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Asme welding procedure

Welding Procedure Qualification: A Crucial Document in ASME BPVC Section IX As a welding engineer with nearly a decade of experience, I've had the opportunity to delve into the world of welding procedure qualification, specifically as outlined in ASME BPVC Section IX. In this article, we'll explore the importance of a Welding Procedure Specification (WPS) and how it ensures compliance with industry codes. A WPS is essentially a set of instructions for welders to follow when performing a specific welding process. This document typically consists of variables such as current, voltage, speed, groove design, and more. These variables must be addressed for each process indicated on the WPS. The format of the WPS can vary, but it's essential that all required information is included. So, why do welders need a WPS in the first place? For experienced welders like those in my shop, the WPS may seem unnecessary. After all, they've spent years honing their skills and know the parameters required for specific welding processes. However, the WPS serves a vital purpose - it provides evidence that the welding process is Code compliant. In fact, a qualified WPS is supported by a Procedure Qualification, which involves preparing a test coupon using certain parameters. This test coupon undergoes mechanical testing to ensure its quality. The WPS must be readily available and produced whenever requested by an authorized inspector. In summary, while experienced welders may not need a WPS for everyday welding operations, it remains a crucial document for ensuring Code compliance. Procedure Qualification is a crucial process that ensures welds made under specific codes meet the required standards. This involves testing in a laboratory with parameters set by code or customer specifications. If these tests are successful, it indicates that the Procedure Qualification has passed, and the parameters used become qualified. In practical terms, this means using these same parameters on a production joint would result in a weld with the necessary strength and ductility. The purpose of Procedure Qualification is to guarantee that any weld made under code must have the properties required by the code. This process involves numerous variables, such as current, polarity, voltage, travel speed, electrode type, and more. Each variable plays a significant role in determining the integrity of the weld. By establishing which set of values for these variables produces a desired weld quality, Procedure Qualification ensures that future welds will meet this standard. A Procedure Qualification involves destructive testing on a test coupon similar to the production weld. This process establishes a qualified WPS (Welding Procedure Specification) that lists these qualified parameters. The qualified WPS contains reference to the PQR (Procedure Qualification Record) that supports it. This document provides guidance to the welder and ensures code-compliant welding. The welder must adhere to the ranges of variables specified in the WPS, ensuring compliance with code regulations. Even authorized inspectors can objectively determine whether a weld is made in compliance with code by consulting this specification. Section IX defines rules that outline a range of variables within which production joints can be welded without affecting quality. Variables are categorized into essential and non-essential ones based on their importance. Essential variables must be followed exactly as defined in the qualification, whereas changes to these would require requalification of the procedure. Non-essential variables, such as groove design or root spacing, do not significantly impact mechanical properties and can be altered without needing a procedure re-qualification. However, revising the WPS is still necessary to reflect these changes. The welding engineer's job includes maintaining accurate records of any modifications made to non-essential variables and updating the WPS accordingly. This ensures consistency in the production process and adherence to code regulations. The Welding Procedure Specification (WPS) must consider total WPS in some cases. If the engineer is unable to complete the task, they need to inform the welding engineer properly. There are two types of variables: essential and non-essential. Non-essential variables include joint design details such as root gap, backing, and groove type. These can be changed during production welding without affecting the WPS. When qualifying a procedure, it's necessary to adopt certain groove designs and root gaps. If you know about the jobs that will be supported by your Procedure Qualification Record (PQR), you can choose these details for the most common joint in production. The availability of sample length for drawing specimens is crucial, and the decision should be based on mutual agreement between the fabricator and the inspector. Regarding the use of PQRs to support welding of base metals with the same P numbers, it's essential to note that any change in the base metal's P number requires re-qualification. However, if using a base metal with the same P number in production as in Procedure Qualification, Section IX rules do not necessitate re-qualification of the Procedure. It's crucial to understand that Section IX only specifies minimum requirements and does not exempt you from applying engineering judgment regarding compatibility and metallurgical properties. The answer lies in making a judgment about the applicability of P-numbers, which is also required for filler metal on the WPS. Contrary to popular belief, welding position is no longer an essential variable for procedure qualifications, as a procedure qualified in any position can be used for production welding in other positions. Historically, this was not the case before 1974, when separate procedure qualifications were required for every position. However, with the changes in Section IX, it's now possible to use a single Procedure Qualification coupon for multiple processes. In cases where multiple welding processes are involved, each process's thickness and weld metal must be measured and recorded. This essentially means qualifying each process individually, with one exception: welding work can be performed on a single coupon. However, when production requires combined processes (e.g., GTAW + SMAW), the Welding Procedure Specification (WPS) for such work can be supported by either a single Qualification Record (PQR) that was qualified using multiple processes in a single coupon or multiple PQRs individually qualified for each process. If toughness testing is crucial, qualifying multiple processes in a single coupon may pose a problem due to requirements from the Section IX and construction codes (such as ASME Section III Part NB). In such cases, preparing multiple coupons that satisfy both requirements is advisable. Furthermore, one PQR can support multiple WPSs, while multiple PQRs can also be used to support one WPS. The possibility of an organization sub-contracting procedure qualification work is a matter of debate; however, the work itself involves verified data from testing on a coupon with variables objectively measured and recorded in a scientific manner, raising questions about its geographical location not affecting the qualification's validity. In some cases, like when sub-assemblies are subcontracted to another organization for Code-related work, the subcontractor is required by the authorized inspector to re-qualify procedures that will be used to support their portion of the joints, despite the technical data remaining unchanged and the eventual Procedure Qualifications done by the subcontractor being similarly valid. The authorized inspector's stance on implementing the same WPS as the company uses is justified by the Code. Section IX mandates that the organization conducting manufacturing work must qualify, certify, and take responsibility for all qualifications, including Performance Qualifications and Procedure Qualifications, used in component manufacture. The owning organization must directly supervise and control personnel involved in Procedure Qualification, either as direct employees or contract employees under their direct supervision. However, the 2023 edition relaxes this requirement, allowing supervisors to be under control of qualifying organizations, as long as they are accountable to them. Section IX permits subcontracting work necessary for qualifying a Procedure if done under direct supervision and control, with the main organization accepting full responsibility. The PQR (Procedure Qualification Record) is a permanent record containing parameters followed during the qualification episode, test results, and other relevant information. It must be certified by the manufacturing organization. Changes to the WPS or PQR can only be made by re-qualifying the Procedure, unless they are editorial in nature or non-essential variables are involved. Section IX requires recording actual values of essential variables and test results on a PQR, but including non-essential variables is optional. Additional information that aids in a good weld may also be included. A PQR differs from WPS in being a certificate-like record, whereas WPS is a working document. While Section IX does not compulsorily require recording non-essential variables, it is left to the organization's discretion. It is good practice to include all non-essential variables in recording procedure qualification results another point to consider is that values shown on pqr must accurately reflect actual recorded values whether it be essential or non-essential variable if recorded during procedure qualification it shall be included but not if not the case stated in qw 200.2 b does section ix require specific format for documenting pqr no a suitable format can be used as long as all necessary variables are addressed suggested format is given in qw 483 of section ix pqr has lifetime validity never expires qualifies done with current edition can support production activity with new edition is required. When a performance qualification fails to meet acceptance criteria, an immediate retest can be conducted using twice the number of samples required originally. However, this exception only applies to performance qualifications and not procedure qualifications. If a test fails, it's essential to identify the root cause, which might not be related to welding variables. In such cases, a retest can be performed on the original coupon or a new one prepared to address the issue. On the other hand, if the cause is linked to welding variables, a new test coupon must be welded with modifications made to the variable that caused the failure. This revised process should be documented on the PQR. For procedure qualifications, groove welds are preferred for supporting fillet welds in all thicknesses of base metal and sizes of fillet welds. However, if a procedure needs to be qualified solely for non-pressure-retaining fillets, it can be done using a fillet weld test coupon. The required tests and limits for procedure qualification as per QW-451.3 include tension, bend, impact, and drop weight tests, depending on the base metal thickness. The number of specimens needed varies based on the base metal thickness in the test coupon. For fillet weld procedure qualification, macro-examination of multiple cross-sections is the required test, with specifications outlined in table QW-451. The orientation of specimens, acceptance criteria, and removal of samples are defined in various sections of ASME Section IX. The specific test required for fillet weld procedure qualification as per ASME Sec IX is macro-examination of five specimens. When a fillet is situated between two pipes or a pipe and plate, four specimens are necessary for macro-examination, as stated in QW-183. This standard outlines testing methods and acceptance criteria. Regarding procedure qualifications, Section IX imposes no restrictions on the use of a qualification done on a plate for pipe welding, or vice versa (IX-89-82). In fact, a procedure qualified on a plate can be utilized for any pipe diameter, provided a qualified welder is present for that specific diameter. However, this liberty does not extend to performance qualifications. A welder certified on a plate can still work on pipes, but with certain restrictions outlined in QW-461.9 (vice versa). Pipe diameter is not considered an essential variable for procedure qualifications because the mechanical properties of the weld metal remain unaffected whether it's situated between plates or pipes. Depositing sound weld metal in pipe joints requires skill, which is why pipe diameter has been deemed an essential variable for welder qualifications. Procedure qualifications, on the other hand, focus solely on the mechanical properties of the weld metal, making pipe diameter irrelevant. This concept is further explained in interpretation IX-89-79 (qs 1). This concludes our discussion on this topic for now, as procedure qualifications encompass a broad subject that cannot be fully addressed within a single article. For more in-depth information, refer to other articles on this website that delve into various aspects of PQRs and their qualification.