U.S. CONSUMER PRODUCT SAFETY COMMISSION
4330 East West Highway
Bethesda, MD 20814

July 16, 2007

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

Re: Request for Comments and Ballot on Proposal for UL 2201 Edition 1, *Portable Engine Generator Assemblies*, dated May 11, 2007

Dear Ms. Sakellariou:

The U.S. Consumer Product Safety Commission (CPSC) staff appreciates the opportunity to review Underwriters Laboratories (UL) proposed standard UL 2201 *Portable Engine Generator Assemblies*.[1]

Staff's comments begin with noting that the rationale provided for establishing limits on carbon monoxide (CO) concentrations in portable generator emissions does not match the 30 ppm requirement stated in Section 10.1. Staff interprets the proposed exhaust emission requirement in Section 10.1, for exhaust CO emissions to be at or below 30 ppm, as a tailpipe (undiluted exhaust gas) CO concentration limit. However, the rationale provided for this limit indicates that UL intends for this to be an exposure (exhaust gas mixed with dilution air) concentration limit. This is an important distinction which needs clarification in the proposed standard. Persons indefinitely exposed to air which contains a CO concentration of 30 ppm are predicted to have a blood carboxyhemoglobin (COHb) level of approximately 5%, a level in which there are no perceptible health effects in healthy, non-smoking adults. An undiluted exhaust gas CO concentration of 30 ppm, when mixed with dilution air, will result in a much lower CO exposure concentration. Regardless of whether the 30 ppm CO is measured in the tailpipe or mixed in the air surrounding the generator, staff believes that this limit is not realistically achievable and that the exception to this requirement will be the method by which manufacturers seeking certification will comply. The exception provides manufacturers with an "option to employ sensors with shutdown features that turn a portable generator off within 15 minutes upon reaching a limit of 400 ppm." Staff has a number of concerns with this and the associated requirements in Section 39.

[1] These comments are those of CPSC staff, have not been reviewed or approved by, and may not necessarily reflect the views of, the Commission.

Similar to the 30 ppm CO concentration limit, it is unclear if the proposed 400 ppm CO limit is applicable to the undiluted exhaust gas in the tailpipe or the diluted exhaust after it exits the tailpipe and mixes with surrounding air. Again, this is an important distinction that needs clarification in the proposed standard. If it is UL's intent that the 400 ppm CO measurement be taken after the exhaust leaves the tailpipe, the sampling location must be specified, such as at some particular location on the generator or some distance away from the generator. It appears to staff that this requirement is based on the sensitivity test specified in Section 38 of UL 2034, *Standard for Single and Multiple Station Carbon Monoxide Alarms*, which requires that a residential CO alarm must activate within 4 to 15 minutes when the CO alarm is exposed to a steady-state CO concentration of 400 ± 10 ppm. At the upper time limit of 15 minutes, the COHb level in the blood of an active healthy adult will reach 10%, based on UL's method for calculating COHb. At a COHb of up to 10%, there are no perceptible health effects in healthy, non-smoking adults. The CO generation rate from engines used on generators, however, is high.[2,3] Therefore, allowing the engine to continue running after 400 ppm of CO has been detected will result in a much higher concentration of CO around the generator 15 minutes later[4], potentially raising exposed persons' COHb levels above 10%. If UL's intent with this exception is to have the generator shut off before an unsafe CO environment around the generator is created, staff believes this requirement is not adequate.

Furthermore, staff believes that for shutoff circuits utilizing a gas sensor, the proposed standard must include requirements for sensitivity, reliability, and durability tests which will verify that the shutoff system will perform accurately when installed on the generator and exposed to all the engine's exhaust products, not just CO, over the expected life of the generator. CPSC staff does not believe that the selectivity requirements in UL 2034 or UL 2075 adequately address the environment representative of portable generator exhaust.

It appears that the sensing shutoff feature will be tested independently of the portable generator. Staff believes it is more appropriate to test the generator and shutdown feature as a system, with the shutdown system installed on the generator. Conducting tests with the system installed on the generator will also verify system performance when exposed to engine heat and vibration. There should also be required tests of the generator with the shutoff system installed when the generator is exposed to anticipated outdoor environmental conditions when the generator is stored and operated in proper locations over its expected life. The standard should include tests that will verify that the generator will perform satisfactorily when operated under a multitude of foreseeable ambient conditions, including wind that blows the exhaust over the

---

[2] Brown, C. J. ,*Engine-Driven Tools Phase 1 Test Report for Portable Electric Generators*, Gaithersburg, MD; U.S. Consumer Product Safety Commission, November 2006.

[3] The current CO emission standard is 610 g/kW-hr, per Environmental Protection Agency, 40 CFR Part 90, Phase 2 Emission Standards for New Nonroad Spark-Ignition Nonhandheld Engines At or Below 19 Kilowatts; Final Rule, March 30, 1999

[4] Based on a CPSC staff-derived CO generation rate of 2.1 million cc/hr from the referenced document in footnote 2, and indoor air quality modeling that assumes a 5.5 kW generator is operated in a basement, staff estimates the CO concentration around the generator will be nominally in the range of 2000 to 3000 ppm 15 minutes after 400 ppm has been detected in the basement.

sensor; hot, high humidity conditions associated with tropical storms; and freezing conditions associated with ice storms.

Finally, staff believes that a shutoff feature designed to activate before an unsafe CO environment is created should have a visual indicator that indicates when the control circuitry has activated. If the product does not have a visual indicator, staff believes the user may misinterpret the shutting down of the generator as being due to the engine stalling and attempt to restart the generator without finding a more suitable location to operate it. The shutoff feature should also require a manual reset of the circuitry before the generator can be restarted after the control circuitry has activated. Staff believes these additional requirements will help the user realize he has placed the generator in a location where the engine exhaust accumulates and increase the likelihood he will find a proper, safe place to operate it. There should also be requirements to ensure that the generator cannot be started if the circuitry has been disabled or bypassed. It should be clearly noted that these CPSC staff suggestions are not intended to encourage consumers to approach a generator location where an unsafe CO environment has been detected.

Sections 31.1 and 31.2 address carburetor icing test requirements which consist of a hot, humid soak of the non-running generator for 48 hours followed by a below-freezing soak of the non-running generator for another 48 hours, followed by an attempt to start the generator. The requirement states that if the generator starts, then it meets the carburetor icing requirement. Staff believes that the requirement should test for the ability of the engine to not only start but also continuously operate in icing conditions, which are the same environmental conditions that cause icing on power lines and subsequently cause power outages, precipitating the need for many consumers to use generators. Staff is uncertain if these test requirements are adequate for this purpose.

Section 43 is an overload test. Staff is uncertain how a maximum sustainable current would provide an overload condition.

Section 19 discusses test requirements for nonmetallic fuel tanks and nonmetallic fuel delivery components. Included in Sections 19.9, 19.11, and 19.12.1 are requirements that appear to test for losses of hydrocarbons in nonmetallic fuel tanks, fuel hoses, and gaskets which staff understands are to address evaporative emissions from these components. With this in mind, staff points out that the Environmental Protection Agency (EPA) has recently proposed emission standards for new nonroad spark ignition engines that include requirements to address evaporative emissions.[5] The scope of the EPA's proposed regulation encompasses those engine classes used on portable generators that fall within the scope of UL 2201. Pending EPA's adoption of the evaporative emission proposed rule, staff believes these requirements should not be included in UL 2201 and the corresponding sections should be deleted. Regarding Sections 19.2 – 19.8 and 19.10, which appear to address the fuel system performance from the safety aspect of preventing fuel leaks, staff notes that the Outdoor Power Equipment Institute (OPEI) recently sponsored the development of a draft ANSI fuel system performance standard, *ANSI B71.10 Small Off-road Ground Supported Outdoor Power Equipment Gasoline Fuel System*

[5] Environmental Protection Agency, 40 CFR Parts 60, 63, et al. Control of Emissions from Nonroad Spark-Ignition Engines and Equipment; Proposed Rule, May 18, 2007.

Performance Specifications and Test Procedures. The scope of this draft standard specifically applies to non-handheld outdoor powered equipment, which includes portable generators. CPSC staff reviewed the proposed standard and provided comments to OPEI as part of the canvass review process for ANSI approval of the draft standard. In general, staff comments noted several absent performance requirements that should be considered to ensure that the standard is representative of consumer-use conditions. Staff's specific comments, which are contained in a letter to OPEI, are attached for your reference since staff's recommendations for tests to be included in ANSI B71.10 are applicable to UL 2201.

Thank you for the opportunity to provide these comments to UL and to participate as a member of the UL 2201 standards technical panel. Please contact me if you have questions about these comments.

Sincerely,

Janet L. Buyer
Project Manager

Attachment

U.S. CONSUMER PRODUCT SAFETY COMMISSION
4330 EAST WEST HIGHWAY
BETHESDA, MD 20814

Susan Bathalon
Mechanical Engineer
Directorate of Engineering Sciences
Division of Mechanical Engineering

Tel: 301 504 7566
Fax: 301 504 0533
Email: SBathalon@CPSC

November 8, 2006

Mr. James McNew
OPEI Standard Development Process
341 South Patrick Street
Alexandria, Virginia 22314

Dear Mr. McNew:

The U.S. Consumer Product Safety Commission (CPSC) staff appreciates the opportunity to provide comments* to the Outdoor Power Equipment Institute (OPEI) on the draft standard, ANSI B71.10 *Small Off-road Ground Supported Outdoor Power Equipment Gasoline Fuel Systems Performance Specifications and Test Procedures*. CPSC staff understands that these comments are part of the canvass review process for approval of the draft standard.

A review of CPSC recall data identified as many as 42 recalls involving gasoline-powered outdoor equipment due to fuel leaks since January 2000. Recalled equipment included backpack blowers, hedge trimmers, walk-behind lawn mowers, chain saws, generators, and garden tractors. The number of units of gasoline-powered outdoor equipment recalled from January 2000 to present is approximately two million.

CPSC staff understands that the fuel tanks for handheld and non-handheld outdoor power equipment are manufactured through similar molding processes, and using the same or similar materials. The fuel lines and fuel tanks for both types of equipment have demonstrated identical performance-related failures. For this reason, CPSC staff believes that the scope of the B71.10 draft standard should include both handheld and non-handheld outdoor power equipment. CPSC staff thus recommends that 'ground supported' be deleted from the scope in *Section 1*. Alternatively, CPSC staff would like assurance that an appropriate standard is in place or being developed that addresses similar fuel tank requirements for handheld power equipment. In addition, the scope should reflect all fuel tank sizes. CPSC staff recommends deleting the fuel tank size requirement of one-liter volume capacity in *Section 4.2*.

* These comments are those of CPSC staff and have not been reviewed or approved by, and may not necessarily represent the views of, the Commission.

The test procedure of the current draft standard applies only to "spark ignition engines greater than 80 cc and less than 1 liter displacement." These criteria would exclude some applications such as tilling equipment with small 4-stroke engines that have displacements of 25 cc. CPSC staff recommends that engine size restrictions be eliminated from the scope, as fuel tank and fuel line testing should be required for all gasoline-powered outdoor equipment.

Sections *4.2 Tank Integrity, 4.3 Resistance to Stress Cracking, 5.2 Fuel Tank Cyclic Pressure Integrity Test,* and *5.3 Fuel Tank Elevated Temperature Fuel Soak Test* reference fuel tank testing based on design changes. Qualification appears to be on a one-time basis. CPSC staff interprets this to mean that although many fuel tanks are manufactured, testing to the standard is only necessary whenever there are significant design alterations. According to recall information, some of the fuel tank failures were related to changes in materials and manufacturing processes. CPSC staff believes that it is important to ensure that products meet or exceed the minimum requirements of a voluntary safety standard on an ongoing basis. As such, this test frequency should not be performed on a one time basis, but rather be determined by the individual manufacturers to ensure their product complies with the standard. In *Sections 4.2 and 4.3,* CPSC staff recommends deleting the language, "shall be qualified one-time…" and in *Sections 5.2 and 5.3* deleting "This test is a one-time test for a given design and material combination."

CPSC recall information shows that plastic fuel tanks can develop stress cracks after one or several years of use by consumers. CPSC staff believes these stress cracks can be caused by several factors including cyclic temperature flux, impact with hard surfaces, UV (ultraviolet light) exposure, vibration, elevated pressure, and elevated temperature. The draft standard only requires an elevated pressure and elevated temperature test. CPSC staff recommends adding the following tests to replicate actual fuel tank environment conditions:

- **Temperature Cycling:** A cyclic temperature test should specify soak times at high and low temperature points. An example of such a test requirement is contained in SAE J288, *Snowmobile Fuel Tanks,* which specifies testing at 60 degrees and -40 degrees Celsius.
- **Impact Test**: Impact tests would ensure the integrity of the fuel tank in situations such as frontal or side impact for non-handheld products or dropping the product with handheld products. CPSC staff recommends that a drop test be added that is similar to the test in SAE J288, *Snowmobile Fuel Tanks,* and ASTM F 852, *Standard Specification for Portable Gasoline Containers for Consumer Use*. Both of these published standards require a minimum drop height of 1.25 meters (approximately 4 feet) onto a hard surface.
- **UV Exposure**: UV can decrease the toughness of plastic fuel tanks and therefore influence failures in the tanks. ASTM G 154, *Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials,* provides guidelines for appropriate UV test and exposure conditions based on material properties. CPSC staff recommends adding a UV exposure test based on the material guidelines included in ASTM G 154.
- **Vibration**: CPSC staff recommends adding a vibration test to simulate the fuel tank conditions created by engine vibration. The number of cycles should closely resemble use by consumers over the life of the product.

To account for fuel tank failures that develop over time, CPSC staff believes that the standard should require tank specimens to sequentially step through the tests described above, including UV exposure, cyclic temperature, cyclic pressure, and vibration testing. This sequence of tests can duplicate the conditions that a fuel tank would likely experience through consumer use. After this sequence of tests, the same tested specimens should be subjected to the impact resistance test and the elevated temperature test. After each of the last two tests, the performance pass/fail criteria should be determined by *5.1 Fuel Tank Leak Test*. This series of tests would more closely represent the typical environmental conditions experienced by a fuel tank in consumer applications.

The current pass/fail criteria specified in *Section 5.4 Fuel Line Assembly Tensile Test* seems to be based on visual observance of slippage. CPSC staff believes that an additional fuel leak performance test should be added that is similar[1] to the fuel leak test procedures in *Section 5.1.1*. This fuel leak test should occur after application of the 30 lbf tensile load (*Section 5.4.2 Initial Assembly Test*) and after application of the 10 lbf tensile load (*Section 5.4.3 Service Test*).

CPSC staff believes that the development of a voluntary standard to address fuel leaks on outdoor powered equipment is a positive step toward the prevention of fire hazards and thermal burn injuries. Thank you for this opportunity to comment and participate as a canvass member for this important safety standard.

Please do not hesitate to contact me with questions about these comments.

Sincerely,

Susan Bathalon

cc: ANSI B71.10 Technical Committee

[1] The leak test procedure could be modified to check for leaks at the fuel line to fuel tank connection.