This document references Chapters and Sections from the ITRC Vapor Intrusion Technical and Regulatory Guidance, and Fact Sheets and Technology Information Sheets from the ITRC Vapor Intrusion Toolkit, published January 2026. These resources can be accessed at: **https://itrcweb.org/vapor-intrusion-toolkit**.

CRAWL-SPACE VENTILATION TECHNOLOGY INFORMATION SHEET

Active mitigation systems (uses electric fan / no sealed membrane barrier)

This Interstate Technology & Regulatory Council (ITRC) technology information sheet provides basic information for using a fan to ventilate a crawl space for mitigating vapor intrusion (VI) into the occupied space of a building. The design objective of crawl-space ventilation (CSV) is to dilute concentrations of vapor-forming chemicals (VFCs) in crawl-space air to below levels of concern. Controls on the location and volume of air removed from the crawl space are needed to avoid significant heating or cooling impacts to the residents above the crawl space.

Consequently, CSV is typically used when other technologies are not feasible. Only experienced practitioners should provide services for this mitigation technology.

Overview

CSV mitigates VI through dilution of VFC concentrations in crawl-space air. Ventilation of a crawl space may be achieved by removing air from the crawl space and replacing it with fresh air. As crawl spaces tend not to be sealed and are usually connected to other parts of the basement and/or the occupied space above, CSV may be more viable than crawl-space depressurization because it may not be practical or desirable to remove enough air from a crawl space to create a significantly depressurized space. CSV typically involves the opening of existing exterior vents, if present, around the crawl space to provide a source of supply air, as opposed to crawl-space depressurization, which would require vents and other openings in the crawl space to be closed. There are varying considerations for design and implementation of CSV depending on whether the crawl space is accessible (from inside the building or from outside) or inaccessible. When the crawl space is accessible, crawl-space sub-membrane depressurization (SMD) may be a better option than CSV.

CSV design should achieve the movement of the minimum amount of air out of the crawl space to create a modest, but consistent, air exchange rate (AER) for the space that is sufficient to dilute crawl-space vapor concentrations to below levels of concern. The AER may vary, but a typical design range is between 1 and 3 air exchanges per hour. Additionally, sealing of openings in the floor separating the crawl space from the above occupied space (and/or basement) should be considered to minimize the volume of indoor air drawn across the floor and into the crawl space prior to the atmospheric discharge through the CSV process. Sealing of cracks/openings between the crawl space and the occupied space can minimize additional energy costs when building air is heated or cooled.

The CSV design should also explicitly avoid the risk of back-drafting combustion appliances. Back drafting may occur if combustion gases are prevented from atmospherically venting and instead are drawn into building and/or crawl-space air spaces, thereby creating unsafe conditions.

Existing in-depth standards for the mitigation of most building types have been developed and published by the American Association of Radon Scientists and Technologists (AARST), also known as the Indoor Environments Association (IEA), which is accredited as a standards development organization by the American National Standards Institute (ANSI). These ANSI/AARST Standards have been expanded to address both radon and soil vapor to incorporate considerations for VI. These documents can be viewed/accessed for free on the AARST Standards website (AARST 2025) and are generally updated every three years. These standards will continue to be labeled as ANSI/AARST due to historic name recognition for AARST, despite the rebranding of AARST to IEA. The ANSI/AARST standards and applicable national and local building codes should be consulted with regard to back-drafting requirements.

Depending on the size of the crawl space, several methods can be used for ventilation. One method involves installing solid piping into the crawl space, sealing the annular space around the piping penetration, and extending the piping to an exterior-mounted fan that discharges ventilated air above the roofline and away from building openings. See [Figure 1](#) for an example CSV system configuration.

For new buildings in areas with VI potential, it is preferable to mitigate vapors in a crawl space using SMD systems rather than CSV because the combination of depressurization and a barrier can typically be engineered to provide for a more effective mitigation solution through capture of impacted vapors before they enter the crawl-space environment rather than relying solely on dilution of air within the crawl space. See the ITRC [Vapor Intrusion Preferential Pathways Fact Sheet](#) for more information.

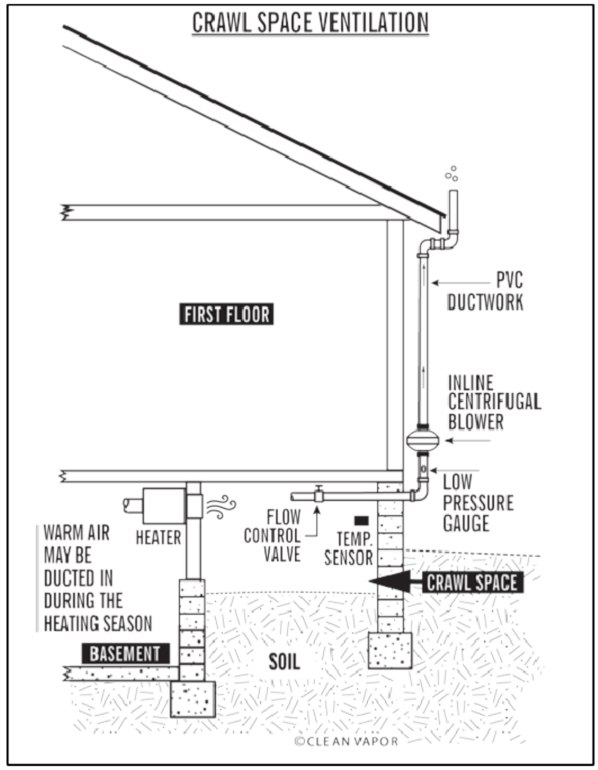

Figure 1. Example crawl-space ventilation system with fan located outside.

Source: Clean Vapor, LLC, used with permission.

Components

This technology requires a fan or blower connected via piping to the crawl space. See [Figure 2](#) for an example photo of piping exiting a crawl space. Other features of a CSV include the following:

- System piping, including a sampling port for accessing system air velocity/flow data and for obtaining effluent samples to quantify chemical concentrations, if needed. These data may be used to estimate chemical mass flux in vented crawl-space air.
- Valves or other means for adjusting the airflow. This may be achieved by installing a flow control valve or fan motor speed controller, or through sizing of the piping and fan.
- Instrumentation (either permanent or included during operations, maintenance, and monitoring [OM&M] visits) to measure system flow rate in the piping.
- An alarm to indicate loss of flow or vacuum.

Figure 2. Example piping into a crawl -pace area.

Source: C. Regan, ERM, used with permission.

Heating season VFC concentrations in the crawl space should be known and targeted AER (system flow rate) as part of the design and implementation process. There will be a variable seasonal relationship between pressure differential values and the volume of air exhausted from the crawl space. In cold climates, design considerations should also include utility insulating, temperature monitoring, heat tracing of pipes, and ducted warm air that is thermostatically actuated to keep pipes from freezing.

Freezing of condensation in ventilation pipes or non-CSV-related utilities that contain water may be of potential concern.

Advantages

CSV has the following advantages:

- This is a readily deployable engineering control.
- CSV works in crawl spaces with limited accessibility.
- It is possible to monitor performance using metrics that are readily measurable (i.e., airflow rates).
- A CSV system can easily be connected to remote monitoring and control technologies.

Limitations

CSV has the following limitations:

- Installation and OM&M may require confined-space training depending on crawl-space construction and whether entry is needed.
- A thorough health and safety evaluation should be completed and potential hazards addressed prior to entering a crawl space. In some cases, crawl-space entry may not be necessary or possible. All applicable protocols for confined-space entry must be followed for crawl spaces.
- Potential impacts to occupants of the building being mitigated from operation of the CSV system should be considered, including the potential for heat loss in the livable space above the crawl space or the potential for increased energy costs from operating the system.
- The presence of asbestos in the crawl space may require removal or abatement prior to CSV installation and activation. In certain circumstances, the presence of asbestos may eliminate CSV as a mitigation strategy.
- CSV may not be used if atmospherically vented combustion appliances are present within the crawl space.
- A high energy penalty may be incurred due to the potential for removal of conditioned air from the building space above the crawl space.
- Extensive sealing may be required between the crawl space and basement (if present) and the crawl space and building space above the crawl space to isolate the crawl space.
- In cold climates, design considerations should include measures to keep pipes from freezing, as described above.

Cost Considerations

The primary factors that affect the overall cost of a CSV system include the following:

- The presence of heating/cooling ductwork
- Water piping
- Size of the building (indirectly as it relates to crawl-space size and length of pipes needed)

- Size of the crawl space
- Tightness of the floor between the crawl space and the overlying occupied space
- Presence of exterior vents
- Remote monitoring
- OM&M requirements

Overall costs should consider items such as installation; the costs of predesign testing; preparation of a work plan, design and specifications; installation monitoring; regulatory agency and stakeholder liaising; post- installation verification testing; and reporting.

Cost factors include but are not limited to the following:

- Size of the crawl space
- System components
- Climate and need for insulation
- Means of controlling and monitoring the system's performance

Energy cost for CSV systems can be calculated by understanding the power draw of the blower, the building energy demand based on climate (i.e., the heating degree days) to estimate heat loss, and the local costs for power.

Special Circumstances

Special circumstances for construction of a CSV include the following:

- CSV should only be considered when SMD is not practical due to lack of access to the crawl space (typically shallow crawl spaces).
- Installation of warning placards may be appropriate at the entrance to the crawl space to notify entrants of the possible presence of vapors within the crawl space and of the importance of maintaining a sealed crawl-space entrance.
- Designs should avoid excess air removal from crawl spaces to protect against the potential for back drafting, minimize the potential for freezing of pipes located within the crawl space, and minimize increases in heating/cooling costs.
- CSV typically requires opening of exterior crawl-space vents when present.
- To the extent possible, a barrier should be placed across the ground surface of the crawl space, even if the barrier cannot be fully sealed or the entire crawl-space extent accessed.
- Instrumentation and equipment to regulate and measure airflow rates to achieve a targeted ventilation rate should be conducted by an individual who is experienced in this practice.
- In cold climates, temperatures should be monitored so actions can be taken to avoid freezing pipes.

Occupant, Community, and Stakeholder Considerations

It is essential to develop and implement a site-specific community involvement plan that addresses how to win trust and gain access to properties, communicate risk to potentially exposed individuals, and minimize the disruption of people's lives and businesses. For more details see **Chapter 3: Community Engagement**.

REFERENCES

AARST. 2025. "ANSI/AARST National Consensus Standards." https://standards.aarst.org/.