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Legal Aspects and Implications of the Expanding Use of Building Diagnostics

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Building diagnostics is the process by which a professional “diagnostician” utilizes a variety of instruments and techniques to assess the performance capabilities of a building. Diagnostic tests have become increasingly important in the construction of a new species of building known as “smart buildings.” These “smart buildings” are equipped with integrated electronic and computer systems analogous to a body’s central nervous system which links temperature control, lighting, energy management, fire, security, data processing, telephone, personal computers and video into one huge customized network. Diagnostics can be used to evaluate the present state of a building. It is a process where a skilled expert draws on available knowledge, techniques and instruments in order to predict a building’s likely performance over a period of time. Diagnosticians use a variety of techniques ranging from visual inspection to sophisticated sensors, telemetering systems and computers.

Diagnostics employs both the social science knowledge of human needs in a work environment and the physical science knowledge of the mechanical operation of the systems within the building. The instruments of building diagnostics include a range of tools, such as—interviews, questionnaires, user surveys, checklists, measuring devices, remote probes, indicating and recording devices, and computers. These measurements, however, are not the essence of building diagnostics. The essence of diagnostics lies in the ability of the diagnostician to translate the measurements into an assessment of the building’s present performance capability, and to extrapolate that assessment to a prognosis about the likely performance of the
This paper addresses some of the legal issues raised by the increased use of building diagnostics in the planning, construction, acceptance, and post-acceptance evaluation of new and renovated structures that include or incorporate substantial electronic enhancements, i.e., heating, ventilation, and air-conditioning systems, telecommunications, fire and safety, and security systems.

From a legal prospective, conventional building construction (or renovation) proceeds in four stages: planning and design, construction, acceptance, and user occupancy. Building diagnostics is increasingly used in the planning and construction of high-technology structures, e.g., for simulation purposes in the design phase, or to confirm that specifications are being met during construction. At the present time, however, the principal applications of building diagnostics in the construction of high technology buildings are in the acceptance and post-acceptance (i.e., warranty) phase of the project. Here, the twin abilities to assess present and future performance make diagnostics a particularly useful tool. The parties first confirm that the project has been completed in accordance with the specifications so that responsibility can be transferred from the construction company to the owner and final payment made, and later determine whether problems that appear are covered by the contractor's warranty.

To a certain extent, the use of building diagnostics in acceptance and warranty applications is more "relevant" from a legal point of view than planning or construction. This paper focuses on the use of building diagnostics in the acceptance of high technology buildings and their post-acceptance evaluation.

I. ACCEPTANCE AND ACCEPTANCE TESTING

Acceptance, traditionally viewed as a single event, has a variety of legal consequences. In addition to signifying a transfer of legal responsibility (and often title), acceptance normally constitutes an acknowledgement by the purchaser that the product conforms with whatever specifications are contained in the contract. That acknowledgement, coupled with the transfer of ownership, control, and responsibility, entitles the contractor to payment of the balance of the unpaid contract price, and imposes limitations on the

5. Id. at 2.
purchaser's subsequent rights. Prior to acceptance, standard contract clauses usually give a purchaser the right to reject nonconforming goods or services, or to demand an equitable reduction in price. Once acceptance has taken place and payment has been made, however, the transaction is final unless latent defects, fraud, or gross mistakes amounting to fraud can be demonstrated, and the purchaser's rights will be limited to those granted by the seller's warranty or guarantee.

Given the legal significance of acceptance, it is not surprising that acceptance provisions are central in construction and sales contracts. Where a product is not standardized (i.e., is unique, custom built or altered, as is virtually always the case with structures) a contract's acceptance testing provisions are crucial. Acceptance testing clauses lay out the inspection or quality standards to be applied, the kinds of tests to be utilized, and/or the party who will perform the tests and bear the costs.

A. Design v. Performance Specifications

There are two specification paradigms. Design specifications focus on means, setting forth the technical details of construction, identifying the material to be used (including, in some cases, the manufacturer), and often specifying the manner in which they are to be assembled. Performance specifications focus on ends — the usage requirements of the completed building (what it will have to hold or do) without laying out how the contractor is supposed to get there. Most plans and specifications include both design and performance elements. Contractors tend to prefer design specifications because they incorporate objective standards. Once those standards are met, the contract is performed and the contractor is entitled to be paid even if the completed product ultimately fails to serve its intended use. Purchasers often prefer performance specifications for precisely the same reason. In most cases, their primary concern is that the tendered product serve its intended functions. In short, "the buyer wants his problem solved, but the seller is only concerned with providing specific services."10


8. 48 C.F.R. § 52.246-12 (1985). See also, McQuage v. United States, 197 F. Supp. 460 (W.D. La. 1961) "Where a contract has been performed and a stipulated consideration has been paid, the general presumption is that the transaction is closed."


B. Specified Standards v. Trade Practice

Standards — of inspection or of product quality — may or may not be specified in a contract. If they are specified, the stated standards are binding and will be enforced.11 In the often imitated argot of government contracts, a contractor can be compelled to meet specific, express standards at its own cost, with little regard for the reasonableness of the standard in question.

If the contractor is required to exceed the specified standards, however — even if that is necessary to make the product fit for its intended user — the contractor is entitled to an “equitable adjustment” of the contract price for the increased expense of performance.12 If standards are not specified in the contract, then prevailing “industry standards” and “trade practices” will govern the acceptability of the completed product, and the determination of whether a particular level or kind of performance was either contemplated by the contract or constitutes a compensable change.13

C. Specified v. Reasonable Test

As with standards, the parties may specify in the contract the tests that are to be conducted in evaluating the work for acceptance. Testing provisions go so far as to list the exact type of testing equipment and the procedures to be employed, or may simply establish general requirements. Test requirements specified in the contract are binding on both parties, and any deviation may be a “constructive change.”14 The use of tests other than those specified in the contract may be allowed, however, if the deviation does not cause any difference in result,15 i.e., does not subject the product to a

11. See DiCecco, Inc., 69-2 B.C.A. P 7821 (1969) (contractor's argument that the standards contained in the contract were so vague and indefinite as to be unenforceable rejected); Warren A. Johnson, 83-2 B.C.A. P 16,562 (1983) (government's tighter application of contract requirements late in the contract did not constitute a “change” entitling the contractor to an equitable adjustment).
12. In essence, by holding a contractor to a specification different from that specified in the contract, the purchaser makes a “change” in the contract. See Southwest Welding & Mfg. Co. v. United States, 413 F.2d. 1167 (Ct. Cl. 1969); L.W.Foster Sportswear Co. v. United States, 405 F.2d.1285 (Ct. Cl. 1969).
higher standard than that specified in the contract.\textsuperscript{16}

In the absence of specified testing provisions, the purchaser may employ any test that is "reasonable" for inspection purposes.\textsuperscript{17} As with standards, a non-specified test is more likely to be found reasonable if it is a test commonly employed by the industry.\textsuperscript{18} A test that effectively imposes requirements on the contractor that are more stringent than those specified in the contract is unreasonable,\textsuperscript{19} as is one that is not reasonably calculated to determine a product's compliance with the contract specifications.\textsuperscript{20}

\section*{D. Who Performs and Bears the Cost of the Tests?}

Who is responsible for acceptance tests and who bears their costs are issues of intense interest in "test intensive" contracts. In both government and private construction contracts, the trend has been to place more of the inspection burden on the contractor. This affects the allocation of costs, because "[a]s a general rule each party bears the cost of inspections it conducts."\textsuperscript{21}

The general rule is complicated when a desired test is not specified in the contract. In such cases, the principle underlying the allocation of testing costs seems to be one of reasonable expectation. If the contractor should have anticipated the possibility that he would be required to perform certain unspecified tests, then he should have expected to bear the costs and included them in the contract price.\textsuperscript{22}

On the other hand, the contractor is entitled to equitable adjustment for the tests that are ordered by the purchaser but are not specified or contemplated by the contract.\textsuperscript{23} The same logic may hold when an inexperienced contractor is required not simply to pass a particular test, but to design and develop the equipment necessary to conduct the test.\textsuperscript{24}

\begin{thebibliography}{9}
\bibitem{17} See, e.g., Lowell Monument Co., 77-1 B.C.A. P12,439 (1977).
\bibitem{18} See, e.g., Fishback & Moore, Inc., 77-1 B.C.A. P 12,413 (1977); Crown Coat Front Co. v. United States, 292 F.2d. 290 (Ct. Cl. 1961).
\bibitem{19} See, e.g., The Testor Corp., 78-2 B.C.A. P 13,373 (1978); General Motors Corp., 65-2 B.C.A. P 4885 (1965).
\bibitem{20} See Puma Chemical Company, 81 B.C.A. P 14,844 (1980).
\bibitem{21} Cibinic, J. & Nash, R., \textit{supra} note 3, at 562.
\bibitem{22} See Tripplets-Abbett-McCarthy-Stratton, 66-1 B.C.A. S 5370 (1966); \textit{Modern Construction}, 81-1 B.C.A. S 14,832 (1980).
\bibitem{24} Given that the contractor was unfamiliar with ultrasonic testing of armor-piercing projectiles and that the contract specified neither the equipment or the procedures that were to be used in such testing, "it would be unreasonable . . . for the [contractor] to understand an
When the contract language is ambiguous, and the intent of the parties at the time of contracting is unclear, a court may simply invoke the legal doctrine of *contra proferetem* and impose the costs on the party (usually the government) that drafted the ambiguous or incomplete document.  

II. **Building Diagnostics and Acceptance Testing in High Technology Buildings**

Acceptance of high technology buildings and the systems in them presents a number of interesting (i.e., difficult), practical and legal issues. This is largely attributable to the complex and sophisticated "product" involved. Unlike the far simpler buildings of the past, where shelter was the entire mission, high technology or "smart" buildings are designed to increase productivity by integrating building controls and security, and incorporating systems for the distribution of voice, data and video communications.

The complexity and novelty of electronic building systems creates novel testing problems. These, in turn, complicate the acceptance process, rendering obsolete the traditional notion of acceptance as occurring at a single moment in time. Once acceptance was conceived of as a single event combining the passing of title, possession and legal responsibility. In high technology buildings, however, such arrangements as rolling and staged acceptance and pre-acceptance occupancy blur or stretch out the "point" of acceptance. Formal acceptance becomes difficult to define, for example, if the purchaser is permitted to try out the product during a "debugging" or "shake-out" period. In this regard, acceptance of high technology buildings is conceptually similar to the acceptance of other high technology products, such as computer or communications systems.

Because a high technology building is an integrated network of systems with distinct but interdependent functions, acceptance of

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such a structure may be thought to involve a series of "sub-acceptances." Individual systems are accepted serially, as they are installed. The notion is appealing because it breaks a complex process down into a number of seemingly manageable components. Acceptance of a high technology building becomes merely the sum of the various systems that are accepted.

The problem with that conception is that it ignores the integrated nature of a truly enhanced building. Rather than a series of independent systems each serving a separate function, such a building includes multiple systems, each incomplete by itself. It is only when these systems are linked together that their full capabilities can be realized.

A second common feature of electronically enhanced buildings is the overcapacity of key systems vis-a-vis present usage requirements. If usage expectations are accurate, a high technology building's systems will be underutilized relative to rated capacity at the time of completion. Indeed, rated capacity may remain untested for a number of years until usage needs finally grow into system capacity.

Both integration of multiple systems and the planned underutilization of a building's systems at the time of completion speak to a common problem: acceptance of a product whose performance is uncertain. Unless that uncertainty can be resolved, acceptance becomes either a single calculated risk — an act of faith — or a long and convoluted process. Both are unacceptable: the former to the purchaser, who has paid for a structure [with systems that work] whose systems do work; and the latter to the seller (contractor), who needs to turn over the project, close out his liability, and move on to the next job.

III. Resolving the Uncertainty in the Acceptance of High Technology Buildings

Building diagnostics can play an important role in solving this problem by reducing the uncertainty that complicates the acceptance of high technology buildings. It may, for example, be possible to simulate the functions of certain incomplete systems to test the capabilities of completed systems in an integrated setting. Similarly, diagnostics may be used to simulate expected future loading in order to test a system against its rated capacity. Under either scenario, the use of building diagnostics facilitates the acceptance process. Rather than having to wait until all systems are installed and linked together, or until usage increases to a system's rated ca-
capacity, diagnostics can help a purchaser predict with at least some degree of confidence the likely future performance of a high technology building as an integrated whole.

Given the potential utility of building diagnostics in performance testing, the legal implications of the use of diagnostic techniques acquires heightened significance. The relevant issues fall into the four broad categories outlined above.

A. Diagnostic Techniques Incorporated Into Design Specifications

First, specific diagnostic techniques can be written into design specifications or, as described earlier, be employed to gauge the present and future performance of an electronically enhanced building. As with all testing devices and procedures, diagnostics can only be used (as a legal matter) to test conformity to a specification agreed upon in the underlying contract. When a design specification is used, diagnostics can be used only to evaluate whether the technical details governing the construction have been followed. Conversely, if a performance specification is relied upon, diagnostic techniques can only be employed to test — and only if they do in fact test — the “performance” of the relevant building or system.

Diagnostics can obviously be useful in determining whether a building or system has been constructed and installed according to whatever standard has been specified. If no standard has been specified, diagnostics can be useful in assessing whether a product conforms to “industry standards.” Because many diagnostic techniques are of recent vintage, however, it is worth noting that “trade practice” or “industry standard” are less likely to contemplate their use than they will five or ten years from now. In this respect, diagnostics are like any other acceptance test, except that their use is less likely to be approved unless expressly provided for in the relevant contract.

B. Use of Specific Contract Language

Because diagnostics is not itself a test, but rather a process encompassing the application of knowledge, techniques and instruments, the contracting parties need to be as specific as possible in describing the tests that are to be conducted and methods to be employed. It is not enough to agree that diagnostics will be used or that a diagnostician will be retained. The parties should specify the details in addition to the approach: how diagnostics will be used and for what purpose.
If necessary, the techniques and instruments that are desired should be specified. Given the relatively recent development of building diagnostics and the complexity of electronically enhanced buildings, it is important that the contracting parties understand the limitation of diagnostics in testing certain systems. This is the only way to avoid forcing a contractor to develop the technology and equipment necessary to conduct tests specified in the contract.

In electronically enhanced buildings, the acceptance test and procedures must be specified in as much detail as possible. In many instances, no "reasonable" test — and certainly not the "industry standard" — will give the comfort achievable through the use of diagnostics. Leaving tests unspecified may then result in the use of unsatisfying and inadequate techniques, and flawed and improper acceptance.

C. Allocation Of The Cost of Testing

Finally, given that building diagnostics is a new and specialized field, the question of which party is to take responsibility for execution and payment requires careful thought. Unless the contractor or the purchaser has appropriate personnel and equipment, it will be necessary to specify a third party who will conduct the agreed-upon procedures, and the person(s) to whom that party will report. Diagnostics entails more than simply the use of certain equipment; it requires skill and knowledge on the part of the person employing the techniques and instruments. Even where the contractor has (or can get) the requisite expertise, it probably makes sense to require that the diagnostician be an independent third party whose reporting responsibility runs to the owner, not the contractor.

Again, novelty counsels in favor of specifying the allocation of testing costs in the contract. This issue is especially important if a third party diagnostician is to be used. Once a third party is brought in, the general rule that the party conducting the inspection bears the cost obviously no longer applies.

The discussion above highlights the legal issues that can arise when a "standard" construction contract is used in an electronically enhanced building. As the cited cases illustrate, many of the difficulties that can emerge are the result of failing to take proper account of the legal issues raised by electronic enhancements. The obvious solution is for the parties to draft a contract which addresses these issues. While the lesson is hardly new, it bears keeping in mind, especially in the context of contracts for high technology buildings in which the use of building diagnostics in acceptance
testing is contemplated. Given the relatively recent development of building diagnostics and the many novel problems posed by the acceptance testing of state-of-the-art buildings and systems, there is a crying need for explicit contractual allocation of each party's rights and responsibilities.