Nondestructive Testing of Geomembranes

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Geosynthetic membranes or geomembranes are 0.5 to 2.5 mm (0.02 to 0.1 in.) thick sheets of plastic that are used to prevent liquid leakage to the environment primarily in landfills, ponds, mining leach pads, and tanks (Fig. 1). They are also used in wastewater treatment plants, potable water reservoirs, dams, canals and as floating covers. Leakage in geomembranes can cause pollution of groundwater, product loss, and even failure of containment systems. Leaks can easily occur because of inadequate installation, damage from construction activities, and damage while placing a protective layer of earth on the geomembrane. Nondestructive testing techniques are used for preservice testing of the seams and sheets for leaks. Often when a leakage problem is experienced, nondestructive leak location techniques are used to locate the leaks for repair.

Some flexible types of geomembranes are custom-made to fit an installation, but the more rigid geomembranes are deployed in rolls and seamed together in the field. The seams can be extrusion welds, fusion welds, and sometimes solvent welds (Fig. 2). Often the geomembranes are covered with a layer of earth materials.

Although not discussed in this article, destructive testing is also performed on the material and particularly on the geomembrane seams to test the physical characteristics. Destructive testing of seams requires cutting out a large section of the seam, requiring large patches at the sample location.

Figure 1. Nondestructive testing techniques are used to locate leaks in geomembranes such as the one shown in this large pond.
Coauthors Glenn Darilek and Daren Laine discuss the various leak testing techniques used to inspect the sheets and seams of geomembranes in “Nondestructive Testing of Geomembranes.” NDT is an effective means of locating leaks in the often huge geosynthetic membrane liners that are routinely used to prevent the leakage of liquids into the environment.


Trent Martz is our subject for the April “Practitioner Profile.” Trent talks about the impact of a mentor on his approach to problem solving.

Jim Houf, Senior Manager of Technical Services, addresses a question regarding independent training as it applies to certification by a current employer.

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Nondestructive testing of geomembranes can be divided into two general categories. The first is testing as part of construction quality control, specifically the testing of the seams and patches. The other category is leak location methods for locating leaks in the geomembrane panels as well as in the seams.\(^1\)

Nondestructive Testing of Seams

Nondestructive methods used to test the seams during the installation of the geomembranes include vacuum box testing, air channel pressure testing, air lance testing, and spark testing.

Vacuum Box Testing. Vacuum box testing is primarily used to test extrusion welds on rigid geomembranes. A rigid rectangular box with an open bottom with rubber seals and a clear plastic window on top is placed on a section of extrusion weld that has been wetted with a soap solution. A vacuum pump is used to draw a partial vacuum on the box. Leaks are visually indicated by bubbling in the soap solution. Because of the labor involved, this method is primarily used only on patches. Some skill is needed to be able to get a good seal and to visually recognize leaks through the window, which is usually obscured with soap solution. It is only applicable on relatively flat surfaces. ASTM D5641 is a standard practice for vacuum box testing.\(^2\)

Pressure Testing of Seams. Double track fusion welders produce two closely-spaced seams at the same time. This allows the ends of the seams to be sealed for pressure testing. An air pump is connected to a hose with a valve, pressure gauge and hollow needle at the end of the hose. The top layer of the seam is punctured with the hollow
needle and the air pump pressurizes the seam to the specified level. The valve is closed and the pressure is monitored for a prescribed time. A specified pressure drop indicates a leak in the seam. Air pressure testing of double seams is conducted in accordance with ASTM D5820.\(^3\) Pressure testing of dual-track seams in polyvinyl chloride (PVC) geomembranes is conducted in accordance with ASTM D7177.\(^4\)

**Air Lance Testing.** Flexible geomembrane seams can be tested using an air lance. An air lance is a hollow tube with an ell and orifice at the end. A suitable air compressor is connected to the air lance with an air hose. The orifice of the air lance is directed towards the edge of the upper flap of the seam. Unbonded areas are indicated when the air flow causes a vibration of the geomembrane. ASTM D4437 describes the air lance test as well as other nondestructive tests for flexible geomembranes.\(^5\)

**Spark Test.** Applied in accordance with ASTM D6365, the spark test is used particularly for seams that cannot be tested using the other nondestructive tests, specifically for curved surfaces, corners, and penetrations through the geomembrane.\(^6\) A wire or other conductive strip is embedded at the edge of the top sheet of an extrusion weld. The end of the wire is grounded. A holiday tester with a current-limited voltage of several thousand volts is used with a conductive probe or brush. The probe or brush is passed along the weld bead and a spark discharge will occur if there is an air channel or void between the probe and the grounded wire.

**Leak Location Testing**

Imagine the task of locating a small leak in a geomembrane-lined pond as large as the one shown in Fig. 1. The second category of nondestructive testing of geomembranes routinely accomplishes that. Leak location testing using electrical methods is sometimes called electrical leak location testing or geoelectric leak location. It goes without saying that the most important test of a geomembrane, whose only function is to prevent liquid leakage, is to test for leaks. Geoelectric methods test for leaks in the seams and patches as well as in the geomembrane panels.

Figure 3 shows the basic geomembrane leak location method is to connect a direct current power supply to one electrode in contact with a conductive material under the geomembrane and another electrode in contact with conductive material above the geomembrane. Although the two media are actually resistive, they are electrically conductive compared to the electrical resistance of a leak. Because the geomembrane is an electrical insulator, with no leaks no electrical current will flow, and the resulting electrical potentials on the geomembrane are uniform. But if the geomembrane has leaks, electrical current will flow through the leaks, causing a characteristic anomaly in the potential at the leaks. Various probes are used to detect or map these anomalies to locate the leaks.

Various implementations have been developed to test bare geomembranes, geomembranes covered with shallow and deep water, and geomembranes covered with earth materials. There is no standardization of the equipment used for the leak location testing. Instead, performance-based standards are used. The equipment and survey parameters are tested to determine the leak detection distance using a simulated or actual leak of a specified size. Simulated leaks are electrical equivalents of a leak in a geomembrane. Leak location measurements are made to determine the maximum leak detection distance for the specified artificial or actual leak size. The leak location surveys are conducted so that measurements are made within that distance of every point on the geomembrane. The various methods and the advantages and limitations of each are presented in ASTM D6747.\(^7\)

**Water Puddle Method for Bare Geomembranes**

For bare geomembranes, leaks are detected by pushing a puddle of water over the geomembrane using a squeegee or other device. A low voltage electrical power supply is connected to a conductive media under the geomembrane such as earth ground. The other output of the power supply is connected through an electronic current monitoring detector to the squeegee in contact with a puddle of water. The puddle of water is pushed ahead of the squeegee and when the water puddle passes over a leak in the geomembrane, the water flows through the leak and contacts earth ground. This completes a circuit and the resulting current is monitored by the electronic detector. The detector typically converts the increase in the current to an audible tone indication and a meter reading. Figure 4 shows the operation of a water puddle system. Leaks with a diameter of 1 mm (0.04 in.) are routinely detected.\(^8\)

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**FOCUS continued on page 4.**

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**Figure 4.** Water puddle system used to detect leaks in bare geomembrane.
A similar method uses a stream of water or water lance that is scanned over the geomembrane instead of pushing a puddle.9

Spark Testing of Conductive Geomembrane

A proprietary geomembrane is available with a conductive surface layer that is installed with the conductive layer downward. The geomembrane is tested in accordance with ASTM D7240 using a holiday tester similar to that described for the spark testing of seams above.10 In this case a wide metallic brush is used to sweep the geomembrane. When a leak is encountered, a spark discharge indicates a leak.

Leak Location with Water on the Geomembrane11

ASTM D7007 contains standard practices for performing leak location surveys with water on the geomembrane. Leaks are detected using one of several dipole probes. One type is a 2.5 m (8 ft) probe that is used while wading in the water (Fig. 4). Another wading implementation uses two electrodes on two arms that are hinged together. Other probes include a towed probe for deep water and a plumb bob probe for vertical walls.

Typically the power supply provides 100 to 400 volts across the geomembrane. The probes are scanned on the geomembrane. An electronic detector measures the voltage and sometimes polarity of the voltage on the probes. Typical detectors convert the signal to a meter reading and an audible tone that increases with leak signal amplitude. When a leak signal is detected, the probes are maneuvered to obtain the maximum signal, which corresponds to the exact location of the leak. With wading surveys the leaks are typically marked with small sand bags connected to a float with a string. Typically, leaks with a diameter of 1.3 mm (0.05 in.) and even smaller can be easily detected.

Leak Location with Earth Materials on Geomembrane11

Geomembranes are often covered with earth materials for protection, particularly for landfills. Leak location testing is used to detect the major damage that can be caused by heavy machinery placing the earth materials on the geomembrane. Instead of scanning the measurement probe along the geomembrane, measurements are made on the surface of the earth material (Fig. 6) using two electrodes spaced a fixed distance apart. This implementation is sometimes called the dipole method. Point-by-point potential measurements are made with the dipole probe and a portable digital data acquisition system along equally spaced survey lines. The data is downloaded to a computer for storage, plotting and analysis. When a suspect area is indicated in the data, manual measurements are made to further pinpoint the leak position. Typically, leaks with a diameter of 6.4 mm (0.25 in.) are routinely detected, and much smaller leaks are detected depending on how close the survey line happens to be from the leak.

Conclusion

Nondestructive testing of geomembrane seams is an important part of construction quality control of geomembrane installations. Several states are requiring geomembrane leak location testing for landfills and ponds on new installations and periodically when in service. Leak location testing is also widely applied as part of construction quality assurance and to solve leakage problems. Engineers, owners, and regulators understand the importance of testing the only function of a geomembrane, which is to prevent leakage.

References


In the course of their employment, nondestructive test personnel may work near or with lasers. Lasers are used to generate and detect ultrasonic waves. Lasers are used in optical methods of nondestructive testing, particularly holography and shearography, as well as for precise measurement of displacement in a wide variety of strain monitoring for structures including critical infrastructure such as road embankments. More often than for inspection, lasers are used for joining and machining operations, including precise etching and cutting. Even inspectors who never use a laser are likely to work around them one day.

Laser Safety

Shearographic test systems are for either portable or fixed production applications. Portable shearography systems can be tripod mounted or configured for on vehicle field inspection. Fixed production systems may use test chambers to allow vacuum stress and scan gantries to inspect large panels or structures. As with all laser devices, exposure of the operator to laser emissions must be controlled and shearography instruments and systems must comply with state and federal laws regarding radiation health.

Laser shearography and holography NDT systems use laser light to illuminate the surface of a test article being inspected. The laser provides a convenient source of monochromatic-coherent light that makes the implementation of shearography and holography NDT possible. With the exception of extremely low powered laser systems, virtually all laser products pose some form of hazard. The most common hazards associated with lasers come from the direct exposure of the eyes and skin to the laser light itself. In the United States, laser systems are classified in accordance with the regulations set forth by the Center for Devices and Radiological Health (CDRH) division of the Food and Drug Administration (FDA), primarily concerned with medical devices. Additional federal, state, and local regulations may also apply to further regulate the use of a laser product for a given application. Many of these secondary regulations are based on classification data provided by the American National Standards Institute (ANSI). Both the American Conference of Governmental Industrial Hygienists and the Laser Institute of America provide valuable guidelines. In the European community, laser system standards are overseen primarily by the International Electrotechnical Commission (IEC) and the British Standards Institution (BSI).

Classes of Lasers

Laser and laser system classifications are divided into four general classifications (Classes 1 through 4) based on levels of increasing hazard. Subclassifications may further define the general hazards associated with a given laser product. Laser classes are based on the wavelength, output power, and whether the laser has been designed to operate in a continuous wave (CW) mode or pulsed mode. Pulsed lasers are designed to release their stored energy in pulses that typically last well under 0.25 s. (Femtosecond pulses are easily achieved with the proper laser system.) For the purposes of most shearography and holography NDT applications, continuous wave lasers are used.

The classification of a laser system is based upon the type and level of exposure an operator would be exposed to during the normal operation and maintenance of their laser system. Based on these conditions, it is very possible that laser systems classified as Class 1, Class 2 or Class 3a may contain Class 3b or Class 4 lasers.

Class 1 lasers or laser systems are generally considered safe because of their low power or because the laser system has been interlocked in such a way as to prohibit operator exposure to laser emissions.

Class 2 laser systems are generally considered safe under most working conditions as the blink reflex (aversion response time) of the human eye will prevent damage in the event of an accidental exposure. Caution should be taken however with regards to the intentional long term direct viewing of this laser light and concentrating the power of the laser light with positive magnification optics such as a telescope or magnifying glass.

Class 3 laser systems are typically broken down into two categories, low power (CDRH Class 3a/IEC Class 3r) and high power (CDRH/IEC Class 3b).
3b) systems. Precautions required for the low powered systems are very similar to those associated with Class 2 lasers but with an increase in allowable power output from 1 mW (Class 2) to 5 mW (Class 3a/3r). Care again must be given to intentional direct viewing of the unexpanded laser light and the use of positive magnification optics to increase the power density of the available light.

Class 3b lasers pose a unique category as they range from relatively safe lasers with outputs slightly above the 5 mW Class 3a/3r requirements, to relatively dangerous lasers with outputs up to 500 mW. Class 3b lasers can easily produce burns to both eyes and skin as power levels increase from about 50 to 100 mW. The class 3b classification applies to both visible and invisible lasers, thus increasing the potential risk of accidental exposure.

Class 4 lasers and laser systems are considered hazardous for both eye and skin exposure. Additional hazards include fire and the production of airborne contaminants such as ozone. In addition to the increased hazards, use of Class 4 laser systems is generally very restricted and requires medical surveillance for operators with respect to possible eye exposure.

From a practical standpoint, laser systems for shearography and holography NDT systems should be classified so as to provide the most usable system for the operator with the least restrictions. To minimize hazard and restrictions, systems with classification of Class 1, 2 and 3a (3r IEC) are often preferred to those with Class 3b and Class 4 classifications.

Shearography and holography systems classified as Class 1 and 2 laser systems generally do not require any special safety consideration beyond a basic understanding of the safe use of lasers. Under normal working conditions.

Class 3a laser systems extend allowable output emissions of the laser system by five times those of Class 2 laser systems without adding additional restrictions beyond a more in depth knowledge of safe laser operation.

Class 3b and Class 4 laser systems should generally be avoided for all but laboratory or well-controlled environments because of operating restrictions and the need for additional medical surveillance.

When working with any laser system a few common sense rules of laser safety will go a long way toward establishing a safe working environment:

Common Sense Rules for Laser Safety

Common sense should be applied to laser safety.

- Never stare directly into the operating laser system or at the bright mirrorlike reflections produced by laser light that is reflected from metallic or other highly reflective surfaces. Intentional extended viewing of a laser beam issuing directly from the laser source or indirectly from mirrorlike reflections can cause injury or blindness.

- Avoid unnecessary eye exposure to both direct and reflected laser emissions. When possible, close the shutter of the laser emissions or turn off the laser power when working near the front of the laser system and access to the laser light is not required.

- Do not leave laser systems powered and unattended or with personnel unfamiliar with basic laser safety procedures. Turn off the laser power, and whenever possible remove the laser interlock key from Class 3b and Class 4 laser systems to prevent unauthorized access to the operating laser system.

- Maintain laser emissions within a controlled working area. The laser work cell should have interlocks on all doors that enter into the work cell that will automatically turn off the lasers when a door is opened. A “Laser On” lighted sign from an approved source should be installed outside each entrance to alert personnel not to enter the work cell when lasers are in use. All windows for viewing activity in the work cell should have laser-safe glass with regular glass panes installed on both sides to prevent damage to the laser coating.

- Be aware of all stray laser emissions and ensure that they do not pose a hazard to others. Warn bystanders or observers of the presence of laser emissions and possible hazards.

- Do not use viewing optics such as binoculars or magnifiers to view the light from the laser system. These devices can increase the concentration of the laser light. Normal eyeglasses are not dangerous: they merely correct the natural vision of the human eye and do not increase the concentration of the light being viewed. However, normal eyeglasses do not provide protection from lasers that are not eye-safe. When working on an active laser, the technician should always wear laser-safe goggles rated for the class of laser.

- Do not disassemble, override, or otherwise modify safety interlocks and sensors for any laser system, including those used in shearography and holography unless you are a laser trained technician with appropriate safety equipment. The classification of your laser system is based on operator access during the normal operation and maintenance of your laser system. Bypassing interlocks or modifying system enclosures may amplify laser illumination beyond normal for a certified laser product. Modifying the system's optics, interlocks, or enclosures may invalidate the classification of your laser system and place technicians or operators in danger.

Acoustic Hazards

Hazardous levels of acoustic noise are not directly associated with the shearography NDT but may be a byproduct of the stressing methods used...
during its application. Sound levels of 130 dB are currently being used for a number of shearography NDT applications employing acoustic or mechanical vibration stressing. In the case of acoustic stressing, large compression drivers are employed with focused horns to vibrate the test article under examination. Within the United States, noise exposure regulations for industry are defined by OSHA as documented within 29 CFR 1910.95. According to 29 CFR 1910.95, noise exposure to sound levels above 85 dB must be regulated through either environmental controls or the use of personnel protective devices such as ear plugs or ear muffs. Long exposure to sound levels above 85 dB may gradually produce hearing loss.

Sound pressure levels referenced by this standard can be readily measured using inexpensive sound level meters available through many audio and electronic supply houses. The measurements are made using an “A-weighted” – “slow response” setting. Limitations as to the permissible time over which an individual can be exposed to increasing levels of noise are defined by 29 CFR 1910.95 and range from 8 h at 90 dBA to 15 min at 115 dBA. Additionally, no exposure to sound intensities greater than 140 dB must be permitted.

Due to variations in the application of acoustic stressing, a worst case exposure corresponding to the maximum output of the acoustic driver over the expected work period (up to 8 h per day) should be assumed. Noise protection devices should be selected to bring personnel exposure levels to no more than 90 dB (preferably 85 dB), over the course of an 8 h work day. General noise recommendations for acoustic and mechanical vibration stressing include the following.

• Always use the lowest noise level necessary for the inspection being performed.

• Always assume that the noise source is active unless it has been made safe (preferably by removal of power).

• Be conscious of both operator and bystander exposure levels. If personnel other than those performing an inspection are present, ear protection should be provided.

• Warning signs should be posted outside the danger zone to warn people entering the test area of possible high intensity noise.

Closing

In closing, one final warning is necessary as a disclaimer. Lasers are a dangerous technology. Do not assume the precautions in the present article are complete or sufficient. Inspectors must acquaint themselves with all health and safety regulations and guidelines appropriate for the job at hand. Employers should provide workers with all equipment and information needed to work safely. Lasers provide great benefit in manufacturing and testing environments but all precautions must be followed.

References


Decibel

The term loudness refers to amplitude in audible frequencies. Some acoustic waves are audible; others have frequencies above or below audible frequencies (ultrasonic or subsonic, respectively). A signal at an inaudible frequency has measurable amplitude but is not called loud or soft.

A customary unit for measuring the amplitude of an acoustic signal is the decibel (dB), one tenth of a bel (B). The decibel is extensively used in acoustics and electronics. The decibel is not a fixed measurement unit but rather expresses a logarithmic ratio between two conditions of the same dimension (such as voltage or energy). In auditory acoustics, an arbitrary sound pressure such as 20 µPa can be used for the reference level of 0 dB. The subscript A in dB_A indicates that the decibel measurements are filtered to approximate the human ear.

Bel and decibel are not units in the International System of Units but are accepted for use with that system. There are often two definitions given for the decibel, so voltage decibel is sometimes written dB(V).
Across
1. Predictive and preventive maintenance using infrared thermography is of great value when practiced using ________ approaches.
4. Well suited for applications such as shaft motion and clearance measurements, displacement sensors are noncontact devices measuring the ___ between the plant equipment and the fixed sensor.
8. The Stefan Boltzmann law defines the relationship between radiation intensity and ____________.
9. ____________ is the peak-to-peak change in an object's position at a given frequency (measured in µm).
11. The intensity of infrared (thermal) _________ emitted from an object is affected by the temperature and the nature of the material's surface.
12. The rate of change of velocity is ____________ (measured in G).
13. Vibration analysis occurs in both the _____ domain and the frequency domain.
14. To take full advantage of oil analysis tests to monitor ____ in metals, a trend should be established to provide an operational baseline of data.
16. Often the relationship between a prime mover and a driven component is affected by one of three types of misalignment: offset, ________ or bearing.
17. _________ analysis compares the equipment's performance over time to detect changes in one or more parameters of operating behavior.
18. Acrylic covers, though clear to the human eye, are completely ________ to an infrared camera.
19. A simple crackle test is used to determine if ________ is present in oil.
20. The goal of an effective oil analysis program is to increase the reliability and availability of machinery while minimizing ________ costs.

Down
2. ________ is present in almost all rotating machinery.
3. The rate of displacement (of change of position) is ________ (measured in mm per second).
5. Alignment is present when coupled shafts share the same geometric ___ of rotation.
6. Two types of automatic particle counters used to test oil ________ are light blockage and pore blockage.
7. Inductively coupled plasma (ICP) _________ is an oil analysis test that can be used to monitor lubricant condition, contaminants and machine wear.
8. The acid or base number of an oil is measured by ________.
10. The first rule of infrared thermography in predictive maintenance is to compare similar equipment under ________ loads.
12. Three primary components associated with characterizing a vibration signal are frequency, ________, and phase.
15. Considered the workhorse of vibration sensors because they offer such a wide range of working frequencies, accelerometers work best for ____ frequencies where acceleration is large.

Answers for Crossword Challenge: Predictive Maintenance

Across
1. qualitative
4. gap
8. temperature
9. displacement
11. radiation
12. acceleration
13. time
14. wear
16. angular
17. trending
18. opaque
20. maintenance

Down
2. imbalance
3. velocity
5. axis
6. cleanliness
7. spectroscopy
8. titration
10. comparable
12. amplitude
15. high

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Trent Martz

Trent Martz is a process analyst using vibration analysis and infrared to test the heavy equipment used in industrial manufacturing. Trent tells us that was a pretty daunting environment for a young man just starting out in his career. Fortunately, Trent had a mentor that taught him how to break big problems down into simple elements.

Q: How did you begin your career in NDT?
A: I studied mechanical engineering in college. We had six quarters of co-op experience where, instead of taking classes, we actually went to work. The company I worked for had a small group of guys that did testing. My last co-op quarter was coming up and I just asked, “Can I work with those guys?” It was actually trouble-shooting — vibration analysis and experimental stress analysis using strain gages. I enjoyed it and had the opportunity to get back into it after I graduated. In part, my mechanical engineering degree got me to where I am. I’m taking data on machinery — trying to determine what the problem is, but the engineering background helps me understand the data. It’s the hands on aspect of engineering.

Q: Do you enjoy the hands on aspect?
A: Yes. Actually, my first job out of college was at a company where I sat in front of a computer eight hours a day doing engineering work and I didn’t like that. Now, I’m in a position where my work is a nice mix. If someone’s got an issue, I’ll go out and take data. Sometimes the environment is dirty, sometimes it’s cold, and sometimes I work sixteen hour days — whatever it takes. Many times, my work is in steel mills and the environment can be unpleasant. But then, I come back to the office and I’m in front of my computer looking at the data and trying to figure out what the problem is in the particular issue.

Q: You’re doing torsional stress/strain and process analysis using infrared and vibrational analysis. Is that predictive maintenance?
A: I’m not actively out there conducting PdM work. A lot of what I do is vibration analysis but I’m not out there every month taking data on the same motor, the same pump and trending the data. I go out when there’s a problem. If it’s a vibration related problem, then I’ll use vibration analysis. I have Level II vibration certification and I am trained to Level II IR. I have done quite a bit of IR, though that work has tapered off a bit for me.

Q: What industries do you work in primarily?
A: I’m pretty heavy into steel manufacturing — lots of primary metal, some aluminum plants, paper, power, some aggregate materials like mining operations, cement factories — typically large industrial with heavy equipment. Right now I’m in a place where they grow silicon crystals used to manufacture microchips.

Q: What kind of equipment are you inspecting there?
A: The actual crystal growing machine. They are looking for very, very minute vibration issues.

Q: When you go to a work site, what do you know in advance?
A: I get called in because there’s a problem. I’ll know if it’s a driveline torque test if there’s a break in the driveshaft or a coupling. The only way to figure out the problem is to measure what they are doing. I’ll have them send me drawings and some photographs if they can. Some stuff can be way out of the box. As an example, there was a pipe mill where they make line pipe. And, when they roll the pipe through the mill, there’s a mandrel inside it. They have to pull that out of the pipe when the pipe is done with a big, long chain drive. The problem was that they were breaking the bolts for the chain. Their maintenance practice was to change the bolts every week because, if they didn’t, the bolts would break the week after. The bolts should have been lasting for several years. Kind of out of the box, we took those bolts, instrumented them up with strain gages, turned them into load cells — calibrated them against traceable load cells so we would know what their actual output was. And, the other issue was the wire. This was a
chain drive that went 120-150 feet down the line and then back around — so you couldn’t just wire it up. So, I used my telemetry systems that I use for torque testing and actually mounted those to this block to get the data.

Q: And, what was causing the problem?
A: Well, I don’t know. I went through the data — we took data for about a week — the peak loading, the ultimate tensile strength, the material and calculated the endurance limit. And, when it came back, I said, “I don’t know why you’re breaking the bolts. From the data that I’ve got — you’ll break them in a year or several million cycles but not every week.” And, pretty much, after I sent in the report, the client said, “Well, we changed the chain design.” So, they had changed the design of the chain. They had actually fixed their problem. They just didn’t know it. I convinced them to leave the bolts in instead of changing them out the next week — leave them in until they did break. So they left the bolts in and they ran several months without breaking. I guess they’ve changed them since for a different reason, but the bolts haven’t broken yet.

Q: What are the biggest challenges in your work?
A: As far as the general job goes, it’s wearing many hats. I’m not out actively pursuing work but sometimes I’m a sales guy. A lot of times, the customer is a referral. They don’t know me. We’re just another outfit to them and I’ve got to talk to them, show them that we know what we are doing and that we can help them solve their problem. There’s also the administrative aspect of it. I write the proposal and when the job’s over, I do the billing. And then there’s the engineering — going through the data and figuring out what the problem is. I don’t have people directly under me but there’s also a management aspect when I do bring a technician. As far as challenges on a more technical end, it’s not necessarily where you just stick an accelerometer on a gearbox and take data. It’s, “Well, I need to measure displacement so how do I mount that sensor? Is it really going to tell me what’s happening? Is it a torsional thing? Do I also need to be looking at axial or bending loading?” It’s a technical challenge. “How do I go about solving this problem?”

Q: Are there areas of NDT that you’d like to know more about or get additional training in?
A: Eddy current inspections and motor circuit evaluation.

Q: Have you ever had or been an NDT mentor or been given good career advice?
A: Ken Ives is the sole reason I’m where I am now. He’s been doing this type of work for many years. He came out of the steel industry. He worked in their process analysis groups and just doing testing mostly for steel. He helped train me when I was a co-op and then hired me directly after I graduated and pretty much taught me everything I know. I still call him when I have difficult questions.

Q: Has he given you one piece of career advice that you think is particularly valuable?
A: It’s nothing he ever said. It just came by example — from watching him and working with him; watching how he deals with difficult situations and how he approaches problem solving; breaking it down. At first, it was very daunting to me to go into a big steel mill. There’s glowing red metal, big giant machinery — and there’s “Well, this thing is breaking and I’m supposed to figure out why.” But, you just break it down into its simple elements.

Q: What’s the most rewarding aspect of your work?
A: Figuring out what the problem is. I liken it to cutting grass. Nobody wants to cut grass. It’s 98 º (36.6 ºC) outside and it’s humid. But, when you’re done, there’s a feeling of satisfaction. It’s kind of like that when I go into a place and have to deal with the elements — grease, cold, hot. But then, I perform the test successfully and get good data. It’s very rewarding at the end to know all the work wasn’t futile.

Q: What advice would you offer to someone considering a career in NDT?
A: It really comes down to the individual. There are people that go to school and want to sit in front of a computer every day — and that’s fine. And, for the people that are like that — don’t get into NDT. But, if you like getting out of your chair and doing something with your hands, NDT is a good fit.

Contact Trent Martz at martzt@ivctechnologies.com.
Q: I took 40 hours of theory and practical training for UT Level I at an independent NDT training company, have 12 months experience in UT with transverse scans, transfer corrections, etc. and now work for another company. I have no idea where this can be used or if my company can use it. Does this mean that I am a Level II if I have 12 plus months of experience, lots of in-house training plus 40 hours from the initial course? Please help explain this to me as I am looking to do my Phased Array Level II, and if I can’t get the answers I might have to go another route. Thanks in advance. M.T.

A: According to paragraph 9.1 in Recommended Practice No. SNT-TC-1A (2006), certification of all levels of NDT personnel is the responsibility of the employer, so you would have to be certified by your current employer. SNT-TC-1A paragraphs 7.4 and 8.1.5 (respectively) do permit the employer to accept outside training and examination services if they meet the requirements of their written practice, so if their written practice is so written, they can accept your previous training documentation as proof of having met some (or all) of those requirements depending on the training hours and exams that are documented. Self-employed personnel must meet all of the SNT-TC-1A guidelines for employers since they are their own employer. SNT-TC-1A recommends 40 hours of training to get to UT Level I and an additional 40 hours for Level II (80 hours total), and training hours, like experience hours, do not expire if properly documented; it will be up to your current company’s Level III to determine whether or not your additional training meets the requirements of their written practice. If it does, and you have the required documented experience, then you would need to pass their Level II General, Specific and Practical exams to become certified; certification is not automatic after 12 months.

Respectfully,
James W. Houf,
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