



U.S. CONSUMER PRODUCT SAFETY COMMISSION
WASHINGTON, D.C. 20207

May 8, 2003

Ms. Heather Sakellariou
Secretary for STP 2201
Underwriters Laboratories, Inc.
333 Pfingsten Road
Northbrook, IL 60062

Re: Request for Comments on the Proposed First Edition of the Standard for Portable Engine-Generator Assemblies, UL 2201, and Ballot for ANSI Recognition

Dear Ms. Sakellariou:

This letter presents recommendations from the U. S. Consumer Product Safety Commission (CPSC) staff regarding the subject standard.

The CPSC staff believes that improvements to the proposed standard are needed before it is recognized as an American National Standards Institute (ANSI) standard. Specifically, the standard does not adequately address the carbon monoxide (CO) poisoning hazard posed by portable generators. From 1990 through 2002, there were 179 CO poisoning fatalities associated with portable generators reported to the CPSC (as of March 13, 2003).^{1,2} Ninety-seven of the reported fatalities, which involved 70 separate incidents, were investigated further by the CPSC.

The main reasons reported in investigations for using a portable generator were to provide electricity due to a temporary situation or to provide power to a temporary location. Sixty-seven of the 97 investigated deaths occurred at the home and most commonly took place when the generator was located in the garage, crawl space, or basement of the home. Although many of the investigation reports did not contain information about provisions the consumer took for venting the generator, 11 reported that consumers employed some type of venting, such as an open, or partially-open, window, door, or garage door. Of the 16 investigations that provided the CO concentration at the location of the death, 14 measured maximum CO levels in excess of 150 ppm. Eight of these had maximum CO levels greater than 600 ppm. Furthermore, some of these values were measured only after the location had been vented and/or the generator had been shut down for some time prior to the measurement. Carboxyhemoglobin (COHb) levels were provided for 55 of the 97 investigated fatalities. The majority of victims (51 out of 55) had COHb levels greater than 50%. In healthy adults, a COHb level of 40 to 50% approximately correlates with symptoms of 'confusion, unconsciousness, coma, possible death', a level of 50 to

¹ Vagts, Susan, *Carbon Monoxide Incidents and In-Depth Investigations Associated with Engine-Driven Tools, 1990-2002*, CPSC Memorandum to Janet L. Buyer, Project Manager, U.S. Consumer Product Safety Commission, Washington, D.C., April 1, 2003.

² This count is the unweighted, actual number in the CPSC files associated with generators; it is not a statistical sample and national totals may not be derived from it.

70% approximately correlates with symptoms of ‘coma, brain damage, seizures, death’, and a level greater than 70% is ‘typically fatal’.³

CPSC staff has reviewed published emissions data on small utility engines, such as those used on portable generators, and other available literature on the subject.^{4,5} The CO output of such engines can generate hazardous concentrations within minutes in spaces equivalent in volume to typical garages and houses, even when the spaces have extremely high ventilation rates. For instance, using modeling techniques, the calculated CO concentration generated by an actual 5-HP engine in a 10,000 ft³ room with an air exchange rate of 1 would exceed 1200 ppm in less than 8 minutes. Even with an air exchange rate of 5, this concentration would be exceeded in less than 11 minutes. With an air exchange rate of 20 in this space, the CO concentration would reach 500 ppm in 10 minutes. These findings indicate that portable generators should not be operated inside buildings or any other semi-enclosed space where CO can accumulate, even if some ventilation is provided.

The proposed standard currently has two sections that address the CO poisoning hazard: sections 41.2.1(e)(1) and 42.1.3, which are the sections pertaining to Markings and Operating Instructions, respectively. Both contain a requirement for the word “Warning” and “Fumes and Gases Can Cause Injury or Death – Use Only In Well-Ventilated Area” or equivalent. CPSC staff believes this warning is inadequate because, as described above, published data shows that maintaining safe CO concentrations in an enclosed or partially-enclosed space requires excessive ventilation rates. Based upon the incident data, adequate ventilation rates are not achievable by means consumers have used, such as opening doors, windows, and garage doors. Since the term “well-ventilated” is open to interpretation, it is foreseeable that consumers will continue to ventilate spaces using these inadequate methods, and they will continue to be exposed to this hazard. CPSC staff believes it is unsafe for portable generators to be used in these spaces, and the markings should state this clearly and prominently, both on the product and in the operating instructions.

Section 42.1.2 of the proposed standard states that the instructions for each product shall contain the following or equivalent wording: “Do Not Use Product in Rain or Wet Locations.” This electrocution hazard warning would pose a conflict with an outdoor-use-only label when consumers want to use their generators during a power outage resulting from an ongoing storm. In incidents investigated by the CPSC, generators were commonly used because of a power outage, which oftentimes was due to a storm. CPSC staff believes that the feasibility of incorporating a performance requirement into UL 2201 that would permit safe outdoor use of generators in rain or other poor weather conditions should be considered, thereby negating the need for this electrocution hazard warning.

In reviewing the in-depth investigation data, CPSC staff observed that several incidents are consistent with what one would expect if the consumer were not aware of the CO hazard, while some incidents appear to demonstrate consumer misunderstanding of CO.⁶ Based on this,

³ Burton, L.E., *Toxicity from Low Level Human Exposure to Carbon Monoxide*, U.S. Consumer Product Safety Commission, Washington, D.C., 1996.

⁴ U.S. Environmental Protection Agency (EPA), *Nonroad Engine and Vehicle Emission Study – Report (EPA pub. 21A-2001)*, Washington, D.C., 1991.

⁵ Earnest, G.S., et.al., *Carbon Monoxide Poisonings From Small, Gasoline-Powered, Internal Combustion Engines: Just What is a “Well-ventilated Area”?*, American Industrial Hygiene Association Journal 58:787-791, 1997.

⁶ Smith, T.P., Human Factors Assessment for the Small Engine-Driven Tools Project, CPSC Memorandum to Janet L. Buyer, Project Manager, U.S. Consumer Product Safety Commission, Washington, D.C., June 18, 2002.

as well as observations of a number of current portable generator on-product warnings and owners' manuals, CPSC staff recommends the following be included in markings and instructions for portable generators:

- Adequate warning about the hazard. Consumers should be warned that CO is a poisonous gas present in the engine exhaust, and that it is odorless, colorless, and tasteless.
- Description of symptoms of CO overexposure. CO can, at the rapid generation rates explained earlier, overcome a consumer so quickly that he/she may not have time to respond before losing consciousness. However, when exposed to a less rapid concentration rise, symptoms such as headaches, dizziness, nausea, vomiting, and weakness can occur. These can easily be mistaken for other illnesses, such as cold, flu, and food poisoning. It is important that consumers be made aware of these symptoms so that they can recognize overexposure when it occurs.
- Specific instructions on how to avoid CO poisoning. Consumers must be alerted to appropriate steps that will reduce the CO hazard. Opening windows, doors, and garage doors, as well as operating fans, do not provide sufficient ventilation.

In addition, CPSC staff recommends that on-product warning labels be consistent with *American National Standard: Product Safety Signs and Labels* (ANSI Z535.4-2002) and that warnings within the owners' manuals also be embedded within the operating instructions.

Thank you for the opportunity to provide these comments to the STP. CPSC staff would be pleased to work with UL and other STP members for UL 2201 to address this hazard. If you have any questions, or if I can be of assistance, please call me at 301-504-7542.

The positions and comments contained in this letter are those of the CPSC staff. They have not been reviewed or approved by the Commissioners.

Sincerely,

Janet L. Buyer

Cc: Colin Church, CPSC Voluntary Standards Coordinator