PERFORMANCE OF LOW WATTAGE FANS & SMALL PIPE SIZES WITH ASD SYSTEMS

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ABSTRACT

Radon mitigators often use radon fans that are much larger capacity than is needed. This paper reviews the performance of over 200 radon mitigation systems that were installed using a low wattage (14-20 watts) radon fan. The paper also reviews the use of PVC piping that is smaller than three inch and its performance as compared to using standard piping with dampers to control the airflow.

INTRODUCTION

Many mitigators tend to use one particular radon fan for almost every one of their mitigation installations without considerations of optimizing the fan for the particular situation. In fact a predominate number of mitigation jobs could be remedied using any available radon fan if proper slab sealing is done. The author over the last 18 months utilized the smallest available radon fan to successful mitigate over one third of the jobs that were contracted. The following graphs demonstrate the success of this approach. There are a number of reasons why the use of a small fan is warranted.

It is often advantageous in a multi-suction radon mitigation system to reduce the airflow from one of the suction holes in order to minimize its effect on the remaining suction holes. Some mitigators prefer to simply use smaller piping to accomplish this while other mitigators will install a damper in the piping to control the flow. The difference in airflow will be compared using different pipe sizes versus installing a damper.

FAN CHARACTRISICS

The first chart gives a comparison of some common radon fans. The fan performance data was obtained by placing five feet of four inch pvc piping on both the intake and the exhaust ports of each fan and then changing the restriction on the intake port while measuring the static pressure and the airflow. This chart was presented in a paper presented at a previous AARST annual symposium conference. The chart illustrates the variation in maximum fan induced vacuum of about 0.8 to 4.0 inches of static water column. The maximum air flow ranged from about 90 cfm to 225 cfm. The primary fan used by WPB in this study was the RP145. This fan has a performance curve that is in the middle of the group with a maximum vacuum of about 2.1 inches of static pressure and a maximum airflow of 150 cfm. The comparison fan in the study is the HP2133 and RP140. These fans are sold by different radon fan manufacturing companies using different housings but a similar motor. The fan performance of the RP140 although not measured should be similar to the HP2133. This fan has a maximum vacuum of 0.8 to 0.9 inches of vacuum and a maximum airflow with ten feet of four inch pvc pipe of about 120 cfm.

ELECTRICAL COSTS

The wattage of the RP140 and HP2133 is approximately one third of the RP145. Note that in the charts below the wattage is a range. The wattage decreases as the airflow is reduced by increasing system static pressure. In other words when the common system indicator, a u-tube, is showing a large difference in the oil columns, the airflow is low and the system electrical consumption is actually less. To compare the difference between the fans we might use a mid-wattage consumption of 17 watts for the smaller fans and 54 watts for the RP145. If you calculate the electrical cost per year using an average electrical rate of 12 cents per kilo-watt hour it equals $17.87 for the RP140/HP2133 and $56.77 for the RP145.

(Hours) X (Wattage) ÷ (1000) X (Kilo-watt per hour rate) = Electrical Operating Cost

For comparison sake the RP265/HP220/GP501 fans, which have a range of 70 to 140 watts, would cost an average of about $118.79 per year. If you used an average length of home ownership of ten years, the radon system electrical cost over that period would be $178.70 for the RP140/HP2133, $567.70 for the RP145 and $1187.90 for the RP265/HP220/GP501. This last fan group would actually cost more to operate over ten years than a majority of the mitigation installation costs in our area.

OTHER FACTORS

There are a number of other factors to consider in choosing a radon fan. Customers will occasionally complain that the system is audible in the living areas to the point of being annoying. The noise can be from different conditions. The fan itself can be the source of the noise. The airflow through the piping can be the noise source. A vibration from fan blades that are slightly out of balance can be transferring to the living space. It is not unusual to find the radon piping was installed by a builder during the house construction and routed through the interior walls adjoining the master bedroom. Any fan vibration can be easily transferred to the drywall because the typical 3” pvc piping is installed in a wall cavity the exact outside dimension of the pipe. The low wattage fan is considerably quieter than the RP145. It is often difficult to determine if these low wattage fans are even operating unless you are immediately adjacent to the fan.

The low wattage fans run considerably cooler than the RP145 and larger fans. This should translate into a longer lasting fan with fewer call backs for repairs. Of the 315 RP145 fans installed in 2001 and 2002 we had 14 (4.4%) that went bad and required replacement. Although these fans were under warranty it still required a service call, office time to package them up and shipping costs to obtain a replacement fan. This is easily one to two hours of total labor cost plus shipping which would add up to $500 to $1000. There was an initial series of 8 bad HP2133 fans out of the 90 (8.9%) that went bad but it appeared it was only from an early shipment. There was however no failures with the RP140s out of 95 fans put in service.

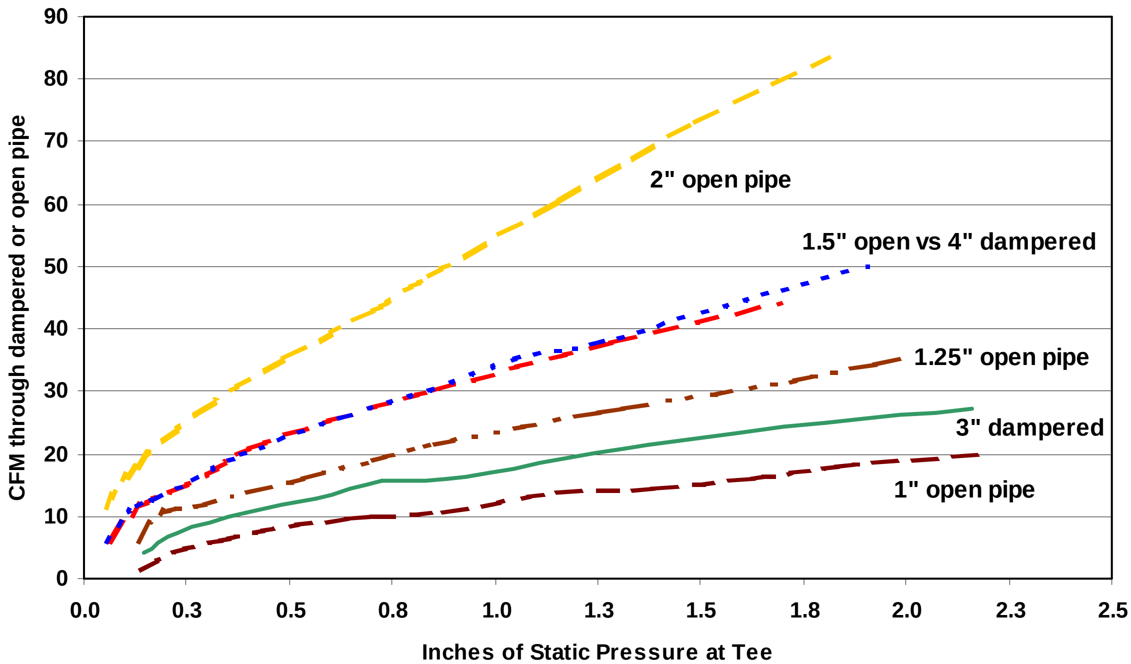
FAN USAGE AND PERFORMANCE

The initial radon levels in the building did not play a part in the selection of a low wattage fan as shown in the comparison graph below. The age of the house did influence the fan selection. Newer homes in our area are more likely to have a very porous sub-slab aggregate layer or even sub-slab perforated piping. This typically allows a single suction location to easily produce a strong sub-slab negative pressure under the whole slab. This is typically the case even though the homes are generally much larger than older homes. The sub-slab communication performance actually has more to do with how well the openings and cracks in the slab can be sealed. Our company policy is to seal all visible cracks that are large enough to get your finger nail into. Sealing dramatically improves the pressure field extension strength. It is not unusual to see the sub-slab negative pressure reading increase by a factor of ten or more. There is often only half a pascal of negative pressure at the farthest distance from the suction hole before the cracks are sealed. This small difference could be easily overcome by house pressures. After the sealing, the pressure difference is often 5 pascals or greater, which would not be over come. In one of the charts below the final sub-slab to basement pressure readings are graphed. Note that the low wattage radon fans actually had greater percentage of systems with higher sub-slab vacuum than the RP145 fan. This is due to the predominate use of the low wattage fans for new homes. Older homes tend to be more likely to have no aggregate under the slab.

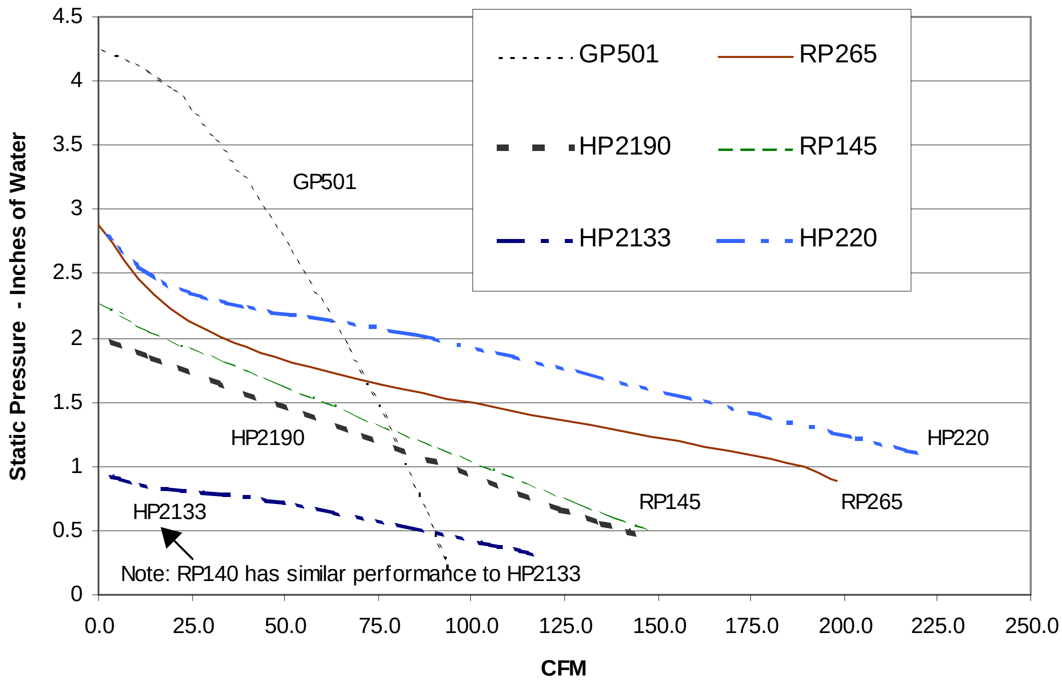
The final percentage radon reduction was actually higher for the low wattage fans than the RP145 fans. This was most likely due to use of the RP145 with more difficult buildings. Even considering this it is obvious that the low wattage fans are more than capable of reducing the radon levels in a significant number of mitigation installations.

REDUCING SYSTEM AIRFLOW IN INDIVIDUAL SYSTEM SUCTION LOCATIONS

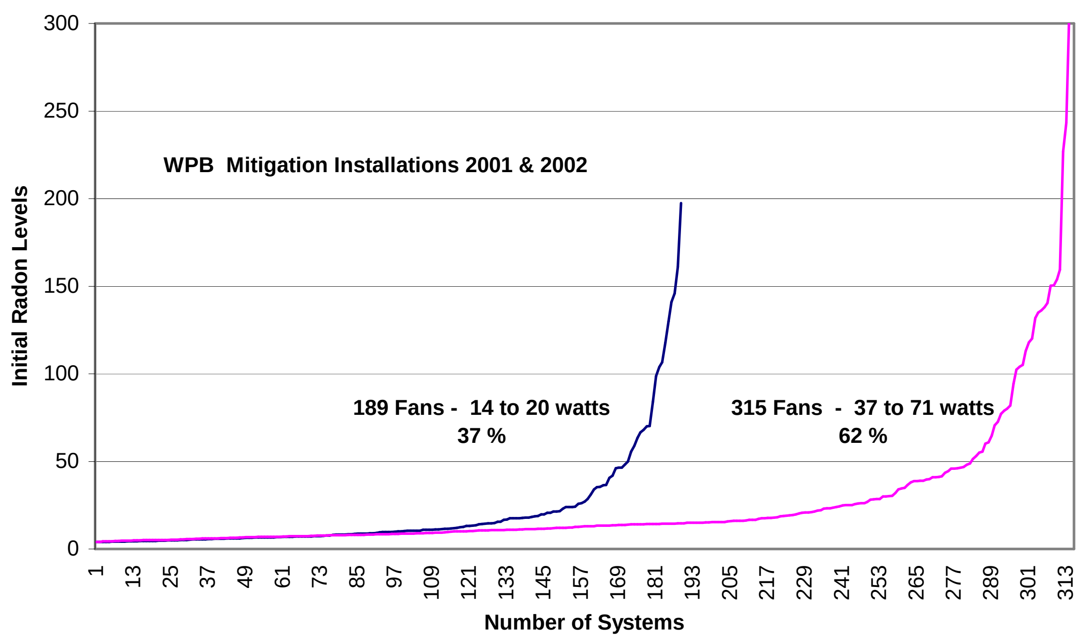
In multi-suction hole system installations the performance of individual suction locations can be significantly reduced if another suction location is allowing a large airflow. This is especially the case if the large air flow suction hole is located on the radon fan side of the piping. Sometimes this high airflow suction location does not require the amount of airflow the system is capable of extracting in order to be effective. It may also be the case that the more significant radon source is from the low flow suction location and not from the large flow location. An example of this would be an older home with a dirt floor crawl space with hollow block walls and a basement slab poured over loose fill. The basement slab will typically be a low flow situation requiring a high static pressure to over come the resistance of the sub-slab soil. The crawl space will tend to be a large flow situation because of the porous conditions of the block wall and the difficulty with sealing the membrane in the crawl space to the exterior crawl space wall. If the crawl space soil barrier can be reasonable sealed it will not require a wide open radon pipe to maintain a negative condition under the new radon crawl space membrane. The last chart shows the amount of airflow through reduced sized pvc piping and different damper usages. The amount of air flow past the damper or through different sized pipe is related to the negative pressure in the pipe induced by the radon fan minus the system pressure drop. Not that an ordinary four inch metal damper has the same air flow as an 1.5" pvc pipe.



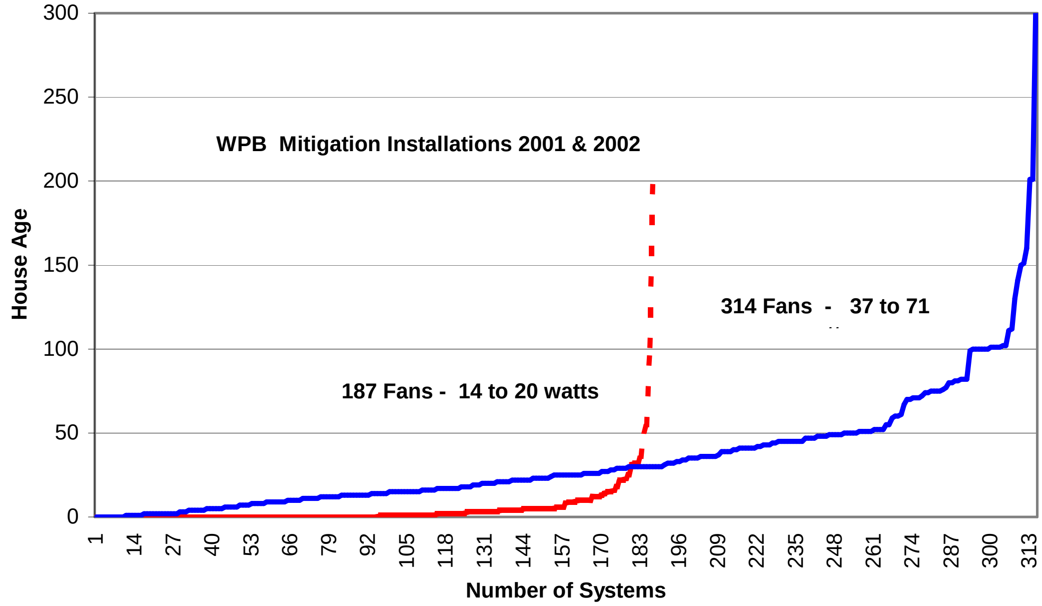
Fan Performance with 10 feet of 4" pvc pipe



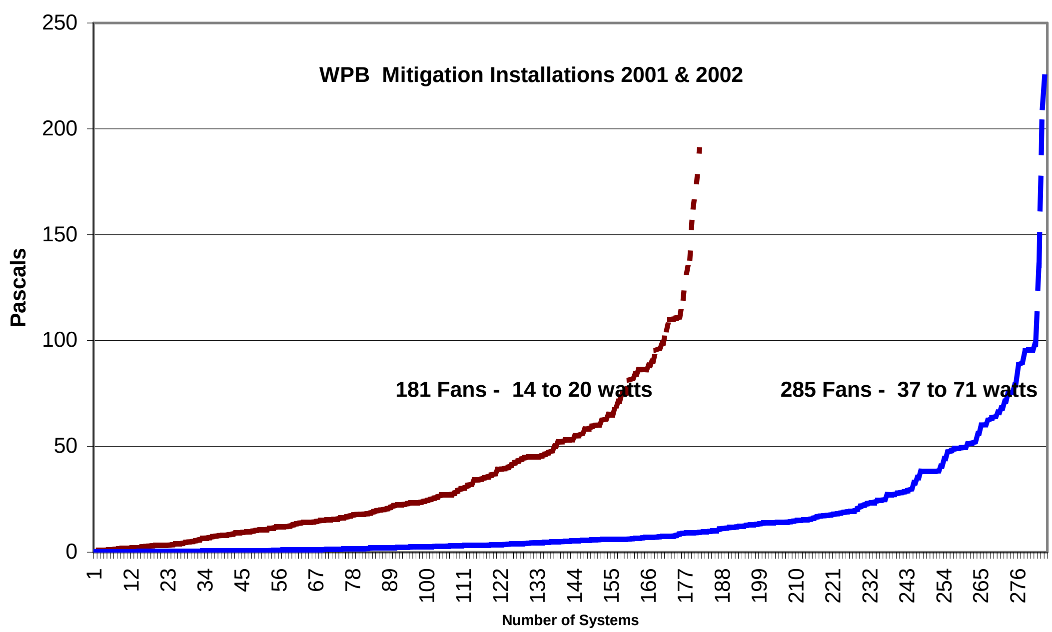
Initial Radon Levels



House Age versus Fan Type



Final Sub-Slab Pressure



Percentage Radon Reduction