



Combustible Gas Dispersion in Residential Occupancies and Detection Location Analysis

Recent experiences with combustible gas releases in residential buildings have led to a proposal for NFPA Standards development for locating combustible gas detectors and consensus on installation location requirements. NFPA has initiated a Standard, NFPA 715, Standard for the Installation of Fuel Gases Detection and Warning Equipment, that will cover the selection, design, application, installation, location, performance, inspection, testing, and maintenance of fuel gas detection and warning equipment in buildings and structures. Technical analysis for justifying combustible gas detector installation location is lacking to support Standards development. This study is proposed to address the residential installation criteria for these devices and systems.

Project Goal & Approach

The present study uses computational fluid dynamics (CFD) to quantitatively evaluate gas detector performance as a function of placement in residential occupancies. Natural gas and liquefied petroleum gas releases are simulated in different residential structures and gas concentrations are tracked at numerous potential detector locations within these structures to evaluate which locations are most effective for reliable and early detection. Over 250 CFD simulations were performed with a wide range of plausible leak types and environments to produce robust technical bases upon which gas detector location recommendations can be made.

A hazard-based approach was applied to compare the performance of gas detector installation locations. More specifically, this study quantified detector location performance based on 1) the ability of an installed detector at a specific location to detect before certain hazardous conditions arise and 2) the ability to provide sufficient response time prior to the hazardous conditions arising.

The final report is available [here](#).

Research by:



Sponsored by:



Summary Observations:

The results of this study highlight the importance of requiring a gas detector in the same room as permanently installed fuel-gas appliances. For these detectors, generally better performance was observed when: the detector was placed closer to the leak source, there was an unobstructed path between the detector and the leak source, and when the detector alarm threshold was lower (i.e., 10% Lower Flammability Limit (LFL) compared to 25% LFL). Generally poorer performance was observed when a detector was located: near HVAC supply registers; near passive openings such as doors and windows; and near openings to adjacent areas (e.g., door openings and stairwells).

For natural gas, the closer the detector was to the ceiling the more likely it was to detect a leak and the more time it provided for occupants to respond to an alarm before hazardous conditions occurred. Based on the applied threshold hazard conditions, detectors placed 6 inches or closer to the ceiling had significantly improved performance compared to those placed farther down in height when the detector alarm threshold was 10% LFL and 25% LFL. If a sensor cannot be placed this close to the ceiling, it should be placed at least above the highest doorway opening.

For liquefied petroleum gas, the closer the detector was to the floor the more likely it was to detect a leak and the more time it provided for occupants to respond to an alarm before hazardous conditions occurred. Based on the applied threshold hazard conditions, and provided certain installation locations are avoided (e.g., excluding locations with an obstructed path to the leak source, locations over registers, or at doorway openings), detectors placed closer than 8-10 feet from the leak and at no more than 6 inches above the floor had significantly improved performance for the alarm threshold of 10% LFL. When the alarm threshold was 25% LFL, improved performance occurred when sensors were placed closer than 8-10 feet from the leak and no more than 4 inches above the floor.

Additional gas detectors in rooms or areas remote from where a gas-fired appliance was located generally alarmed after a properly placed detector in the room where the gas-fired appliance was located. These additional or supplemental detectors mainly provide detection redundancy and the best places to put them include rooms or areas directly adjacent to the room containing the gas-fired appliance, and along pathways to upper and lower floors when the fuel is natural gas and liquefied petroleum gas, respectively.