AASHTO/AWS D1.5 (Bridge Welding Code)
Quick Review on Essential Variables

1-Guide (General)
AWS D1.5, 5.7
General Requirements for WPS Qualification:

AWS D1.5, 5.7.1 A production WPS’s qualification is based on a procedure qualification test record (PQR) produced by the Contractor in conformance with 5.12. Figure 5.1 shall be used for qualification testing of WPSs. WPSs considered prequalified by 5.11 (only SMAW WPSs using electrodes listed in Table 4.1, except for those electrodes used for Gr. 690 and 690W [100 and 100W]), or WPSs qualified in conformance with 5.12, may be used with joint details in Figures 2.4 (CJP) or Figures 2.5 (PJP) without further testing.

Also note: AWS D1.5, 5.7.2 (Pretest), and 5.7.3 (Verification of PQRs)

2-Guide (Position)
AWS D1.5, 5.8:
Each position qualifies WPS for the same position, except that groove test welds made in flat position shall also qualify for horizontal position. (See Clause 5.8.2)

3-Guide (Thickness of Base Metal Range)
AWS D1.5, 5.6.1 PQR on test plate equal or greater than 1 in. (25 mm) shall be used and it will qualify WPS for all thicknesses covered in this code (except for EGW process, WPS qualify range is 0.5T Min., 1.1T Max. [T is qualification thickness]), as Table 5.4, and for ESW only T [T is qualification weld thickness], as Table 5.5)

AWS D1.5, Table 5.3: For grade 690 (100) or 690W (100W) material, increase in plate thickness grater than 1/2 in. (12 mm) or decrease of 1 in. (25 mm) or more is essential variables (except for ESW or EGW process)

Note: AWS D1.5, Table 5.3: PQR Essential Variable Changes for WPSs Qualified per 5.12.4 (Table 5.4 for addition essential variable for EGW & Table 5.5 for ESW)
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4-Guide (Joint)
AWS D1.5, Table 5.3: Essential Variables for Joints:

- For the PQR groove area, an increase or decrease > 25% in the number of passes

- A change from U-groove to V-groove but not vice versa

- A change in the type of groove to a square groove and vice versa

- A decrease in the groove angle and root opening, an increase in the root face exceeding the tolerances in the shape of any type of groove 2.12 (CJP-Figures 2.4) or 2.13 (PJP-Figures 2.5) or 3.3.4.

- The omission, but not inclusion, of backing or backgouging

Note: AWS D1.5, Table 5.3: PQR Essential Variable Changes for WPSs Qualified per 5.12.4
(Table 5.4 for addition essential variable for EGW & Table 5.5 for ESW)

5-Guide (Base Metal Selection)

AWS D1.5, 5.4.1 Base Metal Qualification Requirements:
Higher grades [up to Gr. 345W (50W), incl.] will qualify same grade and lower grades (for example, test on 50W will also qualify Grades 36, 50, 50S, 50W, and HPS 50W), except that Gr. HPS 345W (HPS 50W) will qualify only the same grade, but any steel with minimum specified yield strength > 345MPa (50 ksi) needs to be qualified for the specification and grade.

6-Guide (Filler Metal Selection)
AWS D1.5, Table 5.1
- Each AWS Classification is essential variable

- Each manufacturer’s brand and type of cored electrode (except SMAW electrode) is essential variable
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7-Guide (Heat input)

AWS D1.5, Table 5.3: An increase above 10% in heat input, or decrease over 30% over that qualified, is essential variable, and therefore needs re-qualification.

Heat input may be measured by the following:

Heat input \[J/in. \ (J/mm)\] =
\[(\text{Voltage} \times \text{Amperage} \times 60) / \text{Travel Speed} \ [\text{in./min (mm/min)}]\]