CPSC Staff's Statement[1] on NIST Technical Note 1947, "A Study on the Performance of Current Smoke Alarms to the New Fire and Nuisance Tests Prescribed in ANSI/UL 217-2015"

February 2017

The NIST Technical Note 1947 titled "A Study on the Performance of Current Smoke Alarms to the New Fire and Nuisance Tests Prescribed in ANSI/UL 217 – 2015," December 2016 presents the findings of research conducted by the National Institute of Standards and Technology (NIST), under Interagency Agreement CPSC-I-15-0022.

The study assessed the performance of currently-available smoke alarms to the new fire and cooking nuisance source tests specified in ANSI/UL 217 Standard for Safety of Smoke Alarms, 8th Edition. The new UL requirements for additional room-scale fire tests with smoldering and flaming polyurethane foam and a broiling hamburgers cooking test to evaluate nuisance-tripping will require smoke alarms to be listed starting in May 2020. The objective of this research was to assess whether future smoke alarms which meet the new ANSI/UL 217 requirements will have improved performance compared to a wide range of currently-available smoke alarms

NIST conducted testing on a convenience sample[2] of 45 distinct smoke alarm models from eight different manufacturers. There were 14 ionization sensor models, 14 photoelectric sensor models, seven combination photoelectric and carbon monoxide sensor models, four combination ionization and carbon monoxide sensor models, four combination ionization and photoelectric sensor models, and two combination photoelectric and thermal sensor models. Six units of each model were used in the experiments, for a total of 270 individual smoke alarms tested in the study. The sensitivity of each alarm was measured in a smoke box with cotton wick smoke per ANSI/UL 217. The measured sensitivities across the different models covered nearly the entire range of allowed sensitivities for smoke alarms in the UL 217 standard. The attached report describes the methods used in the study, analysis, and conclusions.

Some of the salient points of the NIST research findings are:

- None of the tested smoke alarm models met the performance level required in the 8th Edition of the Standard.

[1] This statement was prepared by the CPSC staff, and the attached report was produced by NIST for CPSC staff. The statement and report have not been reviewed or approved by, and do not necessarily represent the views of, the Commission.

[2] A convenience sample is one of the main types of non-probability sampling methods. A convenience sample is made up units that were easily acquired.

- Three models, all photoelectric-only sensor alarms, came closest to meeting the requirements by passing the flaming and smoldering PU foam tests specified in the 8th Edition.
- One photoelectric / carbon monoxide model met two out of three criteria (smoldering foam and cooking nuisance resistance).
- Three out of 14 ionization models met two of three performance criteria (smoldering and flaming foam).
- Three out of four ionization / photoelectric models met two of three performance criteria (smoldering and flaming foam).
- One out of four ionization / carbon monoxide models met two of three performance criteria (flaming foam and cooking nuisance resistance).
- Three quarters of the alarm models met only one or none of the performance criteria specified in the 8th Edition

- It is expected that the new smoke alarms listed for the May 2020 deadline will have an across-the-board increase in the level of performance and would significantly improve the overall performance of smoke alarms by expanding the range of fire scenarios that trigger an alarm while requiring resistance to nuisance alarms.
- The changes in the UL 217 8th Edition of the Standard, which include the new performance fire tests and the new nuisance resistance test, may make it challenging for manufacturers to meet the new UL standard without changes to current models that use either or both photoelectric and/or ionization sensors.
- The large variety of cooking aerosols from different cooking scenarios significantly impacts the alarm response, which suggests that a single nuisance source test in the standard may not be representative of the real environment. A consideration to include additional nuisance sources in a potential future revision of UL 217 to create a broader spectrum of cooking aerosols may need to be explored later.
- When testing the effects of toasting bread as an example of an additional nuisance alarm trigger, toasting bread produced essentially no measurable obscuration, carbon monoxide, and heat, thus alarms that use sensors to detect these characteristics will most likely not nuisance alarm. Toasting bread released aerosols that included particles that caused the ionization alarms to respond, which was similar to the measuring ionization chamber (MIC) current as the broiling hamburgers experiments.

The statements in this letter reflect CPSC staff's interpretation of the information in the December 2016 NIST Technical Note 1947. Refer to the NIST Technical Note 1947 for complete information on the testing and results.

The NIST Technical Note 1947 publication is available free of charge from:

https://doi.org/10.6028/NIST.TN.1947