COLD CLIMATE RADON MITIGATIONS

A CANADIAN'S PERSPECTIVE

Preliminary Report

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Abstract

This preliminary report is part of a larger research project that will record how over 50 radon mitigators from North America and Europe effectively mitigate homes in cold climates.

This preliminary research paper is an investigation of the methods and reasoning of 29 radon mitigators who work in the cold climate areas of the USA.

The author's hypothesis was that most of the radon mitigators in the USA follow the ASTM E2121 guidelines with regard to fan location and vent termination. In addition, that they would have good "*workarounds"* to avoid premature fan failures due to icing, freeze up and snow loads that interfere with radon systems.

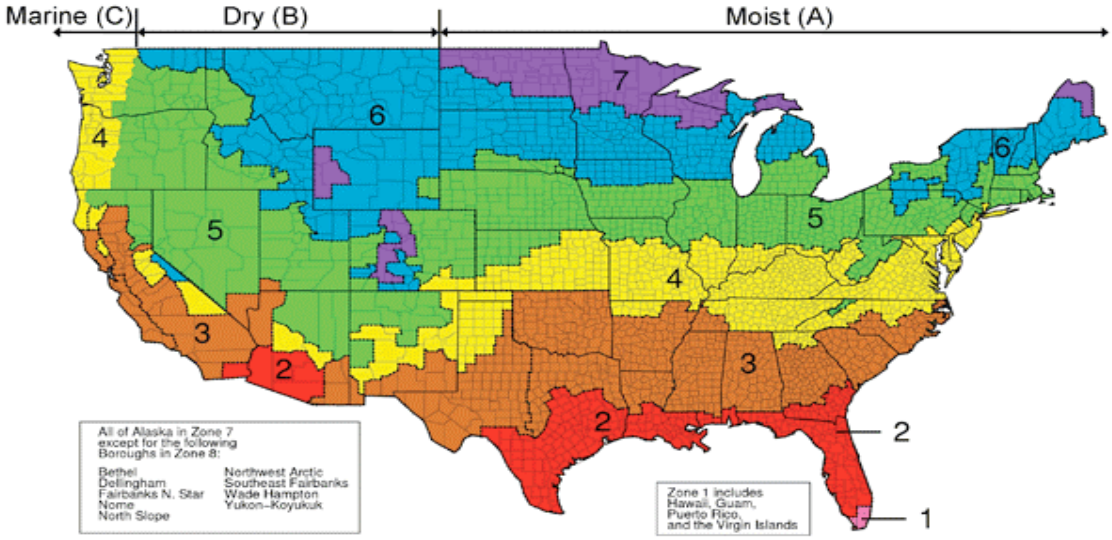
This research study found that ***all*** , not most, of the mitigators interviewed were following the standards of ASTM E 2121 in regard to fan location being located outside of the living envelope. Only the two mitigators interviewed from Zones 7 & 8, working in Alaska, stated that occasionally when they had no other warm choice, they would the consider locating the fan inside the living space.

The researcher heard from many mitigators that in cold and really cold climates (ASHREA Zones 6, 7 and 8) some elements of home construction design are different than in warmer climates. Most have heated attached garages and separate heated mechanical rooms (outside of the living space). These were the normal construction design practices allowing them to follow ASTM E 2121 by placing the fan in these locations and out of the living space.

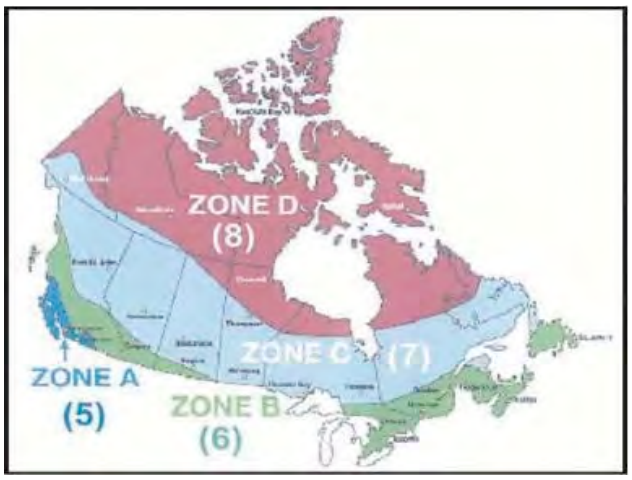
For the average mitigator, some of the "workarounds" that are identified in the report are simple, easy and make sense. Presenting and sharing these ideas should benefit all mitigators in cold climates.

This is a preliminary report that is part of a larger research project that will look at how over 50 radon mitigators from North America and Europe effectively mitigate homes in cold climates.
This research paper is an investigation of how and why radon mitigators who, working in the cold climate areas of the USA mitigate residential homes from high levels of radon. This paper looks at whether these US mitigators actually follow the international ASTM E 2121-03 standard or not. The three specific areas of focus for this paper are the location of the fan, the location of the discharge piping and the direction of the termination. This survey will also find ways mitigators actually make these systems work in cold climates and what way these individuals have developed "*work arounds"* that work within the international ASTM E 2121-03 standard and where they deviate from the standard. These USA working mitigators have the "*boots on the ground"* experience in getting successful long term radon mitigations for their clients should prove to be an informative resource.

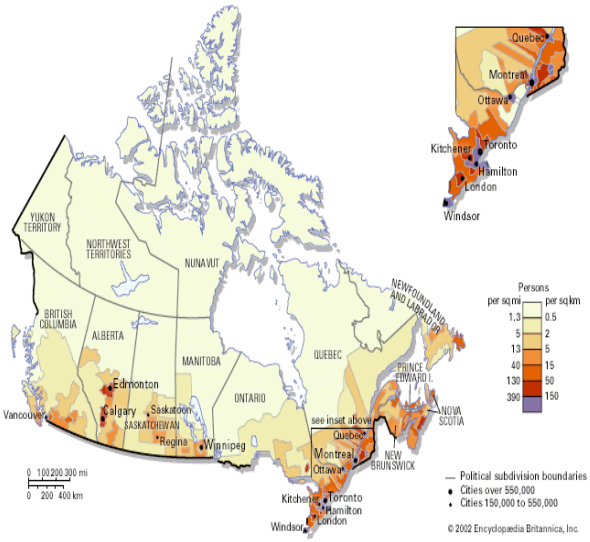
Canada is in the process of creating radon mitigation procedures and possibly standards of their own. As a Canadian mitigator I feel certain that this information will be of great value to the professionals who are formulating the protocols or standards for Canada.



The information from this survey is tracked in the ASHREA temperature zones 5, 6, and, 7 and 8 to ensure that the conclusions are more useful.
Canada's highest population density is concentrated very close to the US border. This places most of our population in ASHREA zone 5 or zone 6 with limited populations in zone 7 and 8.



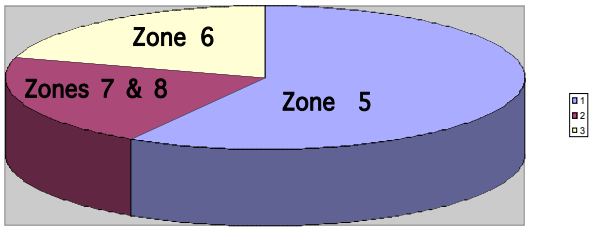
Canada's ASHREA zones



Canada's Population Density

The author's hypothesis for this study was that most of the radon mitigators in the USA will be following the ASTM E2121 guidelines with regard to fan location and vent termination and will have come up with good practices as "*work arounds"* to avoid premature fan failures due to icing and freeze up and snow loads interfering with radon systems.

These results are the preliminary results from a larger study. This preliminary paper is the result of tabulating a study of 29 mitigators from the USA. These mitigators were contacted over the phone. The methodology for these interviews was; two radon mitigators having a conversation about radon mitigations and the survey answers were recorded by the author as the conversation happens rather than a list of dry questions. With twenty nine interviews we have seventeen from zone 5, six from zone 6 and six from zone 7 and 8.



Split of interviews

Here is what this survey discovered; most radon mitigators are owner operators, 55% are single person businesses while 23% have 2 to 3 employees. The balance, 22%, have more than 4 employees.
These numbers seemed to have been consistent across all three ASHREA zones.
Most mitigators are some what busy with average mitigations per month being 13.67. Many reported that they are not as busy as in previous years. The numbers stood up well for zone 5 mitigators with an average of 13.5 mitigations but went up to 17 mitigations per month for the zone 6 mitigators and falling to 10 mitigations per month for zone 7 and 8 mitigators. Across all three zones most mitigators, who were busy (over 13 mitigations / month) were servicing wide geographical areas.

The average cost to install a radon mitigation system across all three zones averaged $1260.00. The results of the zone 5 data was that mitigations came in at a lower average cost of $1180.00, zone 6 was $1200.00 and zone 7 and 8 $1550.00. It seemed that the cost of the system was driven by amount of available work. If a mitigator is busy (over 13/month) they can charge less because the fixed cost/sale is lowered. These numbers make sense because as we headed into colder climates more mitigations were "inside" jobs hence a higher cost.

93% of the mitigators provide a post mitigation test and the balance recommend one be completed by a third party.
Most mitigators (60%) who provide a test use a charcoal test kit, 25% use liquid scintillation and 16% using a CR monitor.

We asked where the mitigators typically located the fan across all three zones. 0% choose to put the fan within the living space, 59% chose fan placement outside at the side of the home, 31% chose the attached garage and 10% in the attic of the home. When we began to review the different climate zones we saw a huge change of attitude. In zone 5, 88% were putting the fan at the side of the home, as a first choice of location and only 12% were installing the fan in attic of the home. When asked why, the overriding reasons were cost or ease of installation of the mitigation system. In zone 6 only 16% reported using 'outside on the side of the home' as their first choice and 84 % are using the attic of the home or attached garage as their first choice of location of the radon mitigation system. In zones 7 and 8 the numbers are very similar with only 16% using 'outside on the side of home' as their first choice and 84 % were using the attic of the home or attached garage as their first choice of location of the radon mitigation system. The only difference between zone 6 and zone 7 and 8 group data is that in the zone 7 and 8 group we had a higher incidence of using the garage. The reasons for the choice of location followed this trend of similarity between zone 6 and zone 7 and 8. The overriding reason for choice of fan and piping location being 'warmth' the mitigators who put the fan in the attic or attached garage and the smaller group choosing to put the fan on the side of the home sighting reduced cost of their outside system as the primary reason for this choice. Even those interviewed from Alaska were finding a location to place the fan in the warmth of the home but have it outside of the envelope of habitable space.

When the author enquired about fan failures (for any reason) we were amazed to see how reliable these fan systems are with most mitigators reporting less than a 5% failure rate on fans under 5 years old.
In the fans older than five years 26% of the mitigators reported finding no fan failures, 11% reporting manufactures defects (squeaky), 49% from old age, 7% from ice damage and 7% from other causes (squirrels).

100 % of the surveyed mitigators contacted were discharging the soil gases of the radon mitigation system above the line of the eave of the roof including those from Alaska. Those from Alaska are terminating in a horizontal fashion rather than in an upright fashion. They typically try to choose a southern or eastern exposure gable wall if possible to take advantage of sun warming or the lee side away from prevailing winds.

The mitigators were asked "do you do anything to deal with the potential of creation of an ice ball, icing and fan blockage in winter"? As a group 66 % did nothing. When reviewing the zone breakdown we had some surprises.
In zone 5 we had a 70% to 30% split in favor of do nothing. The proactive group had some interesting work around solutions. One mitigator always installs the last piece of pipe in black ABS pipe to take advantage of sun warming. Another always tries to use southern exposure, another uses all black ABS pipe whenever he can. (He likes the color on brick homes). Condensate bypasses were mentioned quite often as a solution that was used.
Surprisingly in zone 6, 100% of the mitigators said that they do nothing to deal with the potential of ice ball icing and fan blockage.
In zone 7 & 8, 84 % said that they do make adaptations to be proactive in dealing with potential ice ball, icing and fan blockage in winter. While 16% did nothing.
It was recorded that in Alaska mitigators terminate in a horizontal fashion above the eave and in a gable end wall not very far out from siding (typically less than an inch) so that icicles are not formed, or they insulate the pipe like a bathroom vent (wrap with pipe with 1" insulation or install commercial pipe insulation) and go up through roof. Some other solutions that were offered by zone 7 and 8 mitigators included the insulation of piping where exposed to cold which came up 32% of the time. They often talked about this being necessary on horizontal runs. Use of only 4 inch schedule 40 cellular (foam) core pipe came up 66% of the time, many quoted the insulation value of cellular core pipe. One mitigator always spray paints his last piece of pipe through the roof black. (He tries to place fan in the attic.) Another if he has an outside run, pulls armourflex insulation inside 4 inch pipe to create "a neat workmanlike project that just won't freeze". Another installs a ¾" valve indoors near the u tube and has the customer adjust the opening based on outside temperature.

I spoke to all three major Radon Fan manufactures about placing their fans in cold outdoor situations and any concerns or installation instructions that they would have.

RadonAway:

"All RadonAway fan models are rated for outdoor use with an operational temperature range of -20F to 120F. (-30C to 50C). However, there are a number of considerations that should be taken into account when designing and operating an Active Soil Depressurization (ASD) system in extreme cold climates. Freeze-up can be a serious problem in such an ASD system and if the system freezes it can totally block off the exhaust pipe, rendering the system completely ineffective for radon reduction. Interior pipe runs are preferred to minimize exposure to the extreme cold. Pipe and fan insulation and auxiliary heat can be included in the system design to minimize freeze-ups. Steps should be taken to prevent ice from falling into the fan that could potentially damage the impellers. Piping supports should be designed for the additional weight of any potential ice load. Exhaust points should be extended to ensure they remain open in normal snow cover. Additional factors may need to be considered to account for local codes and building practices"

Fantech:

"Fantech fans are rated for outdoors use. Fantech has no concerns about the fan being placed outdoors in cold temperatures provided:

1/ Fan is installed in a vertical position
2/ Do not turn fans off and on in cold temperatures
3/ Installer should ensure that an adequate moisture bypass built into the piping system."

Festa Manufacturing:

"Festa fans are rated for outdoor use. They had no concerns about their fans being placed outdoors in cold temperatures provided that "the fan is installed in a vertical position"

One of my last questions to these mitigators was what would you change if you could to any part of ASTM E2121? The majority, 62%, stated that they couldn't think of anything to change. Those that had things that they thought should be changed quite often had several ideas. One was the requirement to have a 4 inch suction header if multiple points, was an issue for many mitigators, their objection was not to this rule when multiple mitigation points were planned, but as a retrofit for those 3" systems that were not able to achieve the desired radon reduction on the first go. These mitigators pointed out that they were concerned about achieving lowered radon levels and that this rule was onerous in a retrofit application. The issue of staying 10 feet away or above a chimney came up almost as often. Most felt that treating a chimney as a potential point of re-entrainment, just did not have good science behind it. Some reported that they had not found research to support this requirement.
Several mitigators felt the requirement to provide a fire rated assembly at the garage wall and ceiling was over the top when their system was going in beside other penetrations to the fire wall that were unprotected i.e. central vacuum.
More than half the mitigators working in zone 7 felt that minimum stack size outside should be 4" and minimum schedule for pipe should be schedule 40. Two mitigators

pointed out that the manufacturers of schedule 20 (SDR 35) do not support its use above ground. As it has no UV inhibitors in it.
10% of the mitigators questioned suggested that putting the fans in the living envelope of the home, could result in a cost savings to the mitigation and perhaps extend the life of the fan. One went so far as to suggest that all the manufacturers had to do was improve their gasketing around fan and electrical connections and this should be practical. The author asked two of the mitigators interviewed who were mechanical engineers about this idea and got similar responses from both. "The basis of sound engineering for extraction of any hazardous or unpleasant gasses is to always use negative pressure inside the building envelope to ensure no cross contamination can occur."
The representative from Fantech that the author interviewed also stated that "their radon fans should not be installed indoors. It is extremely rare, but occasionally gaskets fail. The resulting high radon levels inside a home that the owner felt was protected from radon could detrimental to the occupant's health"

When reviewing the data about the authors hypothesis for this study that most of the radon mitigators in the USA are following the ASTM E 2121 guidelines with regard to fan location and vent termination, our study found that ***all*** , not most, of the mitigators interviewed were following the standards of ASTM E 2121 in regard to fan location being located outside of the living envelope. Only the 2 mitigators interviewed from zone 7 & 8 working in Alaska stated that occasionally when they had no other choice and would the consider locating the fan inside the living space but they had to consider their severe climatic conditions. It was interesting to note that they also stated that those severe climatic conditions also led to fact that almost all homes in Alaska were designed with heated attached garages and heated attached mechanical rooms that they could utilize for fan location.
The data from the interviews with regard to vent termination show again that ***all,*** not most, are terminating the radon vent piping above the eave.
When we looked at the data for direction of vent termination only 6% of those surveyed did not terminate in an upward direction. It was again our colleagues from Alaska that stated that they terminate horizontally very close to the siding as not to create a point for an icicle to happen. Should ice form they would prefer it to be on the siding and not as a dangling icicle.
It is the conclusion of the author from this data that even in a cold climate radon mitigation systems work and work well. They can be installed in a cold climate situation and meet the requirements of ASTM E2121. Fans and piping can be located outside of building envelope as long as due care for cold climates situations are brought into play. More care may be required as to the location of the fan in colder environments and higher cost choices of attic or attached garage should be utilized to ensure that while exposed to cold the fan is out of the worst of the weather extremes. The mitigator may have to make choices around using piping with insulation values and utilization of 4" pipe instead of a 3 inch pipe that could be used in a warmer climate. In the extreme cold of zones 7 and 8 mitigators may do well to consider insulating piping systems. Vent terminations of above the eave is a workable rule. Vent termination direction may have to be considered in cold zones of 7 and 8.

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