CLEARING THE AIR

Air Quality and Mobile Sources

Clearing the Air Workshop #5: September 28, 2021
Air Quality Review

Defined as a measure of how clean or polluted the air we breathe is

Why planning is important:
• Protect public health;
• Identify sources of pollution;
• Develop pollution control strategies.
What are the Criteria Pollutants?

EPA established health-based standards for these **SIX** harmful air pollutants, called the criteria air pollutants:

- Carbon Monoxide (CO)
- Sulfur Dioxide (SO₂)
- Ground-level Ozone (O₃)
- Lead (Pb)
- Nitrogen Dioxide (NO₂)
- Particulate Matter (PM₁₀ & PM₂.₅)

*https://www.csusb.edu/ehs/occupational-health-and-safety/indoor-air-quality*
# National Ambient Air Quality Standards (NAAQS)

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>NAAQS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ozone</td>
<td>70 ppb</td>
</tr>
<tr>
<td>Fine PM (PM$_{2.5}$)</td>
<td>35 µg/m$^3$ &amp; 12 µg/m$^3$</td>
</tr>
<tr>
<td>Coarse (PM$_{10}$)</td>
<td>150 µg/m$^3$</td>
</tr>
<tr>
<td>Carbon Monoxide</td>
<td>35 ppm &amp; 9 ppm</td>
</tr>
<tr>
<td>Nitrogen Dioxide</td>
<td>100 ppb &amp; 53 ppb</td>
</tr>
<tr>
<td>Sulfur Dioxide</td>
<td>75 ppb</td>
</tr>
<tr>
<td>Lead</td>
<td>0.15 µg/m$^3$</td>
</tr>
</tbody>
</table>

Source: [https://www.epa.gov/criteria-air-pollutants/naaqs-table](https://www.epa.gov/criteria-air-pollutants/naaqs-table)
Vehicle Inspections control emissions

- The vehicle inspection and maintenance (I/M) program is a control method

Formation of Ground-level Ozone

- Oxides of Nitrogen (NOx)
- Volatile Organic Compounds (VOCs)

- AND -

Strong Spring or Summer Sun (with low RH & light winds) => Ozone (O₃)

- On-Road sources (e.g. cars and trucks) make up 48% of our NOX emissions, and 28% of our VOC emissions
Emission testing timeline in D.C.

- **1983**: Idle test started as the first emission test
- **1997**: New plan (SIP) adopted, conformed to the updated enhanced I/M program requirements
- **1999**: new plan fully implemented, dynamometer testing started
- **2004**: The District starts performing modern OBD testing
Maryland, Virginia, and other states

- As a part of our non-attainment area, Maryland and Virginia also operate similar I/M programs.
- 34 of 50 states and the district have some type of emission inspection program.
What are we testing on your vehicle

- All vehicles are built with a complex emissions control system.
The Three Way Catalytic Converter: A case study

Expanding mat
Insulates, seals and provides an unbreakable enclosure for the monolith

Lambda probe
Measures the residual oxygen content in the exhaust gas

Catalytic layer of noble metal
Washcoat
Ceramic substrate

CO₂
H₂O
N₂
Emission Controls Work!

Average National Light-Duty Fleet Emissions by Model Year

Vehicle Model Year

- Total HC
- Exhaust NOx

Emissions in gram/mile

Inspection Stations

Takoma Rec Center Self Service Kiosk

DPW Inspection Station

1001 Half St SW Inspection Station
## The three types of emissions tests

<table>
<thead>
<tr>
<th>OBD</th>
<th>IM240</th>
<th>Idle</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Entirely computer based</td>
<td>• Uses a dynamometer</td>
<td>• Small probe inserted into the tailpipe</td>
</tr>
<tr>
<td>• Relies on the car’s ECU, a computer that controls everything</td>
<td>• 240 = 240 seconds of runtime on a specific speed cycle</td>
<td>• Gas sample is collected and run through an analyzer</td>
</tr>
<tr>
<td>• If check engine light is on, the test will fail</td>
<td>• Vehicle operated by DMV inspectors</td>
<td>• Car is not under load during test</td>
</tr>
<tr>
<td><img src="image1.png" alt="Check Engine Light" /></td>
<td>• All exhaust gas is sucked into analyzers to determine pollutant levels</td>
<td>• Only tests VOC, CO, and CO2</td>
</tr>
<tr>
<td></td>
<td>• NOX, VOC, CO and CO2 are all tested</td>
<td></td>
</tr>
</tbody>
</table>
Breaking down vehicle tests

<table>
<thead>
<tr>
<th>Model Year</th>
<th>Weight (GVWR)</th>
<th>Test Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996 - 2021</td>
<td>≤ 8500 lbs.</td>
<td>OBD</td>
</tr>
<tr>
<td>1984 - 1995</td>
<td>≤ 8500 lbs.</td>
<td>IM240</td>
</tr>
<tr>
<td>1968 - 1983</td>
<td>≤ 8500 lbs.</td>
<td>Idle</td>
</tr>
<tr>
<td>1968 - 2021</td>
<td>&gt; 8500 lbs.</td>
<td>Idle</td>
</tr>
</tbody>
</table>

2019 tests:

<table>
<thead>
<tr>
<th>Test Type</th>
<th># performed</th>
<th>Percent of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>OBD</td>
<td>152,424</td>
<td>94.8%</td>
</tr>
<tr>
<td>IM240</td>
<td>2,474</td>
<td>1.5%</td>
</tr>
<tr>
<td>Idle</td>
<td>5,884</td>
<td>3.7%</td>
</tr>
</tbody>
</table>
Demonstrating that it works

**MOtor Vehicle Emissions Simulator: MOVES**

- Published by the EPA
- MOVES is an advanced simulation software that models emissions from all motor vehicles
  - Cars, trucks, semis, garbage trucks, busses, etc.
  - Highways, local roads, parking lots, construction sites
  - National level, state/county level, intersection/building level
- MOVES uses huge datasets of emissions parameters developed by EPA as well as local-specific inputs:
  - Vehicle speed
  - Road type
  - Vehicle age
  - Vehicle miles traveled (VMT)
  - Fuel type
  - Weather
  - Month, Day, and time
# Does having an I/M program work?

MOVES3 model results for 2021 ozone season (May 1 - Sep 30)

<table>
<thead>
<tr>
<th>MOVES Run Scenario</th>
<th>CO</th>
<th>NOX</th>
<th>VOC</th>
</tr>
</thead>
<tbody>
<tr>
<td>No I/M</td>
<td>8635.14</td>
<td>735.27</td>
<td>609.81</td>
</tr>
<tr>
<td>Current Program</td>
<td>7335.84</td>
<td>659.68</td>
<td>525.01</td>
</tr>
<tr>
<td>Reduction</td>
<td>1299.3</td>
<td>75.59</td>
<td>84.8</td>
</tr>
<tr>
<td>Percent reduction</td>
<td>15%</td>
<td>10.3%</td>
<td>13.9%</td>
</tr>
</tbody>
</table>

All values are in Tons
What’s next: Remote Emissions Sensing

- Remote Sensing uses Absorption Spectroscopy (lasers) to measure emissions from vehicles as they drive on our roads
- Vehicles cannot ‘prepare’ for a test, since we sample them during normal operation
- DC does not yet operate such a program however we are in the process of developing one
- Can be used to operate a Clean Screen program, identify high emitters, catch tampered vehicles in the act, and provide tons of current real world data
What’s next: Tampering

- Recent data from EPA shows alarming trends in tampered vehicles
  - diesel vehicles that have been tampered with emit from 18-300 times the allowed limit of NOX
  - 10-18% of trucks are tampered with, depending on locality
- EPA initiated a nationwide enforcement effort to halt dealers and aftermarket shops from tampering with vehicles
- While diesel vehicles make up a small portion of vehicles in the District, we are working to develop a program that would identify tampered vehicles
Questions?

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