DEVELOPMENT OF ASTM RADON MITIGATION STANDARDS

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ABSTRACT

The American Society for Testing and Materials (ASTM) is a non-governmental organization formed for the development of independent standards on products, materials, systems and services. The Society operates through a hierarchical structure of committees, subcommittees, and task groups, using a voluntary consensus process to establish standards for methods and processes ranging from atmospheric chemistry to ocean floor drilling. In 1990 a Task Group on Radon Mitigation in Existing Residential Homes was established to develop standard practices for installing radon control systems. The Environmental Protection Agency (EPA)'s radon mitigation standards were used as the basis for the ASTM's first draft and the EPA effectively assumed the lead in developing ASTM standards which would be compatible with its own. During the past five years substantial progress has been made in the development of this standard; but the Task Group's difficulty in distinguishing between its technical guidance and the EPA's policy guidance remains a serious obstacle to consensus and the promulgation of a standard.

INTRODUCTION

The American Society for Testing (ASTM) was incorporated in 1902 as an independent organization which operates through "rigorous democratic procedures"[1] to ensure the development of consensus documents. These procedures include meetings of task groups and committees, and a hierarchical sequence of balloting on proposed standards before any such standards are submitted to ASTM for final balloting and approval.

Following the publication of the EPA's first citizen guides to radon in 1986, discussions began on the subject of developing standards for the installation of radon control systems, and in 1990 an ASTM Task Group on Radon Mitigation was formally established.[2] Initial meetings of the task group in 1990 and 1991 failed to produce any clear direction or working draft, and in 1992 the EPA offered both. In the previous year the EPA had published their interim standards for radon mitigation,[3] and it was working on a revised and expanded version of these standards. Dave M. Murane, working for the EPA's Radon Policy Office, had recently completed development of the EPA's new construction standards for radon prevention and was assuming responsibility for revision of the EPA radon mitigation standards. Accordingly, Murane was asked to chair the ASTM task group in addition to his responsibility at the EPA.

1992 - THE INITIAL EPA/ASTM DRAFT

The ASTM task group met in October, 1992, reviewed the EPA draft mitigation standards, and directed Murane to rewrite the draft as an ASTM Standard Practice[3a] , and delete sections which referred to specific the EPA policy requirements.[4] A revised draft was circulated to the task group in December [5] . Contrary to the task group's directives, however, the expanded draft included new policy requirements from the EPA. In contrast to the the EPA's interim standards of the previous December, which were barely four pages long and included only two substantive technical requirements for the installation of radon control systems, the ASTM draft circulated in December enumerated approximately one hundred requirements, many of which were, arguably, matters of policy rather than technical guidance. For example, the draft required that contractors review test data with clients, advise clients of health risks (referencing only the EPA documents), provide clients with Material Safety Data Sheets, develop detailed building sketches, comply with federal laws, have suitable fire protection, etc.[6,7,8,9]

When this draft was circulated to task group members in December, 1992, it was hoped that changes could be made in time for a sub-committee ballot before the next committee meeting in March, 1993.[10] This expression of hope was ephemeral. The draft generated substantial criticism, both of the technical issues and of the EPA's policies.

1993 - INCREASING DISCUSSION AND DISSENSION

The Sub-committee met again in March, '93, in Atlanta, and in August a revised draft was submitted to ASTM for balloting. Prior to submitting this draft, however, Murane not only made revisions to accommodate the problems of the December, '92 ballot, but made additional changes to reconcile the ASTM draft standard with the EPA draft standard which was under parallel development.[11,12] This new ASTM draft included two significant changes. First, a section was added requiring back-drafting tests[12a]. The EPA had issued an addendum to its interim standards with this requirement, but the requirement was problematic for several reasons, including the fact that it required mitigation contractors to perform time-consuming tests on houses prior to beginning, or even bidding work; and there was no consensus standard which could be referenced for performing the necessary tests.[13] The second change which was made was more far-reaching. Prior drafts had stipulated what "should" be done. In this draft, it was explicitly stated that the standard was "not intended to represent either minimum or maximum acceptable practices and should not be universally applied".[14] However, the word "shall" was inserted in the document more than 100 times, thus effectively requiring virtually all of the practices be universally applied. In contrast, the word "should" was retained in about a half dozen instances.

A variety of responses were received to this draft ranging from specific technical issues to the broader issue of making all of the requirements mandatory.[15,16] When the task group met again in October, '93, in Dallas, the negative ballots were reviewed and it was decided that a revised draft would have to be circulated before being resubmitted for balloting "because of the significant changes need to accommodate the comments"[17]. It also was noted in these comments that the document was out-dated because it failed to reference the Third Edition of the EPA's Technical Guidance manual which had been released in the meantime.[18] This draft was circulated in November[19], but apparently without significant change.

1994 - FUNDAMENTAL POLICY DIFFERENCES

By early 1994 it was clear that objections to the November draft were substantial, and this was underscored by additional responses submitted in January in February.[19a] Despite the task group's initial direction that the ASTM standard should avoid policy and focus on issues of technical guidance, the draft was still significantly shaped by the EPA policies it included. The EPA had decided to revise its Radon Mitigation Standard (RMS)[20] in parallel with the development of the ASTM standards, so that its policy could reference the technical guidance developed by ASTM. Issues which were incompatible with the EPA policies apparently were not submitted to the Task Group for consideration, regardless of the technical arguments which had been received from professional mitigators. Two issues in particular clearly illustrate this problem: fan location and sump sealing.

Fan Locations

In 1991, when the EPA published its first standards for mitigation systems, it contained only two fundamental technical requirements: 1) that fans be placed outside the building space, and 2) that the exhaust be vented away from potential re-entry routes.[21] The requirement that fans be placed outside the living space was based primarily on the argument that this would create fail-safe systems because it eliminated the possibility of suddenly elevated levels occurring as the result of leaks in the system.[22] The EPA requirement was based on evidence of leakage in early, unsealed, fans which had been mounted directly to pvc pipe in the mid-1980's. The problem of leakage from these systems had been identified by late 1986 or early 1987, however, and by 1990 the common practice used factory-sealed fans,mounted to solvent welded pipe with flexible couplings. Under these circumstances, it was argued, the possibility of such leaks is small and there was no evidence that they were actually occurring.[23]

Although this issue appears to have been decided by the EPA as a matter of policy, there are technical questions which are relevant to it: can fans designed for radon applications be "leak-proof;" are the flexible couplings used in radon applications subject to deterioration; can systems be tested for positive pressure leaks; what data is available regarding actual system failures from positive pressure leaks? In order to reach a sound technical judgement, it would seem that answers to questions such as these should be the basis of an ASTM technical standard.

Sump Sealing

A second, similar issue regards the requirement to seal sumps. The July '93 draft included the requirement to provide "a trapped drain(s) with an automatic supply of priming water or with a check value to provide protection... a high-tech, high-cost solution to a simple problem." If there was no requirement for sump sealing, then the possibility of surface water drainage in the basement could be accommodated by simply drilling a 1" hole in the sump cover to allow drainage and design the system to accommodate the additional airflow.[24] The additional airflow would be insignificant, as a 1" hole at a pressure of 1" W.C. allows only 13 cfm of air flow and systems with sumps and drainage fields would be expected to draw between 100 and 200 cfm; but the issue was problematic because it questioned the more fundamental issue of requiring the sumps to be sealed. As with the questions raised about fan locations, the decision about sump sealing should be made on the basis of technical evidence rather than by fiat..[25]

In May '94 a revised draft was again prepared without responding to these objections.[26] In October the Standard was voted on again by the Sub-Committee and nineteen votes were cast in the affirmative; two were cast in the negative (although none of the professional mitigators who were engaged in the process at this time were part of the formal balloting). In December, 1994, a new draft was proposed which included many minor editorial changes, and which restructured the section on mitigation systems to reflect the organization of the Third Edition of the Technical Guidance Manual which had been published by the EPA.[27,28] In March, 1995 the task group met again, a revised draft was again circulated, and extensive comments were received, including the following comments on the difference between "should" and "shall":[29]

"The word 'should' is used throughout this document to indicate a general obligation, as distinct from an absolute requirement, which is dictated by the word 'shall." There is a series of three questions which may be used to determine the appropriate requirement, and therefore the appropriate word, in this document: 1) does the requirement provide a measure of safety in most, if not all instances, 2) are there reasonably foreseeable situations in which the requirement provides little or no measure of safety, and 3) are there reasonably foreseeable situations in which the requirement would be counterproductive...If the requirement provides a measure of safety in all situations it is appropriate to require it with the word 'shall'. If it does not provide a measure of safety in all situations, or it may be counterproductive, then 'should' is more appropriate."[30] These written comments led to further discussions of the subject (at the EPA), but no changes. In October, 1995, the Task Group met in Orlando and in January, 1996, another draft was circulated.

1996 - APPROACHING A STALEMATE

In January, 1996 a draft was circulated to members of the task group. "This informational draft," it was noted in the cover letter, "includes all of the changes resulting from decisions made at the October 1995 meeting of the E0641.3 (sic) Work Group as well as changes resulting from subsequent meetings and discussions with the EPA Staff and ASTM members who submitted negative ballots..."[31] Unfortunately, it neither addressed nor resolved the various substantive technical objections cited in this review. Rather, it reiterated the EPA's position. "Reviewers should be aware," the cover letter continues, "that...EPA intends to cite this ASTM Standard Practice as the primary source of technical guidance to radon mitigation contractors. It will be a substitute for the technical portions of the current EPA Radon Mitigation Standards (RMS).[32] "

Since 1992 the work of the task group has been dominated by the EPA -- which has paid for the work of the Chairman, first as an employee and later as a consultant -- and sparsely attended by professional radon mitigators. While considerable progress has been made, efforts by professional mitigators have been largely limited to written

critiques of proposed drafts and substantive questions in conflict with EPA policies have been repeatedly dismissed. Thus, after more than five years work and substantial progress, a consensus appears unlikely at this time.

Underlying this stalemate are several key issues. First of all, it is unclear whether the work of this task group would be more appropriately spent on a Standard Guide, rather than a Standard Practice. The mandatory nature of a "practice", which is a definitive procedure, may not be appropriate to the variety of structures and circumstances found in retrofitting existing homes with radon mitigation systems. Secondly, a consensus must be reached focussing on technical issues and leaving policy issues, as much as possible, aside. Thirdly, important technical issues which have been raised during the past five years should be reviewed, and, to the extent possible, resolved on their technical merits.[33] To achieve these objectives, it would probably be desirable for the EPA to relinquish the lead role it has assumed in this effort and allow ASTM to develop and independent technical standard. Once that standard has been established, the EPA Radon Mitigation Standard could be revised on the basis of EPA's policies for participation in the Radon Proficience Program, and the ASTM technical standard could be referenced by the RMS where appropriate. The result would be a better process and a better product.

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[1] Regulations Governing ASTM Procedures, ASTM, 1992,

[2] The task group was created in the Committee on Performance of Buildings (E06) Subcommittee on Infiltration in Buildings (.41) Task Group on Air Infiltration (.09). Thus it was officially created as the Task-Group on Radon Mitigation in Existing Residential Homes within the E06.41.09 Task Group.

[3] EPA's Interim Radon Mitigation Standards had been developed and published pursuant to a congressional mandate under the Indoor Radon Abatement Act of 1988

[3a] A "standard practice", in ASTM terminology is "a definitive procedure for performing one more specific operations...", such as procedures for conducting interlaboratory testing programs, ASTM Regulations Governing ASTM Technical Committees, July 1992

[4] Memorandum from David M. Murane, dated 12/01/92.

[5] ASTM Draft Standard Practice for Installing Radon Mitigation Systems in Existing Homes, 11/18/92

[6] ibid

[7] [ib]id, 6.3.1

[9] ibid, 6.1.1; it was also noted in comments to this provision that the requirement was absurd and unconstitutional: "If one want to argue that radon mitigation contractors should be experts in health risk analysis -- a notion akin to requiring that plumbers be experts in sanitary engineering -- then they should be familiar not only with EPA's guidance on the health risks, but also the contrary opinions offered by the National Academy of Sciences, the World Health Organization, federal agency and other countries which have offered different guidance." M. Messing, comments dated December, 1992

[10] D. Murane, Memorandum, op cit.

[11] [D]raft dated 7/22/93

12 D.Murane, Correspondence to Ms. Carolyn Thompson, ASTM, dated 2 August 93.

[12a] Draft dated 7/22/93, sec. 7.2.4

[13] The draft did reference other test procedures; however, the test procedures were complex and considered unsatisfactory by ASTM task groups working on the problem of establishing back-drafting procedures.

[14] Draft dated 7/22/93, sec. 5.1

[15] Because ASTM welcomes all expert assistance in developing standards and the process is voluntary, there are no ASTM membership requirements for participation in the various task groups and committees. It is unclear whether any professional radon mitigators were members of either the task group or the parent committees in 1992; however, extensive comments were submitted by J. Masson of Protech Environmental Services and M. Messing of Infiltec Radon Control.

[16] Comments of J. Masson, Sept 19. 1993; , Comments of M. Messing, 1 Oct 1993

[17] Memorandum from D. Murane to Task Group, dated 3 Nov 93

[18] EPA, Radon Reduction Techniques for Existing Detached Houses; EPA/625/5-93/019, 1993.

[19] Draft 10/28/93

[19a] Comments of W.P.Brodhead, dated 21 January, 1994; comments of M. Messing, dated 20 Feb 94; because these professional mitigators were, apparently, not formal members of the task group, they did not received task force drafts directly, and responses were often out of synch with the group's progress.

[20] The Interim Mitigation Standard had been supplanted by the RMS and was revised again in April, 1994; at this time

[21] "Depressurization system fans... **shall not** be installed in the conditioned (heated/cooled) space of a building, or in any basement, crawlspace, or other interior location... (and) exhaust vents from depressurization system fans... **shall** be discharged according to all of the following requirements: 1) the discharge point **shall be** ten feet or more above ground level, 2) ... (away) from any window, door, or other openings ... 3) away from any private or public access, and 4)... (away) from any opening into an adjacent building." All the other requirements were essentially procedural. EPA, Interim Radon Mitigation Standards, December 1991.

[22] In all active soil depressurization systems -- which probably constituted more than 95% of all radon control systems being installed by 1994 -- the system between the soil and the fan is under a constant negative pressure as soil gas is drawn into the fan. Any leakage in this part of the system, in the pipe or in the fan, is unlikely to cause leakage of radon gas into the house because the system is under a negative pressure. Household air is more likely to be drawn into the leak. The part of the system from the fan to the exhaust point, however, is under positive pressure, and any leakage in this part of the system would force soil-gas borne radon out of the system and into the surrounding area. If that area is in the house, and if the soil concentrations of radon are sufficiently high, the result would be sharp increases in the indoor radon levels. This scenario of an undetected positive pressure leak inside the building space is the only "catastrophic" failure mode that has been identified with radon systems. If systems shut down, radon levels would be expected to rise no higher than pre-existing levels; if leaks occur in the negative side of the system, no increases would occur (except through secondary system degradation); but leaks in the positive side of the system could results in radon levels far higher than any pre-existing levels, and, in the absence of radon measurements, there would be no way to detect such severe and sudden increases. Requiring the placement of fans outside the building envelope therefore eliminates the only catastrophic failure mode associated with radon control systems. This was well understood by the late 1980's and therefore part of the first interim standards.

[23] J. Masson, Comments dated .... It was also argued that interior fan locations would entail simpler wiring, longer fan life, easier detection of failure, fewer chances for damages, lower installation costs and enhanced aesthetics..

[24] M. Messing, op cit

[25] Following the lack of a response to these questions, the argument was carried forward in an article in the Indoor Air Quality Journal", October, 1995: "The leakage area around the circumference of a 24" inch sump yields less than 1/10 the leakage area around half the perimeter of a 30' x 40' basement (assuming comparable leakage around the sump and the perimeter). If suction were applied to the sump it is conceivable that this leakage could short-circuit the system and prevent an effective pressure-field. But if suction is applied away from the sump, a covered -- but unsealed -- sump yields no more leakage area than that accepted at floor wall joints behind inaccessible walls. And if pressure were to be applied to the sump and the pressure-field extension were found to be in adequate, it would be trivial to seal the sump. The important issue here is that EPA protocols require sumps to be sealed in all cases: despite the fact that it is technically unnecessary, it adds some additional expense, and it creates justified consumer anxiety about sump repairs.

"These issues also relate to the attendant requirement that sump covers be fitted with water traps or mechanical traps. These also add to consumer costs, provide no additional benefits, and are unnecessary if the sump cover is left unsealed. (In some instances it also might be desirable to seal the sump for stability and drill a 1" drainage hole in the cover rather than fit it with a mechanical trap.) In low-pressure/high flow systems such as sump pump depressurization, the air leakage from an unsealed sump cover or a 1" drainage hole is generally insignificant, both in terms of maintaining pressure field extension and in terms of energy losses.

"Ironically, while there is no downside to the removing the requirement to seal sumps, there is a very serious potential danger to EPA's current requirement to seal the sumps; namely the potential for flooding. Even though the protocols require a trapped drain to provide drainage, malfunction of the drain could cause flooding, and flooding creates the possibility of both property damage, and, in the worst case, electrocution."

[26] Draft, 5/15/94

[27] Some confusion surrounds the origin of this draft. It was David Saum's understanding, as Chairmen of the Task Group on Radon Mitigation, that Dave Murane had resigned as Chairman of the Task Group following the October ballot because he was retiring and leaving EPA. Accordingly, M. Messing and D. Saum revised this draft on the basis of the comments received to the October ballot and restructured the section on mitigation along the lines of EPA's Technical Guidance manual. The draft, dated 12/15/94 was then reviewed by D. Murane and D. Saum before being submitted for balloting in January, 1995

[28] The structure defined seven categories of active soil depressurization systems and addressed the requirements of each of them specifically: Active Soil Depressurization, Sump Pump Depressurization, Drain Tile Depressurization, Sub-Membrane Depressurization, Block Wall Depressurization, Crawl Space Depressurization, and Pressurization.

[29] The distinction between "should" and "shall" may, in fact, be subordinate to the distinction in ASTM terminology between standard practices and guides: "whereas a practice prescribes a general usage principle, a guide only suggests an approach. The purpose of a guide is to offer guidance, based on a consensus of viewpoints, but not to establish a fixed procedure. A guide is intended to increase the awareness of the user to available techniques in a given subject area and to provide information from which subsequent evaluation and standardization can be derived." Op Cit.

[30] M. Messing, comments dated 4/14/95. Because of confusion regarding the Chairmanship of the Task Group during this period, it is unclear which was the "official" draft at this time, or whether these comments were read in response to the draft to which they responded.

[31] D. Murane, letter dated January 31, 1996

[32] ibid

[33] EPA has, apparently, circulated a more recent draft to EPA reviewers. This issue, dated 8/9/96, was not received in time for review in this paper.