Public Comments to CPSC on NIST Technical Note 1781: Modeling and Measuring the Effects of Portable Gasoline Powered Generator Exhaust on Indoor Carbon Monoxide Level, dated February 2013
(as of June 12, 2013)

Portable Generator Manufacturers' Association

Secretary/Treasurer:
THOMAS ASSOCIATES, INC.

June 7, 2013

Ms. Janet L. Buyer
Project Manager
Directorate for Engineering Sciences
U.S. Consumer Product Safety Commission
4330 East West Highway
Bethesda, MD 20814

SUBJECT: Comments to CPSC on NIST Technical Note 1781

Dear Ms. Buyer:

The Portable Generator Manufacturers' Association (PGMA) is pleased to offer its comments on the recently released NIST Technical Note 1781.

PGMA is a trade association that seeks to develop and influence safety and performance standards for our industry's products. As the history of both PGMA and the individual members of PGMA demonstrate, our commitment to safety is a sincere commitment, one backed by repeated actions and not simply empty words. Since our members include the major industry manufacturers of portable generators sold in North America and a significant majority of the industry, we are the recognized voice of the portable generator industry, particularly with respect to the paramount issue of the safety of our respective customers.

Our member companies include:

- American Honda Motor Company
- Briggs & Stratton Power Products Group
- Champion Power Equipment
- Generac Power Systems
- Pramac America
- Subaru Industrial Power
- Techtronic Industries, North America
- Wacker Neuson Production Americas
- Yamaha Motor Corporation USA

PGMA shares with CPSC the goal of promoting and continuously improving the safe and proper use of portable generators. PGMA would note at the outset that, while the NIST Technical Note 1781 is a valuable contribution to the many efforts already expended by PGMA, CPSC, and others aimed at achieving this shared goal, the NIST Technical Note does not draw any specific conclusions or make any particular recommendations as to actions that should be taken to achieve the ultimate safety goal. It rather confirms by testing a point with which it would be hard for anyone to argue, that being that a device that emits a lower amount of Carbon Monoxide will result in a lower volume of Carbon Monoxide being present in the area in which the emitting device is located. In that sense, it is a bit difficult for PGMA to specifically respond to the NIST Technical Note. Nevertheless, PGMA offers the comments below in a spirit of cooperation and we look forward to working with you, NIST and others to make the use of our products even safer.

It seems that a key premise of the NIST Technical Note is that reduced CO emission rates from common portable generators can provide additional critical time for consumers to recognize and escape, and thus reduce the number of CO deaths from portable generators. There is no documentation or study confirming the validity of that premise. Given the importance of the premise to the Technical Note, PGMA encourages CPSC and/or NIST to provide the documentation or study on which the premise is based or to conduct a study to validate it. While the proposition may seem intuitive, it could also be possible that someone experiencing minor symptoms from reduced CO emissions will be even less likely to attribute them to CO than someone exposed to emissions from an unmodified generator. Moreover, decreasing the rate of symptom onset would not benefit someone who is sleeping and could reduce awareness that a serious problem is at hand.

There are no warning signs commonly and uniquely associated with carbon monoxide poisoning regardless of how quickly the carbon monoxide poisoning occurs or begins to occur. This is because the headache and nausea which are associated with carbon monoxide poisoning are such common, everyday occurrences for virtually everyone that it is questionable whether those symptoms would be recognized as being caused by carbon monoxide exposure. Empirical data would be extremely valuable, and probably necessary, to support the proposition that a consumer experiencing early reactions to carbon monoxide poisoning would realize the source of the symptoms as carbon monoxide and react in the manner desired, that is to quickly remove himself or herself from the area to a place where there was fresh, untainted air.

An additional concern raised by the low CO technology is the potential for users to believe that portable generators are safe for indoor use and whether the implementation of a low CO technology could result in users being more likely to use the product improperly. The potential for such additional misuse should be evaluated by CPSC.

We continue to support the statement in the CPSC's Press Release for the report on its study of low CO portable generators that recognizes that a carbon monoxide (CO) hazard would continue to exist even if the technology applied to the prototype generator that was the subject of the report and now the NIST Technical Note, were applied to commercially available generators, and that educating owners about the proper use of their generators needs to remain the first line of defense:

> "The CPSC continues to urge consumers to never run their portable generators in their attached garages, in or even near their houses, including avoiding placement near windows or vents. Generators should only be used outside, far away from homes. CPSC cautions that even if portable gasoline powered generators were to incorporate this technology, they would still need to be used outside, far from the home. The technology does not make them safe for indoor use." (CPSC Press Release #12-278, September 14, 2012).

PGMA continues to encourage CPSC and/or NIST to conduct a study that includes a human factors analysis to determine the effectiveness of the existing CPSC mandated CO warning adopted in 2007. In any event, PGMA encourages CPSC to revise the mandated warning to incorporate the standards and format in ANSI Z535.3-2011 and Z535.4-2011.

THE NIST Technical Note further demonstrates that CO levels are affected by numerous variables creating a high degree of uncertainty as to how they interact, and an inability to draw reliable conclusions from the demonstration testing performed. The NIST Technical Note is further support for CPSC's previous statement regarding the use of CO alarms:

> [CPSC] also recognizes that "[a]nother important line of defense against CO poisoning is having CO alarms on each level of the home and outside sleeping areas. Based on available alarm data, 93 percent of CO-related deaths involving generators take place in homes with no CO alarms. Much like smoke alarms designed to alert consumers about smoke or fires, CO alarms are designed to alert consumers to dangerous CO levels and give them time to get out of the house before becoming incapacitated." (CPSC Press Release #12-278, September 14, 2012).

States and local communities throughout the United States have recognized the role CO monitors play in protecting consumers from the multiple sources of CO present in everyday life – furnaces, space heaters, and charcoal grills to name a few. As a result, the number of states adopting mandatory CO monitor laws and codes has increased significantly over the last 5 years. PGMA encourages the adoption of such a requirement in every state as a cost effective means of significantly reducing the CO hazard from multiple sources. CPSC and NIST could use their influence to further promote the adoption of statutes, regulations and building codes requiring the use of CO monitors in living spaces as a means of implementing the objective of protecting users. PGMA also encourages CPSC or NIST to analyze the data collected on CO poisoning and deaths to develop a public awareness campaign that is targeted based on use conditions and user groups, similar to what has been done with hazards such as fires and severe weather. PGMA would support such an effort by CPSC and/or NIST.

With respect to the Technical Note, if the electronic fuel injectors and closed loop air/fuel ratio control used in conjunction with catalytic converters employed on the prototype generator were installed on currently available generators, it would result in significant changes to the product that is on the market today. The Technical Note appears to simply repeat the statement from the CPSC Low CO Portable Generator Study concluding that the control technology is commercially available without an evaluation of the changes to the product that would be necessary in order to replace the product currently in the market place and perform comparably to it. As we and others have pointed out

previously, the road from prototype to commercial viability is typically as long and fraught with as many issues as the initial stages of development.

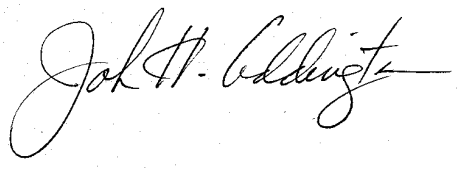
One of the most significant concerns related to the incorporation of the employed technology is the effect of the increase in high combustion temperatures which are detrimental to air-cooled engine durability and performance. In addition, the durability impact varies significantly on engines of different sizes, designs, applications, and rated speeds thus making it difficult, if not impossible for the results from a single product to be generally applicable to the entire category of portable generators. The breadth of product in the portable generator category and the scalability of the employed technology in terms of cost, performance and efficiency will vary significantly between 50 cc and 500 cc sized engines.

Any conclusions regarding the durability of the prototype product used in the study are necessarily limited in scope as the testing was not conducted in accordance with EPA test procedures and was conducted on EPA Phase 2 certified product. EPA Phase 3 has been in effect since 2011, with more stringent emission standards and a useful life category which is now double for the study prototype. To better understand and assess the impact of the employed technology in the NIST study additional information on how and where the thermocouples for measuring temperature were installed should be provided for both the modified and unmodified test units. PGMA is requesting that this information be made available for review.

Even if the technical challenges could be overcome, one would not be surprised to find that there is a significant delta between the cost to manufacture the product on the market today and products that incorporate the technology used with the prototype model. The portable generators on the market today perform a valuable function for consumers, especially during power outages. The limited availability of new product or a significant cost delta will result in this option no longer being a viable alternative for many consumers.

As the leading trade association of manufacturers of portable generators, PGMA is engaged in many activities promoting the safe use of its products. For example, PGMA has worked with the National Association of Regulatory Utility Commissioners to standardize the CO message being delivered via the utility industry's various forms of communication so that it can be clearly and efficiently provided to consumers. Reducing the number of portable generator related CO incidents that occur after a utility company shuts off the power, due to nonpayment for example, shows promise and this effort could be enhanced by the CPSC's participation. We invite CPSC to work with PGMA collaboratively as other opportunities arise.

Very Truly Yours,



JOHN H. ADDINGTON
Executive Director
PGMA

JHA/jlb
pgma

From:	CPSC-OS,
To:	Buyer, Janet
Subject:	FW: Comments to CPSC on NIST Technical Note 1781
Date:	Wednesday, May 29, 2013 11:42:50 AM
Attachments:	image001.png image002.png
Importance:	High

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From: Jim Nice [mailto:jim.nice@kiporpowersystems.com]
Sent: Tuesday, May 28, 2013 11:27 AM
To: CPSC-OS,
Subject: Comments to CPSC on NIST Technical Note 1781
Importance: High

Comments to CPSC on NIST Technical Note 1781

- Always use generators outdoors, away from doors, windows and vents.
- **NEVER** use generators in homes, garages, basements, crawl spaces, or other enclosed or partially enclosed areas, **even with ventilation**.
- Follow manufacturer's instructions to operate generators in a well-ventilated area.
- Install battery-operated or plug-in (with battery backup) carbon monoxide (CO) alarms in your home, following manufacturer's instructions.
- Test CO alarms often and replace batteries when needed.

Even with the “modified” generators, which was never thoroughly explained what or how the generators were modified; the CO levels were still excessive. It would have been interesting to see a comparison of the generators being operated in a proper manner outdoors and see what the CO levels were within the house.

In considering any “rule-making” changes, one of the major considerations should be the cost to the manufacturer and eventually to the end user. Perhaps the most economical and beneficial changes would be to have a reasonable sized decal (label) place on the unit with contracting colors, warning of the danger of operating the generator in enclosed spaces.

Respectfully,

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6/7/13

Comments to CPSC on NIST Technical Note 1781

From Albert Donnay, MHS, adonnay@jhu.edu
Submitted to cpsc-os@cpsc.gov

Thank you for making this report available for public comment.

It is my professional opinion as a certified CO analyst [BPI], environmental health engineer and consulting toxicologist that this NIST study and the Technical Note that describes its results should not be relied upon by CPSC for any rulemaking related to portable generator safety.

The primary problem with the NIST study is that it only tested CPSC's modified and unmodified portable generators in a single 1500 sq ft pre-manufactured house whose design, layout and construction are not representative of most US single family housing [SFH].

Although over 75% of SFH in USA have attached garages [AG] according to the National Association of Home Builders, they are very different from that built by NIST for CPSC.

Most SFH with AG were designed and built simultaneously by the same builder using the same materials with plans from the same architect. As a result, the wall they share is an interior one with no windows, little or no insulation, and sometimes even unfinished on the garage side with studs showing. The connecting door is commonly also of interior quality, rarely solid, and not as tightly sealed as doors leading outside.

If one story, the house and garage commonly share the same roof line, and if without basement, they commonly share the same floor, although the house floor is usually raised at least a few inches if not feet to prevent spills from entering the rest of the house.

In sharp contrast, the AG in the NIST test house was added in 2007, 5 years after the original home was built for a different study that involved greatly 'tightening' the house against air leaks to the outside (Nabinger and Persily 2008, NISTIR 7478).

It was added onto an external endwall that already had a tight window, tight exterior door, and exterior siding. Instead of matching the end wall and roof line, however, it was built with a higher floor, narrower width, and taller roofline.

This NIST note [#1781], like Emmerich's interim report to CPSC of July 6, 2011, gives only the square footage and volume for the garage and house, from which the average heights of each can be calculated by simple division as 2.5 and 2.4 meters respectively, but the graphics in figure 2 of NIST note 1637 [Wang and Emmerich 2009] clearly show the shared wall is much higher than this, with the garage roof extending more than 0.1m above the roof of the house. Why was it not built to match? NIST refused multiple requests to answer this question, and also refused to release any photo of the shared wall from within the garage. The report does show pictures of the inside of the shed, so why not the inside of the garage?

Any CO rising in the garage would naturally rise higher than the house and result in less CO diffusing into other rooms or the attic than if they shared a wall that was the same height and width from floor to ceiling. The higher garage floor also would reduce the opportunity for rising CO to enter the house since the critical floor/wall seam on the house side was below the level of the garage floor.

The NIST test house is thus not a sufficiently representative design for such an important evaluation upon which the lives of all Americans with portable generators may depend.

The second problem is that CPSC's portable generators were tested without any reference to whether the engines were hot or cold when started.

The authors told me that they did not control for engine startup temperature, and so it is impossible now in retrospect to know which of their experimental runs were done with appropriately cold engines [representative of the most likely worst case exposure scenario for the home user] and which were done with done with already warm or hot engines [whose CO emissions would be lower].

I also note with great concern that the authors never measured how long it took for the CO-contaminated test house to return to the baseline CO level with only natural ventilation, as would be the case in most SFH during generator use when no other source of electricity is likely available, but instead turned on mechanical ventilation to speed up the process. Without this information, it is impossible to estimate how long the occupants of a SFH whose portable generator had just automatically shut off might be exposed to just how much CO while they waited [without mechanical ventilation] for the CO in their garage and other rooms to return to a safe level.

Finally, and most critically, the CO levels reported in Appendix C on Additional Garage Tests clearly document that even when the shutoff algorithm worked, the maximum CO level in the garage was in the range of hundreds of ppm. This is far above all levels considered safe by all federal agencies, including the:

1) 9 and 35ppm avg limits of EPA [for 8 and 1 hour exposures, respectively, equivalent to 72 and 35ppm-hours];
2) 35 ppm avg limit recommended by NIOSH for healthy workers and the level at which most fire departments in USA require firefighters to put on their self contained breathing apparatus and order the evacuation of any building
3) 50 ppm avg limit allowed by OSHA
4) 70 ppm limit allowed by CPSC

Rather than continue to pursue this complicated, expensive and ultimately ineffective approach to shutting off portable generators, I urge CPSC to require only a CO-sensing shut off device. Staff have already tested such an approach [2006] and CPSC should release their report so that their findings can be evaluated by the public and portable generator manufacturers before any new rule or is proposed.

Given that over 25 million high quality long lasting CO-sensing switches are sold to the auto industry ever year for approximately $5 each and have been for over a decade, it is outrageous that CPSC has still not even studied the potential of these devices.

They function reliably for 10-15 years, even in cars that are left outdoors all the time, and could easily prevent not just the CO deaths caused by portable generators but also the no doubt much higher number of CO poisonings that clearly cannot be prevented if relying only on electronic emission controls and non-CO sensors.

Thousands of Americans have died needlessly since CPSC started this project 7 years ago. Please do not allow this to continue.

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Written Comments of the Manufacturers of Emission Controls Association (MECA) on the National Institute of Standards and Technology's (NIST) Report, "Technical Note 1781: Modeling and Measuring the Effects of Portable Gasoline Powered Generator Exhaust on Indoor Carbon Monoxide Level"

June 7, 2013

The Manufacturers of Emission Controls Association (MECA) is pleased to provide our comments to the U.S. Consumer Product Safety Commission (CPSC) on the National Institute of Standards and Technology's (NIST) report, "Technical Note 1781: Modeling and Measuring the Effects of Portable Gasoline Powered Generator Exhaust on Indoor Carbon Monoxide Level." MECA is a non-profit association of the world's leading manufacturers of emission control technology for motor vehicles and stationary internal combustion engines. Our members have nearly 40 years of experience and a proven track record in developing and manufacturing emission control technology for a wide variety of on-road and nonroad vehicles and engines. A number of our members have extensive experience in the development, manufacture, and commercial application of carbon monoxide (CO) emission control technologies for stationary engines, as well as expertise in applying catalyst technologies to small, spark-ignited engines less than 25 hp.

MECA has been engaged in CPSC's efforts to improve the safety of portable generators in marine and domestic applications by reducing the level of CO emitted by these small, spark-ignited four-stroke engines. MECA has previously provided comments to CPSC about the available technology for portable generator applications in response to CPSC's request for information on techniques to reduce CO from gasoline portable generators (MECA letter dated April 28, 2006), MECA's written comments on CPSC's ANPRM on portable generators (comments dated February 11, 2007), and MECA's written comments on CPSC's September 2012 test report, "Technology Demonstration of a Prototype Low CO Emission Portable Generator" (comments dated November 7, 2012). Our comments below mirror the comments we submitted to CPSC back in November.

The new report by NIST describes a series of tests performed for CPSC on generators in commercially available and modified low CO emission prototype configurations to determine their CO emission and oxygen consumption rates while operating in a single-zone enclosed space. For two different unmodified commercially available generators (i.e., with carbureted engines lacking CO-emission controls), CO emissions ranged from a low of around 500 grams per hour (g/hr) at near ambient oxygen levels to a high of nearly 4000 g/h as oxygen approached 17%. Tests of two modified, low CO emission prototype generators (i.e., commercially available units adapted with closed-loop electronic fuel injection and a small catalyst integrated into the muffler) showed CO emissions reductions of over 90% with most CO emission rates well below 500 g/hr, and no trend toward higher emission rates was seen as the oxygen level dropped.

Like CPSC's September 2012 test program, the results of the NIST study support the experience of catalyst manufacturers and the recommendations provided by MECA on the effectiveness of the use of catalysts to reduce CO emissions and improve the safety of portable generators. Catalyst technology is a cost-effective technique for substantially reducing CO

exhaust emissions from spark-ignited, gasoline portable generators. Catalyst technology for small gasoline engines like those used in portable generators draws from nearly 40 years of successful experience in the U.S. with catalytic converters applied to light-duty gasoline cars and trucks. Similar catalyst technology has been successfully applied to a wide variety of smaller, two-stroke and four-stroke gasoline engine applications, including handheld equipment (e.g., chainsaws, leaf blowers, string trimmers), non-handheld equipment (e.g., lawn mowers), motor scooters, motorcycles, marine engines, and forklift trucks. In many cases, these catalyst systems have been engineered to provide high reductions of CO emissions as well as reductions in hydrocarbon (HC) and NOx emissions. The U.S. EPA in its small engine test program that was completed in advance of their Phase 3 small engine regulations (published in October 2008) clearly demonstrated that catalysts can be safely incorporated on Class 1 and Class 2 gasoline engines without any significant increase in muffler surface temperatures. MECA and MECA members were active participants in EPA's small gasoline engine test program.

The published experience of catalyst performance on four-stroke gasoline engines indicates that high efficiencies for reducing CO emissions are strongly influenced by the air/fuel stoichiometry in the exhaust upstream of the catalyst. Maximum reduction efficiencies for all three regulated pollutants (HCs, CO, NOx) can be obtained if the air/fuel ratio of the exhaust stream is controlled to be near the stoichiometric ratio of reducing and oxidizing components in the exhaust stream. At or near this stoichiometric air/fuel ratio, catalyst efficiencies can be well in excess of 90% for all three pollutants provided that the catalyst temperature is above its activation temperature (typically 350^{o}C or higher), and that a reasonable catalyst volume relative to the volumetric flow of exhaust gas is contained in the system. Catalyst formulations can be optimized for these small engine applications to deliver maximum CO reductions and/or NOx reductions depending on the final emissions target. Precious metal costs for these small engine catalysts are typically less than half the total cost of the finished catalyst. The addition of a catalyst to a small engine would have only a very small impact on the cost of a gasoline generator.

The most widely used method for accurate, and cost effective, air/fuel ratio control is through the use of fuel injector technology in combination with a closed-loop control strategy that employs a simple engine control unit (ECU) and an oxygen sensor present in the exhaust, upstream of the catalyst. The sensor provides a feedback loop to the engine's intake air and fuel metering system. The combination of closed-loop, electronic fuel injection with a catalyst reduces engine-out emissions and ensures consistent engine operation. This more stable, reduced engine-out emissions operation reduces the thermal stress on the catalyst and improves the catalyst durability. Such an approach has been applied to a whole range of spark-ignited engines from passenger cars to handheld lawn and garden equipment, and this is the same approach that was effectively demonstrated on the two modified, low CO emission prototype generators in the NIST study, as well as on the small gasoline-powered portable generator in CPSC's previous demonstration program.

MECA is aware of two manufacturers of four-stroke, gasoline generators that are already using properly designed exhaust systems with catalysts to reduce CO emissions by more than 90% compared to uncontrolled levels: Westerbeke Corporation and Kohler Power Systems. Both of these companies have targeted marine applications for these ultra-low CO emission

generators. The same strategy is applicable to portable generators for home use. MECA believes that the ultra-low CO emission generators offered by Westerbeke and Kohler employ the same type of strategy (controlled exhaust air/fuel ratio near the stoichiometric point) to achieve high CO conversion efficiencies across a catalyst as documented in the subject report.

In summary, similar to CPSC's September 2012 test program, the commission has effectively demonstrated in the NIST study that catalyst-based exhaust emission controls are a proven, cost-effective, durable, and safe strategy for reducing CO emissions from small, four-stroke gasoline engines like those used in portable generators. The combination of precious metal-based, three-way catalyst formulations and precise air/fuel control has been shown to provide CO conversion efficiencies well in excess of 90% on a small, four-stroke gasoline engine in a portable home generator. We commend the commission on its ongoing work to demonstrate the effectiveness of state-of-the-art combustion controls in combination with catalyst technologies to reduce CO emissions from these generators. MECA continues to strongly support CPSC's efforts in urging portable generator manufacturers to voluntarily implement these cost effective strategies to reduce CO emissions and improve the safety of home portable generators. In addition, in the absence of a voluntary standard, MECA believes that EPA should strongly consider adoption of a mandatory, low CO emission standard for gasoline generators.

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