RESEARCH REPORT

External Research Program

Cold Climate Radon Mitigations: A Canadian's Perspective

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Cold Climate Radon Mitigations

A Canadian's Perspective

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Report

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Cold Climate Radon Mitigations

Abstract

Can cold climate homes be mitigated from high levels of indoor radon using American industry established protocols and standards or does Canada need to establish a different radon mitigation standard because of our cold climate?

This research reveals the combined knowledge and methods of radon industry mitigation professionals that have mitigated over 8500 cold climates homes in the last year.

This research paper will document to what degree existing ASTM International E2121-08 Standards are actually being followed by radon mitigators who work in North American cold climates. The researcher interviewed 51 certified and/or state licensed professional radon mitigation contractors who install radon mitigation systems in the cold climate zones of the USA. These mitigators were selected because they install radon mitigation systems in the same climate zones as Canadian radon mitigators. These climate zones are referred to as ASHRAE climate zones 5, 6, 7 & 8. This research also includes interviews of 5 highly respected European mitigation professionals to determine what they are doing in Europe to mitigate radon in cold climates.

The three specific areas this research focuses on are the location of the fan, the location of the discharge piping, and the discharge piping termination direction (horizontal or vertical).

Cold Climate Radon Mitigations

Executive Summary

By interviewing over fifty radon mitigators from North America and Europe, the researcher discovered how radon mitigators, working in cold climates similar to our weather in Canada, were successfully conducting radon mitigations. These radon mitigators have mitigated over 8500 cold climates homes in the last year.

This research paper focused on whether these US mitigators actually follow the ASTM International E 2121-08 Standard or not. The three specific areas of focus for this paper are the location of the fan, the location of the discharge piping vent termination and the direction of the termination.

This study found that all the mitigators interviewed in the USA were following the standards of ASTM E 2121-08 in regards to the fan location being outside of the living envelope. In regards to vent termination, the data from the interviews also shows that all are terminating the radon vent piping above the eave. The results from the data in regards to the direction of vent termination revealed that 4% of those surveyed did not terminate in an upward direction as is required in the ASTM Standard. Our colleagues from Alaska that stated that they terminate vent piping horizontally, very close to the siding (but above the eave) as not to create a point for an icicle to occur. Should ice form, they would prefer it to be on the siding and not as a dangling icicle.

The author was surprised to learn that most mitigators, 86%, were not following the ASTM Standard E-2121-08 with regards to insulation of piping where it is exposed to potential of freezing. They were not insulating this piping. This may have resulted from a cost issue, a training oversight, or the problem of making insulated piping look aesthetically pleasing. These mitigators were still installing systems that are reported to continue to work and work well in cold climate.

It is the conclusion of the author from this research that even in a cold climate, radon ASD mitigation systems work and work well. They can be installed by trained professionals in a cold climate situation and meet the requirements of ASTM International E 2121-08. Cold climate radon mitigations are probably not for the untrained handy man and do it yourselfers, as much of the internet radon mitigation advice is based on warmer climate installations.

The colder climate Canadian radon mitigations may require interior placement of the piping, fan installation in the attic or garage, and pipe insulation, which will cause mitigation costs to be in the range of $2000-$3500 for the average house. Icing may be a winter problem for uninsulated exterior piping in Canada’s more northern cold climates.

Cold Climate Radon Mitigations

Résumé

L’auteur de cette recherche a réalisé des entrevues avec plus de cinquante spécialistes de la réduction de la concentration en radon dans les bâtiments en Amérique du Nord et en Europe. Il a découvert que les techniques utilisées dans les zones climatiques froides semblables à celle du Canada donnaient de bons résultats. L’an dernier, les spécialistes interrogés ont réduit la concentration en radon dans 8 500 habitations situées dans des régions froides.

L’auteur a cherché à déterminer si les spécialistes américains de la réduction du radon se conforment à la norme ASTM International E 2121-08. Les trois aspects particuliers étudiés sont l’emplacement du ventilateur, l’emplacement de la bouche d’extraction, et l’orientation de la bouche d’extraction.

Selon l’étude, tous les spécialistes interrogés aux É.-U. se conforment à la norme ASTM E 2121-08 en ce qui a trait à l’emplacement du ventilateur (à l’extérieur de la cellule habitée). En ce qui concerne l’emplacement de la bouche d’extraction, les données recueillies pendant les entrevues indiquent aussi que tous les dispositifs mis en œuvre comportent un tuyau d’évacuation placé au-dessus de l’avant-toit. Les résultats pour l’orientation de la bouche d’extraction révèlent que 4 % des spécialistes interrogés ne l’orientent pas vers le haut comme le prescrit la norme ASTM. Nos collègues de l’Alaska ont affirmé disposer la bouche d’extraction à l’horizontale, très près du bardage (mais au-dessus de l’avant-toit), afin d’éviter la formation de glaçons. Ils préfèrent voir la glace éventuelle se former sur le bardage et non des glaçons qui pendent.

L’auteur a été surpris d’apprendre que la plupart des spécialistes (86 %) ne suivent pas la norme ASTM E 2121-08 en ce qui concerne l’isolation des conduits, là où ils sont exposés au gel. En effet, ils n’isolent pas ces conduits. Cette décision pourrait être attribuable aux coûts, à une lacune dans leur formation, ou à la difficulté d’isoler les conduits de manière esthétique. Cependant, ces spécialistes de la réduction du radon installent quand même des dispositifs qui continueraient à bien fonctionner dans des zones climatiques froides.

L’auteur conclut que même dans une zone climatique froide, les dispositifs de réduction du radon par dépressurisation active du sol fonctionnent bien. Ils peuvent être installés par des techniciens qualifiés et répondre aux exigences de la norme ASTM E 2121-08. La mise en œuvre de mesures d’atténuation du radon dans les zones froides ne devrait probablement pas être faite par des personnes sans formation ou des bricoleurs amateurs parce que la plupart des conseils sur la réduction du radon que l’on trouve dans Internet concernent les dispositifs pour régions chaudes.

Cold Climate Radon Mitigations

Au Canada, en raison de la froideur du climat, on pourrait devoir placer les conduits à l’intérieur et les ventilateurs dans le vide sous toit ou le garage, et isoler les conduits. Les mesures d’atténuation du radon coûteraient ainsi de 2 000 à 3 500 $ par maison en moyenne. La formation de glace pourrait être un problème en hiver dans le Nord du pays si les conduits extérieurs ne sont pas isolés.

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Cold Climate Radon Mitigations

Introduction

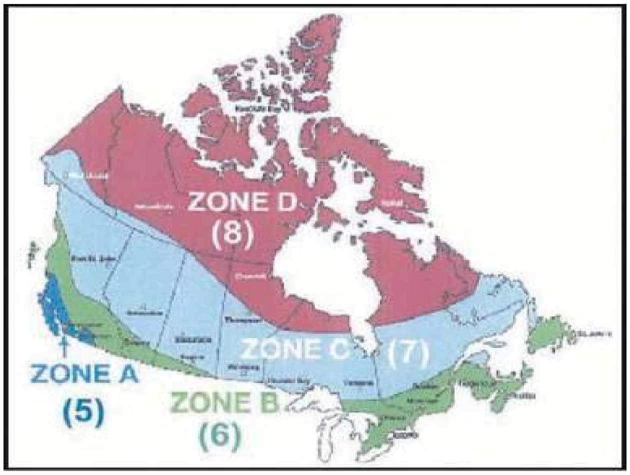
By contacting over fifty radon mitigators from North America and Europe, the researcher investigated how radon mitigators, working in cold climates similar to our weather in Canada, were successfully conducting radon mitigations. This research was conducted by utilizing a guided conversation between two radon mitigators. The guided conversation allowed the researcher to fill in answers to the survey questions without the mitigator feeling he/she were just answering a list of questions.

This research paper focused on whether these US mitigators actually follow the ASTM International E 2121-08 Standard or not. The three specific areas of focus for this paper are the location of the fan, the location of the discharge piping termination and the direction of the termination. This paper also surveys how some European mitigators mitigate in cold climates.

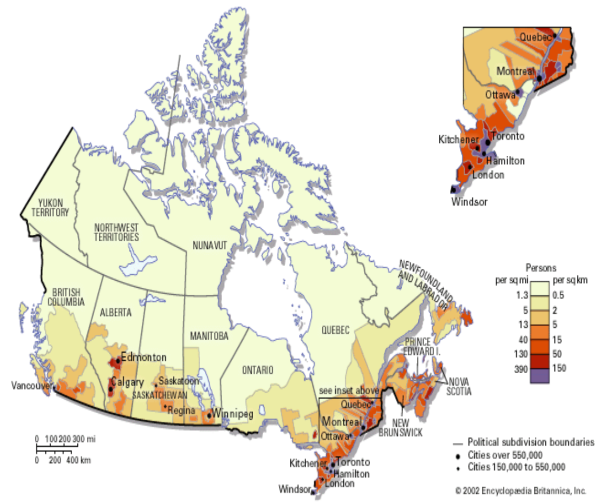
The research will also demonstrate how mitigators actually make these systems work in cold climates; what "w*orkarounds*" have been developed that work within the ASTM International E 2121-08 Standard and where they deviate from the Standard. These USA cold climate working mitigators, who have "*boots on the ground*" experience in successful long term radon mitigations for their clients, have proven to be an informative resource.

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

Cold Climate Radon Mitigations



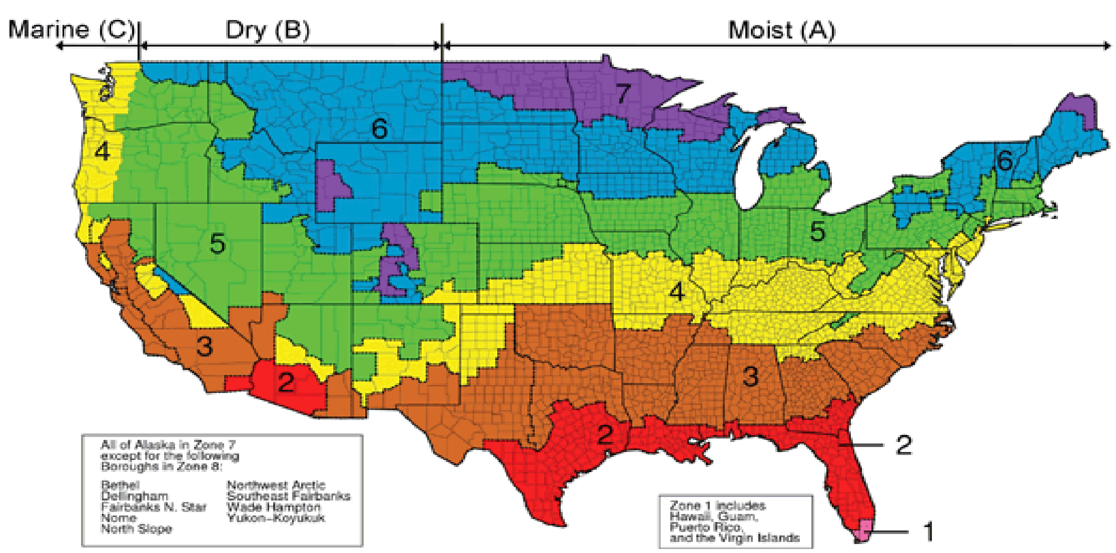
Canada's ASHRAE zones



Canada's Population Density

Canada's highest population density is concentrated very close to the US border. This places most of our population in ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) zone 5 or zone 6. However, we have 4 provincial capitals in zone 7 and 8. While zone 7 and 8 represent a smaller percentage of the Canadian population, there are still millions of Canadians living in those zones.

Mitigators chosen to be part of this survey were selected from their location in ASHRAE temperature zones 5, 6, and, 7 and 8.

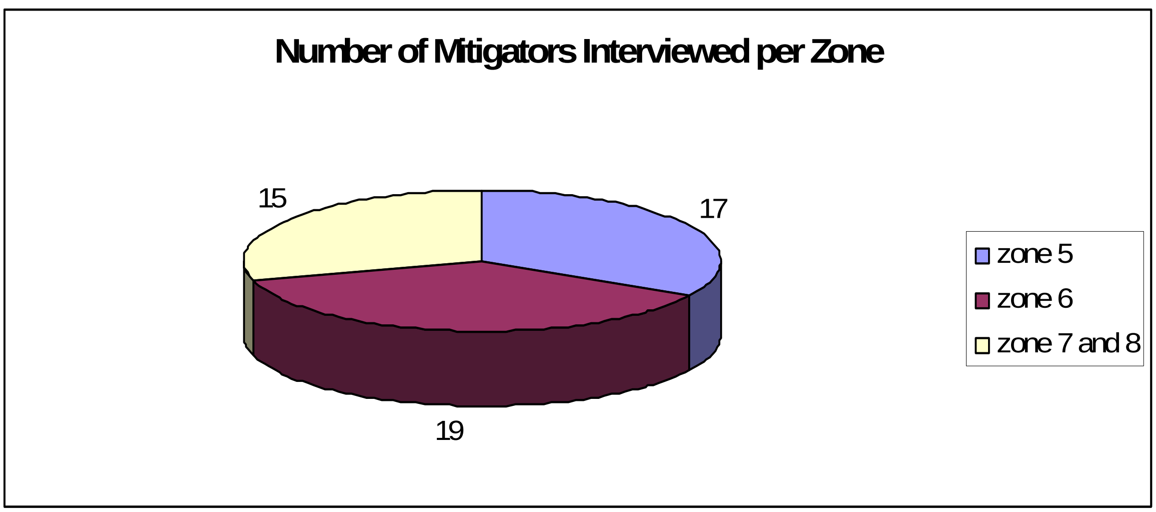


Cold Climate Radon Mitigations

The author's hypothesis for this study was that most of the radon mitigators in the USA follow the ASTM International E 2121-08 Standard with regard to fan location and vent termination in cold climate zones. It was the author's belief that these experienced mitigators will have established good practices as "*workarounds*" to avoid premature fan failures due to icing, freeze up and snow loads.

This paper is the result of tabulating a study of 51 mitigators from the USA and 5 from Europe. The USA mitigators were contacted by telephone and the 5 radon mitigation professionals from Europe were contacted via e-mail and phone. The methodology for these interviews was informal: two radon mitigators had a conversation about radon mitigations; the survey answers were recorded by the author as the conversation happened rather than reading off a list of questions.

Of the fifty one interviews from USA, seventeen are from zone 5, nineteen are from zone 6, and 15 are from zone 7 and 8.



The European interviews are treated separately because of their different construction and radon mitigation methods.

Cold Climate Radon Mitigations

When these USA and European radon mitigators started to talk about radon, it was clear that they were passionate and deeply committed individuals who care about their clients and their craft. These radon professionals are reported to have completed over 8500 cold climate mitigations last year.

The survey of the USA mitigators disclosed that most radon mitigators are owner operators with 49% being single person businesses while 35% have 2 to 3 employees. The balance, 16%, has more than 4 employees. These numbers seemed to have been close across all three ASHRAE zones. Zone 5 has a slightly higher number of 1 man operations reported at 55%. This may possibly be because of the higher number of outside systems reported being installed in zone 5 (fan placed on the outside of home typically at ground level and exhaust is piped to above the eave). These outside systems are reported to be easier to install than inside systems and less expensive.

Most mitigators are fairly busy with average mitigations per month being 13.9. Due to the economic slow down, many reported that they are not as busy as in previous years. The average stood up well for zone 5 mitigators with an average of 13.7 mitigations but went up slightly to 15 mitigations per month for the zone 6 mitigators and falling to 12 mitigations per month for zone 7 and 8 mitigators. Across all three zones most mitigators who were busy (13 or more mitigations / month) were servicing wide geographical areas.

The average cost to install a radon mitigation system in the USA across all three zones averaged $1200.00. The results of the zone 5 data was that mitigations came in at a lower average cost of $1180.00, zone 6 was $1134.00 and zone 7 and 8 $1310.00. 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 per sale is lowered. These numbers appear to reflect the competitive nature of the business. As we headed into colder climates, where more mitigations were “inside”, jobs became more expensive. (Inside systems are where the piping is routed up through the house and fan is located in the attic or garage with discharge typically through the roof). A common complaint of mitigators in zone 6 and zone 7 & 8 was that “the new guy” was doing business below the actual cost of a project.

Authors’ note: These costs in no way reflect what radon mitigations will cost in Canada. *It is my experience that most radon mitigations in Canada will start out in the $2000.00 to $3500.00 dollar range for inside systems (extra if crawl space work is required). If you were recommending outside systems you could see that fall to the $1700.00 to$ 2500.00 range. These higher costs are caused by substantially higher costs for pipe and fittings, fans and specialty radon devices (these often cost double the internet prices by the time they land in Canada), and the requirement in Canada for specialized sub trades (electricians).*

As was expected, 94% of the mitigators provide a post mitigation test and the balance recommend one be completed by a third party. For post remediation testing, 65% provide a charcoal test kit, 16% use liquid scintillation and 19% report using a continuous radon monitor (this is an active electronic monitor that gives hourly readouts of radon levels with a 48 hr average at end of test cycle).

The researcher asked the mitigators where they located the fan. In all three zones, no one chose to put the fan within the living space; 41% of mitigators chose fan placement outside at the side of the home; 51% chose the attached garage; and 8% chose the attic.

When reviewing the different climate zones, we saw a huge difference in practice. In zone 5, 88% were putting the fan at the side of the home (outside system), as a first choice of location, and only 12% were installing the fan in attic of the home or in the attached garage. When asked “why”, the overriding reasons were cost or ease of installation of the mitigation system. In zone 6, only 23% reported using ‘outside on the side of the home’ as their first choice and 77 % are using the attic of the home or attached garage as their first choice of location of the radon mitigation system. When we asked “why” the zone 6 mitigators who chose the outside system as a first choice, they stated that being awarded the mitigation contract in a real estate sale situation was very price sensitive and that outside systems were several hundred dollars cheaper.

Cold Climate Radon Mitigations

Incidentally these were in local markets where the cost of a mitigation system dropped to $800-$900. The mitigators in zone 6 preferred the inside systems as a first choice, stating as their reason the relative warmth of the attic and garage.

In zone 7 and 8, 93% of the fans were being installed in the attached garage or the attic of the home as a first choice of location while 7% were being placed on the side of the home. The overriding reason given was that the attached garage or attic was warmer than outside and often the length of pipe runs that were exposed to cold were shorter. The fan was often placed near the roof as this created a very short run under positive pressure. The smaller group choosing to put the fan on the side of the home cited reduced cost of their outside system as the primary reason for this choice. Those interviewed from Alaska preferred 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 in the manufacturers warranty period he was amazed to see how reliable these fan systems are. The fan manufacturers advised me to expect a failure rate of 2-5%. Most mitigators reported less than 2 new fan failures per year, and over 50% stated that only one or two fans in their career that had failed in the first few months.

For fans older than five years, 26% of the mitigators reported finding no fan failures. For fans that did fail, 11% of the mitigators attributed failures to manufacturers defects (e.g. squeakiness), 49% to old age, 7% to ice damage and 7% to other causes (squirrels and nuts).

The author was surprised to learn that most mitigators, 86%, were not following the ASTM Standard E-2121-08 with regards to insulation of piping where it is exposed to potential of freezing. Most mitigators, when asked, just didn’t think it was necessary, and said that it wasn’t part of their training. A few mitigators from each of zone 6 and zone 7 & 8 stressed it was part of their normal protocols to insulate if they had horizontal runs in cold areas.

Cold Climate Radon Mitigations

All the mitigators surveyed were discharging the soil gases of the radon mitigation system above the line of the eave of the roof, including those in Alaska. Those from Alaska terminate 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 favour of doing nothing. The proactive group had some interesting *“workaround”* solutions. One mitigator always installs black ABS pipe as the last piece of 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 colour on brick homes).

Condensate bypasses were mentioned quite often as a workable solution. Condensate bypasses can be manufactured in the field using pipe fittings or a field installed manufactured system: both systems are designed to allow the condensate water to bypass the fan and drain back into the soil (cooled moist air creates condensate water that will run back down the inside of the pipe). In cold climates if this water is not controlled it will possibly turn into ice on the fan blades and possibly compromise or shut down the radon mitigation system. Mitigators who use these in zone 5 and 6 believed their outside systems operate trouble free with condensate bypasses installed.

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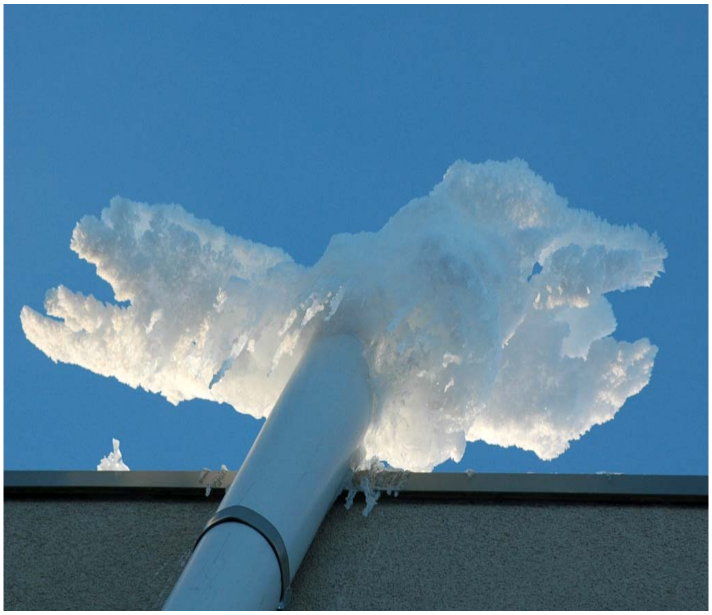
Some mitigators advised not to install a rain/varmint cap as they create an ice ball. They stated that this had been part of their training/mentoring in zone 5. They claimed that “most varmints will not climb up a 600 mm (24”) high pipe to stick their heads into a wind tunnel. Air in a typical 100 mm (4”) ASD vent pipe is travelling at close to 2.5-3.5 m/s (500-700 fpm).



(radon vent, rain cap, ice sculpture photo credit Harry Johnson)

In zone 6, the initial numbers were surprising: 80% of the mitigators said that they do nothing to deal with the potential of icing and fan blockage. The balance installs some sort of condensate bypass (as previously discussed). This was a bit surprising until we dug a little deeper at the survey. Up to 80% of the group that “did nothing” installed inside systems. It is the author’s conclusion, that “do nothing” was really a “do always”, by placing their fans systems, out of the weather, in the unconditioned space of the attic or garage, using foam core or cellular core piping, and perhaps installing insulation on piping.

In zone 7 & 8, 74 % said that they do make adaptations to be proactive in dealing with potential ice ball, icing and fan blockage in winter.

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 25 mm (1”) insulation or install commercial pipe insulation) and go up through the roof. Some other solutions that were offered by zone 7 and 8 mitigators:

Cold Climate Radon Mitigations

32% included the insulation of piping where exposed to cold (they often talked about this being necessary on horizontal runs); using only 100 mm (4 inch) schedule 40 cellular (foam) core pipe came up 66% of the time. Many quoted the insulative value of cellular core pipe. One mitigator always spray paints his last piece of pipe through the roof black, to take advantage of sun warming (He tries to place fan in the attic). Another, if he has an outside run, pulls 13 mm (½ inch) Armourflex insulation inside the 100 mm (4 inch) pipe to create "a neat workmanlike project that just won't freeze". Another installs an 18 mm (¾") valve indoors near the manometer tube and has the customer adjust the opening based on outside temperature. This allows the homeowner to open the valve on the suction side of the fan when outside temps fall below 0 F to allow more heated air into the radon vent piping and help prevent freezing from occurring inside the radon vent piping.

Author's note: *this will increase the chances of back drafting of burning appliances and dangerous levels of CO could result.*

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. Here are the responses to my questions.

Festa International Radon Supply Technologies, Co:

"Festa fans are rated for outdoor use. Festa has no concerns about our fans being placed outdoors in cold temperatures provided:

1/ Install fan in vertical position"

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 our fans 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.”

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”.

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 suggestions quite often had several ideas. One of the requirements that that they would like to see changed was the requirement to have a 100 mm (4 inch) suction header if multiple suction points were utilized. This was an issue for 6 mitigators in zone 5. Their objection was not to this rule when multiple mitigation points were planned, but as a retrofit for those 75 mm (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. Several stated that if a system fails to get radon down in the first attempt it is usually because of tight soils. In a tight soil application, a 100 mm (4”) pipe is not necessarily required, from an air flow perspective.

The issue of staying 3050 mm (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 make sense scientifically. Two mitigators stated that they had not found research to support this requirement.

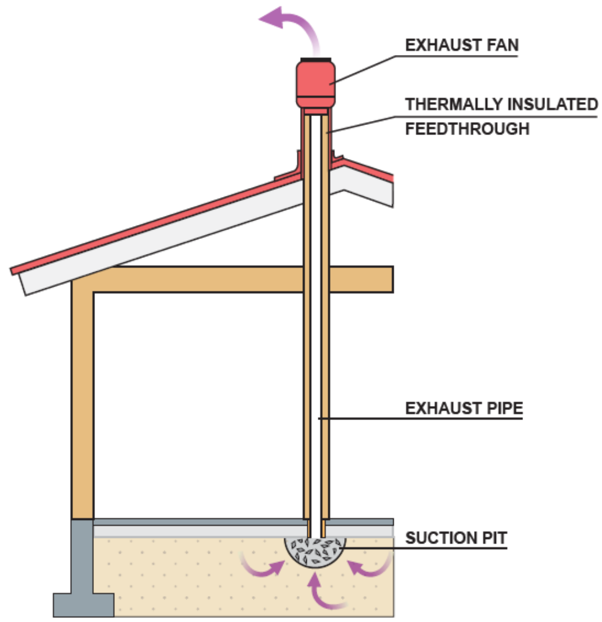
Several mitigators felt the requirement to provide a fire rated assembly at the garage wall and ceiling was excessive, when their system was going in beside other unprotected penetrations to the fire wall, i.e. central vacuum.

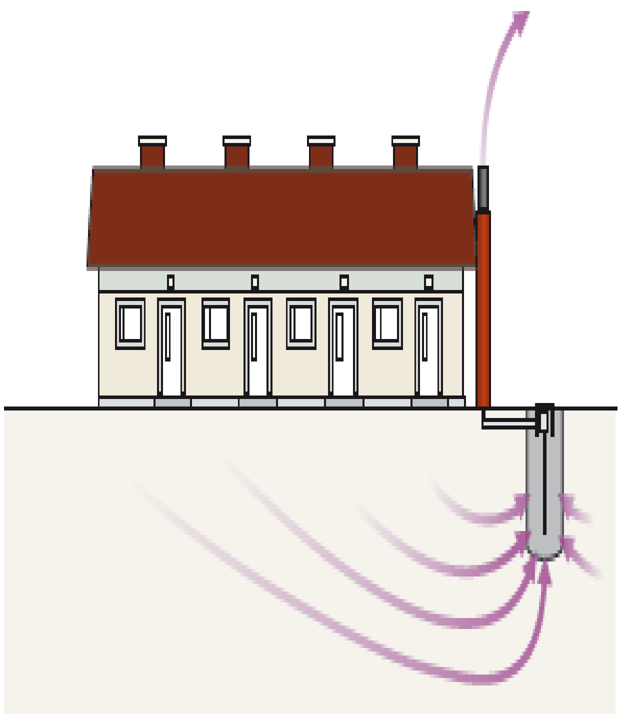
More than half the mitigators working in zone 7 felt that minimum stack size outside should be 100 mm (4”) and minimum schedule for pipe should be schedule 40. Two mitigators pointed out that the manufacturers of schedule 20 (SDR 35) do not support its use above ground. It has no UV inhibitors in it.

Of the mitigators questioned, 6% 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, they thought would 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.”

Cold Climate Radon Mitigations

When interviewing and researching what the European radon mitigators were doing, it was discovered that the Finnish mitigators were mostly installing very similar systems to our active soil depressurization systems. Mitigators preferred to place the fan at the top of the system above the roof, exposed to the elements. The piping was insulated in cold areas of the home.





The Finnish mitigators also have successfully experimented with a system called a “radon well” to fix multiple residences that were in close proximity and that were on highly permeable soils. These were a slab-on-grade construction that is common in many European countries. The author felt that this might not be a viable solution under our Canadian system of property ownership and liability, but may have an application in a one-owner, multiple-unit rental property.

Cold Climate Radon Mitigations

The Swiss contact the researcher made sent this interesting comparison of successful radon mitigation methods. The author suspects these differences are primarily brought on by our radically different construction methods and materials.

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Confederation

Mitigations USA			**Mitigations Switzerland**	
Active Soil depressurization (ASD)	80%		Active Soil depressurization (ASD)	30 %
Passive soil depressurization (PSD)	5%		Passive soil depressurization (PSD)	1%
Ventilation air to air heat exchanger	5%		Ventilation air to air heat exchanger	0%
Crawlspace sub membrane depressurization	10%		Crawlspace sub membrane depressurization	0%
			Crawlspace depressurization without sub membrane	14%
			Depressurization of basement floor	5%
			Depressurization of cellar and lower floor	20%
			Hollow floor or/and walls	5%
			Supply ventilation system, zero air pressure (schools)	10%
			Reduction of house negative pressure	10%
			Combination	5%

[1]

The contacts in the UK by comparison referred mostly to using a radon sump ASD. This was explained to me as a PVC box (a chamber) that they placed under the floor to create a suction chamber. Alternately in the application of slab on grade construction (very common), they place the radon sump outside of building below grade and then piped suction pipes from radon sump to under the slab. They then add a fan and piping to run up the side of home and vent above the eave the same as a plumbing stack.

Conclusions:

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Cold Climate Radon Mitigations

When reviewing the results of research in regards to the author's hypothesis "that most of the radon mitigators in the USA are following the ASTM International E 2121-08 guidelines with regard to fan location and vent termination"; this study found that all of the mitigators interviewed in the USA were following the standards of ASTM International E 2121-08 in regards to the 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 there was no other option, they would the consider locating the fan inside the living space. They had to consider their severe climatic conditions. It was interesting to note that these 2 radon mitigators from Alaska said that most homes in their region were designed with heated attached garages (vehicles just won't start if left exposed to their cold climate) and heated attached mechanical rooms and these were their best choices for radon fan location.

In regard to vent termination, the data from the interviews show again that all are terminating the radon vent piping above the eave.

The results from the data for the direction of vent termination revealed that 96% of those surveyed terminated 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 occur. Should ice form they would prefer it to be on the siding and not as a dangling icicle.

The author was surprised to learn that most mitigators, 86% were not following the ASTM international E2121-08 Standard with regards to insulation of piping where it is exposed to the potential of freezing. This may come from a cost issue, a training oversight, or the problem of making insulated piping look aesthetically pleasing.

While this report was being written, the World Health Organization published (September 2009) its handbook on Radon. In this handbook, in the mitigation section, it shows the fan being located outside of the occupied building envelope and being vented above the eave of the home.

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It is the conclusion of the author from this research that even in a cold climate, radon ASD mitigation systems work and work well. They can be installed by trained professionals in a cold climate situation and meet the requirements of ASTM E2121-08. Cold climate radon mitigations are probably not recommended for the untrained handyman and do-it–yourselfers, as much of the internet radon mitigation advice is based on warmer climate systems.

Fans and piping can be located outside of the building envelope as long as due care for cold climate situations is brought into play. The interviewed mitigators in zone 6, 7 and 8 stressed more care may be required as to the location of the fan in colder environments, and that there is an associated higher cost of attic or attached garage fan location installations. The mitigators stated that this type of installation was selected to ensure that, while exposed to cold, the fan and piping is tempered from the worst of the weather. A few suggested that this inside piping could be insulated using standard insulation (this keeps costs down as weatherproof insulation is very expensive). If the mitigator was installing outside systems they stressed installing a condensate bypass system. They also advised that mitigators needed to be sure to protect the fan from ice falling inside the pipe.

The mitigator may have to make choices around using piping with insulative values (foam core) and utilization of 100 mm (4”) pipe instead of a 75 mm (3”) pipe that could be used in a warmer climate. Piping should be a minimum of schedule 40. 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. Horizontal vent termination above the eave may have to be considered in colder zones of 7 and 8.

This research sought to find if ASTM E 2121-08 could be used to advise Canadian mitigators how to proceed with radon mitigations in our cold climate. ASTM E 2121-08 section X3.4 says “ASD systems of all types carry high concentrations of radon system piping. It is vital that radon fans in ASD systems be located and configured so as to minimize the potential for leaks, in the radon system piping or the fan itself, which result in radon re-entry or re-entrainment into occupiable spaces of the building. To address this issue, this standard of practice limits the location of radon fans in ASD systems to areas outside the building or to non occupiable spaces, which are above the conditioned space of the building. The result is that all radon system piping, which passes through occupiable space is maintained under negative pressure relative to the ambient air. Any leaks, which might develop, in the occupiable space would result in moving noncontaminated air into the radon system rather than allowing soil gas containing high concentrations of radon to escape. This practice is consistent with the management of other hazardous effluents."

This leaves us with three locations for the radon fans and the pressurized piping in most homes. Outside the home at the side of the house, above the home in the attic or in the attached garage if they have one that does not have living space above it. If you are a mitigator located in zone 5, this research suggests that you could choose your primary location for fan and piping at the side of the home as long as you follow good work practices such as schedule 40 pipe, 100 mm (4") pipe, condensate bypasses, locating the fan with a southern exposure, and having it out of prevailing winds.

If you are a mitigator working in zone 6, this research seems to have a mixed message for you. It would seem that picking an attached garage or attic installation as a first choice for fan location would seem to be the best solution. This research also seems to say that if you have a situation that limits those as a first option or that cost is an issue then an outside system with good work practices may still be a workable solution. This will likely result in a higher number of service calls and possibly warranty claims.

If you are a mitigator working in zone 7 or 8 this research suggests that locating the fan in the attic or attached garage is your best option. You also may do well to consider locating the fan as close to the roof as possible to limit condensation on the fan. Adding insulation on the piping may assist in ensuring a trouble free radon mitigation system.

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