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# Carbon Monoxide Detection and Alarm Requirements: Literature Review

Carbon monoxide (CO) poisoning incidents have been occurring in the United States and globally at a fairly consistent rate. CO is a colorless and odorless gas and therefore impossible to detect without an alarm or some other air sampling system. It is a byproduct of combustion reaction, so it is not uncommon for this toxic and fatal gas to leak from appliances, tools, and vehicles. Incidents resulting from these leaks can and will happen almost anywhere, which is why it is imperative to have adequate regulations to eliminate these occurrences. Regulations for CO detection are provided by various codes from both the National Fire Protection Association and International Codes Council. As the 2024 editions are being developed, it is the goal of this report to provide the necessary information to the technical committees to allow them determine if the current CO detection requirements are adequate and consistent across the range of occupancies (new and existing) that the codes regulate.

## Project Goal & Approach

The research goal is to summarize the existing requirements for installation of CO detection devices through a literature review and a consolidation of all available and pertinent non-fire CO incident data. This is achieved through a summary of CO installation requirements from the 2021 editions of NFPA 101, NFPA 5000, and the 2018 editions of International Building Code (IBC), International Fire Code (IFC), the International Existing Building Code (IEBC), International Residence Code (IRC), and the International Property Maintenance Code (IPMC); a summary of the State mandates/laws for CO detection; consolidation of non-fire CO injury and death data; and lastly a brief review of the short- and long-term health effects of carbon monoxide poisoning.

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## Summary Observations:

Regarding CO detection, the IFC and NFPA Codes generally address attached garages, rooms containing fuel burning appliances, and spaces served by fuel-burning HVAC systems. There are several cases of CO incidents that have occurred outside of these areas. For example, incidents that relate to leaks from exhaust system ductwork and equipment (including failure of exhaust fans), which would be outside where the fuel burning appliance is located, yet its CO emission are carried elsewhere. These are the kind of CO migration details that are not recorded, making it difficult to fix this problem.

Regulations on CO detection differ significantly state to state. States typically adopt a model code (IFC, or NFPA 101), and may have state-specific amendments. In some cases, states do not have a statewide adoption of any code. The most impactful details, however, is the edition year of the respective codes that are adopted, and the means of enforcement. Provisions in codes generally become more stringent with more recent editions, but many states have 2012 or 2015 adoptions, and some adoptions are as old as 2006. Further, many states let their local jurisdictions make amendments or even completely let them handle code adoption. Additionally, local jurisdictions are also often seen to be responsible for enforcement of these codes. This leads to inconsistent CO regulation across the US—which can be observed from New York having CO detection requirements for all buildings, while some states do not regulate any buildings.

Out of the various issues that are associated with CO poisoning, one prominent issue is a lack of comprehensive, concise, and coordinated data for these kinds of incidents, and data is required to substantiate regulatory changes. While fire related incidents are well documented, data collection on CO poisoning incidents are limited. For example, injuries and deaths of non-fire CO incidents are not recorded within NFIRS, only incident totals are reported. Similarly, the CPSC does thorough work in their data collection, yet their jurisdiction is limited, and therefore their data is also limited. Despite shortcomings in available data, there is still enough information to draw some conclusions.

While CO incidents have been occurring across the US, the Midwest region disproportionately has more issues with CO incidents. Fuel burning appliances and engine-driven tools (particularly generators) are consistently associated with the most CO incidents. These appliances and tools are also typically powered by gasoline. The lack of awareness to the problem at any level is also prevalent. This is demonstrated by reoccurring incidents of people running generators inside or near window and door openings to the structure. It could be suggested that increased awareness of CO could help reduce CO incidents. This could be accomplished through increased public education and more effective warning labels on products. To partially make up for these shortcomings in the data, a case study review of news stories was also conducted. These stories demonstrated the potential of CO to result in significant loss in any one incident, the various kinds of injuries and medical complications victims endure, and a general negligence to the problem.

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