A number of factors may affect the probability of an inspector missing a defect indication while performing a fluorescent penetrant inspection (FPI) examination. One of these is the brightness difference between an indication and the background. This can be controlled somewhat by the inspector. Providing that the excess surface penetrant has been properly removed, an operator can cause the indication to fluoresce more brightly by increasing the intensity of near-ultraviolet radiation (UV-A). This can be achieved by either moving the sample closer to the radiation source or by using a more powerful source. There are two concerns when using ultra-high intensity UV-A sources for FPI work:

- fading of indications prior to detection, and
- health concerns from prolonged exposure.

Background on UV-A Fade

All fluorescent penetrants, when not contained in a vacuum, will fade when exposed to ultraviolet radiation. The rate of fading observed is related to:

- UV-A intensity,
- temperature,
- air flow, and
- volume of penetrant exposed.

High UV-A intensity, especially when coupled with heat and increased air flow, has been shown to fade defect indications to a fraction of their original brightness within a matter of minutes. Inspectors working on applications where small defects must be found, or where inspections take a considerable amount of time should be aware of this phenomenon.

Typical process specifications encountered in industry provide a minimum ultraviolet radiation intensity for fluorescent penetrant inspection work, but fail to offer guidance on a maximum value. UV-A intensity for handheld sources will vary widely depending on the particular lamp used and remaining life of the bulb. Common UV-A sources provide 4000 to 6000 µW/cm² at 15 in. (38 cm) away, while newer bulb designs emit 40 000 to 60 000 µW/cm² at this distance. Because most commercial digital radiometers have an angular dependence, measurements should be performed with the sensor perpendicular to the incoming beam. While the standard intensity measurement is made at 15 inches (38 cm), actual inspections are often done with the handheld light at a much closer distance resulting in higher UV-A intensity at the surface.

Fluorescence occurs when UV-A energy excites dye molecules, and as the excited molecule relaxes most energy is emitted as visible light. According to convention, in two-dye penetrant systems one dye is excited by wavelengths near 365 nm (peak UV-A wavelength) and emits light with a wavelength of approximately 440 nm (blue light). Utilizing a cascading mechanism, a second dye then absorbs this 440 nm energy and emits yellow-green light in the 530 to 555 nm range that is apparent to the inspector. These three wavelengths are highlighted in the small portion of the electromagnetic spectrum as illustrated in Fig. 1. Fade occurs as the excited yellow-green dye molecules are bleached. This fade effect has been shown to occur with any UV-A intensity, although the rate increases as UV-A intensity, penetrant temperature, and air flow over the penetrant sample rises.

Fade of Bulk Penetrant Samples

Experiments were conducted to determine the relative effects of air flow, UV-A intensity, and
Temperature on the fade rate of fluorescent penetrant. This work utilized a photometer to measure the brightness of penetrant, either in thin layers, or in the form of defect indications. Initial work used a thin layer of undiluted penetrant swabbed onto a UV-grade fused silica disk, which was then exposed to various temperatures, UV-A intensities, and increased air flow. Fused silica was used because of its superior UV-A and visible light transmission ability. Penetrant held between two silica disks allowed for ultraviolet light exposure with minimal air interaction as shown in Fig. 2.

As shown in Fig. 3, temperature and air flow seem to play a greater role than a UV-A increase alone. For example, an increase in air flow

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**FROM THE EDITOR**

The “Focus” article in this issue of *TNT* is entitled “UV-A Induced Fade in Fluorescent Penetrant Tests”. Fluorescent Penetrant Inspection (FPI) is one of the many program topics currently being researched by the Center for Aviation Systems Reliability or CASR (pronounced “kay zar”), a collaborative effort between the Federal Aviation Administration, private industry and Iowa State University’s Center for Nondestructive Evaluation (CNDE).

CASR’s goal is to provide quantitative NDE techniques, procedures and prototypes to assure the airworthiness and reliability of aviation systems. This end is achieved by identifying and prioritizing NDT issues where public domain data is insufficient and then conducting research on these issues. Most significantly, the final aspect of the program is to deliver the results of the research into the hands of practitioners — those engaged in the day-to-day application of NDT. TNT and ASNT are pleased to have an opportunity to participate in this endeavor.

For more information regarding the FPI research efforts, visit <http://www.cnde.iastate.edu/faa-casr/FPI.htm>.

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**Inbox**

Q: My company had several people take Level I and Level II training in Electromagnetic Testing (ET) back in 2002 and received training certificates at that time. Now a client is telling me that the certificates are “out of date” and that I have to have them recertified. Is this correct?

A: Your question is actually two, one regarding training and one regarding recertification. Training hours remain valid throughout the length of an attendee’s career as long as the training can be properly documented. Documentation in the form of a signed letter or certificate of completion that shows the dates of the training, the number of contact (attendance) hours, the training subject, and the instructor’s signature is usually adequate. If initial training documentation is lost it may be necessary to retake training to get new documentation, but training itself does not expire. NDT certification does expire, with the period of validity being dependent on the type of certification being considered.

The Recommended Practice No. SNT-TC-1A guidelines recommend a 3-year recertification cycle for employer-certified Level I and Level II personnel, but if those personnel leave the company prior to that time then their certification expires when they leave the company. They can be re-examined and recertified by another company based in part on the earlier training documents, but they do have to re-examine.

However, if personnel hold central certification, such as that issued through the ASNT Central Certification Program (ACCP), these certificates do not expire when the certificate holder leaves an employer but remain in effect for 5 years from the date of issue. *TNT*

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Focus continued from page 1.

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Figure 2. Typical experimental setup showing (a) photometer, UV-A source, and hotplate. Fused silica disks viewed through the spotmeter with measured region of interest visible as black dot in (b) closed configuration and (c) open configuration.
resulted in the same fade rate as a 25 percent increase in UV-A intensity. This data set contains one experimental run per condition set. Because brightness of UV-A illuminated indications decreases with air flow the use of shop fans should be used sparingly.

The next series of experiments utilized thermally-cracked aluminum blocks. Three light sources were used at two UV-A intensities: 5000 and 10 000 µW/cm² with the samples held at either 68 °F (20 °C) or 160 °F (71 °C). The upper temperature was chosen to match the maximum temperature allowed for in-process dryer ovens to determine what would happen if hot parts directly from the oven were inspected. The plotted lines provided in Fig. 4 are an average of 5 to 15 runs per condition. Results show that increasing UV-A intensity increases the fade rate, and when exciting penetrant at 160 °F (71 °C) the fade rate for a given UV-A intensity is much greater than that of room temperature penetrant.

Additional experiments using low-cycle fatigue (LCF) cracks showed that the fade rate varied with the size of the indication and volume of entrapped penetrant. To remove as much crack-to-crack variability as possible, a single defect in a flat titanium bar was reprocessed multiple times and exposed to increasing UV-A levels. A 30 minute acetone soak in an ultrasonic cleaner and a 30 minute dry at 155 °F (68 °C) were used to completely remove penetrant left over from the prior run.

The 0.069 in. (1.75 mm) LCF crack was processed multiple times and then exposed to UV-A levels from 1000 to 20 000 µW/cm² in order to determine the effect of UV-A intensity over time using a constant penetrant volume. As shown in Fig. 5, the 1000 µW/cm² data set continued to increase in brightness during the run, probably as a result of penetrant bleed-out. Decreasing indication brightness was apparent at all other UV-A intensities tested. Note that a 50 percent brightness reduction occurred within 20 minutes using 10 000 µW/cm², while only 7 minutes were required using an intensity of 20 000 µW/cm². This dataset contains one experimental run per condition set.

The inspector is cautioned about using high-intensity UV-A in situations where it is not required. The inspector should also ensure that the radiation source is not held over a given area for an extended period of time. This may be particularly important when a questionable indication is found that must be verified by a supervisor or cognizant engineering organization.

Health and Safety

UV-A wavelengths are less biologically harmful than their higher energy UV-B and UV-C counterparts, but as with radiography’s As Low

As Reasonably Achievable (ALARA) approach, making the workplace safer should be the general goal. Groups such as the American Conference of Governmental Industrial Hygienists (ACGIH) offer guidance on safe exposure limits for the wavelengths used in nondestructive testing.¹ Safe daily exposure limits for unprotected skin and eyes at the minimum UV-A intensity is many times greater than the recommended maximum exposure to a high-output unit.

Wise protective measures include long sleeves, sunscreen or some form of gloves, and UV-A blocking eyeglasses, especially those that also eliminate reflected purple light from the radiation source. These lenses block

Focus continued on page 4.
Focus continued from page 3.

Focus continued from page 3.

wavelengths below approximately 480 nm, but allow equal transmission of the yellow-green color of interest to fluorescent penetrant and magnetic particle inspections when compared to standard safety glasses. Numerous researchers have been proponents of yellow-tinted lenses, and have written about their attributes for decades, but their use is still not widespread. For example, Betz (1967, 1969)\(^2\),\(^3\), Hagemaeir, et al. (1979)\(^4\), Holden, et al. (1986)\(^5\), and Ness, et al (1996)\(^6\) have all commented on the visual benefit of this lens type. Keep in mind that this special long-pass filter lens is not an auto-darkening (photchromic) or sunglasses-type (neutral density) filter, both of which have an adverse effect on detectability. Reducing purple and blue light in this manner increases contrast sensitivity as shown in Fig. 6. Figure 6a is an image taken with no filter. The image in Fig. 6b was made utilizing a filter nearly matching that used in yellow safety glasses and shows that indication brightness is unaffected while contrast is greatly enhanced.

Conclusion

Inspectors should be aware of the consequences of using high-intensity UV-A sources for penetrant inspections. These include rapid reduction in an indication’s signal-to-noise ratio due to UV-A fade, and increased inspector health concerns. The amount of time required to fade an indication is related to the volume of penetrant being exposed, penetrant or part temperature, air flow over the liquid, and UV-A intensity. Fluorescent penetrant inspection indications from cracks that contain a greater volume of penetrant will fade more slowly than those from shallow cracks. Elevating the temperature of the penetrant, or inspecting components that are still hot from the drying oven will result in faster brightness degradation at a given UV-A intensity. Using radiation sources with integral cooling fans, or directing shop fans into the inspection booth will also speed the degradation of fluorescent indications because of increased air flow. Experimental work supported the existing specification for critical inspections.

Use of yellow-tinted safety glasses will reduce eye fatigue and enhance indication contrast, especially when dealing with polished surfaces that reflect light from the UV-A source back to the inspector. Well formed indications emit yellow-green light, and any purple or blue light emitted by the UV-A lamp simply increases background noise. Depending upon manufacturer, the amount of 555 nm light transmitted to the inspector’s eye may actually be higher with a yellow lens compared to the standard clear version therefore improving detectability. Expanded use of these lenses in the penetrant and magnetic particle inspection community should be considered. TNT

Figure 5. Curves generated by single 0.069 in. (17.5 mm) low-cycle fatigue crack processed multiple times and exposed to increasing UV-A levels from 1000 to 20 000 µW/cm\(^2\) illustrate the effect of UV-A intensity while maintaining constant penetrant volume.

Figure 6. Five fluorescent penetrant indications visible on UV-A illuminated TAM panel showing contrast reduction due to glare: (a) image with no filter and (b) image made utilizing a filter nearly matching that of yellow safety glasses.

References

1. Threshold Limit Values (TLVs\(^\circ\)) and Biological Exposure Indices (BEIs\(^\circ\)). Cincinnati, OH: American Conference of Industrial Hygienists (2006)

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For more details on the results of Iowa State’s FAA-funded FPI research efforts, go to <http://www.cnde.iastate.edu/FAA-casr/index.htm>
Crossword Challenge:

Across
1. The C-scan produces a recording of flaw areas __________ over a plan view of the test piece.
7. As the radius of a curved lens is increased, the focal length of the lens ___________.
8. Compensation for changes in echo height related to variations in discontinuity depth is known as ______.
11. These waves have multiple or varying velocities.
13. Finger damping to locate a discontinuity is referred to as the ______ wave technique.
17. When the incident angle is chosen to be between the first and second critical angles, the ultrasonic wave generated within the part is ______.
19. Lamb waves can be used to detect laminar type defects near the ______.
20. When conducting an angle beam contact test, increasing the incident angle until the second critical angle is reached results in the production of a ______ wave.
21. At an interface between two different materials, an impedance difference results in the division of sound energy into both transmitted and ______ modes.
23. The length of the zone adjacent to a transducer in which fluctuations in sound pressure occur is affected by both the frequency and the ______ of the transducer.
25. In an A-scan display, this circuit triggers the pulser and sweep circuits.
26. When immersion testing using a small tank, it is common to use a manually operated ______ to set both the proper water path and transducer angle.
28. Scanning with a wheel type transducer inside a liquid filled tire would be an example of this type of testing.
29. When adjusting the flaw locating rule for a shear wave weld inspection, the zero point on the rule must coincide with the sound beam exit point of the ______.
30. In an A-scan display, the signal ______ represents the intensity of a reflected beam.

Down
2. In the far field of a uniform ultrasonic beam, sound intensity is ______ at the beam centerline.
3. When straight beam testing, test specimens with nonparallel front and back surfaces can result in a partial or total loss of ___ reflection.

4. As frequency increases, the angle of beam divergence of a given diameter crystal ______.
5. These waves are influenced most by defects located close to or at the surface.
6. Beam divergence occurs in the ___ field.
9. Crystal thickness and transducer frequency are related in that the thinner the crystal, the ______ the frequency.
10. The disjointed appearance of a stick in a glass of water at the water’s surface illustrates this phenomenon.
12. A grouping of a number of crystals into one transducer is called a crystal ______.
14. For aluminum and steel, the longitudinal velocity is approximately the shear velocity.
15. When testing in the ___ field, it is possible for a discontinuity smaller than the transducer to produce indications of fluctuating amplitude as the transducer is moved laterally.
16. The angle at which 90 degrees refraction of a longitudinal sound wave is reached is called the first ______ angle.
18. In a B-scan display, the length of a screen indication from a discontinuity is related to the discontinuity’s length in the ______ of transducer travel.
19. This law can be used to calculate the angle of refraction within a metal for both longitudinal and shear waves.
22. In an automatic immersion scanning system, this serves to support the scanner tube.
24. Large grains usually result in excessive ____ or noise indications.
27. In an A-scan display, the distance covered by the front surface pulse width and recovery time is referred to as this zone.

Questions for “Crossword Challenge: Ultrasonic Testing” adapted from Supplement to Recommended Practice No. SNT-TC-1A (Q&A Book) - Ultrasonic Testing Method, revised edition.

Answer Key

Across
1. superimposed
7. increases
8. attenuation
11. Lamb
13. surface
17. shear
19. surface
20. surface
21. reflected
23. diameter
25. clock
26. manipulator
28. immersion
29. wedge
30. amplitude

Down
2. maximum
3. back
4. decreases
5. Rayleigh
6. far
9. higher
10. diffraction
12. mosaic
14. twice
15. near
16. critical
18. direction
19. Snell’s
22. bridge
24. hash
27. dead

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The word tomography is derived from the Greek word tomos meaning a piece cut off or a slice can be imaged. Through the use of a discontinuity of a specified size:

\[ C \div D_{\text{min}} = X \]

Where:
- \( C \) = circumference of imaged object
- \( D_{\text{min}} \) = minimum defect size
- \( X \) = number of images required

Using this formula, if one wanted to detect a 0.05 in. (1.27 mm) discontinuity in an object that was 30 in. (76.2 cm) in diameter, 600 planar images would have to be acquired. For further discussion of computed tomography, the reader is referred to additional documentation.1-3

Parallax Method

What does parallax mean? Parallax is the apparent change in the position of an object resulting from the change in the direction or position from which it is viewed. The significant advantage of the parallax method is that by employing basic geometry, it can greatly reduce the number of images required to render a component, thereby increasing the number of specimens that can be processed in an equivalent amount of time. Typically, a digital system using the parallax method will only require the acquisition of 4, 8, 16, or 32 images. It is how the images are taken and processed that distinguishes the parallax method from ordinary tomography.

The parallax system images the component at an angle. The angular cross-section represents the component from top to bottom and includes aspects of the component’s width in the image. Picture the first image as a diagonal cross-section of the component. Using correlating data from another diagonal cross section, dimensions and densities are projected vertically and horizontally. By correlating the different perspectives together, the computer generates the different vertical and horizontal planes. One plane may image the front of an object accurately while another images the side. When this data is correlated with a top or bottom view, we gain a three-dimensional image. This technique greatly reduces the effects of geometric unsharpness. Additional information regarding the topics of parallax and stereo radiography can be found in other resources.4

The parallax system developed to inspect the RCC panels for the space shuttle program is permanently installed in a vault that is 15 ft. X 15 ft. X 20 ft. (4.6 m X 4.6 m X 6 m). The wall behind the linear array is lined with 1.75 in. (4.4 cm) of lead shielding to protect personnel. Wall-mounted emergency shut-off switches and a safety interlock on the entrance door are additional safety requirements. A 450 kilovolt (kV), horizontally mounted, X-ray device is required for detection of a 0.05 in. (1.27 mm) discontinuity in an object that was 30 in. (76.2 cm) in diameter, 600 planar images would have to be acquired.
utilized (Fig. 1a). The linear CMOS array is mounted horizontally between two upright masts (Fig. 1b). The array may be moved to any elevation on the masts.

Also mounted on two vertical masts in the center of the system is a mechanized turntable. The six-foot diameter round table has motion control in two axes. The imager and X-ray tube remain stationary and the component is rotated. The component does not rotate during data acquisition. Through the use of gear reduction motors, the table is tilted to 45 degrees before processing begins and is held at that angle for the duration of the inspection by two locking rotors. High strength aramid fiber straps secure the test component to the turntable. The restraining straps are relatively transparent during imaging and will not adversely affect the procedure.

Image quality indicators (IQIs) can be used during the course of the inspection. Traditional penetrometers or wire-type penetrometers can also be incorporated around the component to ensure sensitivity. However, for accurate linear measurements of a component, the most important indicators are round metal discs of known diameters. These serve as points of reference when the images are correlated and provide a known dimension within the completed images as well. Step wedges may also be placed within the viewing area for the same purpose.

With the proper X-ray procedure for imaging the material of interest established, the parallax system is now ready to begin data acquisition. The required voltage (V) and amperage (A) are programmed into the X-ray machine and the tube is turned on. The linear array takes a snapshot of the photon energy penetrating through the component. When the image is complete, the X-ray tube is turned off. For most materials, the image is acquired in less than one second. A computer communicates with a motion control system that drives the rotation of the table and the table is indexed the predetermined number of degrees with feedback from encoders. When in position for the next perspective, the X-ray tube is reactivated, and another image is captured. This process will repeat itself until the required numbers of images have been completed.

The individual images are then processed by the computer to form a three-dimensional representation of the component. This aspect of parallax imaging process is the most time consuming part, taking approximately an hour.

FYI continued on page 10.
Todd Kupfer likes to be busy and he likes being challenged by unusual applications of NDT, as he demonstrates when he describes examining US Navy sonar domes with X-ray. He’s also an innovator. His acumen recognized the potential to apply a pulsed X-ray technology being utilized by law enforcement in the inspection of boiler tubes in a fossil fuel power station. He’s Level III and management now but he started as a technician and he still enjoys “hands-on” NDT.

Q: How did you first become involved in NDT?

A: I started in the Navy right out of high school as a hull technician in general maintenance doing welding and piping. Near the end of my first enlistment, the Navy offered me NDT school. It seemed like a good career path so in 1987 I reenlisted to go to school. I was a hull technician and certified welder with a specialty of nondestructive testing.

Q: Can you describe your military NDT experience for us?

A: My NDT experience began on the Abraham Lincoln, an aircraft carrier. It was actually in the shipyard being built and I was the first NDT person on the ship. I set up the nuke [nuclear] welding and NDE programs there. From there, I went to the sub base in Groton, CT for three and a half years. That’s probably where I received the majority of my NDT knowledge. At any one time, there were probably 20 submarines there and the work was constant. It was all submarine repair from piping to hull X-ray. We did a lot of weld inspection and ultrasonic thickness testing for FAC or flow accelerated corrosion on piping. From there I went to Norfolk on a submarine tender. When I left the Navy, I hired on with a company in Richmond [VA] as a technician. Pulp and paper was their specialty and we primarily did MT, PT, RT and UT.

Q: Did you find that your military training transferred successfully into private industry?

A: Being a hull technician in the Navy is almost identical to what we do out here — to what I’m doing now. All the inspections are the same, MT, PT, RT and UT. It was just a matter of getting adapted to the civilian culture and, instead of working on submarines I had to learn my way around boilers — the applications are different. That was the big challenge. I’ve worked in various industries since then including power generation.

Q: What were your NDT responsibilities while working in power generation?

A: I was a full time in-house tech at the Surry Power Station. There are three in-house technicians in each plant that primarily do planning. In-between refueling outages, they cover the general maintenance. Unfortunately, there was a lot of down time and I didn’t feel challenged by the work. During planned outages, contractors came in to do all the inspections and I wound up doing contract management. I’m more of a hands-on person and I missed the fieldwork. I hired back up with a previous employer that went into chapter 11 after a few months. As a group, the NDT personnel at that office decided to find another company. We shopped around and found Applied Technical Services, my current employer. Our group brought a lot to the table and it’s been a great fit ever since.

Q: How do you spend a typical workday?

A: Well, in the past week, I’ve been overseeing an outage back down at the Surry Power Station. In addition, I’m the operations manager here in Ashland and the Level III. However, Dominion is our biggest customer right now and they like to see me onsite for all radiography. It’s about an hour and a half drive down there so we meet at 5:30 pm and we’re down there by 7:00 pm. We typically work till five in the morning and then I’m in the office for two to three hours and then I go home and try to get some sleep.

Q: You’re supervising again. Are you able to do any of the “hands-on” you really enjoy?

A: Yes, we primarily do the radiography for the North Anna and Surry Power Stations, the two nuclear plants here in Virginia. Currently, we’ve got eight guys on site, two shifts of four and I kind of jump around whenever we’re doing the radiography.

Q: Is that digital or film radiography?

A: We’re doing both. A lot of the digital right now is just for informational — shooting valves, profiles for valve positioning. We’re also doing some FAC inspections with digital. This is more of a pilot program for them. Refineries use a lot of radiography for FAC and the utilities are trying to do the same to get away from strictly using ultrasonic testing.

Q: Is digital radiography as effective as film in this application?

A: I think it does just as good, if not better. Of course, it depends on the system you have. We bought our system back in December because Dominion fossil requested that we start doing everything digital. They also came to me about a year ago and asked for a way
to shoot their boiler tubes with a low energy source so that they could keep people working. When we used to do boiler radiography, they would typically give us a window of time in the boiler say from 3 to 6 am in the morning to shoot all the boiler replacement tubes. Using an Iridium source, they would have to run everybody out of the boiler and we’d have to rope off a big area. We tried selenium with good results using digital but still had a large boundary. Then I found a small, pulsed X-ray unit that runs off a battery pack — it’s totally portable. Our boundaries are now about 10 foot on each side of the unit. So we can keep people working all around us in the boiler. The 10 foot boundaries are more to keep people out of our way; we could probably go down to about 5 foot on each side.

Q: How were you aware of the low energy source technology?

A: I saw a demo a few years ago that used the pulsed X-ray tube with a digital system. It was more for examining explosive ordnance; state police use it for X-raying packages, looking for bombs and that kind of stuff. I just had a brainstorm of using this on boiler tubes. It was the lowest energy source that I knew of and it wound up working really well on boiler tubes. It works well on anything under about 3/4 in. (1.9 cm) thickness in steel. You can get the same sensitivity as film, if not better.

Q: What additional training have you had since the military?

A: I’ve been through Level III refreshers and I’ve got my Level III in MT, PT and RT

Q: Those are ASNT certifications?

A: Yes, they’re more universally recognized and actually the nuke work we do is to CP-189 [ANSII/ASNT CP-189: Standard for Qualification and Certification of Nondestructive Testing Personnel] and that requires that you have an ASNT cert.

Q: What’s the worst part of the work you do in NDT?

A: Probably the customer demands — scheduling. And also the fact that most customers don’t understand everything that is involved in delivering them a quality product.

Q: What’s been the best part of the work you do in NDT?

A: Job satisfaction. I’ve got a great group of guys here and we do some good work. Every day is different. Our work is very diverse and that’s one thing I enjoy. The X-ray work we do on sonar domes on Navy destroyers is a good example.

Q: Can you tell us about that?

A: On the front of a destroyer, and on some cruisers, there’s a sonar dome, a big rubber window below the water line and around the front dome of the ship. Behind the rubber window, there’s a sonar array of about 700 transducers. It’s pumped up with fresh water on the inside while the ship is under way. These things are made like a tire; thicker than a tire obviously. They’re about an inch to 2 inches thick and made in two halves spliced together in the front. That’s where they’ve had most of the failures. We look along the splice lines with X-ray. The challenging part is that some of the tests have to be done while the vessel is pier-side and in the water. They pump out the fresh water from the inside of the dome and pressurize it with air and then we go down with our X-ray tube on the inside. We actually go through an interlock of about 15 pounds of pressure to equalize us to the pressure inside the dome. There’s a cover stretched over the outside of the dome that’s been gridded off with coordinates and with lead numbers stitched into it. We send a diver down with a film pouch and tell him exactly where we want the pouch positioned for each shot. These inspections are one of our specialties. There are just a few companies that do it.

Q: Has membership in ASNT benefited you?

A: Yes. It’s a good networking tool. I’m not as active in my Section as I’d like to be because I’ve got such a hectic work schedule. But I do know a lot of the local guys and it’s definitely a good networking tool.

Q: What do you consider the growth areas of NDT?

A: Definitely digital radiography. And, ultrasonic phased array.

Q: What advice would you offer to someone considering a career in NDT?

A: Go through a good training program whether it’s the military or a two-year associates program. Outside of that, it’s important to find a good mentor. I had several in the military. A good mentor can help you get to the level of professionalism you need in this business quickly. It’s not just for the nondestructive testing. For example, in utilities, you’ve got to know the plants and how things are set up — you’ve got to know the boiler and piping and your way around a turbine. The only way you’re going to learn these things is through a mentor. TNT

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The round metal disks that were placed around the component are now used to calibrate an accurate virtual caliper. Precise measurements can be made by clicking a mouse where the measurement is to start and dragging the cursor to the point where the measurement is to end. Discontinuities can be sized and evaluated by precise measurements in all three major axes. The three-dimensional representation is scalable and can be viewed in any plane with sharp, distinct edges.

Detecting Panel Discontinuities

The procedure to detect discontinuities on the RCC panels requires the X-ray radiation to penetrate the material at a line tangent to the discontinuity. One of the primary areas of interest in each of the forty-four shuttle panels is the point at which the leading edge blends into the straight section of the panel. Using a tomographic system, it would be necessary to image through approximately 24 in. (61 cm) of material. This is because the panel sits flat on the turntable as the horizontal images are acquired. At certain points, some areas of interest cannot be viewed because the material is too thick to be imaged.

Alternatively, the parallax method tilts the panel 45 degrees for imaging and all of the images are acquired while in this plane. This means that if an area is too thick to view in one plane, there are at least two other image planes that bisect the area of interest at different angles. The data from those two planes can be projected to reconstruct the area of interest. Thus, the parallax method increases the effective volume that can be imaged when compared to tomography.

Conclusion

Similar to computed tomography in that it also allows for the construction of a three-dimensional representation of the component being examined, parallax imaging has the significant advantage of requiring far fewer images to do so. This results in a proportional increase in the number of components that can be processed in an equivalent amount of time. In addition to the ability to render scalable images with distinct delineation, parallax imaging also allows accurate depth (location) and linear measurements and can image unique part geometry not possible with traditional tomography.

References


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