NONDESTRUCTIVE SEAM TESTS
A CQA PERSPECTIVE

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Abstract

Construction Quality Assurance (CQA) requires that the NDT seam tests required by the project specifications be consistent with the actual seaming method employed in construction. This paper reviews problems related to NDT tests resulting from inconsistencies between design and project specifications.

Introduction

Construction Quality Assurance (CQA) is performed by the owner or his agent to confirm that the completed component satisfies the design specifications. It must be assumed that the design specifications are sufficient to ensure that the design objectives of the component are met. In many applications, the design firm is also responsible for CQA and a continuity of minds exists from design through CQA. Increasingly, however, the CQA effort is independent of design and must rely solely upon the standards and procedures established by the designer. Such standards and procedures are normally part of the contractual arrangement between the client and the installer. Significant constraints are placed on the CQA program when such standards and procedures are incomplete or improper.

From a CQA perspective, the success of the nondestructive seam testing (NDT) program relies on the following:

- o Appropriateness of the test for the given seam
- o Accurate application of the test
- o Completeness of the seam specifications
- o Physical ability to apply the test

This paper reviews problems encountered by Westinghouse in these areas during CQA related projects. The common links to all such problems are they occur on those projects where design and CQA are independent efforts.

Appropriateness of NDT Seam Test

Table 1 (1) provides a summary of existing NDT seam tests and the liner types for which they are appropriate. Note that, in general, each NDT test has membrane and seam types for which it is not appropriate. Failure of the designer to specify the NDT test most appropriate to the membrane and seam type results in serious CQA seam validation problems.

On a recent project for a government agency, a membrane was included in a cap being placed over a radioactive waste pile. The membrane selected through the procurement process was a 40-mil HDPE using an extrusion seam. Original design specifications required that all seams and repair cap strips would be 100% inspected using the air lance method. Unfortunately, the stiffness of HDPE prevents the blast of air used in the air lance method from separating the seam. When this concern was expressed to the owner, additional funding for non-specified, but more appropriate, CQA testing was denied. The CQA inspection was therefore forced to continue air lance testing, while in truth relying essentially on visual inspection.

If the substitution of an alternate membrane type other than that envisioned by the design engineer is allowed, e.g. by value engineering, then the designer must not specify specific CQA testing but reference manufacturer's recommendations. This is particularly true with government procurement where purchasing is receptive to value engineering product substitution and field inspection can be intractable in interpreting specifications.

Accurate Application of Test

All the NDT tests can be influenced by manipulation of key test paramenters. The CQA program must ensure that all tests are performed in a manner that does not subvert the intent of the test. At the same time, the CQA program must be realistic so that such testing can be performed in a time frame that will not hold up the project. Problems experienced in the field include:

Vacuum Box Test: An intelligent installer soon learns that the number of defects detected can be minimized by reducing the dwell time of the box and the vacuum level. Many installers have in fact attempted to run this test with the box in continual motion. This movement minimizes dwell time and reduces the effective seal between the box and the membrane. Our CQA tests are performed using vacuums of 2.5 to 5 psi and dwell times of 15 to 30 seconds.

Pressurized Dual Seam: Ironically this test is frequently compromised by over specification that allows no pressure loss or retest. Typical practice is to use 30 psi inflation with a 5 to 15 minute dwell time. The pressure remaining at the completion of the dwell time should be ± 10% of the inflation pressure. This last point is provided to compensate for potential volume changes caused by temperature changes resulting from changing cloud cover, etc. Seam specifications are being encountered that require 15 minute dwell time and allow <u>no</u> pressure loss. Under such conditions, a 'retest' must be allowed. Typical specifications for dual seam test also fail to ensure continuity over the full seam length. Such continuity must be verified by either installing a pressure gage at both ends of the seam or, at a minimum, by puncturing the non-gauged end of the seam to verify pressurization.

Completeness of the Seam Specifications

To allow a more competitive bid, most designers do not specify a specific seam type. Unfortunately, these same designers will include minimum seam testing criteria that may not be consistent with actual seam. For instance, a recent project required a specific frequency of destructive tests. The actual seam used on the project was a double-hot wedge seam that would normally be tested by pressurizing the seam. This raises a number of questions:

- Should the dual seams be destructively tested even if it passed the pressurization test (which was not in the specs)?

- If the dual seam is tested, must both seams pass the criteria?

If a specific seam is not specified in the design documents, then the specifications must be broad enough to be applicable to all potential seam types. Unfortunately, as the CQA contractor we are responsible for meeting the project specifications and not rewriting them. With an industry owner, modifications to specifications are possible; with government, they are nearly impossible.

It is important that a preconstruction meeting be held to clarify all inspection and repair criteria. At this time, all important aspects of installation must be agreed upon by the installer and the owner's CQA officer. Obviously, the CQA officer is severly restricted if the specifications are poorly written.

<u>Physical Ability to Apply NDT Test</u>

The design specifications must recognize the physical impossibility of using many of the NDT test at critical details within the containment cell. For instance, the vacuum box (VB) and pressurized dual steam (PDS) NDT tests cannot be performed at the following locations:

- Pipe penetrations (VB and PDS)
- Sump corners (VB and PDS)
- Three panel joints (PDS)

Typical specifications provide no alternative tests for these critical locations. We frequently must rely on the integrity of the installer to voluntarily perform electrical sparking tests of such details. In general, the Construction Quality Control (CQC) program maintained by reputable installers is more rigorous for such details than the specification based CQA program.

Summary

The use of NDT seam tests is an integral part of an effective CQA program. However, these tools are frequently less than effective due to poorly written project specifications that limit the CQA program. If the selection of the seam type will be part of the bid process, then the project specifications must be general enough to encompass all possible seams.

The quality of specifications that can be tolerated by the CQA program is dependent upon the objective of the inspection. Frequently, the CQA program is required only for conformance testing, i.e. that the liner is installed according to specifications. For these cases, poor specification limits the ability of the CQA effort to serve the owner but do not transfer liability to the CQA company. Many CQA programs, however, require the CQA company to certify performance of the facility. In such instances poor specifications are intolerable. If such specifications cannot be renegotiated, then the CQA role is intolerable and such work must be refused.

References

(1) Koerner, R. M. and G. N. Richardson, (1987), "Design of Geosynthetic Systems for Waste Disposal," Proc. ASCE-GT Conf. on Geotechnical Practice in Waste Disposal, Ann Arbor, MI, June.

TABLE 1 AVAILABLE NDT METHODS FOR EVALUATING SEAMS

Geomembrane system	Air Lance[a]	Vacuum chamber[b]	Pressurized dual seam	Electrical sparking[c]	Mechnical point stress	Electronic: Ultrasonic pulse echo (5-15 MHz)	Electronic: Ultrasonic shadow (0.5-5)	Electronic: Ultrasonic impedance (160-185 kHz)
Thermoplastics (PVC, TN-PVC: ELA)								
Reinforced	X	X			X		X	
Nonreinforced	X	X			X	X	X	X
Crystalline thermo-plastics (LDPE; HDPE)								
Nonreinforced		X	X	X	X	X	X	X
Elastomers (Butyl; EPDM; CR; CO)								
Reinforced	X	X			X		X	
Nonreinforced	X	X			X		X	
Thermoplasatic elastomers (CPE; Hypalon; T-EPDM)								
Reinforced	X	X			X		X	X
Nonreinforced	X	X			X	X	X	X

[a] Air lance should be restricted to thickness less than 45 mils: this method is not recommended for stiff sheeting.
[b] Vacuum chamber should be restricted to 30 mils and greater due to deformation.
[c] Electronic methods do not work on EIA material.