TCR Advanced Engineering P. Ltd

Experts in Metallography, Failure Investigation and RLA

Metallurgy for Industries

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Welding procedure specification (WPS), Procedure qualification record (PQR) and welder performance qualification (WPQ)

De-mystifying the requirements of ASME Sec.IX

For carrying out any type of welding it is vital to have a procedure to perform the welding, validate the same by destructive and non-destructive testing – freezing the procedure after results of testing and then subsequently qualify the welders and weld the job using the established procedure.

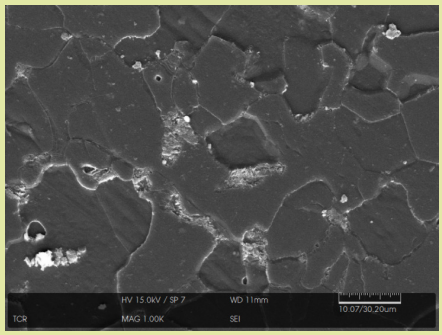
Before starting a welding, a qualified welding inspector AWS – CWI (American welding society – certified welding inspector) suggests the procedure for carrying out welding. The procedure shall specify welding parameters in range or as required otherwise. This becomes suggestive welding procedure specification (WPS). Using suggestive procedure a good welder prepares the coupon plate under the witness of welding inspector, maintaining all the welding parameters. Welding inspector notes down the actual welding parameter used during welding of coupon plate sample. This becomes procedure qualification record (PQR). The coupon plate sample is subjected to non- destructive and destructive testing depending upon the application. Destructive testing is carried out to validate that the welding in no way has degraded the quality of product and all the required properties of product like strength, ductility, toughness, wear resistance, corrosion resistance etc. as per requirement of product are retained. Results of destructive testing are recorded in to the procedure qualification record (PQR). Upon agreement of results with requirement, suggestive WPS shall be freeze as a WPS along with PQR.

In case the testing results are not as per requirement, a modification in suggestive WPS shall be done to attain the required property. It is a good practice to carry out radiography of coupon plate and ensure that there are no defects in the weld that can affect destructive testing results.

The final WPS-PQR is used to qualify the welders. Welders shall prepare a coupon plate under witness of CWI using the welding parameters of WPS-PQR. The coupon plate is subjected to destructive and/or non-destructive testing; Confirmation of the results, CWI shall certify the welder for particular approved WPS-PQR. Certification of welder is also called as WPQ-Welding performance qualification

ASME Boiler and pressure vessel code section IX – welding and brazing qualification provides mandatory and non-mandatory requirement for making WPS, PQR and WPQ.

Microstructure of the Month



Magnification: *1000X*

MOC: *P11*

Component: *Boiler tube*

Etchant: *2 % Nital*

Observation: *Microstructure shows fine-grained ferrite with few pearlite. Pearlite is observed at the grain boundaries. Presence of isolated creep cavities are observed.*

Useful hints: Quality Control check during production stage through Microstructure examination would help in process control during heat treatment to eliminate the problem. Faster cooling rate is required during final stage of heat treatment to produce Pearlitic matrix.

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Qualification of procedure and welders for construction code as per ASME can be divided into three steps.

1) The first step includes preparation of WPS, testing and qualification of WPS and the certification of tests and qualification on a procedure qualification record
2) The second step includes testing and qualification of the welder and the certification of tests and qualification on a welders performance qualification (WPQ) record
3) The third step is the implementation of a program to control the selection of welders and the procedure they will use, and the training, instruction and education of all personnel involved in the control of the quality of the application.

ASME section IX is divided in two parts : "QW" – requirements for welding and "Part QB" requirements for brazing. Each part is divided in to four articles: Article 1 – General requirements, Article II – Procedure qualifications, Article III – Performance qualifications and Article IV- Data

Basics for welding before you strike

WPS specifies variable ranges, Essential variables and Non-essential variables for the welding process.

PQR is a record of welding procedure it records actual variables, Essential variables, Test and results for welding process.

WPQ is a record of qualified welder it contains Record Variables, Specific ranges of qualified Welding application

Step 1: Welding shall be made following the direction of a welding procedure specification (WPS). The code user shall prepare a WPS to cover each application. QW 250 lists the essential and non-essential variables that must be specified in each WPS for each process. Each WPS shall be supported by one or more PQR(s).

Step 2: QW-250 lists the essential variables for qualifying a WPS for each process. The code user must supervise the welding of a test coupon following the variables of a WPS. The code user must record each essential variable, tests and the test results on a PQR form.

Step 3: QW – 350 lists the variables for qualifying welders for each process. Welders qualify by welding a test coupon following the directions of a WPS. The code user shall supervise this welding, record the variables, the tests, test results and the ranges qualified on a WPQ form

Step 4: Code users include the manufacturer, contractor, assembler or installer, the owner/user or the repair firm responsible for controlling the welding on pressure – retaining items

Step 5: The code user must describe on a WPS the details to control how each weld is to be made. The WPS shall specify an allowable range for each variable. The WPS shall be used to provide direction for the welder

Step 6: The code user may perform the required tests, or testing may be subcontracted to a testing lab. The PQR is intended to prove weld ability of the base metal, filler metal and process combination. The code user in each case must certify the PQR thereby accepting responsibility for the results.

Step 7: Test coupons shall be mechanically tested or examined by radiography. The tests and examinations may be subcontracted but the WPQ must be certified by the code user. The code user shall maintain each welder's qualification using a record which verifies the welder has used the process at least every six months.

Step 8: An authorized inspector shall verify that each WPS to be used is properly prepared and supported by a valid PQR and that each WPQ to be used has been properly prepared and is valid in accordance with section IX. The Authorized inspector should document this concurrence prior to the start of any new construction or repairs by welding on pressure retaining items.

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