PORTABLE GENERATORS
AND CARBON MONOXIDE POISONING

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U. S. Consumer Product Safety Commission

- Independent, federal agency
- Established in 1973
- 5 Commissioners
- Over 500 staff
- Headquarters in Bethesda, MD
- Laboratory in Rockville, MD

*CPSC’s Mission:*
Protecting the public against unreasonable risks of injury from consumer products through education, safety standards activities, regulation, and enforcement.
What Do We Regulate?

Consumer Products

“. . . any article, or component part thereof, produced or distributed (i) for sale to a consumer for use in or around a permanent or temporary household or residence, a school, in recreation, or otherwise, or (ii) for the personal use, consumption or enjoyment of a consumer in or around a permanent or temporary household or residence, a school, in recreation, or otherwise…”¹

What Do We Not Regulate?

- Tobacco products (FDA)
- Drugs, cosmetics, food (FDA, USDA)
- Motor vehicles for road use (NHTSA), aircraft (FAA), boats and watercraft (USCG)
- Pesticides (EPA), medical devices (FDA), workplace products (OSHA and others)
Generator CO Poisoning Hazard

5 kW generator

Typical engine powering a 5 kW generator emits a weighted average CO rate of nominally 1500 g/hr

=  

~ 450 cars

Idling mid-size late 1990s model cars emit 2.4 – 5.4 g/hr of CO

Sources:
1. http://www3.epa.gov/otaq/certdata.htm#smallsi
Generator-Related CO Death Counts and CO Injury Estimates, 2004-2012

• 659 CO deaths (average 73 deaths/year)

• More than 25,000 estimated medically-treated CO Injuries (about 3,000 injuries per year)

• 25% of fatal incidents involved multiple fatalities, so these incidents account for 44% of all the deaths.
Hazard Patterns

Sites Where Generators Were Used that Caused Fatalities

- Fixed-structure home: 75%
- Non-fixed home or temporary shelter: 16%
- External structure at home: 6%
- Unknown or other locations: 3%

Specific location of generator in incidents that occurred in fixed-structure homes

- Living space (non-basement): 45%
- Attached garage or enclosed carport: 25%
- Basement or crawlspace: 25%
- Unknown location but at home: 2%
- Outside home: 3%
Staff Investigations of Reducing Portable Generators’ CO Emission Rates

- CPSC prototype generator demonstration program
- EPA demonstration on engines to lower HC+NOx
- Staff testing of EFI generators
Prototype Development and Durability: University of Alabama
End-of-Life Emission Testing: Intertek Carnot Emission Services
Scenario Testing: National Institute for Standards and Technology

Prototype configuration:
• Modified 8.2 kW Class II engine with 500-hour rated useful life, certified to EPA Phase 2 standard
• Adapted EMS with closed loop EFI
• Calibrated for stoichiometric AFR at all loads
• Integrated 3-way catalyst, primarily to target NOx reduction, into shrouded muffler
Hazard Characterization of Common Incident Scenario: Generator operation in SFH attached garage (NIST)

Garage and Family Room CO Concentration Profiles from Unmodified Carbureted 5 kW Unit and Prototype 5 kW Unit

Carbureted unit turned off and forced venting initiated
Generators’ CO Emission Rates in Enclosed Space

CO Emission Rates of Unmodified Carbureted Generator

![Graph showing CO emission rates vs. O₂ level](image_url)
Generators’ CO Emission Rates in Enclosed Space

CO Emission Rates of Prototype Generator

![Graph showing CO emission rates vs. O2 level](image-url)
Conclusions from CPSC’s Demonstration Program

• Prototype used same commercially available EMS being currently used in marketplace on small SI engines and on small scooters and motorcycles.

• Prototype met Phase 3 EPA exhaust emission standard for HC+NOx and reduced the CO emission rate by 93% - 97%.

• Weighted CO emission rate of carbureted unit increased 3-fold when oxygen in intake air is 17%. Prototype generator did not appear to increase CO rate in reduced oxygen.
## CPSC Generator Categories

<table>
<thead>
<tr>
<th>Generator Category</th>
<th>Engine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Handheld</td>
<td>≤ 80 cc</td>
</tr>
<tr>
<td>Class 1</td>
<td>&gt;80 cc to &lt;225 cc</td>
</tr>
<tr>
<td>Class 2 single cylinder</td>
<td>≥225 cc, up to 25 kW maximum engine power and 1 cylinder</td>
</tr>
<tr>
<td>Class 2 twin cylinder</td>
<td>≥225 cc, up to 25 kW maximum engine power and 2 cylinders</td>
</tr>
</tbody>
</table>
### Proposed Performance Standard by Generator Category

<table>
<thead>
<tr>
<th>Generator Category</th>
<th>Draft Proposed CO Emission Rate Limit, g/hr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Handheld</td>
<td>75</td>
</tr>
<tr>
<td>Class 1</td>
<td>75</td>
</tr>
<tr>
<td>Class 2 single cylinder</td>
<td>150</td>
</tr>
<tr>
<td>Class 2 twin cylinder</td>
<td>300</td>
</tr>
</tbody>
</table>

Rates are weighted CO emission rates calculated based on six specified loads applied to generator operating in atmosphere with normal oxygen content.
Current Status of NPR

• Staff delivered NPR package to Commission on 10/5/2016: 
  (cut and paste this link into your browser window)

• Staff briefed Commission on the NPR package on 10/19/2016: 
  https://www.cpsc.gov/newsroom/video/portable-generators-notice-of-proposed-rulemaking

• Commission held decisional meeting on 11/2/2016 and voted (4-1) to approve the NPR: 
  https://www.cpsc.gov/content/commission-meeting-minutes-decisional-matter-proposed-rule-portable-generators and https://www.cpsc.gov/Newsroom/Video/commission-meeting-decisional-matter-portable-generators

• Notice will soon be published in Federal Register, officially starting 75-day comment period on NPR.

• Contact me if you want to be notified of latest status on NPR: 
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