RADON TEST TAMPERING: FIVE YEARS OF TEST DATA USING HIGH-RESOLUTION CONTINUOUS MONITORS EQUIPPED WITH MOTION DETECTORS, PROXIMITY DETECTORS, AND TEMPERATURE SENSORS

Keith S. Fimian
Radonics®, Inc./InVision Technologies™
Fairfax, VA

ABSTRACT

Tampering with radon testing devices and/or test conditions in order to disguise high levels of radon has been an ongoing concern for radon professionals. Tampering will continue to be a primary area of concern with the increase in state disclosure laws which require sellers to provide any radon test information they have for the home. The potential for test interference in real estate transactions is real, and is evidenced by a review of the results of more than 75,000 radon tests in the Radonics® database from the past five years. Placing the results in a graph format shows what a tampered test really looks like from the "eyes" of a high-end continuous monitor. The issue has found renewed interest, in large part because of radon litigation taking place in various parts of the country.

INTRODUCTION

Radon programs have been a part of the real estate landscape for about eight years, particularly in the relocation industry where numerous service firms are involved in assisting corporate clients with employee transfers. During that time, real estate professionals have learned a great deal about the unusual and hypertechnical subject of radon measurement, and about the complications attendant to getting high-quality measurements that are adequate to protect their businesses against future liability. It is an issue that all professionals need to be concerned about, be they independent brokers or part of a large, national real estate brokerage or relocation management company.

If one were to ask a group of knowledgeable people, "What is the single largest contributor to unreliable radon measurements in homes?" some would list use of low-quality measurement devices that are unsuited for real-world field application. Others would cite day-to-day fluctuations of radon levels in homes. Still others might mention poorly trained testing technicians. Each of these factors is important; however, measurement experts with extensive experience in the field would not offer these answers. The resounding reply of such experts would be that the greatest menace to reliable radon measurements in all real estate transactions is tampering.

The problem of radon measurement tampering is important - so important, in fact, that prevention and detection of tampering are the cornerstones of any effective radon testing program. While under-qualified technicians, crude testing devices, and the variable nature of radon all can impact measurement accuracy, tampering with the measurements can and does alter results much more dramatically, and always in the same dangerous direction: downward, generating results well below the actual radon level. Further, although discovery of measurement tampering causes some short-term awkwardness for professionals who are out on the front lines - the brokers, the relocation administrators, the inspection technicians - such discovery is of tremendous value to the general buying public at large and, in the long run, serves everyone involved much better than an undetected act of fraud.

RADON IN THE REAL ESTATE TRANSACTION

The purpose of a radon component in a real estate transaction is twofold: public health and safety, and the avoidance of downstream liability. Clearly, the relationship between the two is inescapable, for where there is disregard concerning the dangers of radon, the potential for liability increases dramatically. It is obvious that undetected tampering with the measurement of a radon testing device undermines the purposes of radon testing entirely. Properties with high radon levels that slip undetected into the resale market because of measurement tampering pose a significant threat to everyone involved in the transaction process, particularly the purchaser. Every such property is a potential time bomb. The longer after occupancy the radon problem goes undetected by the new owner, the more likely becomes the possibility of a costly lawsuit naming anyone and everyone associated with the transaction as co-defendants. No one is immune from suit - the real estate company, the brokers, the corporate employer, the relocation management company, the radon measurement firm - and when one hits, words such as fraud and negligence are bandied about with regularity, sullying the reputations of even innocent "bystanders" involved in the crossfire. The real estate industry recently witnessed just such a case in Pennsylvania.

A couple in Allegheny County, a short drive from Pittsburgh, was awarded $30,000 in damages when a Common Pleas Court jury concluded that three real estate agents were guilty of fraud or negligence in 1991 when they failed to disclose a radon problem in the home.[1] The jury found that Phyllis Rosenfeld of Howard Hanna Real Estate Co. and Virginia Clelland and Elaine DeBildt of The Prudential Preferred Realty violated the state consumer protection act.

While the couple, Peter and Sue Ann Radakovich, received less in damages than the amount they sought, the fact that they were successful on the merits demonstrates the very real dangers faced by real estate professionals who fail to take radon seriously. In this case, a 1990 test of the home for a prospective buyer who backed out of the transaction showed basement radon levels of 29.3 picocuries per liter, a measurement well above the 4.0 pCi/L level the U.S. Environmental Protection Agency has targeted as the recommended action level. A second test was performed in 1991 when the couple were negotiating to purchase the home.

The test commissioned by Peter and Sue Ann Radakovich revealed no problem, and the couple went on to purchase the home for $172,500. It is quite possible that the couple would have never considered radon again, but action was prompted when a form letter from a radon mitigation contractor arrived asking whether or not the homeowners were still interested in having the radon problem in the home remediated. A call to the contractor convinced them to test the house for themselves, and after the couple purchased their own test kit, the discovered concentrations of 44.3 pCi/L.

In court, the couple claimed that someone had tampered with the second test as they prepared to close the deal to purchase the home. Suit was filed against the three agents and the real estate firms, the former owners of the home, Richard and Sherry Fila, and the radon testing firm which provided the second test. The testing firm was dropped as a defendant after it filed for bankruptcy.

While the jury cleared all of the defendants of tampering allegations, the case suggests the sway such allegations can have over a jury. The jury determined that agents Clelland and DeBildt had disclosed to agent Rosenfeld that the home had previously failed a radon test, but failed to make known the severity of the radon problem in the home. At the very least, this finding seems to indicate that members of the jury had strong feelings that Peter and Sue Ann Radakovich were victims of a "fast one" by the agents, who apparently were more interested in closing a deal than disclosing a danger.

The Radakovich case may simply be a starting point for the future of radon testing in real estate transactions. This is because the success on the merits and the award of damages demonstrates that plaintiffs can win these kinds of cases. Hence, a precedent is out there for other victims of tampering to use as a guide in the courtroom. Factor in the tremendous legal fees expended by all of the parties in this action and advances in biomedical technology that

[1] Case information taken from news accounts published between April 30, 1996 and May 11, 1996 in the *Pittsburgh Post-Gazette*.

may someday allow scientists to draw more than a correlation between elevated radon levels and lung cancer and it seems obvious that this kind of case will be popular among attorneys. The first lung cancer victim who can demonstrate that his or her disease was caused by elevated indoor radon is likely to extract a healthy judgment or settlement from any "deep pocket" defendant connected to the sale of the property.

THE TAMPERING PROBLEM

The current state of technology does offer proven measurement methods and techniques for continuously monitoring the levels of radon (and the actual cancer-causing radon decay products) during the testing period while simultaneously monitoring other relevant environmental factors and conditions. Just as important is the fact that this technology has enabled radon professionals to reduce the likelihood of tampering, in large part because of the capability of equipment that can actually monitor the occurrence of tampering. Collectively analyzed, the body of information drawn from a continuous monitor radon measurement offers a high degree of protection against radon measurement tampering, to all parties involved, be they home buyers, real estate brokers, or relocation administrators. Before covering the details of such technology, however, a brief digression is necessary to set out a few basic principles of radon measurement.

The two general categories of measurement tampering are tampering with the condition of the air and tampering with the device itself. The "preferred" mode of tampering depends to some extent on the type of measurement device the tamperer is confronted within the home. If a passive device such as a charcoal canister is deployed, the easiest and most effective strategy for tampering is simply to move the device outdoors for a major portion of the test. More creative methods have been devised, however. During a group move, for example, one group of transferees spread the word that applying a fight coating of hair spray to an open faced charcoal canister interfered effectively with the ability of the device to absorb radon.

Tampering with the test device itself is much more rare when the measurement is performed with an active electronic device, particularly when those involved with the testing realize the device is equipped with anti-tampering features. Where such devices are deployed, and where passive devices are augmented with movement detection gadgets, the primary mode of tampering is ventilation of the measured environment. Short-term radon measurements are performed under conditions of limited ventilation ("closed house conditions"), the purpose being to discover how high the radon level inside the structure will climb during periods of non-ventilation, such as the heating season or, in hotter regions, the cooling season. If a property is sufficiently ventilated during a short-term radon measurement (a mere 15 minutes or so of ventilation is enough to corrupt the ensuing 12 hours of test data), the results produced by a passive measurement device will show near ambient levels of radon even in homes where the true radon potential is 100 pCi/L or more.

There are a number of ways to increase the rate of air replacement (ventilation) inside a home well beyond the normal closed-house rate. A whole-house fan can, of course, replace the indoor air entirely in just a few minutes. Opening doors and windows even a small amount can effect significant air replacement and, therefore, dramatically reduce the radon level inside the property. In homes equipped with forced air HVAC systems, the system can be used to distribute outside air introduced on upper levels throughout the entire house. This latter practice, used as a tampering method most often by technically advanced home sellers, is just one illustration of why merely taping windows shut in the testing area is a meaningless deterrent to measurement tampering.

THE CONTINUOUS MONITOR SOLUTION

There are other methods of tampering with devices and ventilation rates and new methods are being invented all the time. As a result, short of posting a sentry inside the tested property, there is no way to achieve 100 percent protection against radon measurement tampering. The question becomes, therefore, one of due diligence: What reasonable means are available for limiting the risk of home seller tampering by rendering such conduct more susceptible to discovery?

Increasingly, radon measurements are being performed with continuous monitors rather than "passive" devices. A continuous monitor is designed to measure and log the radon level inside the property continuously - hence its name. The result from such a measurement, far from the single, "average" number yielded by a passive device, is instead a series of numbers reflecting the radon response throughout the testing period (approximately 48 hours or more for a short-term measurement). This measurement technology provides the home buyer a much more detailed picture of the radon behavior inside the subject property, particularly with regard to abnormal variations in the radon level.

Illustrations of actual field test data best demonstrate the relevant points. Figure I graphs the data from a typical, non-elevated radon measurement taken in Acton, Massachusetts. Notice the many tiny steps along the top fine of the graph; each of those represents a new measurement of the radon level (in this case the radon progeny, as this was a continuous working level monitor), taken continuously and recorded at 15-minute intervals. The data is graphed in real time, allowing the quality assurance technician to correlate any unusual swings in radon level with any relevant meteorological activity (high winds or storms). Notice also the slightly irregular blue and green lines running through the top of the graph, representing temperature and barometric pressure, two environmental factors that can have significant bearing on a radon measurement and that can give considerable insight into whether it was tampered with by someone inside the property. The overall average inside the property tested in Figure I was .0124 working levels (WL), well below the established EPA risk tolerance of .020 WL. The lowest 15-minute measurement after the measuring equipment had reached equilibrium (ramp-up) was .0088 WL; the highest was .0164 WL. This is an acceptable variance during a two-day measurement period, consistent with the known behavior of radon and its progeny.

Notice also the horizontal bar at the top of the graph, labeled "Tamper." Marks along the top of that bar indicate proximity; their appearance shows that someone was present in the testing area within the 180-degree field of "vision" of the measurement device. The darker those marks, the longer was the person's presence in the testing area. Additional marks along the bottom of the tamper bar indicate motion; one of these signifies that someone actually moved the measurement device. There are no motion indicators present on this graph, save for those caused by the technician at installation and pick-up. Note that marks along the tamper bar may be correlated with real time, with the radon levels before and after the proximity and motion activity, and with any unusual changes in the temperature or barometric pressure.

Figure 2 depicts a typical elevated radon measurement taken in Vienna, Virginia. Here the portion of the graph shown in red represents radon progeny levels above .02 WL, the current EPA action level at which mitigation is recommended. You also will notice a pinkish line running along the top of the graph in Figure 2 that is not present in Figure 1. That fine represents the radon concentration. The continuous monitor deployed for this test measures both radon progeny and radon gas. The data here were quite steadily high; out of 191 fifteen-minute measurements after ramp-up, 190 were in excess of the EPA action level. The overall averages for this test were .059 WL and 9.4 pCi/L. The normal ramp-up times, the overall steadiness of the radon response data and the absence of any suspicious activity in the temperature and barometer levels or along the tamper bar suggest that the measurements shown both in Figures I and 2 are valid.

Contrast these with Figure 3, the graphic rendering of a 24-hour measurement tampered with by the "classic cheater." The continuous monitor was installed in a home in Hopewell Junction, New York at 10:20 a.m., as indicated by the beginning of the data collection and the left edge proximity marks on the tamper bar attributable to the presence and activity of the installing technician. The radon level ramps up very quickly, and well beyond the 4 pCi/ L and .02 WL EPA action levels, as indicated by the red delta on the left and the corresponding climb of the pink gas line. Mysteriously, though, the radon level suddenly drops precipitously, all the way down to near ambient levels. But circumstantial evidence is present to help solve the mystery. Exactly coincident with the wildly abnormal drop in radon level is a proximity mark on the tamper bar, indicating that someone entered the room and opened the window(s) or a door at about 12:30 p.m. This interpretation is corroborated by the second mark on the tamper bar, occurring at approximately 7:20 a.m. the following day in anticipation of the technician's scheduled return to the house, and exactly coincident with a second ramp-up of the radon level. Finally, notice also the

corroborative drop in the blue temperature line, consistent with outdoor air conditions during an April evening in New York.

The graph in Figure 3 represents a solid case of transferee tampering by ventilation of the testing area. Review of the parallel data files for this test would show a variance of 30 to 1 between the high and low levels during this measurement period; radon gas simply does not behave that way under prescribed testing conditions. It is, of course, impossible to prove conclusively intent to tamper from these graphics, but there is little doubt that the testing area was ventilated beginning at 12:30 p.m. and ending at 7:20 a.m. the following morning. Hence, the test is invalid. However, had a passive measurement been conducted in this property, it would have yielded a report indicating a radon level of 1.8 pCi/L and the home would have been considered "risk-free" by a prospective buyer.

The property in Figure 3 was re-tested one week later. No tampering occurred during that test and the home was found to contain a solid 12.6 pCi/L radon level. Clearly, a home that may have at one time been considered "risk-free," becomes a potential litigation threat to everyone involved with the real estate transaction because it can and will be argued by the home buyers - with a high level of persuasiveness - that they were victims of fraud.

Finally, Figure 4, from a test in Dover, New Jersey, is included to show the many amazing things that can and sometimes do occur during a radon test. The continuous monitor in this case actually was moved several times (as indicated by the motion marks on the tamper bar), presumably next to a window or actually outside (as indicated by the wild upward and downward spikes in temperature coincident with the motion marks).

The barometric pressure also fluctuated badly. Such abnormal depressurization within a home often is induced by the operation of fans, in further violation of the agreed-upon test conditions. All in all, the owners of this property appear to have had a few laughs over their radon test. Unfortunately for them - but fortunately for the future home purchaser and everyone involved with this real estate transaction - they did not have the last laugh; as the measurement was reported invalid. Absent the continuous data set and the accompanying clues from the tamper bar, the temperature sensor, and the barometer, the parties in the transaction, including the buyer, may well have gotten a report on this property of 3.0 pCi/L. Instead, it was ultimately found to contain elevated levels of radon (5.7 pCi/L) and mitigated before resale.

Worthy of mention here is that the graphics displayed in Figures 1 through 4 are merely a visually useful rendering of all the data gathered by the continuous monitors used for those tests. In reality, there are several files for each of those tests comprising detailed compilations of all the data represented by the graphs. Altogether, it amounts to many pages of specific and revealing quality assurance information for each 48-hour measurement.

Without active, continuous monitor technology of the sort behind these graphics, it is impossible to obtain any reasonable protection against seller tampering in real estate-related radon measurements. Of course, passive measurement devices may be made somewhat resistant to tampering through various means, but none of these is adequate to ensure a high quality, reliable measurement. For example, some passive measurement technicians and vendors place the device in a protective cage or apply some sort of shock/tilt mechanism to deter movement of the device. But such gimmicks do absolutely nothing to prevent simply covering the device, with a plastic bag or otherwise, to prevent the device from absorbing the surrounding radon (applicable to the charcoal canister) or undergoing voltage reduction commensurate with the available alpha energy (applicable to the electret, another radon measurement device that measures alpha energy).

While taping the windows to combat ventilation tampering would seem to solve the problem, this practice fails to address the vexing problem of doors that, when open for even a brief period, will ventilate the house as fully as open windows. It is, of course, impossible to tape the doors shut, as home sellers cannot be entombed inside their homes for several days while a radon test is in progress. Even if this tactic were effective, the crass message of distrust it sends to the home seller can only harm his or her perception of the real estate professionals involved in the transaction process.

AFFORDING THE FIGHT AGAINST TAMPERING

It is the nature of technology to become less expensive even as it advances. The technology of radon measurement and other environmental assessment procedures promises to follow this well established trend. For example, multi-channel analysis technology, only a few years ago beyond the budgetary reach of all but the Pentagon, is now affordable to nearly anyone. In the radon arena, this technology already is being fielded; it allows precise breakdown of the various isotopes of radon progeny, a process which, by itself, eventually may allow conclusive determination as to whether radon measurement was corrupted by ventilation. In Canada, a patent is now pending on a short term radon measurement process that will produce a reliable estimate of annual average radon concentration inside the property. Finally, it is quite likely within a few years that infrared spectroscopy will revolutionize indoor air quality by allowing complete breakdown of an indoor environment into every airborne element present in the room.

Meanwhile, real estate industry standards for transactional radon measurements will continue their evolution toward higher quality and greater protection against seller tampering, even as the cost of such measurements dips below what is currently often commanded by less advanced devices. High-quality radon programs are now only moderately more expensive than the rest, but they have found growing acceptance in various sectors of the real estate industry, particularly with major relocation management companies and corporate employers, because they deliver value in return.

Of course, continuous monitors are not all created equal. In fact, there is a wide disparity between the accuracy, resolution, quality assurance features and additional tamper-detection attributes of the devices currently manufactured. Further, the manufacturing interests are constantly striving toward better product development. Vendor managers must research these differences and developments and seek, as ever, the best value and service available. But there can be scarcely any question about the advantages of continuous monitoring in real estate-related radon measurement, particularly in relocation. Acceptance of contaminated properties into inventory is a risk that can be reduced dramatically through diligent inquiry into available measurement technologies.

CONCLUSION

It would be nice to be able to say that tampering is a rare event among the many millions of real estate transactions closed each year. The fact of the matter, however, is that a temptation does exist for many home sellers to pass a radon problem onto an unsuspecting public. For some, particularly those who believe radon is a minimal or nonexistent threat, tampering has been viewed as an innocent game that hurt no one involved in the real estate transaction. "After all," the thinking goes, "I've been living here for X years, and it hasn't hurt me." Whether or not this attitude changes in the wake of the Radakovich case remains to be seen. What seems clear, however, is the fact that real estate professionals have better things to do with their time and money than defend themselves against allegations of fraud, misrepresentation, and negligence associated with a real estate transaction. This reality alone is likely to bring about positive change in the real estate transaction process, and drive awareness of tampering issues to the forefront, where they belong.

Figure 1

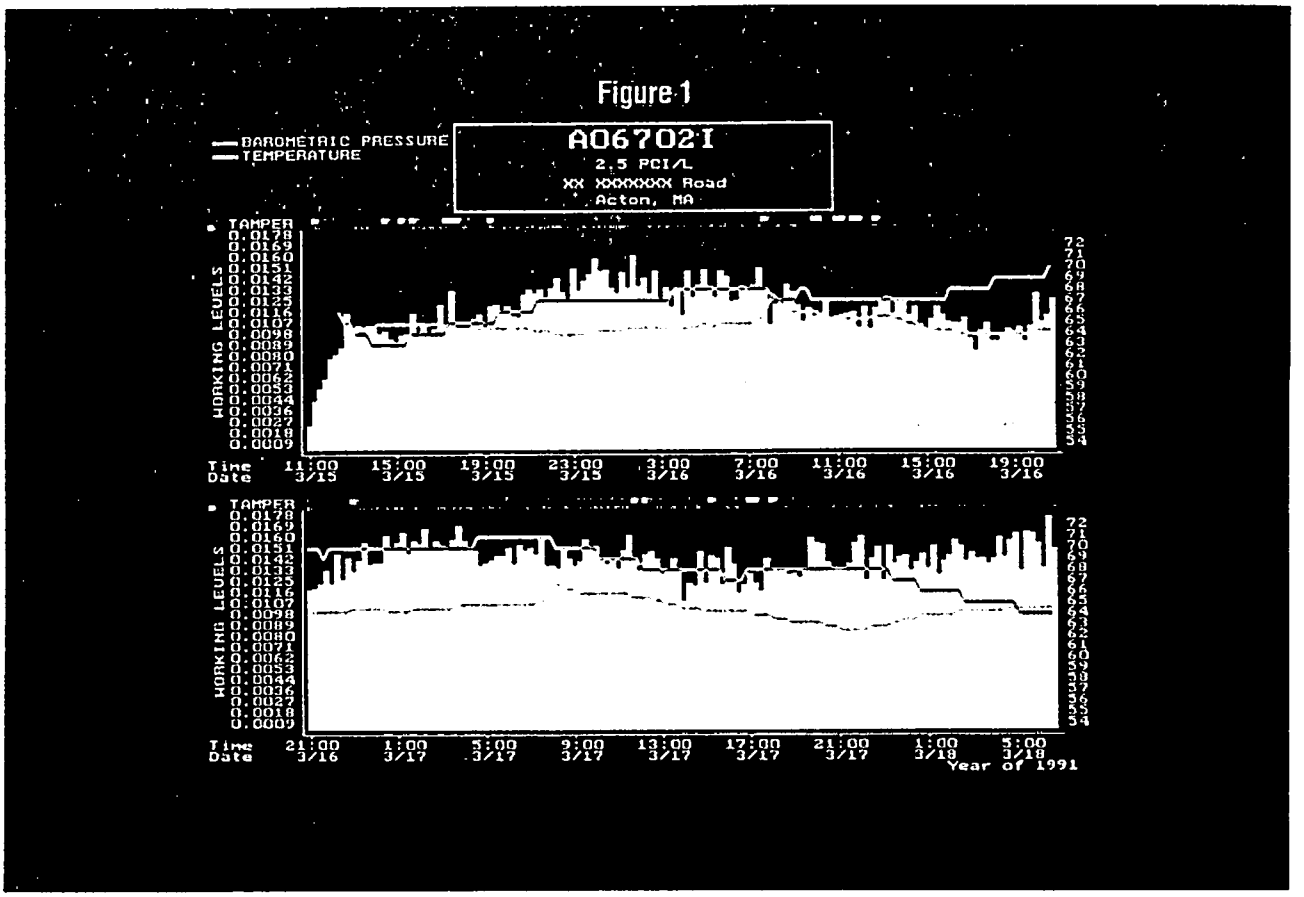

Figure 2

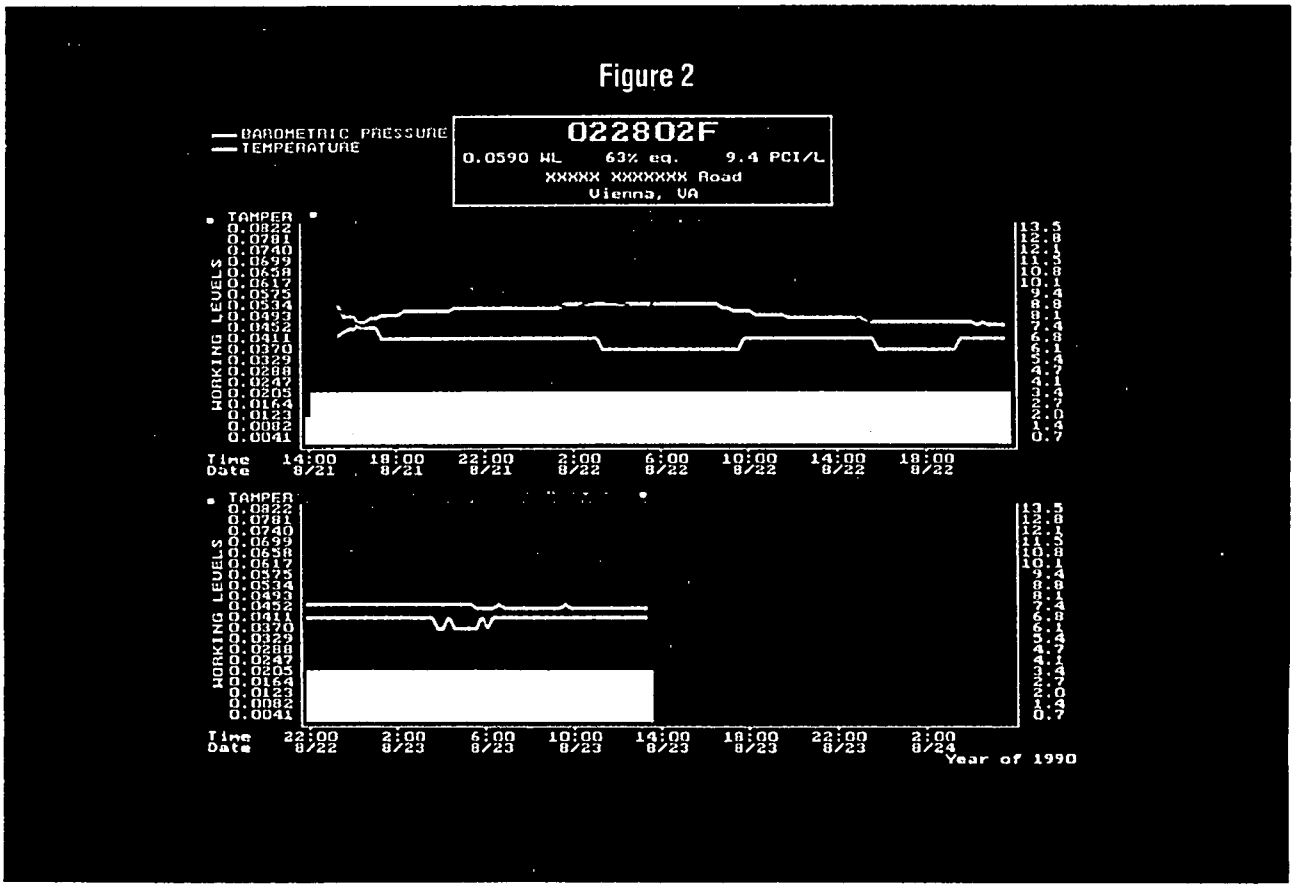

Figure 3

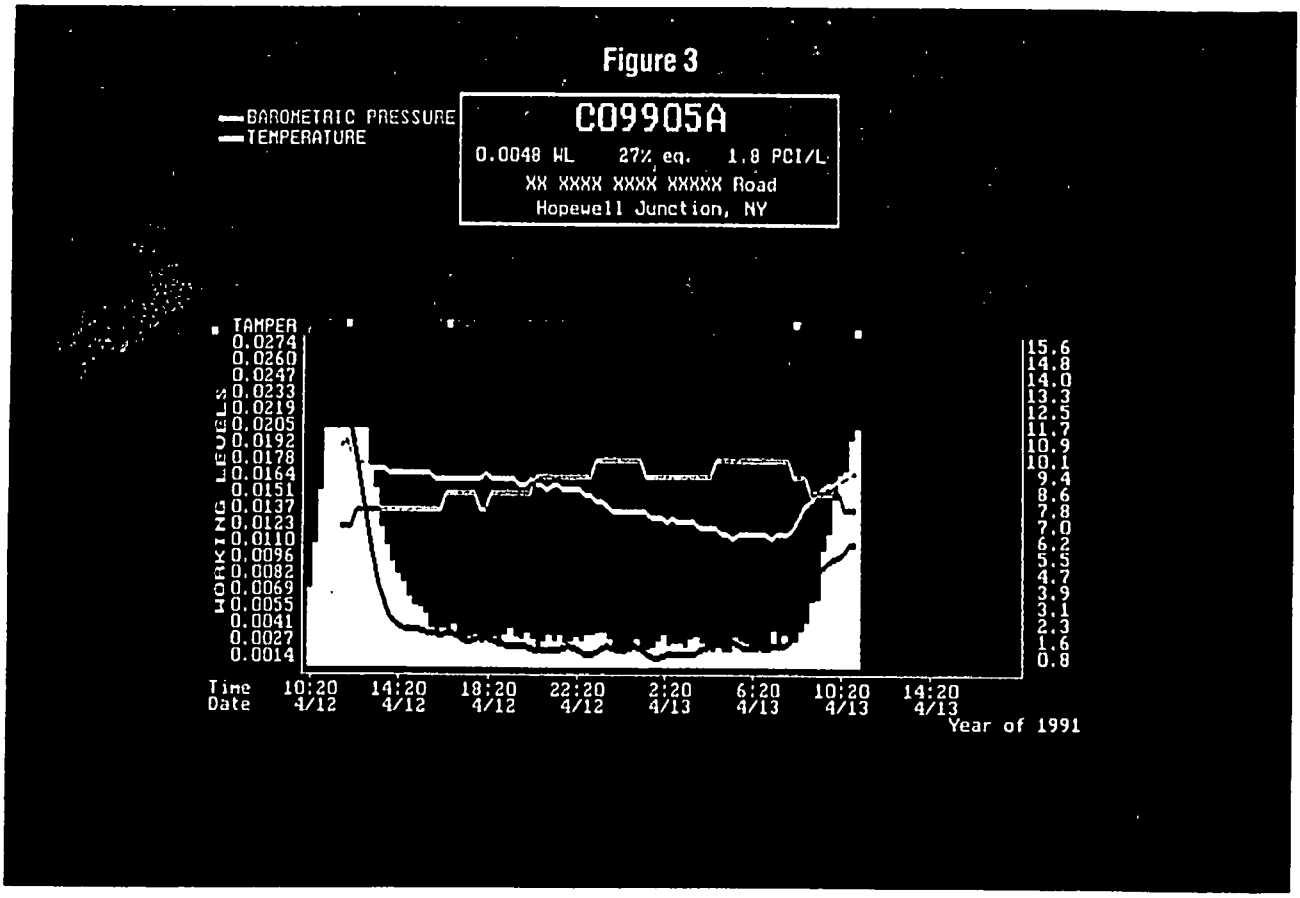

Figure 4