Duplex stainless steels, austenitic stainless steels, and nickel-based alloys used in the oil and gas industry are resistant to atmospheric corrosion in most industrial environments. However, corrosion may result from surface damage that often occurs during storage and transportation. A thorough visual inspection should therefore be performed prior to the pipe entering service. Where the damage has resulted from contact with a noncorrosion-resistant steel, foreign material embedded in the surface may form rust. Embedded rust may act as an initiation site for further corrosion or create a stress riser where stress corrosion cracking could initiate, resulting in a catastrophic failure. This article explains the difference between embedded rust and superficial rust, a technique for remediation, and postremediation inspection of pipe for oil and gas production.

During storage and transportation of pipe, it is likely to come in contact with foreign materials containing iron or iron oxide (meaning, rust). This can range from iron oxide in the air settling on the pipe to damage from chains, racks, or forklifts during material movement. This will result in the appearance that the corrosion-resistant alloy pipe has corroded, when in fact it is the rusting of the foreign material. If this rust hasn’t disturbed the original pipe surface, it is considered to be superficial and not detrimental to the product. Superficial rust is not bonded to the surface of the pipe and the passivation layer providing corrosion resistance to the base metal still exists. However, if the foreign material has become embedded in the surface, it can be detrimental and should therefore be removed. Examples of superficial and embedded rust have been provided in Figure 1.
Visual testing is the most efficient nondestructive testing (NDT) method for identifying embedded rust. Where embedded rust is associated with a pit or gouge, it is easily recognized through visual inspection. One hundred percent visual testing should be performed in accordance with established company procedures by Level II personnel or Level I personnel under the direct supervision of Level II personnel who are qualified in accordance with SNT-TC-1A (ASNT 2016). The inspectors will require proper training and the visual acuity to differentiate between superficial and embedded rust. API product specifications typically specify the lighting level to be a minimum of 500 lux (50 foot-candles) at the inspection surface.

Embedded rust imperfections may be removed by grinding. The ground area should be blended to avoid sharp edges or contours. An example of an acceptable blended area is shown in Figure 2. A #36 grit or finer grinding wheel is recommended to reduce the risk of excessive material removal and to obtain an acceptable surface roughness. Abrasives containing iron or iron oxide should not be used, as they will form superficial rust. The operator must use caution to prevent excessive removal of material and heat buildup. The alloy should remain cool to the touch during grinding operations. After grinding, a commercially available copper sulfate spray solution can be applied to determine whether all of the embedded material has been removed. If any free iron is still present, copper will plate out and become visually apparent within 30 seconds to a minute. If copper plates out, additional grinding should be performed and copper sulfate solution reapplied until all contamination has been removed. Once completed, the area should be wiped with a cloth to remove excess copper sulfate solution.

Where defects have been removed by grinding, the remaining wall thickness of the pipe needs to be measured to verify it meets the requirements of API 5CRA or other applicable specification. API 5CRA requires the wall thickness be within 87.5% of the specified wall thickness for hot-finished products, or 90% for other products (API 2010; API 2018). This inspection should be performed by qualified personnel using a calibrated UT thickness device, following written company procedures. Localized areas are
typically tested with a handheld device, while large areas may be inspected by automated equipment, as determined by company procedures. The ultrasound velocity of the UT device needs to be verified. To do this, the typical process is to use a calibrated round tip × flat tip outside micrometer and measure the wall thickness of the test material. Then, calibrate the velocity of the handheld UT gauge to the known thickness of the test material. Ensure the proper amount of coupling gel and scan the entire remediated surface to ensure that the wall thickness is greater than the specification limits. Document the thinnest wall reading measured on the inspection report. The mechanical remediation can be followed by grit blast to ensure thorough removal of contamination and uniform surface finish (Figure 3). As always, Level I or II technicians should consult with their Level III personnel and company procedures for inspection and documentation requirements.

In summary, superficial surface contamination may be of no concern when using corrosion resistant alloys; however, the material needs to be properly inspected to confirm the contamination is not embedded. If embedded contamination is present, a proper remediation and reinspection needs to be performed. Embedded contamination in the form of rust may become an initiation site for corrosion, as well as a stress riser, leading to a catastrophic failure by stress corrosion cracking.

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**REFERENCES**


Over the last three months Materials Evaluation has published a series of articles relating to employer-based certification programs (specifically SNT-TC-1A) and some of the challenges facing the industry as it relates to the correct interpretation/understanding of employer-based programs, but also to clarify expectations as it relates to the content of certificates issued by the employer.

This is a multipronged initiative to educate users, owner/operators, employers, service providers, and the like. This includes the readers of The NDT Technician (TNT).

ASNT Certificate Compared to SNT-TC-1A Based Certificate

One item that continues to provide confusion is when a person holds an ASNT certificate as opposed to someone holding an SNT-TC-1A based certificate. An ASNT certificate is a third-party central certification program (similarly to ACCP) in that only ASNT can issue ASNT or ACCP certificates. ASNT, through the Certification Management Council (CMC), develops and maintains these programs in accordance with ASNT’s ISO 17024: Conformity assessment - General requirements for bodies operating certification of persons accreditation granted by ANSI (American National Standards Institute). SNT-TC-1A based certificates are employer-based certification programs for which ASNT does not hold the responsibility for certification. This is the responsibility of the employer. An employer, when required by the customer to meet SNT-TC-1A, will develop a written practice (procedure) that addresses how the employer will train, qualify, and certify NDT personnel to perform the required functions. While SNT-TC-1A contains many references to “should,” the employer is responsible for addressing specific needs, and so in the employer’s written practice any “should” references are replaced by the word “shall.” The employer and the employer’s Level III will approve the written practice and implement it into the employer’s quality system as a mandatory requirement for all to follow.

The Written Practice

From an SNT-TC-1A based certification standpoint, for an individual to perform NDT to Level I, II, or III, it is necessary to be certified by their employer in accordance with the employer’s written practice. This is generally understood by all involved in NDT, but are you familiar with the written practice that your company uses? Have you read it? Do you know where it is located if you wanted to look up the requirements? If the answer is “No” to any of these questions, ask your employer or Level III to show you the procedure which spells out how you become a certified NDT Technician to your employer’s written practice. In general, the employer’s written practice will be similar in format to SNT-TC-1A, except that “should” becomes “shall” and will contain employer-specific requirements. While you may not need to read the written practice on a regular basis, as a technician it is important to have an appreciation of the requirements. If you are planning to pursue a career in NDT, it makes a lot of sense to begin to understand the requirements now and not later. If there is something you do not understand about certification, speak with your employer or Level III.

The Certificate

Most people are familiar with the content of an NDT certificate, but sometimes it is not always clearly understood who is responsible for issuing the certificate. Over the last year or so, ASNT has been forwarded many different types of
documents that are being used as certificates. In a number of cases, those certificates are actually evidence of completion of a training course and examination results. The following are two examples of certificates that were submitted to ASNT.

**Example 1**
Figure 1 is a wallet card that a company issued to an individual to SNT-TC-1A. From the use of the ASNT logo and the number of times ASNT is mentioned, it may be misinterpreted that this wallet card was issued by ASNT (that was the query the International Service Center received). Those familiar with the ASNT wallet cards will know that is not the case; however, there are many people that do not know this, so the content is extremely important. Firstly, it is illegal to use the ASNT logo unless specifically authorized by ASNT. Secondly, employer-based certification programs are not ASNT certifications, therefore there is no basis for using the ASNT logo.

In no case shall a certificate be issued by an employer with the ASNT logo.

**Example 2**
Figure 2 is a document that was issued by a training agency but is being misrepresented as a certificate to perform NDT. At best this could be declared as evidence of obtaining a qualification in NDT through a training class and by passing a nondescript series of examinations; however, some aspects need further identifying.

“NDE Certification as per American Society for Nondestructive Testing”
- What does this mean, since employer-based certifications are to a written practice?
- Why is only SNT-TC-1A referenced when it is not possible to certify directly to SNT-TC-1A? Why is there no reference to the employer's written practice?

“Self-Sponsor”
- What is a self-sponsor in the context of this example? A company owner, an independent contracting inspector, or something similar? If you are an owner of a company, an independent contractor, or both and need to be certified to an SNT-TC-1A based program, then a written practice is still necessary and it still needs to be approved by the employer and the Level III. Self-sponsor is not the correct terminology that should be used.
Recertification

- Why is a training agency recertifying an individual to SNT-TC-1A 2006 and not to the employer’s written practice?
- “Based on experience and continuous performance reviewed up to…” This stamp has been used on two occasions (slightly different wording each time) to record a recertification (2013 and 2018) to SNT-TC-1A 2006. Is 2006 the requirement, or should 2011 or even 2016 apply? Note: this will be dependent on what is required by the customer.
- How can a training organization or outside agency confirm that the individual has continued satisfactory performance since they are not part of the individual’s supervisory structure for their employer?
- Why is the employer not involved in this process? Is the person still a self-sponsored individual even after initial certification and two recertifications issued by the training agency?

Interpretations

On occasion when reading specifications and standards, it is necessary to obtain clarification or an interpretation of a requirement. Did you know ASNT has a process for obtaining interpretations to SNT-TC-1A? At the end of the SNT-TC-1A document, there is a page that contains the template for obtaining clarifications (Figure 3). Simply copy the page, complete it, and send it to ASNT. Consider that ASNT can only provide interpretations and not consultation in terms of whether a requirement is being met or not.

Did you know ASNT also publishes Interpreting SNT-TC-1A: Interpretations from 1976 through 2017 (Figure 4)? This document can provide clarification to some of the most common types of interpretations requested since 1976. Even some of the older interpretations still stand the test of time and can prove very useful!

If there are topics relating to certification and other ASNT technical initiatives that you are interested in reading more about in TNT, please feel free to reach out to me.

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ASNT ...Creating a Safer World!
In October, the Publications Department conducted a survey to collect data from 13,000 readers on the usefulness of the computer tutorial program that accompanies the self-study books in the Programmed Instruction Series (Figure 1). The Programmed Instruction Series is written for Level I and Level II candidates. Among other things, recipients of the survey were asked how they prefer to access digital interactive content (Figure 2). While the currently used flash drive delivery system remains popular, survey respondents expressed interest in using responsive web-based tutorials easily accessible on smartphones and tablets. To address this desire, the Publications Department will begin developing web-based tutorials starting with the Introduction to Nondestructive Testing Programmed Instruction Book, which will be released in early 2019. The computer tutorial will include the same content as in prior editions, such as interactive questions and curated content from the book, but with additional functionality and a sleeker design. Users will be able to access this program anywhere there is an internet connection and also offline when connectivity is unavailable. As an added bonus, ASNT Publications staff will have the ability to make corrections and updates to the tutorial in real time.

![ASNT Survey Results](image)

**Figure 1.** Did you find the interactive tutorial beneficial in helping your understanding of the material?

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>92.06%</td>
<td>7.94%</td>
</tr>
</tbody>
</table>

**Figure 2.** How likely would it be for you to access an interactive tutorial on a mobile device such as a smartphone, smartwatch or another wearable device, or tablet?

<table>
<thead>
<tr>
<th>Very likely</th>
<th>Likely</th>
<th>Somewhat likely</th>
<th>Unlikely</th>
<th>Very unlikely</th>
<th>Maybe while on a break</th>
</tr>
</thead>
<tbody>
<tr>
<td>38.48%</td>
<td>27.05%</td>
<td>15.05%</td>
<td>8.57%</td>
<td>7.24%</td>
<td>3.62%</td>
</tr>
</tbody>
</table>
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Practitioner Profile
Candice L. Major

Candice L. Major started her NDT career in the United States Air Force. She now performs radiography for the aerospace industry and works for Element Materials Technology.

Q. How did you first become involved in NDT?
A. When you join the Air Force you get to choose four potential jobs called a “wish list.” I wanted something artistic, like a photographer perhaps, but the recruiter convinced me to consider NDT. I put it as an option, as there are not many artistic options in the military. I actually got the photographer job, but it was taken out of its own field and incorporated with videography, which caused me to lose my slot. The next one on the slot—NDT!

Q. Can you tell us about your certification and training?
A. I received my training in the military and on-the-job training as a civilian since 2003. I am a Level III in radiography (film and digital), penetrant, and visual testing, and am currently working towards gaining my ASNT NDT Level III certifications.

Q. Describe the work you do.
A. I have filled many roles and job duties, being a contractor for many years. I’ve worked at all stages of aerospace and on almost every alloy that exists. I currently work for Element Materials Technology helping them with internal reviews. We are looking to the future of setting up remote digital read radiography, which is something I’ve been trying to pioneer for years now, so that is extremely exciting.

Q. Can you tell us a little more about remote digital read radiography?
A. Before, you had film radiography. With this technology, if someone wanted to read out of their house, they would have to have it set up to meet all the regulations and procedures, the company would have to mail you the film, you’d have to mail it back...it just would not have been a feasible option.

When digital radiography came out and started being more commonly used, I was in a situation when I was flying back and forth across the United States each month. Between the costs of travel (hotel rooms, rental cars, per diem) and the time, it started to seem to me like an obvious solution would be for the company to send me the images. I could be set up with a digital read system, and then I could download the images and inspect them from where I was. If I see something, I create a report, and someone on site could follow up with the necessary procedures from there. With this technology, someone off-site could complete 80% to 90% of the work for the people actually in the facility from a remote location.

One of the reasons I think this could be so crucial to our industry is that finding radiographic readers is extremely hard. When hiring someone on site, you’re often asking them to move to the location where the facility is, and a lot of people don’t want to or cannot do that. If we could make remote read a more common practice, this problem would be solved. Not that remote read will not come with its own problems. You have to know you have a really good Level II and also have to be thorough—audit your audit system—and make sure the individual is doing their job properly. But if done correctly, remote read could make a big difference.
Q. What is your typical working environment?
A. I work in a remote location in Michigan helping the Hillsboro, Oregon team but belong to the Rancho Dominguez team. We have a saying around the company, because we have so many locations worldwide, that we’re supposed to think of it all as “One Element,” one team. My particular position coordinates between so many different locations, it’s become an inside joke that my job takes the One Element motto to a whole new level!

Previously in my career I have worked on the flight line, in the field, labs, nuclear facilities, factories, and more.

Q. Is your work focused on a particular field?
A. My current work is very specific: aerospace investment casting, digital radiography.

Q. What kind of structures/materials are you testing? What kind of indications are you looking for?
A. We test aircraft engine components using computed radiography and are looking for cast manufacturing defects such as shrink, gas, gas porosity, foreign material, and welding repair defects such as lack of fusion, lack of penetration, and such.

Q. How do you keep up with changes in technology?
A. Any time there has been a change in technology, I’ve been lucky enough to work for companies that provide training. NDT is a very small world, so it’s easy to keep a network of other Level IIIs, and we discuss such things. It was a good thing for me to do contract work and move around, because I was able to meet some of the best minds in the industry and form great relationships with them.

Q. Do you have experience in training NDT personnel? What characteristics do you think define a good NDT technician?
A. I have a lot of experience, and it’s actually one of my favorite parts of NDT. I think good characteristics are attention to detail, patience, focus, and above all else integrity. It’s imperative to stand strong and stay accountable because as I mentioned before, this is a very small industry: if you don’t have your reputation, you have nothing.

Q. What’s been your most interesting/ unusual application of NDT?
A. When I was in the Air Force we had a small Army unit on our base that consisted of two UH-1H helicopters that were used for missions at White Sands in New Mexico. There was a particular area in the tail boom that needed X-ray inspection and was almost impossible to reach. Being as small as I am, I most often got that job, and would be grabbed by the knees with my arms out in front of me (picture Superman) while they lifted me into the tail boom so I could place the film. Every time I’d come out with scratches all down my arms and bleeding, but it was worth it and quite hilarious. That is just one of thousands of stories I could tell.

Q. How has NDT changed during your career? What trends do you see?
A. The biggest change I have seen personally is the advancement of digital radiography. When I started in 1999 it was not even an option—the quality just wasn’t there. Now we have surpassed the quality of film in some cases. It’s amazing to watch and be a part of. It’s also opening up a lot of doors, like remote reading. That is something I’m very passionate about getting off the ground. I am a mother now; before this, I was used to being the worker, including all the traveling—it was my life. Now I’ve come to realize I can’t live my life like that anymore. If I could have the ability to do my job in my house and my child was sick, I could still take care of them and be able to work. It would minimize the time that any parent, mother or father, would have to spend away from work.

Q. What do you consider the growth areas of NDT?
A. Aerospace is booming right now. I know that Radiography Level IIIs are in high demand, so much so that they can’t meet the demand. NDT is not going anywhere as long as things are still being manufactured. It will always be a strong field, and I’d highly recommend it to anyone!

Q. What areas of NDT would you like to learn more about?
A. I’d like to learn more about digital detector array simply because most of my exposure has been computed radiography. My number-one focus now, however, is remote read and how we can make that happen. A lot of Level II personnel are qualified for the jobs that are out there, but are unwilling to relocate. Remote read would eliminate this altogether, keeping in mind you have to have very strong Level IIIs or IIIs to accomplish it.

Q. What are your professional goals?
A. Remote read and gaining my ASNT NDT Level III certifications in RT, PT, and VT.

Q. Have you ever had/been an NDT mentor? How helpful have mentoring relationships been in your work? What’s the best career advice you’ve received?
A. I feel as if, yes, I have been a mentor. I try, when I’m working anywhere, to make every individual there as smart as me, if not smarter. I want them to have a passion for what they do and understand it, not just go through the motions because a procedure tells them to. I’ve gotten my team raises and promotions; it’s a great feeling to see them succeed.

I think the best career advice I received was to become a Level III. I didn’t feel I was ready for some reason, but all those who knew me kept telling me I was crazy. So I went for it and I loved it. It gives me the opportunity to stand up for my team, fight for them, and train them to be the best possible. You can’t do that as a Level II.
PRACTITIONER PROFILE | Candice L. Major

**Q. What's the best part of NDT?**

A. The best part of NDT, as in method, for me is radiography. I don’t know why, but I’m drawn to it and understand it, especially castings. The most rewarding aspect of my work is being able to take pride in it, knowing I’m keeping people safe when they fly and knowing that I’m contributing to my company and my team to help them advance. What I enjoy the most is finding defects. I know... I know... that’s a bad thing, yet when you find something you actually get to start analyzing and doing your job. Trying to find a small defect in a 500 lb castings with eight walls isn’t an easy task. I love that.

**Q. What important is student outreach to NDT? How can we encourage students to pursue education and careers in NDT?**

A. I think it’s very important. If younger individuals do not know NDT exists, they will seek different career paths. Once that happens it’s hard to get people to move over to NDT; change scares a lot of people.

**Q. What advice would you offer to individuals considering careers in NDT?**

A. Go for it! It’s a great career with many different avenues. It’s never going to go away and it’s getting stronger. The pay is good, you can stay put or you can travel, and the opportunities are endless.

Candice Major can be reached at candice.major@element.com.
Across
1. The ______ image quality indicator functions in a thickness mode, the thickness being a percentage of the weldment thickness.
3. This type of wear occurs when particles in a fluid or other carrier slide and roll at relatively high velocity against a surface.
4. The typical crack will appear as a narrow, irregular line when clearly detected in one of these.
7. A groove for.med at the toe or root of a weld when base metal is melted away and left unfilled by weld metal.
9. Fillet welds may have a flat convex or ______ face.
10. These tracks are parallel slag lines that correspond to weld bead width.
12. Lack of fusion is usually oriented ______ to the direction of welding, the test indication often appearing at or near the toe of the weld.

Down
1. A group of gas pockets or voids, inside or on the surface of weld metal.
2. For aerospace structures, a particular weld routinely inspected with ultrasonic testing is the ______ stir weld.
5. ______ joint penetration leaves an unfused area—the weld does not completely penetrate the joint.
6. A base metal separation that occurs in plates and other rolled steel exhibiting a high nonmetallic inclusion content is called a ______ tear.
9. Boring of pipe inside diameter to correct out of roundness caused by manufacture.
10. The materials joining process that produces coalescence of materials by heating them to acceptable temperatures.
11. A structure being welded is said to be ______ with respect to ground and this serves to aggravate the acoustic noise problem.