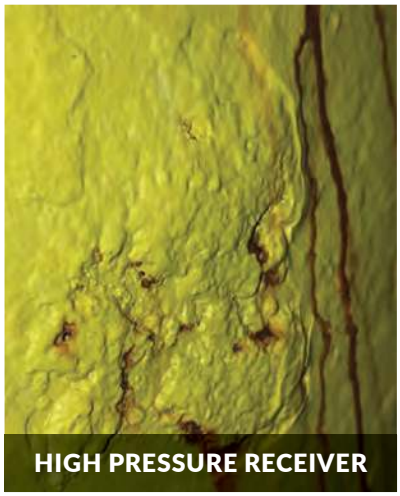
EPIC FAIL



HIGH PRESSURE RECEIVER

HIGH PRESSURE LIQUID VALVE

HOT GAS LINE

LIPSTICK ON A PIG

Look, I get it. If a regulator walks in the front door, send your maintenance guys out the back door with a bucket of paint. We've all been there and done that. We want to make the system look shiny and as new as we can get so that the regulator might cut us some slack. However, the issue is what happens when we don't remove the lipstick, so to speak, and clean up the dirt (in this case, corrosion) underneath. Imagine what a celebrity would look like if they never washed off the makeup that they applied each day. Now take a look around your system. Do any of your pipes or valves, or even vessels, look like those above?

IIAR 6 requires that piping (including valves) and pressure vessels be inspected annually for indications of degradation of the protective coating (i.e., paint). The facility is also required to inspect metal surfaces of piping and vessels annually for pitting or surface damage. If pitting or surface damage is noted, then the remaining wall thickness must be measured. For piping, the standard states *(with my comments in red):*

11.1.1 *Where pitting, surface damage, general corrosion, or a combination thereof, is visually observed on a metal surface of the piping, deficient areas shall be further evaluated per Sections 11.1.1.1 – 11.1.1.3. *Okay, we've identified this corrosion or damage. Now what?*

11.1.1.1 *Where pitting, surface damage, general corrosion, or a combination thereof, has materially reduced the remaining pipe wall thickness, the piping remaining wall thickness shall be measured using appropriate techniques. *Here is where mechanical pit gauges or non-destructive testing (NDT) methods come into play. They are the "appropriate techniques."*

11.1.1.2 *Where pitting, surface damage, general corrosion, or a combination thereof, has not materially reduced the remaining pipe wall thickness, the piping metal surface shall be cleaned and recoated to arrest further deterioration. *Even though the surface hasn't been materially reduced, we can't just leave it. We need to clean it up and paint it.*

11.1.1.3 Where pitting, surface damage, general corrosion, or a combination thereof, has materially reduced the remaining pipe wall thickness beyond the owner's established acceptance criteria, the piping shall be evaluated to determine suitability for continued operation. *Back to those NDT techniques. But this time, we need some "acceptance criteria." What does that mean?*

11.1.1.3.1 *Where the owner does not have established acceptance criteria for pipe wall thickness from the original design or subsequent calculations, the owner or owner's

designated representative shall establish a replacement thickness that shall not be less than the calculated thickness for pressure containment in accordance with the code or standard in which the component is designed at its design pressure. *Here's how we create acceptance criteria. Time to get an engineer involved.*

11.1.1.3.2 Where a pipe is determined to be at or below the owner's established replacement thickness, the owner shall immediately isolate the pipe from service and proceed with a plan for its replacement or decommissioning (for decommissioning, see ANSI/ IIAR 8) *Time to spend money.*

Appendix A of IIAR 6 offers some clarification for the normative, or required, language above.

A.11.1.1 Pitting implies corrosion. Pitting corrosion is the formation of holes in an otherwise relatively unattacked surface. Pitting is usually a slow process causing isolated, scattered pits over a small area that does not substantially weaken the piping. It could however, eventually cause a leak. Pitting can be measured with a pit gauge or other qualifying technique.

General corrosion implies surface rust and/or oxidation staining which, by itself, has not materially reduced the remaining wall thickness.

A.11.1.1.1 Surface damage to piping is considered to have materially reduced the wall thickness when the surface damage exceeds the owner's established acceptance criteria (see Section 11.1.1.3).

A.11.1.1.2 Where visual inspection cannot fully determine the condition of the piping, then additional nondestructive testing (NDT) is recommended. *Remember that paint that we slapped on the pipe, valve, or vessel? Well, we can't visually determine it's condition. We know that there is corrosion under there, but it will take more sophisticated NDT techniques to determine the condition.*

The recommendation of A.11.1.1.2 is what really drive the point home that you cannot leave pipes in the condition pictured above. While visual observation tells you that the pipe has suffered some corrosion. You cannot identify the extent of that corrosion without resorting to non-destructive testing techniques such as ultrasonic thickness measurement or radiometric profiling. Without knowing the extent of the corrosion, it would be unsafe to take a wire brush to the pipe in order to clean it up.

It is far better to keep up with your pipe inspections and painting. Identifying light, general corrosion, that has not yet impacted the material thickness, is essential as that is the time to take a wire brush to the pipe, clean any remaining paint and corrosion off of it, and re-paint the pipe (or valve).

For vessels, IIAR 6, has some additional acceptance criteria:

10.1.1.1.2 *Where pitting, surface damage, general corrosion, or a combination thereof, has materially reduced the vessel wall thickness beyond its permitted corrosion allowance, the owner shall proceed in a timely manner with an analysis or using the following criteria to determine suitability for continued operation:

1. For line or crevice corrosion, the depth of the corrosion shall not exceed 25% of the original wall thickness.

2. Isolated pits may be disregarded provided their depth is not more than 50% of the required wall thickness of the pressure vessel (exclusive of any corrosion allowance), provided the total area of the pits does not exceed 7 sq. in. (4500 sq. mm) within any 8 in. (200 mm) diameter circle, and provided the sum of their dimensions along any straight line within that circle does not exceed 2 in. (50 mm).

3. For a corroded area of considerable size, the thickness along the most critical plane of such area may be averaged over a length not exceeding 10 in. (250 mm). The thickness at the thinnest point shall be not less than 75% of the required wall thickness.

If the vessel is deemed to be suitable for continued operation using the criteria above, then it may be cleaned and re-painted. If the vessel proves to be unsuitable for continued operation using the criteria above, then the options are to re-rate the vessel to a lower design pressure (assuming that this is feasible given process conditions), have the vessel repaired by someone holding an ASME "R" stamp, take the vessel out of the system, or replace the vessel. All of these options are fairly expensive. Much more than a couple of wire brushes and a bucket of paint. So, if you are putting "lipstick on that pig," be sure to go back quickly and clean it up and repaint it.

If you have photos of an Epic Fail please pass them on to nh3isB2L@gmail.com.

Bill Lape is Project Director for SCS Engineers. Bill is a Certified Industrial Refrigeration Operator, a Certified Refrigeration Service Technician, and a member of the National Board of Directors of the Refrigerating Engineers and Technicians Association.