

Standards for Workmanship

Walter J. Sperko, P.E.

Any fabricator employing welders knows that welding codes and customer specifications limit the extent of cracking, incomplete penetration, incomplete fusion, undercut, reinforcement, porosity, slag, and other conditions that may exist in welds. Codes and customer specs also specify the required methods of flaw detection. Visual inspection is always required, sometimes supplemented with radiographic, ultrasonic, magnetic particle, or liquid-penetrant examination.

As an example, consider ASME B31.9, *Building Services Piping*. This code permits 1.5 inches of incomplete penetration in any 6 inches of weld length on the root side of any weld. However, another ASME code, B31.1, *Power Piping*, does not permit any incomplete penetration. Too, this criteria applies only to weld roots that can be observed during fabrication by the unaided eye, so incomplete penetration discovered by the use of a borescope, radiography, or other means is not included.

Therefore, every fabricator should recognize that the customer's inspector is only entitled to examine and inspect a weldment to the extent dictated in the applicable codes and contract documents. The fabricator should also recognize that the acceptance criteria found in those codes and contracts are what everyone should use to measure weldment integrity. This concept is important, since requiring a fabricator to reweld a perceived flaw at the whim of the customer's inspector always costs more than if the welder had known beforehand precisely what was expected of him. In the same vein, the customer's inspector should not demand repairs to a weldment unless he can show the code or contract provisions that detail the inspection method required and the acceptance criteria for welds.

Beware the overzealous welding inspector

The above is nothing more than "Contract Law 101", but many inspectors fail

to understand that the continued success of the fabricator and the customer depends on giving the purchaser the type of product agreed on in the contract and applicable codes. An overzealous inspector compromises the ability of a fabricator to earn profits, and can unnecessarily delay the completion of a job, harming the reputation of the owner, the inspector's employer.

This concept is clearly supported in many fabrication codes. For example, B31.1, paragraph 136.1, specifies that:



"The degree of examination and the acceptance standards beyond the requirements of this Code shall be a matter of prior agreement between the fabricator or erector and the Owner."

Comparable paragraphs are found in other B31 Code sections, in ASME Sections I and VIII of the *Boiler and Pressure Vessel Code*, and in AWS D1.1, *Structural Welding Code—Steel*. Paragraph 6.6.5 of AWS D1.1 says:

"If nondestructive testing other than visual is not specified in the original contract agreement but is subsequently requested by the owner, the contractor shall perform or shall permit any testing to be performed... The owner shall be responsible for all associated costs, including handling, surface preparation, nondestructive testing, and repair of any discontinuities... at rates mutually agreeable between the contractor and the owner. However, if such testing should disclose an attempt to defraud or gross nonconformance to this code, repair work shall be done at the contractor's expense."

These paragraphs recognize that additional inspections and examinations above and beyond those required in codes and contracts cost time and money. Costs of a job can quickly rise due to a number of reasons, including more time needed by the welder to prepare joints, align and fitup weldments, deposit and finish tack welds, deposit root passes, clean between subsequent finish-weld passes, and prepare the cover pass for examination. The result of additional examinations: job costs to the fabricator rise due to increased labor, and the fabricator deserves to be compensated. If the owner and its engineer want welds that contain fewer flaws than standard welding codes allow, the contract documents should specify this up-front, and the owner should be willing to pay the costs associated with depositing those high-quality welds.

As stated in AWS D1.1, the owner has the right to perform any additional examinations and inspections which it deems necessary to ensure that the work is suitable for service. However, the cost of making any repairs to the work due to the discovery of flaws which were not part of the original Code or contract requirements should be considered outside the scope of the contract and be handled as described in D1.1.

Of course, the owner can choose to follow routes other than those outlined in codes. Here is a list of inspection techniques it can call for, in decreasing order of cost:

- One-hundred-percent radiographic or ultrasonic examination of all welds.
- Radiographic or ultrasonic examination of only those welds that will be highly stressed in service, as determined by stress analyses.
- Require that the owner's inspector or a third-party resident inspector inspect all welds after fitup and tack welding.
- Specify documented inspection at fitup by the contractor's Certified Welding Inspector, other lesser-qualified inspector, or at least the welder's foreman.

Mr. Sperko is president of Sperko Engineering, and a member of several ASME and AWS committees. Contact him at (910) 674-0600; fax (910) 674-0202.

