Indoor Shooting Range Ventilation Systems [†]

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It is understood that bullets are dangerous, assuming that they are fired into a body at high velocity. However, there are other ways in which a bullet can cause harm, such as through the emission of toxic fumes and metals. Performing experimental shooting with 9 × 19 mm caliber weapons systems leads to certain reaction products being generated in quantities that can exceed the exposure limits of the human body. Carbon monoxide (CO) and ammonia (NH₃) are typical components of the fumes that result during shooting. These gases, in addition to smoke particles, can cause symptoms such as nausea, headache, and coughing. Exposure to high concentrations of CO over time can ultimately lead to unconsciousness and death.

Experimental measurements were made for 10 9 × 19 mm caliber cartridges. Under special training conditions, in 1 h, more than 1000 fired cartridges can be produced. In order to keep the indoor air quality at an acceptable level, recirculation of the airflow must be prevented, so the ventilation or air conditioning system's air should be taken from the outside. The minimum fresh airflow is calculated to satisfy the following conditions: the dilution of harmful substances and the maintaining of healthy conditions.

For a given number of fired cartridges, the volumetric mass of the substances with harmful potential obtained is 4.69 g/m³, as detailed in Figure 1, while the total occupied volume is 3.68 m³, at standard atmospheric conditions, as shown in Figure 2. In order to dilute these toxic reaction products, the minimum fresh airflow calculated is 891.6704 m³/h. Also, the minimum fresh airflow needed to maintain safe conditions is 375 m³/h.

Figure 1. Percentage of substances with harmful potential.

Figure 2. Occupied volumes at standard atmospheric conditions.

In order to prevent health risks due to the emissions of fumes from the use of weapons and ammunition, adequate ventilation and the use of protective measures are mandatory.

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