ASME Codes and Standards

ASME Codes and Standards – A summary

Sections of ASME Boiler and Pressure vessel Codes (BPVC)

The following list includes some of the most widely used Boiler and Pressure Vessel codes (BPVC) prepared and published by ASME.

Section I……Rules for construction of Power Boilers

Section II……..Materials

- Part A. Ferrous Material Specifications
- Part B. Nonferrous Material Specifications
- Part C. Specifications for Welding, Rods, Electrodes and Filler Metals
- Part D. Properties

Section III…….Rules for Construction of Nuclear Facility Components

Subsection NCA. General Requirements for Divisions 1 and 2

Division 1

- Subsection NB. Class 1 Components
- Subsection NC. Class 2 Components
- Subsection ND. Class 3 Components
- Subsection NE. Class MC Components
- Subsection NF. Supports
- Subsection NG. Core Support Structures
- Subsection NH. Class 1 Components in Elevated Temperature Service

Division 2. Code for Concrete Containment

Division 3. Containment Systems for Storage and Transport Packaging of Spent Nuclear Fuel and High-Level Radioactive Materials and Waste

Section IV ……Rules for Construction of Heating Boilers

Section V……..Nondestructive Examination

Section VI……Recommended Rules for the Care and Operation of Heating Boilers

Section VII…… …Recommended Guidelines for the Care of Power Boilers

Section VIII……..Rules for Construction of Pressure Vessels

- Division 1. Pressure Vessels
- Division 2. Alternative Rules for Pressure Vessels
- Division 3. Alternative Rules for Construction of High-Pressure Vessels

Section IX……Welding and Brazing Qualifications

Section X…….Fiber-Reinforced Plastic Pressure Vessels

Section XI……Rules for Inservice Inspection of Nuclear Power Plant Components

Section XII……..Rules for Construction and Continued Service of Transport Tanks

Brief introduction of some of the widely used BPVC sections:

SECTION I: Section I gives requirements for the construction of

- Power Boilers, Electric Boilers, Miniature boilers
- Heat recovery steam generators (HRSG)
- Power boilers used in Locomotive, Portable and Traction type
- High-temperature water tube boilers
- Certain fired pressure vessels to be used in stationary services

SECTION II: Section II is exclusively dedicated to materials and their specifications. These specifications contain requirements for chemical and mechanical properties and other necessary details. It includes four parts viz. Part A, Part B, part C, and Part D.

Part A – Ferrous Material Specifications

It provides specifications for ferrous materials which are suitable for use in the construction of pressure vessels. The specifications provided in this part give the mechanical properties, heat treatment, heat and product chemical composition and analysis, test specimens, and methodologies of testing. They are designated by 'SA' numbers and are identical or similar to those published in ASTM specifications.

Part B – Nonferrous Material Specifications

It provides specifications for nonferrous materials. The specifications provided in this Part specify the mechanical properties, heat treatment, heat and product chemical composition and analysis, test specimens, and methodologies of testing. They are designated by SB numbers and are identical or similar to those published in ASTM specifications.

Part C – Specifications for Welding Rods, Electrodes, and Filler Metals

It provides mechanical properties, heat treatment, heat and product chemical composition and analysis, test specimens, and methodologies of testing for welding rods, filler metals, and electrodes used in the construction of pressure vessels.

They are designated with 'SFA' numbers which is derived from the American Welding Society (AWS) specifications.

Part D – Properties (Customary/Metric)

It provides tables for the design stress values, tensile and yield stress values, and material properties.

SECTION III: It provides guidelines for the construction of nuclear facility components and supports as well. Section III includes different divisions and subsections.

SECTION IV: Provides guidelines for design, fabrication, installation, and inspection Heating boilers, such boilers are primarily used for:

- Steam Heating
- Hot water heating
- Hot water supply boilers
- Potable water heaters

These boilers are meant for low-pressure service and are directly fired by solid or liquid fuels such as coal, oil, gas, electricity, etc.

SECTION V: This section is dedicated Non-Destructive tests (NDT). It provides requirements and methods for non-destructive tests. It also contains the detailed duties of authorized inspectors, manufacturer's examination responsibility, and requirements for qualification of personnel, inspection, and examination. These examination methods are key to detect the discontinuities present in the material, weld, and fabricated components. It also includes a glossary of all related terms.

SECTION VI: Provides guidelines for operation and maintenance of Heating boilers which are manufactured as per Section IV.

Section VI also covers guidelines for associated controls and automatic fuel-burning.

SECTION VII: Provides guidelines for operation, maintenance, and inspection of power boilers. It also includes the necessary guidelines for the operation of auxiliary equipment and appliances that are directly responsible for the safe and reliable operation of power boilers.

Boilers which come under the purview of Section VII are Stationary, Portable, and Traction type boilers, but not Locomotive and High-temperature water boilers, Heating boilers (Section VI), and Nuclear power plant boilers (Section XI).

SECTION VIII: It provides detailed guidelines for the design, fabrication, testing, inspection, and certification of pressure vessels (both fired and unfired). Section VIII includes three divisions viz. Division I, Division II, and Division III

Division 1: Division provides guidelines for design, fabrication, inspection, testing, and certification of pressure vessels operating at either internal or external pressures exceeding 15 psi (100 Kpa).

Division 2: It provides requirements for the materials, design, and Non-destructive examination for pressure vessels. Division 2 standards are more rigorous than division 1. However, it allows for higher stress intensity values. These rules may also be applied to human occupancy pressure vessels such as those used in the diving industry.

Division 3: It provides guidelines for pressure vessels operating at or more than 10,000 psi (in general) either internally or externally. The maximum pressure limit is nowhere mentioned in the code even in divisions 1 and 2 too.

SECTION IX: This Section covers necessary guidelines and requirements pertaining to welding and brazing procedures (as per the requirements of other BPVC standards). It also contains guidelines for qualification and requalification of welders, welding operators and brazing operators. It also contains all the essential, non-essential and supplementary essential variables required for welding and brazing.

Section IX is further divided into four parts, Namely

- Part QG: Contains General Requirements for all material – joining processes (viz. Welding, Brazing, and Plastic Fusing)
- Part QW: Contains requirements for Welding
- Part QB: Contains requirements for Brazing
- Part QF: Contains requirements for Plastic Fusing

(NOTE: Detailed summary for Section IX including preparation of welding procedure specification (WPS), steps followed for Procedure Qualification Record (PQR), Welder performance qualification test, range, and limits, etc. has been explained separately).

SECTION XII: It provides guidelines for construction and continued service of pressure vessels used for transportation of dangerous goods at pressures from full vacuum to 3000 psi and volume greater than 120 gallons.

List of some of the most widely used ASME Standards:

CSD-1……Controls and Safety Devices for Automatically-fired Boilers

B1.1……..Unified Inch Screw Threads (UN and UNR Thread Form)

B1.20.1 ……..Pipe Threads, General Purpose (Inch)

B16.1……Cast-iron Pipe Flanges and Flanged Fittings

B16.3……Malleable Iron Threaded Fittings, Classes 150 and 300

B16.4……Gray Iron Threaded Fittings, Class 125 and 250

B16.5……Pipe Flanges and Flanged Fittings

B16.9……Factory-made Wrought Steel Buttwelding Fittings

B16.11 ……Forged Fittings, Socket-Welding and Threaded

B16.15 ……Cast-bronze Threaded Fittings, Classes 125 and 250

B16.20 ……Ring-joint Gaskets and Grooves for Steel Pipe Flanges

B16.24 ……Cast Copper Alloy Pipe Flanges and Flanged Fittings

B16.25 ……Buttwelding Ends

B16.28 ……Wrought Steel Buttwelding Short Radius Elbows and Returns

B16.34 ……Valves — Flanged, Threaded, and Welding End

B16.42 ……Ductile Iron Pipe Flanges and Flanged Fittings, Classes 150 and 300

B16.47 ……Large Diameter Steel Flanges, NPS 26 Through NPS 60

B18.2.2 …….. Square and Hex Nuts (Inch Series)

B31.1 …… Power Piping

B31.2 …… Fuel Gas Piping

B31.3 …… Process Piping

B31.4 …… Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids

B31.5 …… Refrigeration Piping and Heat Transfer Components

B31.8 …… Gas Transmission and Distribution Piping

B31.9 …… Building Services Piping

B31.11 …… Slurry Transportation Piping

B36.10M …… … Welded and Seamless Wrought Steel Pipe

QAI-1 … …….. Qualifications for Authorized Inspection

PVHO-1 …… Safety Standard for Pressure Vessels for Human Occupancy

ASME PERFORMANCE TEST CODE PTC 25……..Pressure Relief Devices

List of important ASNT Standards

ACCP ……Central Certification Program

CP-189 ……The standard for Qualification and Certification of Nondestructive Testing Personnel

SNT-TC-1A…… Recommended Practice for Personnel Qualification and Certification in Nondestructive Testing

List of some of the most widely used ASTM standards;

A 126…….. Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings

B 139 ……..Standard Specification for Phosphor-Bronze Rod, Bar and Shapes

D 56…….. Standard Test Methods for Flash Point by Tag Closed Tester

D 93…….. Standard Test Methods for Flash Point by Pensky-Martens Closed Tester

E 8 ……Standard Test Methods of Tension Testing of Metallic Materials

E 83……..Methods of Verification and Classification of Extensometers

E 125……Reference Photographs for Magnetic Particle Indication on Ferrous Castings

E 140……Hardness Conversion Tables for Metals

E 186……Standard Reference Radiographs for Heavy-walled (2 to 4-1/2 inch) Steel Castings

E 208……Method of Conducting Drop Weight Test to Determine Nil Ductility Transition Temperature of Ferritic Steel

E 280…… Standard Reference Radiographs for Heavy-walled (4-1/2 to 12-inch) Steel Castings

E 446…… Standard Reference Radiographs for Steel Castings up to 2 Inches in Thickness

Important ASME Designators

ASME Code designators and the associated sections of the ASME Boiler and Pressure Vessel Code are listed for user's convenience:

Section I……A, E, M, PP, S, V

Section II……..None

Section III……N, NA, NPT, NV

Section IV ……H, HLW, HV

Section VIII……..Division 1: U, UM, UV

Division 2: U2, UV

Division 3: U3, UV3

Section XII……..T, TD, TV

ASME Material Specification and Grades for Pipes, Tubes, Forgings, Castings, Fittings, Valves, Nuts and Bolts (SEC 2)

1. For the complete identity of a material we need two things;
2. Material Specification
3. Material Grade

For Example, In SA 106 Gr.B the "SA106" is the material specification, and "Gr.B" is the grade of the material.

Please note that for a particular specification there may be more than one grade. For example, SA106 has three grades i.e. Grade A, Grade B, and Grade C.

In this article, The Material Specification & Grades has been explained, as per ASME Sec II, for the following Items/commodities;

1. Pipes
2. Tubes

3. Forgings
4. Castings
5. Fittings
6. Valves
7. Nuts and Bolts

ASME Material Specifications for Pipes:

1. SA 53: Hot-dipped, Zinc-coated, Welded, And Seamless Pipes
2. SA 106: Seamless Carbon Steel Pipe For High-temperature Service
3. SA 312: Seamless, Welded, And Heavily Cold Worked Austenitic Stainless Steel Pipes
4. SA 333: Seamless And Welded Steel Pipe For Low-temperature Service And Other Applications With Required Notch Toughness
5. SA 335: Seamless Ferritic Alloy-steel Pipe For High-temperature Service
6. SA 358: Electric-fusion-welded Austenitic Chromium-nickel Stainless Steel Pipe For High-temperature Service And General Applications
7. SA 376: Seamless Austenitic Steel Pipe For High-temperature Central-station Service
8. SA 409: Welded Large Diameter Austenitic Steel Pipe For Corrosive Or High-temperature Service
9. SA 672: Electric-fusion-welded Steel Pipe For High-pressure Service At Moderate Temperatures

Popular Grades for Pipes:

Material Specification and Grade (ASME)	P.No/Group No.
SA 106 Gr.B	**P 1/1**
SA 672 Gr.B	**P 1/1**
SA 106 Gr.C	**P 1/ 2**
SA 335 P 11	**P 4/1**
SA 335 P 12	**P 4/1**
SA 335 P 22	**P 5/1**
SA 376 TP 321H	**P 8/1**
SA 376 TP 304H	**P 8/1**
SA 376 TP 316H	**P 8/1**
SA 376 TP 347H	**P 8/1**

Material Specifications for Tubes:

1. SA 179: Seamless Cold-drawn Low-carbon Steel Heat-exchanger And Condenser Tubes
2. SA 192: Seamless Carbon Steel Boiler Tubes For High-pressure Service
3. Sa 209: Seamless Carbon-molybdenum Alloy-steel Boiler And Superheater Tubes
4. SA 210: Seamless Medium-carbon Steel Boiler And Superheater Tubes
5. SA 213: Seamless Ferritic And Austenitic Alloy-steel Boiler, Superheater, And Heat-exchanger Tubes
6. SA 249: Welded Austenitic Steel Boiler, Superheater, Heat-exchanger, And Condenser Tubes
7. SA 556: Seamless Cold-drawn Carbon Steel Feedwater Heater Tubes
8. SA 688: Seamless And Welded Austenitic Stainless Steel Feedwater Heater Tubes

Popular Grades for Tubes:

SA 179	**P 1/1**
SA 192	**P 1/1**
SA 210 Gr A1	**P 1/1**
SA 210 Gr. C	**P 1/ 2**
SA 556 Gr C2	**P 1/ 2**
SA 209 T1	**P 3/1**
SA 209 T1a	**P 3/1**
SA 209 T1b	**P 3/1**
SA 213 T11	**P 4/1**
SA 213 T12	**P 4/1**
SA 213 T22	**P 5/1**
SA 213 T5	**P 5/1**
SA 213 T9	**P 5/2**
SA 213 TP 321H	**P 8/1**
SA 213 TP304 H	**P 8/1**
SA 213 TP 304	**P 8/1**

SA 249 TP 304	**P 8/1**
SA 688 TP 304	**P 8/1**
SA 213 TP 316 H	**P 8/1**
SA 213 TP 347 H	**P 8/1**

Material Specifications for Plates:

1. SA 240: Chromium And Chromium-nickel Stainless Steel Plate, Sheet, And Strip For Pressure Vessels And For General Applications
2. SA 299: Pressure Vessel Plates, Carbon Steel, Manganese-silicon
3. SA 302: Pressure Vessel Plates, Alloy Steel, Manganese-molybdenum And Manganese Molybdenum-nickel
4. SA 387: Pressure Vessel Plates, Alloy Steel, Chromium-molybdenum
5. SA 515: Pressure Vessel Plates, Carbon Steel, For Intermediate-And Higher-temperature Service
6. SA 516: Pressure Vessel Plates, Carbon Steel, For Moderate- And Lower-temperature Service
7. SA 517: Pressure Vessel Plates, Alloy Steel, High-strength, Quenched And Tempered
8. SA 204: Pressure Vessel Plates, Alloy Steel, Molybdenum
9. SA 225: Pressure Vessel Plates, Alloy Steel, Manganese-vanadium-nickel
10. SA 283: Low And Intermediate Tensile Strength Carbon Steel Plates
11. SA 285: Pressure Vessel Plates, Carbon Steel, Low- And Intermediate-tensile Strength
12. SA 353: Pressure Vessel Plates, Alloy Steel, Double-normalized And Tempered 9% Nickel
13. SA 455: Pressure Vessel Plates, Carbon Steel, High-strength Manganese
14. SA 533: Pressure Vessel Plates, Alloy Steel, Quenched And Tempered, Manganese molybdenum And Manganese molybdenum-nickel
15. SA 537: Pressure Vessel Plates, Heat-treated, Carbon-manganese-silicon Steel
16. SA 542: Pressure Vessel Plates, Alloy Steel, Quenched-and-tempered, Chromium-molybdenum, And Chromium molybdenum-Vanadium

Popular Grades for Plates:

Material Specification and Grade (ASME)	P.No/Group No.
SA 516 Gr 60	**P 1/1**
SA 516 Gr 70	**P 1/ 2**
SA 299	**P 1/3**
SA 515 Gr 70	**P 1/ 2**

SA 387 Gr 12	**P 4/1**
SA 387 Gr 22	**P 5/1**
SA 240 TYPE 321	**P 8/1**
SA240 – TYPE 304	**P 8/1**
SA240 – TYPE 316	**P 8/1**
SA240 – TYPE 347	**P 8/1**

Material Specifications for forgings:

1. SA 105: Carbon Steel Forgings, For Piping Applications
2. SA 181: Carbon Steel Forgings, For General-purpose Piping
3. SA 182: Forged Or Rolled Alloy And Stainless Steel Pipe Flanges, Forged Fittings, And Valves And Parts For High-temperature Service
4. SA 266: Carbon Steel Forgings For Pressure Vessel Components
5. SA 336: Alloy Steel Forgings For Pressure And High-temperature Parts
6. SA 350: Carbon And Low-alloy Steel Forgings, Requiring Notch Toughness Testing For Piping Components
7. SA 372: Carbon And Alloy Steel Forgings For Thin-walled Pressure Vessels
8. SA 723: Alloy Steel Forgings For High-strength Pressure Component Application

Popular Grades for Forgings:

Material Specification and Grade (ASME)	P.No/Group No.
SA 105	**P 1/ 2**
SA 182 F12	**P 4/1**
SA 182 F22	**P 5/1**
SA 182 F321 H	**P 8/1**
SA 182 F304 H	**P 8/1**
SA 182 F316 H	**P 8/1**
SA 182 F347 H	**P 8/1**

Castings Material Specifications:

1. Sa 216: Steel Castings, Carbon, Suitable For Fusion Welding For High-temperature Service

2. Sa 217: Steel Castings, Martensitic Stainless And Alloy, For Pressure-containing Parts, Suitable For High-temperature Service

3. Sa 351: Castings, Austenitic, Austenitic-ferritic (Duplex), For Pressure-containing Parts

4. Sa 352: Steel Castings, Ferritic And Martensitic, For Pressure-containing Parts, Suitable For Low-temperature Service

Popular Grades for Castings:

Material Specification and Grade (ASME)	P.No/Group No.
SA 216 WCB	**P 1/2**
SA 216 WCC	**P 1/2**
SA 217 WC1	**P 3/1**
SA 217 WC6	**P 4/1**
SA 217 C 5	**P 5/2**
SA 217 WC 9	**P 5/1**
SA 351 CF 8	**P 8/1**
SA 351 CF 8M	**P 8/1**
SA 351 CF 8C	**P 8/1**
SA 351 CH 20	**P 8/2**

Material Specifications for Fittings:

1. SA 234: Piping Fittings Of Wrought Carbon Steel And Alloy Steel For Moderate And High-temperature Service
2. SA 403: Wrought Austenitic Stainless Steel Piping Fittings
3. SA 420: Piping Fittings Of Wrought Carbon Steel And Alloy Steel For Low-temperature Service

Material Specifications for Flanges:

1. SA 105: Carbon Steel Forgings, For Piping Applications
2. SA 182: Forged Or Rolled Alloy And Stainless Steel Pipe Flanges, Forged Fittings, And Valves And Parts For High-temperature Service
3. SA 350: Carbon And Low-alloy Steel Forgings, Requiring Notch Toughness Testing For Piping Components

Material Specifications for Valves:

1. SA 216: Steel Castings, Carbon, Suitable For Fusion Welding For High-temperature Service

2. SA 217: Steel Castings, Martensitic Stainless, And Alloy, For Pressure-containing Parts, Suitable For High-temperature Service
3. SA 352: Steel Castings, Ferritic And Martensitic, For Pressure-containing Parts, Suitable For Low-temperature Service
4. SA 182: Forged Or Rolled Alloy And Stainless Steel Pipe Flanges, Forged Fittings, And Valves And Parts For High-temperature Service

Material Specifications for Nuts and Bolts:

1. SA 193: Alloy-steel And Stainless Steel Bolting For High-temperature Or High-Pressure Service And Other Special Purpose Applications
2. SA 194: Carbon And Alloy Steel Nuts For Bolts For High Pressure Or High-Temperature Service, Or Both
3. SA 320: Alloy-steel And Stainless Steel Bolting For Low-temperature Service

Summary of ASME BPVC Section IX – Part 1

ASME Boiler and Pressure Vessel Code (BPVC), Section IX contains qualification standard for the following

- Welding, Brazing, and Fusing procedures
- Welders and welding operators
- Brazers and brazing operators
- Plastic fusing operators

Section IX is a reference document for the qualification of material joining (welding, brazing, and plastic fusing) processes, used by various construction codes such as Section I, III, IV, VIII, XII, etc.

NOTE: The different material joining processes covered in Section IX are;

- Welding
- Brazing
- Plastic Fusing

The ASME BPVC Section IX is divided into four parts, Namely;

- Part QG: Contains General Requirements for all material – joining processes (viz. Welding, Brazing and Plastic Fusing)
- Part QW: Contains requirements for Welding
- Part QB: Contains requirements for Brazing
- Part QF: Contains requirements for Plastic Fusing

Note: Part QG General Requirements and Part QF Plastic Fusing were added in the 2013 Edition of ASME Section IX.

Since our focus is on welding henceforth we will discuss the two parts only, i.e. Part QG (General requirements with a focus on welding) and Part QW (Requirements for welding).

Part QW is further divided into five articles, these are;

- Article 1. Welding – General requirements for welding
- Article 2. Procedure qualification for welding
- Article 3. Performance qualifications for welders and welding operators

- Article 4. Welding data
- Article 5. Standard welding procedure specifications (SWPS)

These articles contain general references and guides that apply to welding procedure specification, Procedure qualification and welder performance qualifications such as positions, type and purpose of various mechanical tests, acceptance criteria, and the applicability of Section IX.

We will discuss part QG of ASME Section IX in this article:

Part QG gives general guidelines for the following;

1. Procedure Specification (QG 101)
2. Procedure Qualification Record (QG 102)
3. Performance Qualification (QG 103)
4. Performance Qualification Record (QG 104)
5. Variables (QG 105)
    - *Essential Variables – for Procedure (QG 105.1)*
    - *Essential Variables – for Performance (QG 105.2)*
    - *Supplementary Essential variables (QG 105.3)*
    - *Non-Essential Variables (QG 105.4)*
    - *Special Process Variables (QG 105.5)*
    - *Applicability (QG 105.6)*
6. Organizational Responsibility (QG 106)
    - *Organizational responsibility for procedure qualifications (QG 106.1)*
    - *Organizational responsibility for performance qualifications (QG 106.2)*
    - *Organizational responsibility for simultaneous performance qualification (QG 106.1)*
7. Ownership Transfers (QG 107)
8. Qualifications made to previous editions (QG 108)
9. Definitions (QG 109)

QG 101: Procedure specification: For each material joining process there should be a procedure specification, these procedure specifications are termed as

- Welding Procedure Specification – WPS (for Welding)

- Brazing Procedure Specification – BPS (for Brazing)
- Fusing Procedure Specification – FPS (for Fusing)

Contents of a Procedure specification: The procedure specification i.e. A Welding Procedure Specification (for Welding) contains parameters related to the welding process along with the values or range (as applicable) required to produce a sound weld. These parameters have been termed as variables by ASME. Variables are of three types;

- Essential Variables
- Non-Essential variables
- Supplementary Essential Variables

Essential Variables (For WPS – QG-105.1 & QW-251.2): A change in the essential variable is considered to affect the mechanical properties (other than toughness) of the welded joint. Hence the WPS must be requalified if the essential variable is changed.

Supplementary Essential Variables (QG-105.3 & QW-401.1): A change in the supplementary essential variable will affect the toughness properties of the joint, heat-affected zone, or base material. Hence supplementary essential variables become additional essential variables in situations where procedure qualification requires toughness testing. When procedure qualification does not require the addition of toughness testing, supplementary essential variables are not applicable.

Nonessential Variables (QG-105.4 & QW-251.3): Nonessential variables are those in which a change can be made without the requalification of the existing WPS since it is not considered to affect the mechanical properties of the joint. Though a change in the nonessential variable doesn't require the requalification of the WPS, still it should be properly addressed in the welding procedure specification (WPS).

QG 102: Procedure Qualification Record: A Test coupon is welded based on the variables given in the proposed welding procedure specification (PWPS), then that test coupon is sent to the lab for destructive tests. After a satisfactory report of the destructive test, we say that the proposed welding procedure specification (PWPS) is qualified. This entire process of qualifying the proposed WPS is known as procedure qualification and the entire data i.e. the real-time data (or variables) recorded during the welding of test coupon along with the lab report of destructive test is known as Procedure Qualification Record (PQR).

Why procedure qualification is required?

The purpose of qualifying the procedure specification is to prove that the proposed welding procedure is capable of producing weld joints having the required mechanical properties for the intended application.

Qualification of the proposed welding procedure specification (PWPS) demonstrates the mechanical properties of the welded joint, and not the skill of the welder or welding operator.

The PQR shall be produced to the Authorized Inspector whenever required. One welding procedure specification (WPS) may be supported by one or more PQR(s), and one procedure qualification record (PQR) may be used to support one or more welding procedure specification(s).

Contents of a procedure qualification record (PQR)

The procedure qualification record (PQR) shall contain

- All the real-time values (or range) of all essential variables (Mandatory) recorded during welding of the test coupon,
- Values of all non-essential variables (as required) recorded during welding of the test coupon
- Values of supplementary essential variables (if toughness test is required) recorded during welding of the test coupon

- Lab test report of the welded test coupon

QG 103: Performance Qualification: Since, Part QG is focused on general requirements for welding, brazing, and plastic fusing. Hence, it talks about the performance qualifications for all material joining processes viz. welding, brazing, and plastic fusing. But since, our area of interest is welding only hence this discussion is restricted to welding only.

Performance qualification for welders (or welding operators) is carried out for checking the capability of that person to produce a sound weld.

QG 104: Performance Qualification Record: All the real-time data observed during the welding of test coupons along with the mechanical test/Non-destructive test report is documented and is known as the performance qualification record. The performance qualification record shall be produced to the Authorized inspector whenever needed.

QG 105: Variables: The following variables have been explained under this topic

- QG 105.1: Essential Variables for procedure specification
- QG 105.2: Essential Variables for performance qualification
- QG 105.3: Supplementary Essential Variables
- QG 105.4: Non-Essential Variables
- QG 105.5: Special Process Variables
- QG 105.6: Applicability

QG 106: Organizational Responsibility: Three broad terms have been discussed under this topic.

1. Organizational responsibility for procedure qualifications (QG 106.1)
2. Organizational responsibility for performance qualification (QG 106.2)
3. Simultaneous performance qualifications (QG 106.3)

The important points pertaining to organization responsibility are as follows;

QG 106.1: Organizational responsibility for procedure qualifications: The Organization shall be fully responsible for the qualification of their procedure specification. Welding of test coupons shall be done under the full supervision and control of the qualifying organization and the person involved in this qualification process shall be a direct employee of that organization or shall be from an organization hired on contract for the welding services.

The following activities can be subcontracted, provided the organization accepts the full responsibility, these are;

- Preparation of test coupon
- preparation of test specimens (after complete welding)

  Mechanical test or destructive test of those specimens

Two or more companies with different names but working under the same corporate ownership can use a single Welding Procedure Specification (WPS), provided all the criteria of ASME section IX has been fulfilled.

QG 106.2: Organizational responsibility for performance qualifications: the performance qualification test shall be carried out only after the qualification of Welding procedure specification (WPS).

The person involved in welding of test coupons for the qualification of welding procedure specification (WPS) shall be qualified for welding within the ranges specified for performance qualification for that particular welding process.

The performance qualification test shall be carried out under the full supervision and control of the organization. However, the following activities may be subcontracted;

- Preparation of test coupon
- preparation of test specimens (after complete welding)
- Mechanical test or destructive test of those specimens

The successfully qualified welders (or welding operators) shall be issued a number/letter or Symbol by the organization, for identification purposes.

QG 106.3: Simultaneous performance qualifications: Two or more different organizations can participate in association to collectively qualify one or more welders and may share the information among themselves. During simultaneous performance qualifications, each participating organization shall be represented by an employee of that organization designated responsibility for that purpose.

QG 107: Ownership Transfers: When a new owner acquires an Organization, then the Welding procedure specification (WPS), procedure qualification record (PQR), and the welder's performance record of that organization remain valid for the new owner (with some conditions). Hence separate requalification is not required.

QG 108: Qualifications Made to Previous Editions: The welding procedure specification (WPS), procedure qualification record (PQR), and welder's performance qualifications made with respect to any previous version of ASME Section IX shall remain valid and do not require any revision except as specified by QW 420. However, qualification for a new welding procedure specification and performance qualification shall be carried out in accordance with the latest edition of ASME Section IX.

QG 109: Definitions: Several definitions related to welding have been given in part QG 109. These definitions can be found on page no. 4 through page no. 14.