

Sulzer Quality Specification	Technical Quality Sulzer Pumps	
Guide to Qualification of a PQR and WPS		Page: 1 of 4

1. SCOPE

This document describes the basic steps to qualify a PQR and WPS. It is intended to act as general guide and shall not take precedence over any governing standard.

The requirements of the welding code such as ASME BPVC Section IX or ISO 15614 must be fulfilled. This guidance document does not take the place of formal training on the codes and standards.

2. REFERENCES

The following documents are referenced in this specification. The latest edition applies unless otherwise noted.

Sulzer documents can be downloaded from <http://www.sulzer.com/q-documents>

ASME BPVC Sec VIII, Div. 1	Rules for Construction of Pressure Vessels
ASME BPVC Sec IX	Qualification Standard for Welding, Brazing, and Fusing Procedures
AWS D1.1	Structural Welding Code Steel
Sulzer PS-4008	Minimum requirements on welding from supplier and sub-supplier
PM-PU 6.028	Welding Procedures and Qualification
EN ISO 15607	Specification and qualification of welding procedures for metallic material—General rules
EN ISO 15614-1	Specification and qualification of welding procedures for metallic materials—Welding procedure test
SQS-0018	Core Closure / Window Welding Procedure
SQS-0019	Buttering Procedure

3. TERMS AND DEFINITIONS

3.1 Procedure Qualification Record (PQR)

This document is a record of the actual variables recorded during the welding of the test coupons and also contains the results of the tested specimens. The welding of the test coupon is performed to verify compatibility of materials and that the techniques used result in a sound weld with acceptable mechanical properties. This information is used to support welding procedure specification. Because the PQR is a record, changes are generally limited to editorial changes, such as the correction of typographical errors. The PQR is typically accompanied by a copy of the official reports of mechanical testing that are produced by the laboratory that conducts the destructive and non-destructive testing of the test coupon.

3.2 Welding Procedure Specification (WPS):

The WPS serves two functions:

1. It is used as a set of instructions for the welders and implies that if the instructions are followed, a sound weld having acceptable mechanical and chemical properties can be expected.
2. It is used to communicate between organizations how a weld is intended to be carried out in production. The WPS is typically provided to a customer along with the PQR and mechanical test records prior to production welding to demonstrate an organization's ability to produce a sound weld under a specific set of conditions.

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The governing standard provides explicit requirements for the information that is to be included and excluded from the WPS, but in general, any condition that affects the mechanical properties of the resulting weld shall be documented in the supporting PQR.

A WPS is an instruction document for a specific welding process for a group of similar materials. For different welding processes or material groups, separate WPS and PQR documents must be created.

3.3 Preliminary or Proposed Welding Procedure Specification (pre-WPS or pWPS):

This document is generated during the planning of a new WPS and is used to demonstrate the intended outcome of the welded test coupon.

3.4 Governing Standard or Code:

A comprehensive set of provisions that serve as the legally binding rules for construction. The code addresses essential factors such as design, materials, fabrication, and inspection requirements. It is possible for more than one code to apply. For example, the ASME BPVC and ASME B31.1 may both apply to the construction of piping of a pump for a power generation plant.

3.5 Welding Engineer or Welding Coordinator:

A qualified and competent person who is has the responsibility of ensure welding is performed in accordance with contract documents and applicable standards to produce a satisfactory product. The specific qualifying requirements and responsibilities of the welding engineer may be further defined by the organization, regional laws, and governing standards and may belong to one or more people in the organization.

3.6 Welding Variable:

Any parameter (amperage, chemistry of base metal and filler metal, post weld heat treatment, etc.) that when changed will alter the mechanical properties of the weld. ASME IX separates the variables into three categories:

- 1. Essential variables:** Variables that have a significant effect on the mechanical properties of a joint. They must not be changed except within the limits specified by this code. e.g. Material thickness range, Material Group etc.
- 2. Non-essential variables:** Variables that have no significant effect on mechanical properties. They can be changed on the WPS without requalification of the PQR.
- 3. Supplementary essential variables:** Variables that have an effect on the impact properties of a joint. They are classed as Non-Essential if impact testing is not required

All variables listed as essential, non-essential or supplementary essential should be addressed on both the WPS and the PQR. If any of the variables do not apply to the particular application, then they should be specified as *not applicable*.

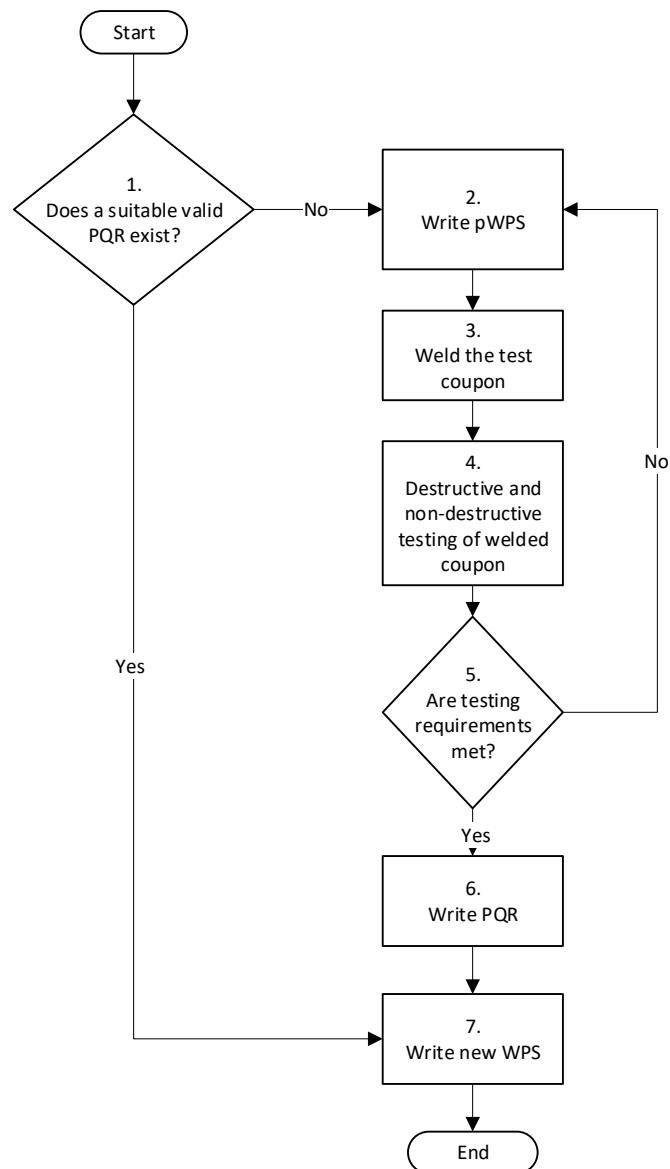
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4. FLOWCHART

The following flowchart illustrates the basic path taken during the development of a new WPS.



It should be noted that the process for creation of a WPS and PQR can be complex, costly and time-consuming especially when working to extend capabilities beyond what is currently qualified such as in welding different kinds of materials.

5. FLOWCHART STEPS

Step 1: When the need for a new WPS has been realized, the first practical step is to determine if a suitable PQR already exists. Note that a single PQR can be used to support more than one WPS and typically remains valid for the life of the organization that created it.

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Step 2: If a suitable PQR exists, a new WPS may be written with no need to weld a test coupon. If a suitable PQR does not exist, a pWPS can be drafted by the Welding Engineer to outline the important aspects that are to be addressed by the new PQR and WPS. While drafting the pWPS, the Welding Engineer should consider the relevant regulations of the governing code, Sulzer (PS-4008, PM-PU 6.028), and Sulzer's customers to ensure all requirements will be met by the new WPS

Step 3: . A test coupon is welded by the organization using the exact variables specified on the pWPS. Welding of the test coupon, destructive, and non-destructive testing may need to be witnessed and certified by a third party, such as Lloyd's Register. The weld test typically consists of two plates that are welded together but may be any of several various material configurations, such as pipe-to-pipe, pipe-to-plate, or a single plate with weld overlay. Care should be taken to ensure all relevant data is accurately collected during the welding of the test coupon. Typically, the welding engineer or another trained person will remain in the weld area to collect the data while the welder focuses on welding.

Step 4: Mechanical testing of the welded test coupon is performed to verify that the resulting weldment meets the applicable code and customer requirements. Testing may be non-destructive (radiographic, ultrasonic, etc.) and destructive (tension, bend, Charpy impact testing, etc.).

Step 5: The Welding Engineer or other designated responsible person reviews the mechanical test reports to ensure all requirements have been met. If the test results are not satisfactory, welding of a new test coupon will be necessary. Appropriate adjustments should be made to the welding variables on the pWPS.

Step 6: If the results of the mechanical testing are satisfactory, the Welding Engineer compiles the test results and appropriate test parameters to create the PQR. It may be required by certain standards or jurisdictions that a 3rd party certifies the PQR.

Step 7: A new WPS can be written.

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