr>
<tr>
<td>Light Duty Trucks (\leq 6,000) lbs GVWR</td>
<td>2001</td>
<td>2002</td>
<td>2003</td>
</tr>
<tr>
<td>Light Duty Trucks &amp; Medium Duty Vehicles (6,001–8,500) lbs GVWR</td>
<td>2004</td>
<td>2005</td>
<td>2006</td>
</tr>
</tbody>
</table>

The number of ORVR vehicles will continue to increase as older vehicles, which don’t have ORVR, reach the end of their useful life through natural attrition. By 2030, staff estimates 97 percent of gasoline dispensed in the state will be to ORVR vehicles, as shown in Figure 1, which was obtained using CARB’s EMFAC 2017 model population predictions.

Figure 1: Percentage of ORVR vehicles and Percentage of Gasoline Dispensed to ORVR Vehicles by Year

New fill pipe designs
Until about a decade ago, fill pipe designs varied very little from model to model. They were a metal pipe sealed with a cap that fastened onto its end. In 2008, a new fill pipe design, capless, began to emerge. Like the name suggests, these fill pipes do not have a cap, and the shapes and features varied more relative to the traditional capped models. For instance, the early versions of capless pipes had various drain holes and gaps between mating plastic parts. This led to an inadvertent open path to the atmosphere and compromised the nozzle from making a good seal with the pipe.
Vehicle features influencing overpressure
 Fill pipe characteristics that interfere with nozzle sealing and recognition include drain holes and gaps (as noted above), a deep locking lip, and an obstructed access zone, which is the space around the end of the fill pipe designated to be open and clear of obstructions. Gaps inhibit the ability to create a vacuum and cause misidentification of the ORVR vehicle. A deep locking lip and/or a larger outer diameter result in needing a larger force to latch the nozzle and can lead to a “loose latch,” where the nozzle is only partially engaged with the fill pipe but still can dispense fuel. Lastly, items in the access zone can block the nozzle’s bellows from sealing with the fill pipe. Because they can interfere with the seal, these fill pipe attributes alone and in combination all contribute to overpressure in the underground storage tank (UST).

B. Phase II Vapor Recovery at California Gas Stations

Vapor recovery at GDFs
 Vapor recovery at California’s GDFs was introduced in the 1970s. At that time, motor vehicles did not have refueling emission controls, so all refueling vapor recovery was handled by the GDF. As the vehicle tank is filled, vapors from the vehicle tank are recovered via the nozzle and drawn down into the GDF’s UST (see Figures 2 and 3). The amount of gasoline dispensed from the GDF’s UST was matched by the amount of gasoline vapor returned to it, which kept pressure at equilibrium in the UST. CARB implemented Phase II Enhanced Vapor Recovery (EVR) at gasoline stations starting in 2001 for USTs. The Phase II EVR systems are an improved version of gasoline station vapor recovery and are certified to capture at least 95 percent of vapor generated during refueling.

Figure 2: California GDF with vapor recovery and underground storage tank

Phase II EVR nozzles
 There are two types of Phase II vapor recovery systems in California: balance systems and vacuum assist systems (assist systems). Balance systems use nozzles with dedicated low resistance vapor return pathways and rely on direct displacement to pull vapor from the vehicle fuel tank to the GDF storage tank. Assist systems use nozzles
with dedicated vapor return pathways and remote or dispenser-mounted vacuum pumps to achieve a controlled collection of vapor from the vehicle fuel tank.

Currently, there are three Phase II EVR nozzles certified and available for use at California gasoline stations. Two nozzles are designed for use with balance systems, and the third nozzle, the Healy Model 900, is designed for use with the assist system. All the certified balance and assist nozzles are considered ORVR-compatible because they are designed to reduce or restrict the volume of air ingested when refueling ORVR-equipped vehicles.

Table 2: Percent of GDFs with Assist and Balance Phase II EVR Systems

<table>
<thead>
<tr>
<th>GDFs</th>
<th>Type of Phase II EVR Systems</th>
<th>Assist 52%*</th>
<th>Balance 48%*</th>
</tr>
</thead>
</table>

*April 2018 Survey of California Air Districts

The shape of today's nozzles, especially the vapor recovery boot, is different from the earlier models. The most prevalent assist nozzles uses a boot with a concave face, which overlaps the fill pipe, unlike earlier versions of nozzles.

GDF and vehicle potentially competing for vapor recovery

Today's assist system is designed to identify if the vehicle being fueled is an ORVR vehicle. As shown in Figure 3, if the vehicle is identified as having ORVR, then the GDF return pump reduces its flow, since the vehicle will recover the vapors on its own. But this identification relies on a good seal between the vapor recovery nozzle boot and the vehicle fill pipe. When this seal is insufficient on ORVR vehicles, assist system then misidentifies the vehicle as a non-ORVR vehicle. As seen from Figure 2, when the vehicle is misidentified as a non-ORVR vehicle, the system attempts to recover vapors from the fuel tank and does not limit the return air flow. ORVR vehicles do not have much vapor for the nozzle to collect, so instead the nozzle returns excessive air to the GDF's UST. This excess air then contributes to a pressure increase in the UST.
Overpressure issue
Overpressure refers to a condition where the vapor space in the GDF’s UST is under excessive pressure. This leads to an overpressure alarm occurring and the excess pressure is relieved by venting fuel vapors into the surrounding air. This contributes to ozone formation as well as increased benzene exposure. The frequency of overpressure alarms at California’s GDFs has significantly increased in recent years and mostly occurs during winter months when the vapor pressure of consumer gasoline is larger. This prompted CARB staff to conduct nine field studies from 2013 to 2017 to better understand the magnitude of the overpressure problem, identify primary causes, and develop effective solutions.

Testing at GDFs used vapor/liquid ratio to identify problem fill pipes
Testing revealed that the assist nozzle is consistently misidentifying certain ORVR vehicles. In CARB’s study, nozzle recognition was recorded from 1,356 ORVR-equipped vehicles that refueled at GDFs in the San Diego area in January 2015.2 All

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data was collected using the Healy 900 vapor recovery nozzle, since it is the only assist nozzle certified for use at California gasoline stations. Staff also investigated the fill pipes from vehicles that were consistently misidentified, and noticed certain features in the fill pipe that contribute to the issue.

To measure at what point the nozzle-fill pipe interface was contributing to overpressure, CARB assessed the vapor/liquid (V/L) ratio during refueling. The V/L ratio is the volume of vapor (when refueling non-ORVR vehicles) or the volume of air (when refueling ORVR vehicles) returned to the GDF storage tank divided by the volume of gasoline dispensed from the nozzle. When refueling non-ORVR vehicles, a V/L ratio of about one (1.0) is desired; for every gallon of gasoline dispensed, a gallon of vapor is displaced from the vehicle tank and is returned to the GDF storage tank. When refueling ORVR vehicles, a V/L ratio of approximately 0.5 or less is desired because the ORVR systems capture at least 95 percent of the displaced gasoline vapors. CARB found that misidentification led to a V/L ratio of greater than 0.5.

C. Working to solve the problem

CARB certification and regulatory staff discussed this issue with auto manufacturers, many of whom worked with CARB to develop a solution. During this process, it was apparent that additional clarifications to the regulation are needed to ensure fill pipes are designed properly in the future to avoid misidentification.

Collaboration between Society of Automotive Engineers and multiple CARB divisions

The proposed changes to the specification are largely a result of collaborative work between CARB staff and the Society of Automotive Engineers (SAE) Fuel Systems J285/J1140 Task Force. This SAE group is made up of automotive and gasoline station equipment manufacturers and suppliers. Members of this SAE group contributed to the testing and development of the performance leak standard and clarifications to the dimensional specifications of this proposal.

Joint Rulemaking

To ensure compatibility of the vehicle fill pipe with the nozzle, CARB has developed a parallel rulemaking. CARB MLD staff is proposing EVR amendments that will standardize EVR and ECO nozzle and dimensions for compatibility with the vehicle fill pipe specifications. Some of the issues not solved on the vehicle fill pipe side are being addressed on the nozzle side, which is a more cost-effective solution.

(CARB). November 29, 2017. (ORVR Recognition Study) Available at: https://www.arb.ca.gov/vapor/op/studies/assist/vropa3.pdf
II. THE PROBLEM THAT THE PROPOSAL IS INTENDED TO ADDRESS

A. The Problem: Overpressure at California gasoline stations attributed to vehicle fill pipe design

In the winter of 2013-2014, CARB MLD conducted a statewide field study to determine the extent of overpressure at GDFs.\(^3\) This study showed that 70 percent of GDFs with vacuum assist systems experienced ISD overpressure alarms. In January 2015, CARB MLD staff, along with the California Air Pollution Control Officer’s Association (CAPCOA) Vapor Recovery Subcommittee, conducted the Healy Model 900 Assist Vapor Recovery Nozzle ORVR Vehicle Recognition Study at six retail GDFs in San Diego, California.\(^4\) The study found the misidentification rate of the Healy assist nozzle was 30 percent, which means that 30 percent of ORVR vehicle fueling events had a V/L ratio greater than 0.5. For reference, assist nozzles are employed at approximately half of all retail GDFs statewide.

From the study and additional discussions with manufacturers, staff identified fill pipe design features that caused high V/L at the gasoline station. The key fill pipe features identified by staff include the following:

1. Capless fill pipe with drain holes or injection molded components that contain gaps. These fill pipes were introduced in the 2008 model year, and 75 percent of these vehicles yielded a V/L ratio above 0.5. These holes create an open path to the atmosphere during refueling events and lead to excess air being ingested into the USTs. The drain holes were designed by the vehicle manufacturer to allow for debris, rain water, or liquid gasoline to not enter the fill pipe and gasoline tanks on motor vehicles.

2. Some nozzles require excessive force by the operator to properly latch with the fill pipe because the locking lip is too far into the fill pipe. Since the operator is able to fuel without a proper latch, a loosely latched refueling event will lead to higher V/L at the gasoline station.

3. Other features of the fill pipe that make it harder to form a tight seal. For instance, the secondary ring or bezels in the access zone may obstruct a good seal. Some European manufacturers also have vehicles that use a bayonet-style fill pipe cap instead of threaded-style caps, and 77 percent of those vehicles yielded a V/L ratio above 0.5. Additionally, a fill pipe’s outer ring may meet the...


current dimensional specifications but still be hard to latch the nozzle at refueling
because of the concave boot design of some of the nozzles.

As staff talked to manufacturers, other dimensional clarifications and changes came to
light. The specific changes are described in the next section.

III. THE SPECIFIC PURPOSE AND RATIONAL OF EACH ADOPTION,
AMENDMENT, OR REPEAL

Given South Coast and San Joaquin Valley air basins are designated as severe-non-
attainment for National Ambient Air Quality Standards, it is critical that additional ROG
emissions from overpressure be mitigated. Thus, CARB is proposing amendments to
the Fill Pipe Specifications. This proposal adds a new requirement for automakers to
verify that their fill pipes interface sufficiently with the widely used assist type vapor
recovery nozzle. This new verification procedure is a performance leak standard using
a bench test. This standard specifies an allowable leak rate between the fill pipe and
nozzle interface. Since this is a bench test, it does not require flowing gasoline or
testing at gasoline stations. It uses equipment that automakers typically have available
in their testing facilities.

Additionally, fill pipe dimensional specifications are being proposed to enable a better
interface with the nozzle. These dimensional changes would only apply to future
vehicle fill pipe designs and are intended to ensure that future designs would use
geometries that have optimal interfacing with California’s vapor recovery nozzle.

1. Performance leak rate of fill pipe and nozzle interface

The ideal scenario would be zero air leakage between the fill pipe and nozzle at
refueling. However, manufacturers voiced that requiring zero leakage would be too
expensive and not feasible, especially since there are more mating parts in new capless
fill pipe designs. Staff and industry worked together to propose a maximum allowable
leak rate, which would still allow for good performance in the real world while keeping
costs manageable. The leak rate is checked by latching the nozzle into a fill pipe,
inducing a 500 Pascal vacuum in the nozzle’s vapor recovery boot, and measuring the
corresponding flow rate. This apparatus is shown in Figure 4 below. A fill pipe’s
recirculation line, if present, would be plugged since its effect would be difficult to
duplicate in a bench test. Any pre-existing holes in the nozzle’s boot would either be
plugged or used for inducing vacuum and measuring. The flow rate is indicative of the
degree of leak in the nozzle and fill pipe system. A passing test would result in a flow
rate at or below 2.5 standard liters per minute (SLPM). Data supporting this standard is
in the Technical Support Document: Performance leak rate standard justification,
Appendix C.

This standard was also tested at GDFs by automakers working together with CARB.
Actual refueling was performed at a California gasoline station, using various sized
orifices put into the fill pipe. The resulting V/L ratios from these refueling events were
measured, and the orifice diameter of 2.5 millimeters (mm) resulted in a V/L ratio of 0.3 (under the 0.5 threshold). Staff adjusted 2.5 mm downward to 1.6 mm diameter in order to include a safety buffer accounting for design variables such as recirculation lines.

Finally, a bench test was set up at CARB, and staff performed the leak test using a fill pipe that has a 1.6 mm diameter orifice. A Healy 900 nozzle was latched into this fill pipe and a 500 Pascal vacuum was applied, which resulted in a leak rate of 2.5 SLPM. This leak rate of 2.5 SLPM is the proposed performance leak rate in this rulemaking. The performance leak rate standard is proposed to phase-in starting with model year 2022 and to completely apply to manufacturers’ new vehicle fleets by model year 2024. Staff expects this will give sufficient time for manufacturers to acquire necessary equipment and perform the performance bench test used to verify this standard is met. The performance leak rate is being proposed to provide assurance that the vapor recovery nozzle will be able to seal and operate correctly with the vehicle’s fill pipe and not draw in excess air into the gasoline station UST. Reducing the influx of excess air into the gas station UST will help alleviate overpressure, which staff projects will result in 0.63 tons of ROG emissions reduction per day on average.

In addition, a definition for “Fill pipe head” was added for clarification because it is used in the test procedure.

2. Performance bench test

The bench test is a surrogate to measuring the V/L ratio in the field and will verify performance of the fill pipe-nozzle interface. As discussed above, the proposed bench standard of 2.5 SLPM at 500 Pascal vacuum ensures that gasoline station performance would be at or below the 0.5 V/L ratio threshold.

Figure 4: Bench Test Apparatus

Note: Vacuum and pressure/flow measurement can occur at different locations in this apparatus, so long as it is representative of what is occurring inside the nozzle’s boot.
An automaker would have the option to provide either an attestation when certifying that their vehicle fill pipe meets the proposed requirement or test data when asked by the administrator during certification.

3. Adding dimensional requirements, which apply only during a fill pipe head design change

To prevent future increases in overpressure at California gasoline stations, staff proposes expanding the access zone and adding dimensional changes. These dimensional changes only apply when an auto manufacturer is changing the fill pipe head design on model year 2024 and subsequent vehicles. This provides flexibility, since the cost of redesigning and testing the fill pipe would already be incurred by the manufacturer during a planned redesign. This dimensional proposal also does not restrict manufacturers from carrying over a current fill pipe design to future model years, though it would still be required to meet the current dimension specifications and satisfy the performance test. Further language is also proposed to define a manufacturer’s vehicle fleet to clearly describe the scope of a manufacturer’s compliance with the proposed new dimensional specifications.

The access zone addition would account for the concave boot shape of today’s assist-type vapor recovery nozzle. This shape is shown in Figure 5.

Figure 5: Assist nozzle boot overlaps end of fill pipe

There is already a fairly comprehensive access zone denoted in California’s current fill pipe specification. During conversations with auto manufacturers, staff clarified the
importance of the access zone to ensure that the size, design, and location of the fill pipe are compatible with the nozzle and form a good seal between the fill pipe face and the nozzle boot. Some capless designs had bezel attachments that were obstructing the access zone. Those have been removed for new vehicles.

This proposal would expand the current set of specifications, as shown in Figure 6. The addition to the access zone would be set at a 40 degree angle, to match the shape of the vapor recovery nozzle model with the most concave shape. Staff selected the radius of this addition to be 43 mm, representing what staff believes to be a realistic envelope of space that the nozzle boot would need, since it is slightly larger than the diameter of nozzle boots currently used in California. Finally, the added access zone that overlaps the fill pipe by a maximum of 12 mm incorporates the maximum distance that the assist nozzle can overlap a fill pipe.

Figure 6: Supplemental Access Zone

The bayonet style fill pipes used on most Mercedes and BMW vehicles have an outer ring shown in Figure 7, which infringes into the proposed access zone. But due to the relatively small proportion of the fleet using this fill pipe (more details are in Appendix E), the resulting emissions are relatively small. By proposing the new access zone apply to manufacturers' future fill pipe head designs, there is assurance that usage of
the bayonet style design will remain small, and therefore the overpressure emissions from bayonet fill pipes will be constrained.

**Figure 7: Bayonet Style Fill Pipe Head**

In addition to the supplemental access zone, staff had also identified the possibility of reducing the allowable locking lip depth. In the current specification, the locking lip depth is between 4 and 13 mm and is depicted as “d” in Figure 8 below. This proposal entails reducing this to a range of 4 to 11 mm.

**Figure 8: Fill Pipe Locking Lip**

The locking lip is the feature just inside the end of the fill pipe that the nozzle latches onto, shown in Figure 8. This lip typically doubles as the thread that the fuel cap engages with. A deeper locking lip requires more force to be exerted to latch the nozzle into the fill pipe during refueling. When the nozzle is inserted partially, without enough force and thus not completely latched, this is referred to as “loose latching.” A loosely latched nozzle can result in a gap between the nozzle’s boot and the fill pipe, which contributes to the overpressure issue.

Testing performed by the SAE J285/1140 Task Force revealed that latching force substantially increases when the locking lip is deeper than 10 mm. This data is shown in Figure 9. In fact, about 40 pounds (176 Newtons) is needed to latch the nozzle at depths greater than 10 mm, while roughly half this force is needed to latch when the locking lip is shallower than 10 mm. There are two data points at about 10 mm locking...
lip depth that have a latching force of 150 and 250 Newtons. Staff believes the 150-Newton point can be disregarded since it comes from a fill pipe with an outer latch ring that likely interfered with the nozzle boot. The 250-Newton data point that has an outer diameter that exceeds specification. Since there are two other data points showing a smaller latching force at a locking lip depth of 10 mm, staff believed this would be an acceptable basis for this specification.

However, after more consultation with SAE J285/1140 Task Force, it was revealed that a common design specification, SAE J1114 (for the standard shape), can have a locking lip depth up to 11 mm once depth variations across an angled locking lip/thread are factored in. The locking lip depth of a fill pipe meeting the SAE J1114 standard shape specification would be at 10 mm when measured at the 6:00 (bottom most) portion, but depth reaches 11 mm when measured at 35 degrees clockwise from the 6:00 position, where the thread is deeper. The data points in Figure 9 below were measured at the 6:00 position, so a locking lip depth at showing 10mm in Figure 9 would actually reach deeper level at different portions of the thread and as such is representative of the SAE J1114 standard shape. Therefore, to make the proposal represent the real world aspect of the locking lip shape, staff along with assistance of the SAE J285/1140 Task Force, decided that 11 mm would be an acceptable and feasible limit, allowing manufacturers to use a standardized fill pipe design while still reaching the desired result of reducing necessary latching force. The analysis supporting this is in the SAE J1114 Locking Lip Analysis.5 The shallower locking lip specification ensures future fill pipe designs will be easier to latch and therefore constrains the influx of air from “loose latching” that contributes to overpressure.

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Staff is also proposing language indicating that the depth of the locking lip shall be measured down to its deepest edge (the edge facing the fuel tank) in order to clarify where the measurement should be made for compliance with this dimensional specification. Language is also proposed indicating that the allowable depth range of the locking lip shall be maintained throughout at least 100 degrees of the inside circumference of the filler pipe and extending to at least 35 degrees to either side of the reference plane. The ISO 13331 specification already indicates that the locking lip coverage shall be maintained throughout these angular dimensions. This proposed addition adds that the locking lip depth applies across the territory encompassed by those angular dimensions. This provides for variation in customer behavior by helping assure that the nozzle will still be fairly easy to latch even if someone latches the nozzle into the fill pipe at locations other than the bottom most part of the fill pipe.

The last dimensional element proposed is restricting the fill pipe’s allowed outer diameter allowed under the current J1114 alternative shape provision. CARB’s fill pipe specification adopts the J1114 alternative shape, which allows the outer diameter to reach up to 61.6 mm. This is larger than what is referenced in ISO 13331-1995(E), which is CARB’s current primary specification reference. As shown in Figure 10, a larger diameter fill pipe head contacts higher on the nozzle boot, which leads to more compression of the nozzle boot and will therefore require more latching force. Staff

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therefore proposes reducing the maximum allowable diameter to 57.9 mm, which matches the standard J1114 shape, and will help constrain the influx of air from “loose latching” that contributes to overpressure.

**Figure 10: Fill Pipe Outer Diameter, showing larger diameter resting higher in conical boot**

4. Clarification of existing fill pipe dimensions and provisions

The definition of “[v]apor recovery nozzle” is amended to update its reference to CARB’s nozzle certification regulation. This is necessary because the previous regulation reference is outdated.

Clarifying language is added to the term “[f]ill pipe sealing surface.” The ISO 13331 specification already has a definition for this term, but further definition is needed to relate the sealing surface feature to the proposed access zone updates here, since the contact point of the sealing surface with the access zone is used to gage compliance with the proposed change to the access zone requirement.

The spitback and spillage provision prohibiting unlatching during refueling is also reworded to state instead that “the nozzle shall remain in the normal resting position.” “Normal resting position” is a defined term in the ISO 13331 specification and requires the nozzle to be completely latched. This change thus brings the California specification more in line with the adopted ISO specification and does not lose the requirement of a complete latch during refueling.

The spitback and spillage provisions also are provided in “millimeters.” This is an apparent typo. The 1990 version of the Fill Pipe Specification indicates “milliliters” when referring to spitback and spillage liquid gasoline loss. Moreover, the proper measuring unit of a liquid is milliliters and not millimeters. Therefore “millimeters” is changed to “milliliters” for the spitback and spillage provisions.
A few additional typos are also corrected for clarity. In the section on Fill Rate, Spillage, and Spitback, “sued” is changed to “used.” In the Exemption of Vehicles section, “lest” is changed to “least” and “while” is changed to “whole.”

5. Adding a certification checklist recommended format.

Auto manufacturers have traditionally submitted a list of measured dimensions for their fill pipe openings during certification, showing that they comply with California’s specification. CARB’s certification group provides a suggested form for reporting this information. This proposal adds an entry on the form for the performance bench test. The suggested form is in Appendix D.

6. Specific purpose and rationale of each change:

Title 13, California Code of Regulations, section 2235:

An amendment date for “Specifications for Fill Pipes and Openings of 2015 and Subsequent Model Motor Vehicle Fuel Tanks” is added. This change is needed to reflect that this referenced document (Appendix B) is being amended as a part of this rulemaking.

Specifications for Fill Pipes and Openings of 2015 and Subsequent Model Motor Vehicle Fuel Tanks:

Section II. Definitions

Subsection 2: The reference to section 94001 “Certification procedures for Gasoline Vapor Recovery Systems at Service Stations” is replaced by a reference to section 94011 “Certification of Vapor Recovery Systems of Dispensing Facilities” in the definition of “vapor recovery nozzle.” This change is necessary to update and provide the correct reference in “vapor recovery nozzle,” as the previous regulation reference is outdated.

Subsection 5: Staff also has added a definition for the term “fill pipe head.” “Fill pipe head” is a term used in the proposed procedures, so defining it provides clarity to the specifications being proposed here in section III and VI.

Section III. General Design Specifications

Language is added defining a manufacturer’s vehicle fleet to clearly describe the scope of a manufacturer’s compliance with the proposed new dimensional specifications. It is necessary to limit the scope such that a manufacturer’s vehicle fleet consists of the vehicles produced and delivered for sale by the manufacturer in California, because this proposal is limited to apply to vehicles which will be for sale in California.
Subsection A: Clarifying language and dimensions for “fill pipe sealing surface” are added. Though the ISO 13331 specification already has a definition for “fill pipe sealing surface,” further definition is needed to relate the sealing surface feature to the proposed access zone updates of this section, since the contact point of the sealing surface with the access zone is used to gage compliance with the proposed change to the access zone requirement. Language is also added indicating the start date and applicability for the added provisions of subsection A, which is needed to let manufacturers know when and how to start complying.

Subsection B: The allowable range for locking lip depth has been changed from 4-13 mm to 4-11 mm. This change is needed to reduce nozzle latching force on future fill pipe designs. Language is added to the specifications indicating that the depth of the locking lip shall be measured down to its deepest edge (the edge facing the fuel tank) in order to clarify where the measurement should be made for compliance with this dimensional specification. Language is also added indicating that the allowable depth range of the locking lip shall be maintained throughout at least 100 degrees of the inside circumference of the filler pipe and extending to at least 35 degrees to either side of the reference plane. This proposed addition is needed to clarify that the locking lip depth applies across the territory encompassed by those angular dimensions. Language is added indicating the start date and applicability for the added requirements of subsection B, which is needed to let manufacturers know when and how to start complying.

Subsection C: The current set of specifications for the access zone has been expanded. The addition to the access zone would be set at a 40 degree angle to match the shape of the vapor recovery nozzle model with the most concave shape. Staff selected the radius of this addition to be 43 mm, representing what staff believes to be a realistic envelope of space that the nozzle boot would need, since it is slightly larger than the diameter of nozzle boots currently used in California. Finally, the added access zone that overlaps the fill pipe by a maximum of 12 mm incorporates the maximum distance that the assist nozzle can overlap a fill pipe. These changes to the access zone are needed to leave adequate space around the fill pipe for interfacing with California’s vapor recovery nozzle. Language is added indicating the start date and applicability for the added requirements of subsection C, which is needed to let manufacturers know when and how to start complying.

Subsection D: This change restricts the outer diameter of fill pipes designed to meet the current J1114 alternative shape provision. This change is needed to ensure future fill pipe designs will be easier to latch, constraining the influx of air from “loose latching” that contributes to overpressure. Language is added indicating the start date and applicability for the added requirements of subsection D, which is needed to let manufacturers know when and how to start complying.
Section V: Spillage and Spitback Specifications

Subsection A: “Millimeters” is changed to “milliliters” for the spitback and spillage provisions. This change is needed to fix an apparent typo. A reference to “Section 6” is changed to “Section 7” since section numbers were incremented as a result of adding a new section 6.

Subsection B: The spitback and spillage provision prohibiting unlatching during refueling was re-worded to state instead that “the nozzle shall remain in the normal resting position.” This change is needed to bring the California specification more in line with terminology of the adopted ISO 13331 specification, as “normal resting position” is a defined phrase in ISO 13331. A reference to “Section 6” was changed to “Section 7” since section numbers were incremented as a result of adding a new section 6.

Section VI: Bench Leak Rate Specification

This is a newly added section that describes the bench leak rate specification. The performance leak rate is being proposed to provide assurance that the vapor recovery nozzle will be able to seal and operate correctly with the vehicle’s fill pipe and not draw in excess air into the gasoline station UST, thus reducing emissions resulting from overpressure.

Subsection A: The maximum allowable leak rate of 2.5 SLPM for the Nozzle to Fill Pipe Interface Bench Leak Rate is described. Also the corresponding vacuum level is specified at 500 Pascal. This language is needed to describe the standard and conditions which manufacturers would be responsible for in meeting this specification. A phase-in for this specification is described as starting in 2022 and to completely apply to manufacturer’s new vehicle fleets by model year 2024. This phase-in is needed to give sufficient time for manufacturers to acquire necessary equipment and perform the performance bench test to verify this standard is met. An allowance is included for complying by attestation. This is needed to minimize the burden of compliance for manufacturers.

Section VII. Test Procedures: Fill Rate, Spillage, and Spitback

This Section number is changed from “Section VI” to “Section VII” since section numbers were incremented as a result of adding a new section 6. Clarifying language is added to indicate that this section applies to Fill Rate, Spillage, and Spitback specifications. This clarification is needed to differentiate between these specifications and the newly added Bench Leak Rate specification.

Subsection F: “Sued” is changed to “used.” This change is needed to fix a typo.

Subsection G: “Millimeters” was changed to “milliliters” for the spitback and spillage provisions. This change is needed to fix an apparent typo.
Section VIII. Test Procedure: Bench Leak Rate

This is a newly added section that describes the procedure for performing the bench leak test on a fill pipe. The bench test is needed to provide a standardized means for testing fill pipes to verify that the proposed performance leak rate standard is met. And each individual step in this test is needed to simulate the positioning during an actual refueling event, and provide standardized and repeatable method and equipment settings for performing this test.

Section IX. Specifications to Reduce Damage to Vapor Recovery Nozzles

“Section VII” was changed to “Section IX” since section numbers were incremented as a result of adding a new sections above.

Section X. Fill Pipe Assembly and Restriction Device Durability and Other Specifications

“Section VIII” was changed to “Section X” since section numbers were incremented as a result of adding a new sections above.

Section XI. Exemption of Vehicles

“Section IX” was changed to “Section XI” since section numbers were incremented as a result of adding a new sections above.

Subsection A: A reference to “Paragraph 8” was changed to “Paragraph 10” since section numbers were incremented as a result of adding a new sections above. “Lest” was changed to “least” for the exemption application provisions. This change is needed to fix an apparent typo.

Subsection B: “While” was changed to “whole” for the exemption provisions. This change is needed to fix an apparent typo.

Section XII. Phase-in Schedule

A phase-in for the Bench Leak Rate Specification is described as starting in 2022 and completely applying to manufacturer’s new vehicle fleets by model year 2024. This phase-in is needed to give sufficient time for manufacturers to acquire necessary equipment and perform the performance bench test used to verify this standard is met. Language is added defining a manufacturer’s vehicle fleet to clearly describe the scope of a manufacturer’s compliance with the proposed new specification. A provision for small volume manufacturers is added to allow more flexibility for this type of business to comply since they have more limited resources than larger manufacturers.
IV. BENEFITS ANTICIPATED FROM THE REGULATORY ACTION, INCLUDING THE BENEFITS OR GOALS PROVIDED IN THE AUTHORIZING STATUTE

The proposed amendments to the fill pipe specifications will lead to air quality benefits by decreasing the amount of ROG and benzene emissions released into the atmosphere, described more in section V below. This in turn reduces the amount of ozone formed and toxic exposure near gasoline stations. Reducing ROG emissions will benefit the health and welfare of California residents by reducing ambient ground level ozone and is an integral part of California's strategy to attain federal ozone standards. Reducing ambient ground level ozone also helps to reduce smog, which is a benefit for the state's environment. Reducing benzene emissions is critical for protecting the health of people who live and work near GDFs and people who own and fuel ORVR vehicles with fill pipes that do not form a good seal with the nozzle. In addition, reducing overpressure conditions will reduce the frequency of GDF In-Station Diagnostic system overpressure alarms, which will reduce the frequency and cost of service calls for many GDFs with vacuum-assist vapor recovery systems.

V. AIR QUALITY

The combined performance leak test and EOR nozzle implementation proposed by CARB MLD would eliminate 0.09 gallons of excess air for each gallon of fuel dispensed and drop the ORVR fleet averaged V/L from 0.62 to 0.53. Such a reduction would be enough to drop the V/L ratio below the V/L thresholds needed to ensure neutral pressure on days with winter average and winter highest observed vapor concentrations, 0.59 and 0.54, respectively, as shown in Figure 11 below. Consequently, these estimates indicate that the combined performance leak test and EOR nozzle implementation are anticipated to substantially reduce overpressure emissions that result from incompatibilities at the interface between the nozzle and fill pipe.

On any winter day, depending on saturated vapor concentration, the emission reductions projected for the combined staff fill pipe and nozzle proposals in 2030 may vary up to 2.22 tons per day, with an average value of 0.63 tons per day. The calculation of this emission reduction value and V/L limits are detailed in Appendix E.
VI. ENVIRONMENTAL ANALYSIS

This chapter provides an environmental analysis for the proposed regulatory amendments. A brief explanation of this determination is provided in section B below. Based on CARB’s review, CARB staff has determined that the proposed regulatory amendments are exempt from the requirements of the California Environmental Quality Act (CEQA). The following sections provide a brief explanation of this determination.

A. Environmental Review Process

CARB’s regulatory program, which involves the adoption, approval, amendment, or repeal of standards, rules, regulations, or plans for the protection and enhancement of the State’s ambient air quality, has been certified by the California Secretary for Natural Resources under Public Resources Code section 21080.5 (14 CCR 15251(d)). Public agencies with certified regulatory programs are exempt from certain CEQA requirements, including, but not limited to, preparing environmental impact reports, negative declarations, and initial studies. CARB, as a lead agency, prepares a substitute environmental document (referred to as an “Environmental Analysis” or “EA”) as part of the Staff Report prepared for a proposed action to comply with CEQA (17
CCR 60000-60008). If the amendments are finalized, a Notice of Exemption will be filed with the Office of the Secretary for the Natural Resources Agency and the State Clearinghouse for public inspection.

B. Analysis of Proposed Regulatory Action

CARB staff has determined that the proposed amendments are categorically exempt from CEQA under the “Class 8” exemption (14 CCR 15308) because it is an action taken by a regulatory agency for the protection of the environment.

The proposed amendments will ensure that vehicle fill pipes will be compatible with nozzles that are certified for use at California gas stations. The amendments to the Fill Pipe Specifications add a new performance standard and a performance bench leak test. The performance standard will guarantee a better seal between the fill pipe and the nozzle and reduce misidentification rates.

The proposed amendments, in conjunction with EVR amendments, will result in a beneficial impact to air quality by reducing ROG emissions, which also contain benzene. The reduction in ROG and benzene will reduce the amount of ozone formed and reduce toxic exposure near the gas stations. Ozone (created by the photochemical reaction of ROG and oxides of nitrogen) leads to harmful respiratory effects including lung damage, chest pain, coughing, and shortness of breath, especially affecting children and persons with compromised respiratory systems. Benzene is an air toxic contaminant and reducing benzene emissions is critical for protecting the health of the people who live and work near gasoline dispensing facilities. Thus, the proposed action constitutes an action taken by a regulatory agency, as authorized by state law, to ensure the maintenance, restoration, enhancement, or protection of the environment, as contemplated by the Class 8 exemption.

Compliance with the proposed regulatory amendments does not require the construction of any new fill pipe manufacturing facilities, the refurbishment of any GDFs, or replacement of existing fill pipe components before the end of their useful life. Consequently, compliance with the proposed regulatory amendments does not involve or result in any adverse physical changes to the existing environment, such as new development, modifications to existing buildings or facilities, or new land use designations. It is not reasonably foreseeable that there will be any adverse impacts on the environment because the proposed requirements would not require any action by regulated parties that could affect these resources.

The proposed actions are designed to protect the environment, and CARB staff found no substantial evidence indicating the proposal could adversely affect air quality or any other environmental resource area, or that any of the exceptions to the exemption applies (14 CCR 15300.2). Therefore, this activity is exempt from CEQA.
VII. ENVIRONMENTAL JUSTICE

State law defines environmental justice as the fair treatment of people of all races, cultures, and incomes with respect to the development, adoption, implementation, and enforcement of environmental laws, regulations, and policies. Government Code, section 65040.12, subdivision (c). CARB is committed to making environmental justice an integral part of its activities. The Board approved its Environmental Justice Policies and Actions (Policies) on December 13, 2001, to establish a framework for incorporating environmental justice into CARB's programs consistent with the directives of State law (CARB 2001). These policies apply to all communities in California, but recognize that environmental justice issues have been raised more in the context of low-income and minority communities.

The proposed amendments to the Fill Pipe Specifications would reduce gasoline vapor released into the atmosphere and thus reduce ROG and benzene emissions. Reducing ROG emissions is an integral part of California reaching its goal of attaining federal ozone standards. Benzene is an air toxic contaminant, and reducing benzene emissions would reduce benzene exposure to people who live and work near GDFs, who tend to belong to lower-income communities. Consequently, all communities, including environmental justice communities, will benefit from the air quality benefits associated with this proposal. Alternatives to the proposed recommendations, such as not implementing the proposal, would affect all communities throughout the State.

The proposed amendments are consistent with CARB’s environmental justice policy of reducing exposure to air pollutants and reducing adverse health impacts from toxic air contaminants in all communities.

VIII. ECONOMIC IMPACTS ASSESSMENT

ECONOMIC IMPACT STATEMENT

Performance leak test standard
Staff expects negligible cost to industry, since the proposed performance leak standard and bench leak test uses equipment which auto manufacturers and fill pipe suppliers typically have on hand, and the test is relatively simple and is not time-intensive to perform. The bench leak test is a straightforward and standard method for manufacturers to gage if fill pipes are designed with minimal leakage. Industry had previously asked CARB for guidance in the form of a test verifying fill pipe leak performance. Therefore, staff expects this proposed test will save industry time and hassle by providing a straightforward verification method.

Direct costs related to the proposed amendments can be broken down for bench testing into two categories: equipment and testing personnel. Additionally, staff estimates a cost for reporting during certification. CARB staff anticipates the lifetime of the proposed regulatory amendments to be three years, from 2022 through 2024, when all
The testing for fill pipe designs are expected to be completed. No additional costs are anticipated after 2024 as a result of the proposed amendments.

The proposed dimensional changes to the Fill Pipe Specifications are limited to cases where a manufacturer is already changing a fill pipe design. Staff assumes the cost of redesigning and testing the fill pipe would already be incurred by the manufacturer during a planned redesign, and there are no additional costs as a result of the proposed amendments.

- **Initial Cost of Equipment** - The equipment for the bench test is fairly standard and should be already found in an auto manufacturer’s testing laboratory; however, the cost attributed to initial set up would be about $5,000 after talking to industry representatives involved in the SAE Fuel Systems J285/J1140 Task Force.

- **Testing Cost** – The second cost would be for performing the leak test for each fill pipe, which would take approximately two hours for each fill pipe design on the conservative side. The Bureau of Labor and Statistics (BLS) estimates the mean hourly wage for a mechanical engineer nationwide to be $43.99 in 2017. The hourly benefit should also be included in the cost estimate. According to the latest BLS report, the hourly wages accounted for 69.5% of the total compensations in the private industry and the benefits account for the other 30.5% of the total compensations. Thus, the total hourly cost for a mechanical engineer is $63.29 (i.e., $43.99 + $19.30).

- **Annual Reporting Costs**: Staff estimates additional reporting requires four hours to prepare for a mechanical engineer. Thus, the reporting cost is estimated to be around $250 (i.e., $63.29 * 4 = $253.16) per business.

Taking that into account, the calculation for the total cost over the three-year lifetime would be:

- **Initial Costs:**
  26 auto manufacturers * $5,000 for initial equipment = $130,000

- **Testing Costs:**
  196 fill pipes* ($63.29/hr * 2 hrs) = $24,809
  Approximately $25,000

- **Total Reporting Cost:**
  $250 * 26 businesses* 3 years = $19,500

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7 Bureau of Labor and Statistics, Occupational Employment and Wages, May 2017
[https://www.bls.gov/oes/current/oes172141.htm#nat](https://www.bls.gov/oes/current/oes172141.htm#nat)

Total cost over 3 years of phase in:
($130,000 + $25,000 + $19,500) = $174,500 (Costs to auto manufacturers)
$174,500 * 1.46 = $255,000 (Potential costs to California vehicle purchasers)

Thus, the cost to comply with the proposed amendments over three years is $174,500 for 26 businesses, of which 25 are located outside of California. Since fill pipe designs do not change much over time, the testing data can be carried over to future model years. Additional testing would only be required when there are new fill pipe designs. This impact would be minimized if the businesses pass on costs to consumers. According to U.S. EPA, the average Retail Price Equivalent (RPE) multiplier for the auto industry is 1.46, meaning that the increase in the direct cost to the auto industry of $174,500 would increase the cost to California vehicle purchasers by approximately $255,000 (i.e., $174,500 * 1.46) if manufacturers are able to fully pass on the cost increase. The increase in new vehicle purchase price is anticipated to have a negligible impact considering about two million new vehicles sold in California annually. This would result in an increase in purchase price of four cents per vehicle ($255,000 / 3 / 2 million).

Cost to a Small Business
Cost to a small business includes $5,000 for initial equipment costs, and ongoing costs of $500 per year. The ongoing costs include bench testing for two fill pipes ($63.29/hr * 2 hrs = $253) and $250 for annual reporting cost.

Cost to a Typical Business
Cost to a typical business includes $5,000 for initial equipment costs, and ongoing costs of $1,250 per year. The ongoing costs include bench testing for eight fill pipes ($63.29/hr * 2 hrs = $1,013) and $250 for annual reporting cost.

If these costs are passed through to the consumer they result in no cost impact to the typical business. As described above, passed through costs are anticipated to have a negligible impact on vehicle purchase price. Thus, a typical California business that purchases a new vehicle will experience no impact.

Effect on Jobs/Businesses:
Given the estimated time required to perform the testing (page 26, Testing Costs) and reporting required (page 26, Annual Reporting Costs) amounts to approximately six hours annually, the workload is expected to be absorbed by industry with no impacts to the creation or elimination of jobs in California. Also, given the negligible impact costs to businesses highlighted above, staff does not expect an impact to the creation, elimination, or expansion of businesses in the State of California as a result of this rulemaking action. Furthermore, there is not a significant adverse economic impact to businesses in the State of California expected as a result of this rulemaking.

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9 U.S. Environmental Protection Agency, Automobile Industry Retail Price Equivalent and Indirect Cost Multiplier, February 2009. [https://nepis.epa.gov/Exe/ZyPDF.cgi/P100AGJ1.PDF?Dockey=P100AGJ1.PDF](https://nepis.epa.gov/Exe/ZyPDF.cgi/P100AGJ1.PDF?Dockey=P100AGJ1.PDF)
Dimensional changes proposal: would only apply when manufacturer redesigns fill pipe
As described above in section III, the proposal for dimensional changes to the current Fill Pipe Specifications are limited to cases where the manufacturer is already changing their fill pipe design in model year 2024 and beyond. The cost of redesigning and testing the fill pipe would already be incurred by the manufacturer during a planned redesign. This dimensional proposal also does not restrict manufacturers from carrying over a current fill pipe design to future model years, so long as they meet the current dimension specifications and satisfy the performance test. For these reasons, staff does not anticipate any cost impact to manufacturers resulting from this part of the proposal.

Dimensional changes alternative: would have applied to manufacturer's existing fill pipe designs
In developing this proposal, staff had considered an alternative that would lead to manufacturers needing to change their existing designs to meet the proposed dimensional changes. This is “Alternative 1” below.

Under this alternative scenario, there would be cost associated with modifying the fill pipe head design, mating the new fill pipe head to the existing vehicle, modifying vehicle assembly line tooling to handle new fill pipe shape, and performing crash, pre-mature shutoff, spitback, ORVR, and evaporative emission testing. To estimate the cost of this alternative, staff consulted with automakers and fill pipe suppliers. This resulted in a worst-case (highest) cost figure of $3 million for a manufacturer, BMW, which has the largest variety of different vehicle models (27) and different fill pipe designs (15) affected by the regulation. When spread across the three-year period before the phase-in, the anticipated cost per year would be $1 million for BMW. This worst-case (highest cost) figure was adjusted downward for the annual cost for other manufacturers, depending on the number of vehicle models and fill pipe designs which would be affected for each case. This adjustment used the following equation (in terms of millions of dollars annual cost during each of the three years before the phase-in):

\[
Indiv. Mfr. Cost = 0.5 \times (\text{# of vehicle models score}) + 0.5 \times (\text{# of fill pipe models score})
\]

Where:

\[
\text{# of vehicle models score} = \left( \frac{\text{Qty of Indiv Mfr's vehicle models}}{\text{Qty of Worst Case Mfr's vehicle models}} \right)
\]

\[
\text{# of fill pipe models score} = \left( \frac{\text{Qty of Mfr's fill pipe models}}{\text{Qty of Worst Case Mfr's fill pipe models}} \right)
\]

The cost to implement the added dimensional requirements for this alternative was estimated to be $5.8 million per year, or about $17.5 million over the three-year time span staff projected for manufacturers to begin meeting this alternative.
The objective of the proposed regulatory action is to minimize air leakage in vented fill pipes. CARB staff estimates that compliance with the proposed amendments will result in a reduction of ROG emissions, which also contain benzene, by about 0.63 tons per day during winter months using average vapor concentration. Reducing ROG emissions will benefit the health and welfare of California residents by reducing ambient ground level ozone and benzene exposure. Although the regulation will not directly affect worker safety, workers at GDFs with assist vapor recovery systems may experience reduced occupational exposure to benzene after the improved fill pipes enter the fleet. Reducing ambient ground level ozone also helps to reduce smog, which is a benefit for the state’s environment.

IX. EVALUATION OF REGULATORY ALTERNATIVES

Government Code section 11346.2, subdivision (b)(4) requires CARB to consider and evaluate reasonable alternatives to the proposed regulatory action and provide reasons for rejecting those alternatives. This section discusses alternatives evaluated and provides reasons why these alternatives were not included in the proposal. As explained below, no alternative proposed was found to be less burdensome and equally effective in achieving the purposes of the regulation in a manner than ensures full compliance with the authorizing law. Staff has not identified any reasonable alternatives that would lessen any adverse impact on small business.

**Alternative 1: Applying Proposed Dimensional Changes to Existing Fill Pipe Designs**

In developing this proposal, staff had considered an alternative requiring manufacturers to change their existing fill pipe designs to meet the proposed dimensional changes. This alternative was presented during workshops before the staff proposal.

Staff initially expected these dimensional changes to impact pipe design without a corresponding substantial cost increase. However, discussions with auto manufacturers and parts suppliers revealed the cost of this change would be substantial (as estimated in section VIII, above), as it would require manufacturers to change their fill pipes outside of their natural design change cycles. Staff understands that the fill pipe heads designs do not change often, with some designs having been around for decades. Changing a fill pipe has a domino effect and triggers a variety of verification testing must be done to make sure functionality is not impaired by the change.

As discussed in section V above, the proposed fill pipe and nozzle changes are projected to bring the average V/L just below the threshold of emission reductions. Therefore, further improvements at this time to the fill pipe and nozzle interface are not expected to yield additional reductions in emissions. The current proposal, for manufacturers to follow the improved dimensional specifications in cases where they
are already changing their fill pipe design, will ensure that future fill pipe designs, as they emerge, interface well with California’s vapor recovery nozzle. Staff thus does not believe that Alternative 1 will yield additional emissions gains and is therefore not worth the additional cost of a forced design change. Staff believes the current proposal contains the most effective and feasible combination to achieve the desired result of reducing overpressure emissions at California’s gas stations and that Alternative 1 should be rejected.

**Alternative 2: Just the Performance/Bench test and No Dimensional Changes**

Per Government Code section 11346.2(b)(4), staff considered the alternative of not adding to the existing prescriptive dimensional standards. But updated dimensional standards are necessary because they will ensure future fill pipe designs, as they emerge, will be shaped to optimally interface with California nozzles, which will prevent future increases in overpressure at California gasoline stations. Since the proposed dimensional specifications only would apply in cases where a manufacturer is already changing their fill pipe design, staff believes the proposed changes to the dimensional standards are not unnecessarily burdensome, as they help ensure uniform compatibility. For instance, the performance test alone likely may mask the variation in the public’s latching of the nozzle, so having dimensional standards protects against the variation and maximizes emissions and overpressure benefits at minimal cost. Staff therefore recommends rejecting this alternative.

**Alternative 3: No Action**

As part of the assessment, CARB staff considered no action as an alternative to this rulemaking. This would maintain the status quo, meaning that future capless designs may potentially have drain holes and gaps that lead to a high number of these vehicles being misidentified by the assist nozzles. This would continue the current path and exasperate overpressure at GDFs during the winter. Although only about three percent of vehicles currently have capless designs, staff believes the number of capless designs will increase. Multiple manufacturers have communicated in their certification preview plans that all of their vehicles will have capless fill pipes in the near future. As the percentage of the fleet with capless fill pipes increases, it is imperative that dimensional changes are made and a performance specification added to ensure that Phase II gasoline stations and ORVR vehicles are compatible to adequately capture vapor generated during refueling. Staff therefore recommends rejecting this alternative, since it would not see any of the needed changes and only worsen the problem.

**Small Business Alternative**

The Board has not identified any reasonable alternatives that would lessen any adverse impact on small business. Small businesses impacted by this proposal are aftermarket vehicle modifiers who change out fill pipes.
Performance Standards in Place of Prescriptive Standards

The proposed amendments include both a performance standard and additions to existing prescriptive dimensional standards. The performance standard preserves manufacturers’ flexibility in designing their fill pipes, so long as the leak rate meets the standard. The additions to existing prescriptive standard are needed to help ensure compatibility between vehicle fill pipes and the vapor recovery nozzle by minimizing the effect of variation in how the general public latches the nozzle, which may be masked by the performance test being performed by a trained operator.

Health and Safety Code section 57005 Major Regulation Alternatives

The proposed regulation will not result in a total economic impact on state businesses of more than $10 million in one or more years of implementation. Therefore, this proposal is not a major regulation as defined by Health and Safety Code section 57005.

X. JUSTIFICATION FOR ADOPTION OF REGULATIONS DIFFERENT FROM FEDERAL REGULATIONS CONTAINED IN THE CODE OF FEDERAL REGULATIONS

As described above in the introduction, California’s GDFs employ vapor recovery nozzles with a boot that needs to form a seal with the vehicle’s fill pipe in order to function effectively. Many other states had vapor recovery done by the gasoline stations in the past, but have since removed it because of increasing numbers of ORVR vehicles in the fleet. Therefore, the federal regulation does not have a requirement for vehicle fill pipe openings. But such requirements exist and are necessary in California to help ensure vehicle fill pipes will be able to interface with the vapor recovery nozzles unique to California’s gasoline stations.

XI. PUBLIC PROCESS FOR DEVELOPMENT OF THE PROPOSED ACTION (PRE-REGULATORY INFORMATION)

Consistent with Government Code sections 11346, subdivision (b), and 11346.45, subdivision (a), and with the Board’s long-standing practice, CARB staff held public workshops and had other meetings with interested persons, including automakers, during the development of the proposed regulation. These informal pre-rulemaking discussions provided staff with useful information considered during development of the regulation.

Table 2: List of Meetings between CARB and stakeholders, starting December 2017:
<table>
<thead>
<tr>
<th>Meeting Date</th>
<th>Met With</th>
<th>Subjects Discussed</th>
</tr>
</thead>
<tbody>
<tr>
<td>12/13/2017-12/14/2017</td>
<td>Public Workshop with MLD, ECARS and Stakeholders</td>
<td>Discussed proposed changes for both vehicle fill pipe and gasoline station nozzle specifications</td>
</tr>
<tr>
<td>3/7/2018</td>
<td>Webinar presentation to ITB Automotive Energy Storage Systems conference</td>
<td>Background on overpressure and latest proposal of changes</td>
</tr>
<tr>
<td>4/10/2018</td>
<td>SAE Fuel Systems Standards Committee</td>
<td>Logistics of regulation proposal</td>
</tr>
<tr>
<td>5/23/2018</td>
<td>Public Workshop with MLD, ECARS and Stakeholders</td>
<td>Discussed proposed changes for both vehicle fill pipe and gasoline station nozzle specifications and provided draft regulation language</td>
</tr>
</tbody>
</table>

Note: Multiple meetings with individual auto manufacturers and fill pipe suppliers occurred but are not recorded on this list.

XII. REFERENCES


4. Repeat reference CARB 2017 (noted above in 2).


References from Appendix B:


3. CARB. 2017 Healy Model 900. (same as referenced above in 2.)


CEC. 2018. California Retail Fuel Outlet Annual Reporting (CEC-A15) Results for 2016. California Energy Commission (CEC) website accessed on April 24, 2018:
http://www.energy.ca.gov/almanac/transportation_data/gasoline/piira_retail_survey.html


16. CARB. 2018a. Initial Statement of Reasons (same as referenced above in 11.)

XIII. APPENDICES

Appendix A: Proposed Regulation Order

Appendix B: “Specifications for Fill Pipes and Openings of 2015 and Subsequent Model Motor Vehicle Fuel Tanks”

Appendix C: Technical Support Document; Performance leak rate standard justification

Appendix D: Fill Pipe certification document recommended format

Appendix E: Emission Estimate supporting calculations