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INSPECT YOUR PRIMARY PROCESS SMALL BORE PIPING THE RIGHT WAY, USING PROFILE RADIOGRAPHY

RYAN T. BAGGETT, *General Manager at Pro-Surve Technical Services*

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INTRODUCTION

Small Bore Piping (SBP), defined as pipe or piping components that are less than or equal to nominal pipe size (NPS) of 2", is a major element of every mechanical integrity (MI) program. This category of equipment includes a majority of plant process piping and ancillary systems, including many critical piping systems that are fabricated with SBP, such as, level bridles, flow control loops, pressure and temperature indicating systems, and bypass and pressure relief systems. Despite numerous industry publications, recommended practices, and inspection codes recommending Profile Radiography (PRT) as the preferred method of inspection for pipe diameters of NPS 1" and smaller, equipment owners continue to utilize digital ultrasonic thickness gauging, which is often unreliable.

DIGITAL ULTRASONIC TESTING (DUT)

Most owner-user facilities utilize embedded DUT technicians to obtain thickness and corrosion data on their equipment and piping systems. In these cases, DUT is often selected because of outdated past practices and as a means to minimize costs. However, when using DUT, specialized equipment (i.e., special curved or miniature shoes/wedges, as well as diameter specific calibration blocks) is required to accurately assess SBP. Unfortunately, in a career spanning almost three decades, I've witnessed that most do not bother obtaining such items prior to inspection. In areas in which you wish to inspect that are insulated, inspection ports are cut in the insulation to facilitate taking DUT readings.

Let's assume that, contrary to what I have experienced as the status quo, DUT is conducted appropriately with proper equipment and accurate readings. You end up with just that—an accurate reading of one small, isolated spot. Furthermore, how can you even be sure that you are hitting the right spot? Relying on isometric drawings to show the general area and taking manual readings is like finding a needle in a haystack—especially when it comes to localized corrosion—and using digital thickness meters to pinpoint the exact location is added work and also not completely reliable.

A group of well known and respected industry experts sat on a panel during the 2019 API Inspection and Mechanical Integrity Summit. These experts were asked to discuss their findings regarding the accuracy and precision of technicians testing SBP in their facilities. The findings discussed were eye opening and telling. In some cases, less than 50% of the readings taken were accurate and usable, thereby reinforcing the switch to PRT. One of the experts even stipulated that their organization could eliminate the use of DUT for inspection of SBP altogether and receive the same result—and at no cost!

If industry experts recommend PRT for inspecting SBP and DUT has proven to be unreliable for these inspections, then why hasn't the use of PRT become the preferred method?

On the other hand, PRT can be conducted through insulation and without the specialty equipment required by DUT. PRT does not result in a reading of a single spot, but instead provides you with a digital or film image of a much larger area for better analysis. The image includes all of the spots included in the CML. The image will be a cross-section of the assessed area, but you will see density changes on the image. Changes in density make it easy to quickly know if another PRT profile is needed and from what angle.

PROFILE RADIOGRAPHY

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The availability and talent (or lack thereof) may often deter MI program leaders from utilizing PRT as such. It doesn't help that most tenured folks in our industry probably have several horror stories in their past experience with radiographic testing (RT) technicians. Demands from "outside the gates" have driven RT industry providers and technicians into chasing larger revenue streams. Working long hours at remote locations in the mid and upstream sectors while concentrating on conventional weld quality has become a more appealing option. As the saying goes, "follow the money." Furthermore, entry requirements for the above-mentioned sectors are considerably less cumbersome than those required to enter the downstream facilities. As a result, when RT is used in plants, technicians do not typically fit the culture within the gates. And that's putting it lightly. To overcome this, RT technicians need dedicated training to not only be able to perform the work, but also to conduct themselves in a manner in which the industry expects. This is key to developing and retaining individuals that will consistently perform quality work.

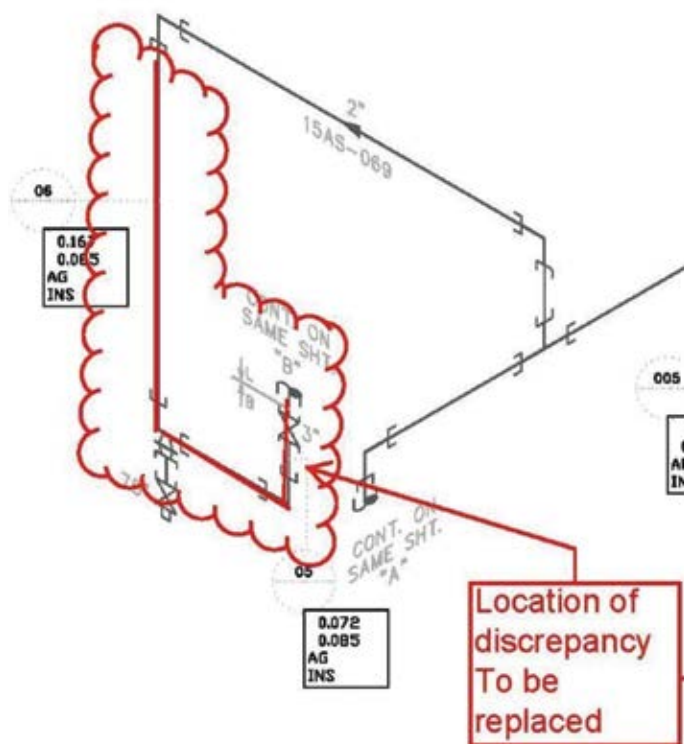


Figure 1. Isometric Drawing of 1-2" Piping Configuration Examined Noting the Location of the Discrepancy

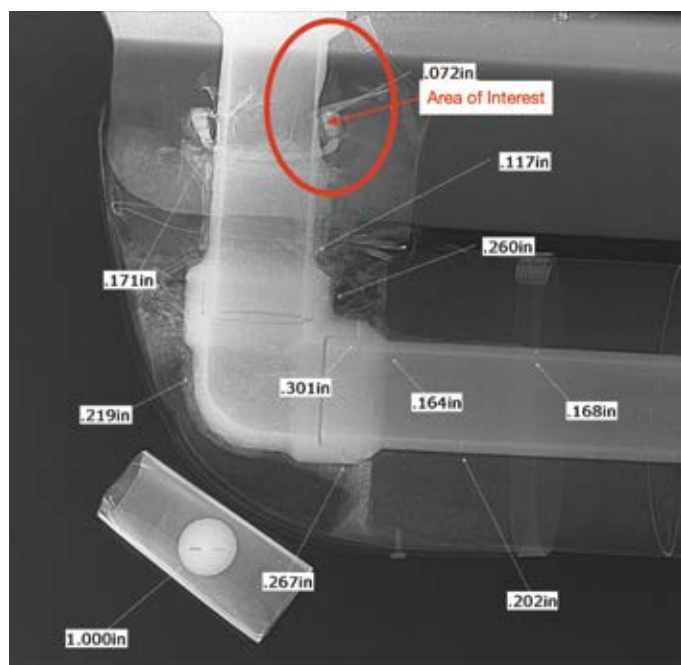


Figure 2. PRT, Conducted Through Insulation, Showing the Discrepancy

Many view RT as a fading practice due in part to how long it has been around. Advancements in ultrasonics and the availability of newer techniques lead some to think that more modern methods are superior to PRT. In some cases, they are, and in some cases, they are not.

The fact is, many advancements in the nondestructive examination (NDE) world have been in RT, including conventional film digitization, computed radiography, and digital radiography. Each of these techniques produce a permanent electronic record of examination and can easily be utilized in any inspection data management system (IDMS). And by recording the exact position and angle, the inspection can easily be repeated with tremendous accuracy. With the proper service provider, personnel, and training, profile radiography is the right choice for inspection of SBP. The product generated (usually 14" x 17" film) illustrates much more of the entire condition of the test section, as compared to a few spot thickness readings using a 1/2" diameter DUT transducer.

Below are a few specific points about PRT to consider when selecting the appropriate NDE technique for your situation.

INSPECTION THROUGH INSULATION

On the Texas Gulf Coast alone, millions of dollars are spent annually to assess and repair corrosion under insulation (CUI). In my years as a Reliability Superintendent, CUI was responsible for a large portion of asset replacement costs. Utilizing DUT on insulated SBP can also increase the risk of CUI. Removing or cutting into insulation exposes the equipment to direct and/or atmospheric moisture. If not monitored properly, these areas can allow



Figure 3. Severe Deterioration and CUI Visible After Insulation Removed from Piping

for moisture to accumulate beneath the insulation, and, in turn, significantly increase the likelihood that CUI will occur. Why elect to compromise an insulation system by adding multitudes of inspection ports which are subject to faulty installation and material degradation due to heat and environmental surroundings if they did not have to? PRT can be performed through the insulation and give you a greater overall condition of the test subject that includes corrosion as well as physical anomalies, such as misfit socket weld connections, obstructions, etc. The figures illustrate an example.

As seen in **Figures 1 - 3**, PRT was performed through the insulation and detected CUI at a U-bolt connection. In addition, the PRT



Figure 4. 2" Dummy Support Leg Welded to 3" Pipe at a 90° Angle

image also indicated that the socket welded fitting was not properly gapped on one end during installation. Even if the insulation was stripped, this would not likely have been discovered using traditional methods.

INSPECTION OF OBSCURED AREAS

While there are many potential obscured areas in a facility, one in particular comes to mind. While not confined to SBP, piping dummy supports are extremely difficult to properly inspect (insulated or not). PRT is an extremely effective method to determine the condition of the pressure containing portion of the piping obscured by the support. Here are some examples:

As seen in **Figures 4 - 6**, the inside of the dummy support is completely corroded and affecting the attached pressure containing elbow. In addition, note the duplex nail inside the pipe (try finding that with UT). When these types of issues are identified visually, PRT can be conducted to help you know what's going without having to wait for a leak or a failure and what to expect if a repair is necessitated.

SMALL BORE VALVE INTEGRITY

PRT is the only suitable means to achieve a holistic evaluation of the internal components of valves short of disassembly for internal inspection. Moreover, this evaluation can generally be performed while the equipment is in service and can reveal numerous integrity issues, such as:

- Erosion around the seating surfaces
- Failure of the internal attachment to the gate or globe
- Erosion-corrosion
- Broken or damaged springs and pins
- Identification of obstructions or foreign bodies



Figure 5. End View of 2" Dummy Leg from **Figure 4** Shows a Heavily Corroded Internal Surface

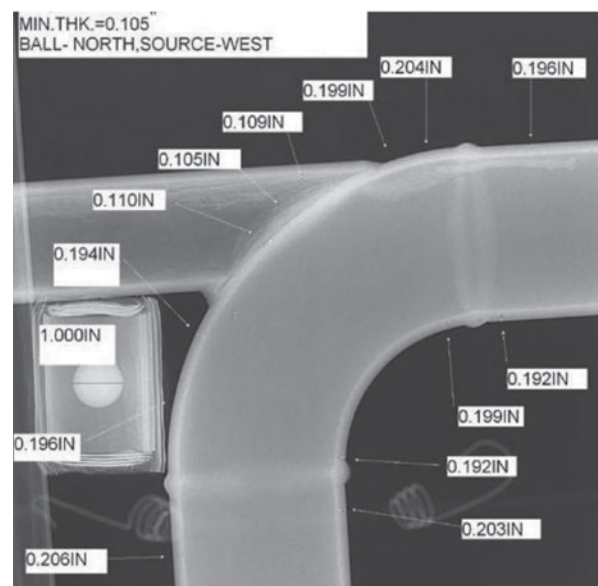


Figure 6. PRT Image of Corroded Elbow

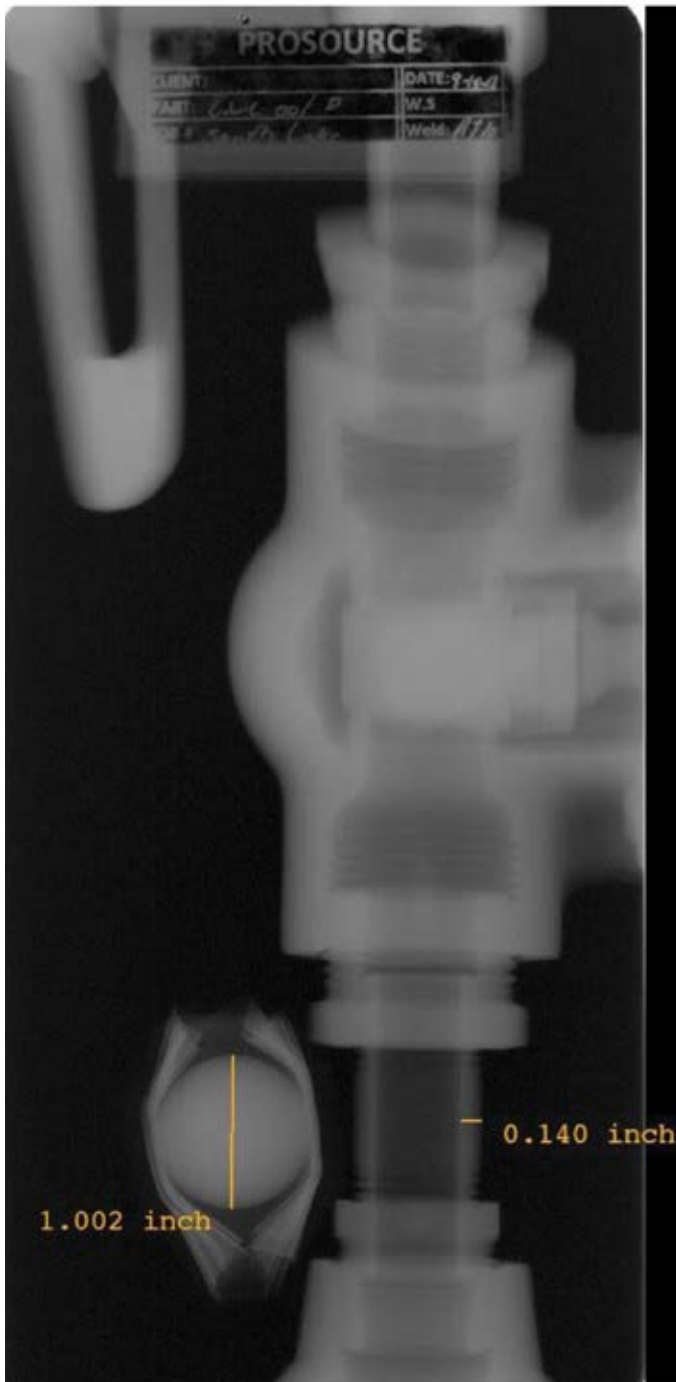


Figure 7. PRT Image of Valve Body

CONCLUSION

The examples discussed above are just a few applications where the advantages of PRT can be observed, but there are many more. In a time where the qualitative aspect of data input into one's IDMS is so important for compliance issues, PRT is an extremely viable option for repeatable, cost-efficient thickness/condition monitoring. It has also been discussed by many industry experts that an alarming percentage of data input into large scale IDMS systems is incorrect. With UT, the results are manually input as thickness values along with a record of the technicians name or a data logger system is utilized for inputting thickness values. PRT provides a permanent electronic image in addition to the primary elements of thickness data acquisition.

In summary, while planning methods for thickness data acquisition in any Inspection Data Management Program, consider PRT from a reputable provider as a cost-efficient, effective, and qualitative means to increase the value of your program for small bore piping or any other suitable situation. ■

For more information on this subject or the author, please email us at inquiries@inspectioneering.com.

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RYAN T. BAGGETT

Ryan T. Baggett currently serves as General Manager for Pro-Surve Technical Services and ProSource Radiography. His career in equipment integrity and reliability spans over two and a half decades. He has served the industry as both an owner-user and service provider in a broad spectrum of roles, including entry level NDE technician, Chief Reliability Superintendent, Director of Business Development, and Regional Director. Ryan is a highly motivated individual with proficient organizational skills and a strong will to succeed. With a broad technical background in the inspection industry, he has successfully managed large groups of personnel/assets as well as assisted in the development and maintenance of various programs utilized today by many major clients. The key components to his successes are attributed to solid client relations, passionate leadership skills, a strong attention to safety, dedication, and drive.