



**INCREASING USE
OF AIR ADMITTANCE VALVES
FOR ENERGY SAVINGS**



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passivehousealberta.com

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Project Abstract

Utilizing a grant provided by the Alberta Ecotrust Foundation in December 2021, Passive House Alberta initiated a multi-year project with a focus on 'Building Better/Retrofitting Wiser.' The project was designed to explore potential stepping stones to Mass Electrification and Deep Energy Retrofits (DER) on residential buildings in Alberta through the increased use of Air Admittance Valves to cap all or all but one of the plumbing vents on a building.

A single plumbing vent left open to the atmosphere in Alberta's cold climate will lose between 1 and 2 GJ of energy per year based on calculations using the Passive House Planning Package (PHPP) energy model and the length and configuration of the plumbing vent.¹

Air Admittance Valves (AAV) currently have limited allowed uses listed in the Canadian Plumbing code, most often to vent a sink in a kitchen island. Air Admittance Valves are certified to the ASSE 1051 and 1050 standards and allow air to enter and plumbing vent pipe when negative pressure is exerted on them and then close due to gravity. There is no maintenance required on them.

The grant specifically explored the use of the Studor Maxi-Vent AAVs to cap all, or all but one vent of homes, in both new and existing homes. These larger Maxi-Vents are designed to cap a 3" or 4" plumbing vent.

Conclusions drawn from a review of existing installation and a small pilot study in Cold Climate Alberta concluded that the code clause requiring one plumbing vent open to the atmosphere needs to be maintained, but increasing the use of Studor Maxi-Vents to cap all but one plumbing vent is a valid energy saving measure with low installation cost.

Minor code variances still need to be requested and documents to simplify the process are included in the report.

¹ Dr. Jürgen Schnieders, "Heat losses caused by drain pipes in the PHPP", *Passive House Institute, Rheinstr. 44/46* (2022).

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1. Code review of the use of Air Admittance Valves

The 2020 and 2015 National Canadian Plumbing codes are available online at:

[National Plumbing Code of Canada 2020](#)

and

[National Plumbing Code of Canada 2015](#)

A list of relevant code clauses and their potential concerns and solutions include:

2.2.10.16 Air Admittance Valves

1) Air admittance valves shall conform to ASSE 1051, “Individual and Branch Type Air Admittance Valves for Sanitary Drainage Systems.” (See Note A-2.2.10.16(1))

Response: No concern with this clause as the Studor Maxi-vent and smaller Mini-vent are both certified to this standard.

2.5.9.1 Air Admittance Valve as a Vent Terminal

1) Individual vents and dual vents are permitted to terminate with a connection to an air admittance valve as provided in Articles 2.5.9.2. and 2.5.9.3. (See also Sentence 2.2.10.16(1))

Response: This is the clause that after review is the one that would need to be modified for Maxi-Vents to be used as Maxi-Vents are designed for use with more than individual and dual vents. Depending on the jurisdiction an “Alternative Solutions” submission would be required to use the Maxi-Vents, however, an engineer or architect is not required for submission. A letter was obtained from Studors’ North American distributor stating that there is no fundamental difference between a Studor mini-vent, for use on Individual and Dual vents and the Studor Maxi-vent which is certified for use on multiple vents. This letter is included in section 4 of the report.

2.5.9.2 Air Admittance Valves

1) Air admittance valves shall only be used to vent:

- a) Fixtures located in island counters,
- b) Fixtures that may be affected by frost closure of the vent due to local climatic conditions,
- c) Fixtures in one- and two-family dwellings undergoing renovation, or
- d) Installations where connection to a vent may not be practical.

This clause is both very specific and very vague in different sections.

Response: Part c) should allow the use of AAV anywhere as part of any type of renovation.

There is no definition of the word ‘renovation’ in the Plumbing code. Cambridge Dictionary defines a Renovation as the “act or process of repairing and improving something, especially a building.”²

Since adding an AAV improves the energy performance of a building, installing them on all but one plumbing vent of any one and two-family dwelling should meet 2.5.9.2(1)(c).

For new construction one can propose that from an Energy Efficiency perspective connecting plumbing fixtures to a plumbing vent is not “practical” as the associated energy loss is too high. Clause 2.5.9.2(a) allows installation for fixtures located in island counters, so Air Admittance Valves must work, and fundamentally there should be no reason why they can not be used to vent any fixture as long as one vent is left open to the atmosphere.

2.5.9.3 Installation Conditions

5) Drainage systems shall have at least one vent that terminates to the outdoors in conformance with sentence 2.5.6.5(1).

Response: Initially the grant explored the potential to cap ALL plumbing vents which would mean contravening this clause, however after feedback received in the “1 Winter Pilot Study Survey” (See Section 2 AAV Install Pilot Program Survey feedback) and discussion with other Engineers and Architects the goal was changed to cap ALL BUT ONE plumbing vent. The North American sewer system is designed such that overpressure or positive pressure in the system needs to be released to the atmosphere via plumbing vents in the buildings connected to that system. If all plumbing vents are capped, then sewer gas bubbles could be forced into the building through a P-trap. This is a rare but real problem thus 1 plumbing vent must be provided to the atmosphere for each building. However, there is no code clause that states the plumbing vent to atmosphere must go through the building envelope. Therefore, to maintain the energy savings for new construction or renovations one vent to atmosphere can be provided outside the building envelope, using a Tee fitting where the plumbing pipe exits the foundation and before it connects to the city-owned sewer system. A minimum 3” or an oversized 4” pipe can be installed from the Tee to above the roof line meeting other code requirements.

2. AAV install pilot program

As part of the grant, 40 Studor Maxi-Vents with insulated aluminum caps were purchased and distributed to homes in Calgary and Edmonton for installation to cap ALL plumbing vents on a pilot program basis. The intent of this pilot program was to test the Studor claim that their Maxi-Vents worked down to -40°C when installed open to the weather but with the insulating aluminum cap attached. Different installation locations were trialled including:

1. Above the roof line
2. Below the roof line in the vented attic
3. Inside the building envelope

² Cambridge Dictionary, 2023, <https://dictionary.cambridge.org/dictionary/english/renovation>.

Most homeowners self-installed the AAV's while some contracted an experienced tradesperson to install the device. All installations followed Studor's recommendations outlined in their Studor Technical Manual³ or the shorter⁴ instructions⁴ (studor.net).

Based on Passive House Recommendations, to maximize energy savings, the entire length of pipe exposed to the outside air below the AAV and 1m inside the building envelope should be insulated⁵.

3. AAV install pilot program survey feedback

After one winter of use, a survey was issued to obtain feedback from the pilot program participants. During that winter Edmonton temperatures reached below -40°C, and Calgary reached around -32°C. Calgary rarely sees temperatures below -40°C (before wind chill), the last time being Jan 24 in 1954. None of the pilot program homeowners reported any issues with freezing up of the Maxi-vents, which would result in slow draining drains. As such, the Studor claim of operation down to -40°C appears to be valid.

Two homeowners did report issues with positive pressure from the sewer system:

1. One homeowner had a clog in the sewer pipe between the home and the City's main sewer pipe, unrelated to the AAV's use or installation. When the City came to remove the clog, they used a high-pressure water hose. With AAV's capping all plumbing vents, the positive pressure created by the water and air had nowhere else to go but out one of the toilet P-traps, which made a bit of a mess.
2. A second homeowner reported some "bubbles" in the toilet on one occasion. The exact cause could not be confirmed but it's thought to have come from some sort of overpressure event in the sewer system. With AAV's capping all plumbing vents the air/sewer gas had nowhere else to go to be released.

For these reasons the goal of capping ALL plumbing vents with AAV's was revised to ALL BUT ONE.

A 2nd homeowner also had a clogged sewer line, unrelated to the AAV as it had occurred previously, they had the clog removed via auger / roto-rooter starting from the home working outwards. They did not experience any issues related to the AAVs.

³ Studor Technical Manual.

⁴ Studor Maxi-Vent Installation Instructions.

⁵ Trevor Butler & Brett Sichel, "Living and Learning, Passive House Style", BuildEX Calgary 2017, Slide 35.

4. Alternative methods submission documents

The following are documents that can be used as part of an Alternative Methods submission:

1. The Studor Maxi-vent specification sheet can be found [here](#).
2. IAPMO listing certificates for the Maxi-Vent and Mini-Vent are available at: [Stack AAVs](#) and [AVVS](#).
3. The ASSE 1050 and 1051 certifications for the Studor Maxi and Mini vents can be found [here](#).
4. The letter below can be used as proof that there is no functional difference between a Studor Mini Vent (approved for use by code) and a Studor Maxi Vent (not approved for use by code). There is no scheduled maintenance on air admittance valves, but they do need to be installed in an accessible location.



July 12, 2023

To Whom It May Concern:

The industry standards for Air Admittance Valves are ASSE 1051 and 1050 and both the Mini-Vent and the Maxi-Vent are listed to those standards directly with ASSE.

Concerns regarding failures, maintenance requirements, or indoor air quality issues for AAVs will be addressed in the subsequent paragraphs.

Our AAVs rarely fail when installed properly – in fact, since IPS purchased the rights to Studor in the US and Canada in 1998 we have sold millions of these products and rarely see any product defects in the field. We send out fewer than 10 replacement Maxi-Vents or Mini-Vents each year, and the ultimate root cause is generally proven to be installation error.

There is no required maintenance on AAVs as a standard practice. No routine procedures must be performed to ensure the continued function of an AAV – nothing to clean, lubricate, or adjust. AAVs open with negative pressure and close with gravity.

AAVs do not produce indoor air quality issues as a matter of course, since AAVs prevent sewer gasses from entering the building.

The Mini-Vent and the Maxi-Vent are functionally identical with an internal donut-shaped membrane/flapper that opens with less than 0.3" of negative pressure and closes due to gravity. Positive pressure from the plumbing system causes the membrane to seal tighter. The only difference between the two is size – the Mini-Vent is designed primarily for use on 1-1/4" through 2" pipes, allowing 2 CFM, and can handle up to 6 Drainage Fixture Units (DFUs) on a 2" horizontal branch and 24 DFUs on a 2" vertical stack, while the Maxi-Vent is designed for use on 3" and 4" pipes, allowing 4 CFM, and can handle up to 160 DFUs on a 4" branch and 500 DFU's on a 4" stack.

If you have any other questions, please feel free to contact our Customer Service department at (800) 888-8312.

Sincerely,

A handwritten signature in black ink that reads "Ken Smithart, Jr." in a cursive style.

Ken Smithart
Manager, Technical Services

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The following wording may be used as part of the Alternative Solution application to install Studor Maxi-Vents on all but one of a building's plumbing vents in one of 3 Studor approved locations shown in their manual:

- a. Outside the conditioned space above the roof line.
- b. Outside the building envelope inside the vented attic of the building.
- c. Inside the building envelope in an accessible vented box.

The first installation (above roof line) may be considered the simplest and easiest to install and approve. However, it is our finding that the best location for AAV installation is within the conditioned envelope for at least the following nine reasons:

1. Make-up air vents (AAVs) should be located as close to the trap as possible so there is no static pressure or pressure transient caused by excessive distance and number of bends in the pipes between the vented fixture and the AAV.
2. Plumbers are occasionally injured in the process of installing vent stacks above the roof (or filling them with water to test for the rough-in inspection).
3. Air leakage is the easiest cause of heat loss to prevent. Although one can attempt to seal the junction where the vent pipe penetrates the air barrier in the ceiling or the roof, air leaks are possible and typically result in a high proportion of total air leakage because of the stack effect.
4. AAVs installed in the conditioned space do not face the harsh environmental conditions above the roof. Therefore, despite the AAVs being rated down to -40°C/-40°F, we recommend installation within the conditioned space to reduce the chance of decay or malfunction.
5. AAVs installed in the conditioned space do not need the optional insulating cover and protective metal cover. Avoiding these optional components reduces material production, embodied emissions, and cost.
6. We wish to avoid unnecessary penetrations of the roof which increases the risk of water leaks, maintenance (replacement of jacks and rubber boots), etc.
7. In the event the homeowners eventually wish to install rooftop PV, they will not need to avoid vent pipes.
8. In the event of possible malfunction or failure, replacement is easier and safer than working on the roof.
9. Installing AAVs within the building instead of above the roof reduces materials, material cost, labour cost, toxic material manufacturing with its costs and risks, and the embodied emissions from the manufacture and transportation of extra material.

If expert assistance is required, you may contact:

Ron George, CPD, President, Plumb-Tech Design & Consulting Services, LLC

Email: Ron@Plumb-TechLLC.com

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Website: www.Plumb-TechLLC.com

Mailing Address: P.O. Box 47. Newport, Michigan 48166

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IPS is the North American Distributor for Studor AAV's. IPS contact information:

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References

Butler, Trevor & Sichello, Brett. “Living and Learning, Passive House Style”, BuildEX Calgary 2017. [Slide 35](#).

Cambridge University, 2023. <https://dictionary.cambridge.org/dictionary/english/renovation>

Schneider, Dr. Jürgen. “Heat losses caused by drain pipes in the PHPP”, *Passive House Institute, Rheinstr. 44/46* (2022). [Passipedia.org](#)

Studar Maxi-Vent Installation Instructions. [IPS Plumbing Products](#)

Studar Technical Manual. [IPS Plumbing Products 2](#)