

WELDING QUALIFICATION

Welding Qualifications

- A Mandatory Requirement from Codes /Std / Regulations
- Qualification Tests in accordance with the Applicable Code / Standard / Regulation.
- Acceptance Criteria of Test Results as per the Code of Construction
- Qualification Range & Limits as per Code / Std / Regulation
- Qualification Records and Test Results to be Documented

Welding Qualifications

Qualification Requirements

For Equipments to be Made as per
ASME Boiler & Pressure Vessel Code

- ASME Sec IX + Applicable Design Code
(Sec.VIII Div I or II, Sec. I, Sec. III)

Welding Qualifications

- Welding Procedure Qualification
- Welders' or Welding Operators' Performance Qualification

Welding Procedure Qualification

- Proves the Quality / Properties of Weld Joint Prepared by a set of welding variables
 - Welding Process
 - Base Material
 - Welding consumable
 - Welding Parameters & Techniques (Position, Polarity, Preheat, Inter Pass Temp. Back Gouging--)
 - PWHT
- Qualification limited to the essential variables of the Specific Process

Welding Procedure Qualification

- **WELDING DATA**

- A set of Welding Variables involved in Preparing a Weld Joint.

- **ESSENTIAL VARIABLE**

- A change in welding condition which will affect the mechanical properties (Other than notch toughness) of weld joint .

- **SUPPLEMENTARY ESSENTIAL VARIABLE**

- A change in welding condition which will affect the notch toughness properties of weld joint

- **NONESSENTIAL VARIABLE**

- A Change in welding condition which will not affect the mechanical properties of the weld joint

Welding Performance Qualification

- Ascertain the skill of a welder or a welding operator to Produce defect free/Sound weld
- ✓ Makes A Weld Coupon Using an Approved WPS of a Qualified Procedure.
- ✓ Weld Coupon Undergoes Soundness Test
- ✓ Each Qualified Welder Shall be Assigned by A Unique Welder Number
- ✓ Welders' Qualifications Records Are Documented
- Performance Qualification limited to the essential variables of the Specific Process

Welding Performance Qualification

- **WELDING DATA**

- A set of Welding Variables involved in Performing a Weld Joint.

- **ESSENTIAL VARIABLE**

- A change in welding condition which will affect the ability of welder to deposit sound weld metal.

- **NONESSENTIAL VARIABLE**

- A Change in welding condition which will not affect the ability of welder to deposit sound weld metal

How To Qualify Groove Butt Weld Procedure?

1) Understand ASME Sec. IX Classifications & Requirements

- Welding Data - Essential, Non Essential & Supplementary Essential Variables. – QW-251, 400
- Parent Metal Grouping - “P” No / S No; Group No – QW-420 & 422
- Filler Metal Grouping – “ F” No – QW-431,432, 433
- Weld Metal Composition Grouping (For Ferrous Metal) – “A” No – QW- 440, 441, 442
- Welding Positions, Groove & Fillet – QW-461
- Types of Tests & Acceptance Limits – Tension, Guided Bend, Notch Toughness – QW-141, 451, 153, 163, 171, 172, 462, 463
- Test Requirements – QW-451,
- Test Specimen – Location, Dimension & Testing Procedure – QW-462,463, 464, 466
- Qualifications – Range in Thickness - QW-451,
- Record & Documentation of WPS & PQR

How To Qualify Groove Butt Weld Procedure?

- 2) Understand ASME Sec.II Part C.
 - Specification for Filler Analysis – SFA No
 - AWS Classification of Welding Consumable
 - Limits for Chemical Composition & Mechanical Properties of Consumables

How To Qualify Groove Butt Weld Procedure?

3) Write A Welding Procedure Specification –WPS

- WPS Provides Direction for A Specific Welding
- WPS Shall Include All **Essential**,
Supplementary Essential & **Non Essential**
Variables
- WPS Format Available in ASME Sec. IX.
- Each WPS Shall be Assigned with A Unique
Number.

How To Qualify Groove Butt Weld Procedure?

4) Prepare A Test Coupon As Per WPS

- Coupon Size: Pair of 300 mm X 150 mm Plates Or Pipes 150 mm long as Specified in WPS
- All Other Details as per Written WPS
- Complete the Welding by Reasonably Skilled Welder
- All **Welding Variables** Shall be Used Within the Limit Specified in WPS.
- All Variables Actually Used Shall be Documented as Annexure to PQR (Procedure Qualification Record)

How To Qualify Groove Butt Weld Procedure?

5) NDT Of Weld Coupon - Optional

- X-Ray / Radiograph the Weld Joint (Not a Code Requirement)
- Mark Transverse Tensile & Guided Bends As Per QW463
- Eliminate Defective Weld Portion If Any, While Marking the Test Specimens
- Preserve RT Report & X-Ray Film as Annexure to PQR

How To Qualify Groove Butt Weld Procedure?

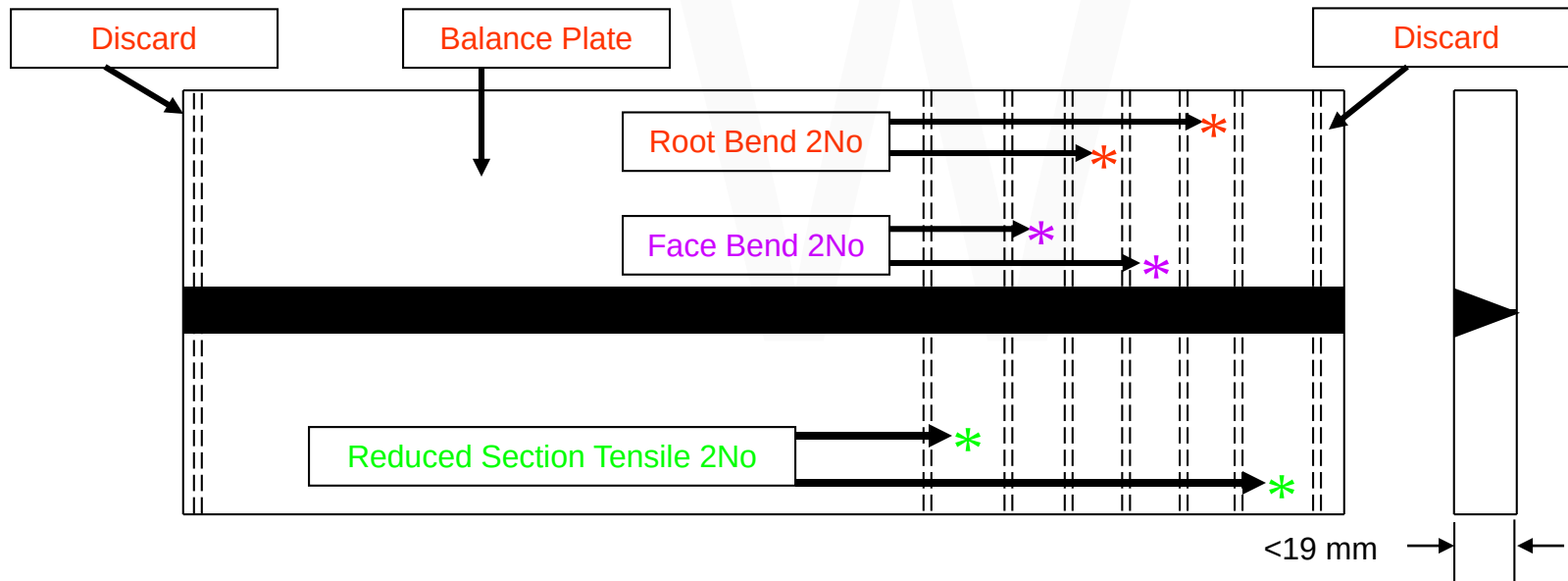
6) Mechanical Tests – Qw 451, Groove Weld.

- Up to 19 mm in Thickness
 - Transverse Tensile :- 2No →
 - *Root Bend :- 2No →
 - *Face Bend :- 2No →
 - 19 mm and above in Thickness
 - Transverse Tensile :- 2No
 - Side Bend :- 4No →
- * For material 10 mm and above in thickness, 4 side bend Tests may be substituted for Face & Root bends

How To Qualify Groove Butt Weld Procedure?

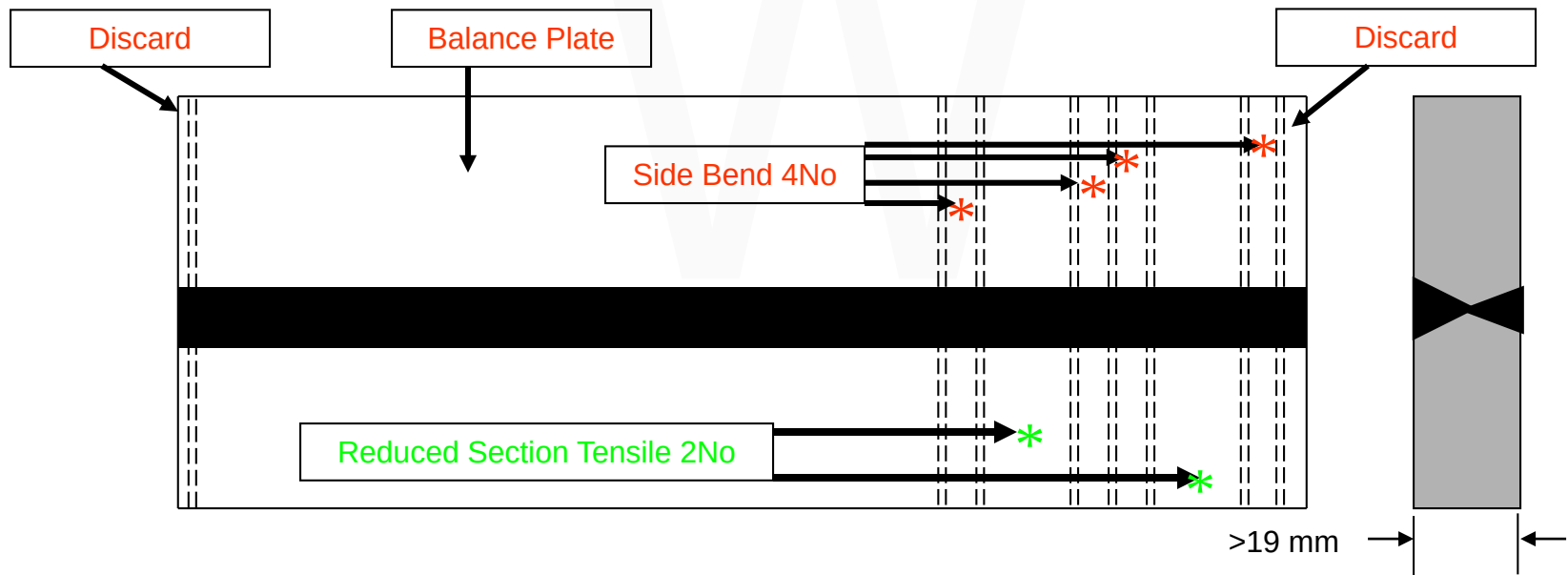
Location of Test Specimens From Test coupon – QW 463.1

Plates thickness less than 19 mm



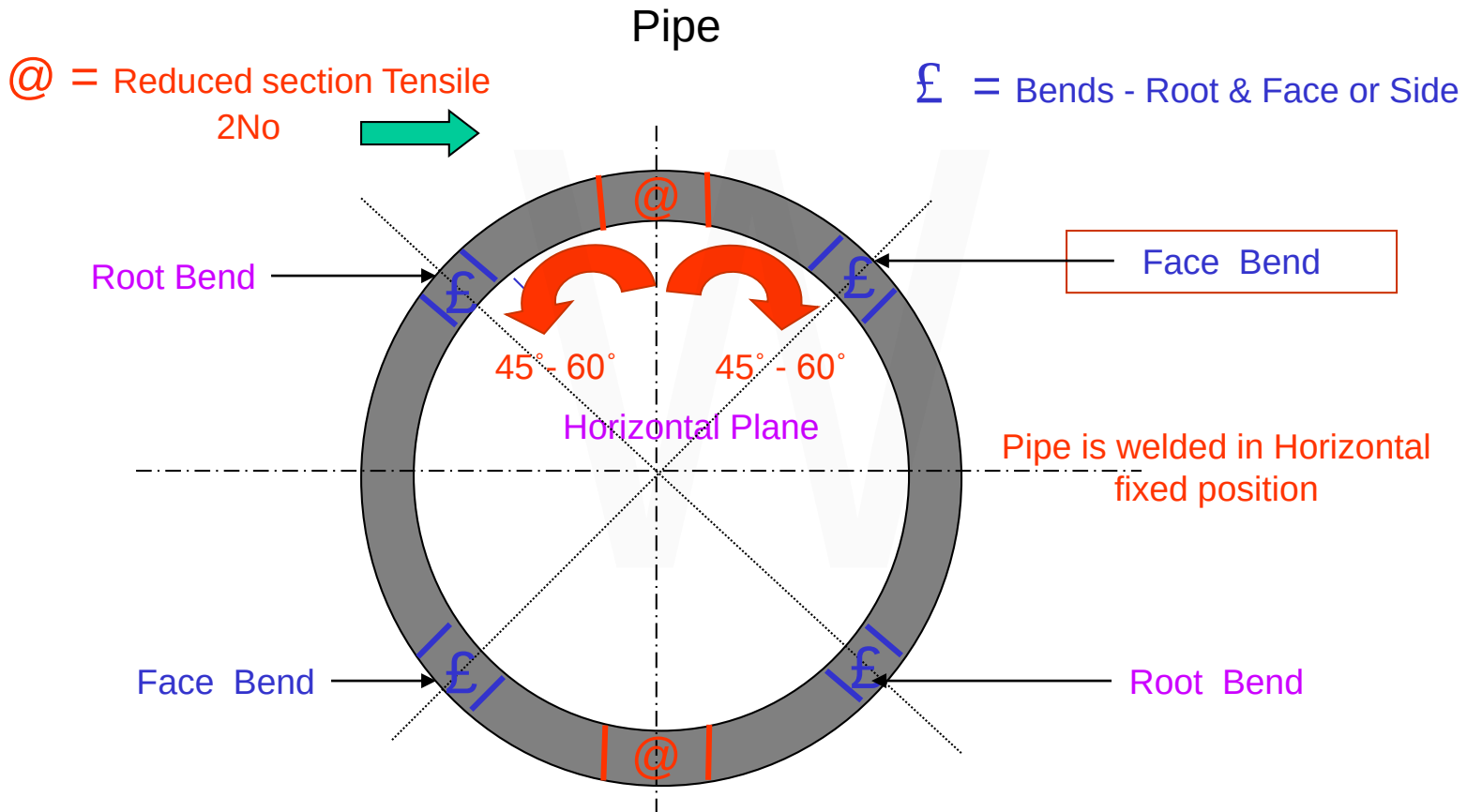
How To Qualify Groove Butt Weld Procedure?

Location of Test Specimens From Test coupon – QW 463.1
Plates thickness 19 mm and above



How To Qualify Groove Butt Weld Procedure?

Location of Test Specimens From Test coupon QW 463.1



When Pipe Thickness is 19 mm or more, In place of Root & Face,
4 Side Bends shall be Taken

How To Qualify Groove Butt Weld Procedure?

7) Acceptance Criteria for Test Results.

- Tensile Strength (Qw / QB-422)
 - Minimum Tensile Strength of Material Used
- Bend Test (Qw 163)
 - Opening Not More Than 3 mm in Any Direction on Convex Surface Within the Weld & HAZ

How To Qualify Groove Butt Weld Procedure?

8) PQR – Procedure Qualification Record

- PQR Format Available in Sec. IX
- Record All Relevant Data in the Format.
- Record All Mechanical Test Results
- Attach All Test Reports & Welding Parameters Used as Annexure to PQR
- Assign Unique Number to Each PQR
- WPS No Shall be Referred in PQR

Qualified WPS

- A WPS Remains Qualified When
 - A Procedure Qualification Coupon Is Welded As Per WPS
 - All Mechanical Tests of The Coupon Are Completed
 - All Test Results Are Within The Acceptable Limit
- And
- The Supporting PQR No Is Referred In The WPS

Thickness Limit For Groove Butt Weld Procedure.QW451

Thickness "T" Of Test Coupon Welded in mm	Range Of Thickness "T" of BM Qualified in mm		Thickness "t" of Deposited Weld metal Qualified in mm
	Mini	Max	Max
Less Than 1.5 (1/16")	T	2T	2t
1.5 to 10 (1/16" to 3/8") Incl	1.5 (1/16")	2T	2t
Over 10 to below 19 (3/8" to 3/4)	5 (3/16")	2T	2t
19 to below 38 (3/4 " to 1 1/2")	5 (3/16")	2T	2t When t < 19
19 to below 38 (3/4 " to 1 1/2")	5 (3/16")	2T	2T When t ≥19
38 (1 1/2") and over	5 (3/16")	200 (8")	2t When t < 19
38 (1 1/2") and over	5 (3/16")	200 (8")	200 When t ≥19
Over 200 (8") – QW 403.7	5 (3/16")	1.33 T	1.33 t

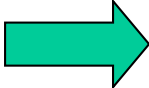
Minimum Base Metal Thickness Limit For Butt Weld Procedure With Impact .QW403.6

Thickness "T" Of Test Coupon Welded in mm	Range Of Thickness "T" of BM Qualified in mm		Thickness "t" of Deposited Weld metal Qualified in mm
	Mini	Max	Max
Below 6	1/2T	2T	2t
6 to 16 (1/4" to 5/8") Incl	T	2T	2t
Over 16 to below 19 (5/8" to 3/4")	16 (5/8")	2T	2t
19 to below 38 (3/4 " to 1 1/2")	16 (5/8")	2T	2t When t < 19
19 to below 38 (3/4 " to 1 1/2")	16 (5/8")	2T	2T When t ≥19
38 (1 1/2") and over	16 (5/8")	200 (8")	2t When t < 19
38 (1 1/2") and over	16 (5/8")	200 (8")	200 When t ≥19
Over 200 (8") – QW 403.7	16 (5/8")	1.33 T	1.33 t

Impact Testing – UG 84

Qualification With Supplementary Essential Variable.

A) Weld Joint Thickness 38 mm (1½ “) And Below

Two Sets Of Charpy V Notch Impact Specimens 

- One Set Of 3 Nos. Each From HAZ – Within 1.5 from Any Surface
- One Set Of 3 Nos. Each From Weld – Within 1.5 from Any Surface

B) Weld Joint Thickness Above 38 mm (1½ “)

Three Sets Of Charpy V Notch Impact Specimens

- One Set Of 3Nos. Each From HAZ – Within 1.5 from First Half Surface
- One Set Of 3 Nos. Each From Weld – Within 1.5 from Any Surface
- One Set Of 3 Nos. Each From Weld – Midway In Second Half

Procedure Qualification - QW-253

SMAW Variable

Group of Variables	Brief Of Variables	Essential	Supplementary Essential	Nonessential
QW 402 Joints	Change in Groove Design	---	---	*
	Addition / Deletion of Backing	---	---	*
QW 403 Base Metals	Change in group Of P No	---	*	---
	T Limits Impact	---	*	---
	T/t Limits > 200 mm	*	---	---
	Change in T Qualified	*	---	---
	“t” pas > 13 mm	*	---	---
	Change of P Number Qualified	*	---	---
QW 404 Filler Metals	Change in F No	*	---	---
	Change in A No	*	---	---
	Change in Dia	---	---	*
	Change in Dia > 6 mm	---	*	---
	Change in AWS classification	---	*	---
	Change in t qualified	*	---	---

Procedure Qualification - QW-253

SMAW Variable

Group of Variables	Brief Of Variables	Essential	Supplementary Essential	Nonessential
QW 405 Positions	Addition of Position	---	---	*
	Change in Position	---	*	---
QW 406 Preheat	Decrease > 56°C	*	---	---
	Increase > 56°C IP	---	*	---
QW 407 PWHT	Addition / Deletion of PWHT	*	---	---
	Change in Time & Temp. Qualified	---	*	---
QW 409 Electrical Characteristics	Increase in Heat Input	---	*	---
	Change in Current / Polarity	---	*	---
	Change in Current / Voltage	---	---	*
QW 410 Technique	Change from String / Weave	---	---	*
	Method of Cleaning	---	---	*
	Method of Back Gouging	---	---	*
	Change From Multiple to Single Pass	---	*	---

Procedure Qualification - QW-254

SAW Variable

Group of Variables	Brief Of Variables	Essential	Supplementary Essential	Nonessential
QW 402 Joints	Change in Groove Design	---	---	*
	Addition / Deletion of Backing	---	---	*
QW 403 Base Metals	Change in group Of P No	---	*	---
	T Limits Impact	---	*	---
	T/ t Limits > 203 mm	*	---	---
	Change in T Qualified	*	---	---
	“t” pas > 13 mm	*	---	---
	Change of P Number Qualified	*	---	---
QW 404 Filler Metals	Change in F No	*	---	---
	Change in A No	*	---	---
	Change in Dia	---	---	*
	Change in Wire & Flux Combination	*	---	---
	Change in Alloyed Flux	*	---	---

Procedure Qualification - QW-254

SAW Variable

Group of Variables	Brief Of Variables	Essential	Supplementary Essential	Nonessential
QW 404 Filler Metal	Alloy Elements / supplemental Wire	*	---	---
	Change in Flux Type	*	---	---
	Change in “t” Qualified	*	---	---
QW 405 Positions	Addition of Position	---	---	*
QW 406 Preheat	Decrease > 56°C	*	---	---
	Increase > 56°C IP	---	*	---
QW 407 PWHT	Addition / Deletion of PWHT	*	---	---
	Change in Time & Temp. Qualified	---	*	---
	T Limits	*	---	---
QW 409 Electrical Characteristics	Increase in Heat Input	---	*	---
	Change in Current / Polarity	---	*	---
	Change in Current / Voltage	---	---	*

Procedure Qualification - QW-256

GTAW Variable

Group of Variables	Brief Of Variables	Essential	Supplementary Essential	Nonessential
QW 402 Joints	Change in Groove Design	---	---	*
	Addition / Deletion of Backing	---	---	*
QW 403 Base Metals	Change in group Of P No	---	*	---
	T Limits Impact	---	*	---
	T / t Limits > 203 mm	*	---	---
	Change in T Qualified	*	---	---
	Change From T Qualified	*	---	---
	Change From P Number Qualified	*	---	---
QW 404 Filler Metals	Change in F No	*	---	---
	Change in A No	*	---	---
	Change in AWS Classification	---	*	---
	Addition / Deletion of Filler	*	---	---
	Addition / Deletion of Consumable Insert	---	--	*
	Change From Solid – Flux / Powder Cored	*	---	---

Procedure Qualification - QW-256

GTAW Variable

Group of Variables	Brief Of Variables	Essential	Supplementary Essential	Nonessential
QW 405 Positions	Addition of Position	---	---	*
	Change in Position	---	*	---
QW 406 Preheat	Decrease > 56°C	*	---	---
	Increase > 56°C IP	---	*	---
QW 407 PWHT	Addition / Deletion of PWHT	*	---	---
	Change in Time & Temp. Qualified	---	*	---
	Change in T thickness Qualified	*	---	---
QW 408 Gas	Addition / Deletion / Change in Trailing Gas	---	---	*
	Addition / Deletion / Change in Shielding Gas	*	---	--
	Change in Flow Rate of Shielding / Backing Gas	---	---	*
	Deletion of Backing Gas	*	---	---

Procedure Qualification - QW-256

GTAW Variable

Group of Variables	Brief Of Variables	Essential	Supplementary Essential	Nonessential
QW 409 Electrical Characteristics	Increase in Heat Input	---	*	---
	Change in Tungsten Electrode Size	---	---	*
	Addition / Deletion of Pulsing	---	---	*
	Change in Current or Polarity	---	*	---
QW 410 Technique	Change in Nozzle / Gas Cup Size	---	---	*
	Method of Cleaning	---	---	*
	Change in Oscillation	---	---	*
	Method of Back Gouging	---	---	*
	Change From Single to Multi Electrode	---	*	---
	Change From Closed Chamber to Out Side	*	---	---
	Change From Manual to Auto / Auto to Manual	---	---	*
	Addition or Deletion of Preening	---	---	*

Procedure Qualification - QW-255

GMAW & FCAW Variable

Group of Variables	Brief Of Variables	Essential	Supplementary Essential	Nonessential
QW 402 Joints	Change in Groove Design	---	---	*
	Addition / Deletion of Backing	---	---	*
QW 403 Base Metals	Change in group Of P No	---	*	---
	T / t Limits > 200 mm	*	---	---
	Change From T Qualified	*	---	---
	When “ t” in Single Pass > 13 mm	*	---	---
	T Qualified Limit for Short Circ. Transfer	*	---	---
	Change From P Number Qualified	*	---	---
QW 404 Filler Metals	Change in F No	*	---	---
	Change in A No	*	---	---
	Change in AWS Classification	---	*	---
	Change from solid - Flux Cored / Powder Cored	*	---	---
	Addition / Deletion of Alloy Elements	*	---	---
	“t” Qualified Limit for Short Circ. Transfer	*	---	---

Procedure Qualification - QW-255

GMAW & FCAW Variable

Group of Variables	Brief Of Variables	Essential	Supplementary Essential	Nonessential
QW 405 Positions	Addition of Position	---	---	*
	Change in Position	---	*	---
QW 406 Preheat	Decrease > 56°C	*	---	---
	Increase > 56°C IP	---	*	---
QW 407 PWHT	Addition / Deletion of PWHT	*	---	---
	Change in Time & Temp. Qualified	*	---	---
	Change in T thickness Qualified	*	---	---
QW 408 Gas	Addition / Deletion / Change in Trailing Gas	---	---	*
	Addition / Deletion / Change in Shielding Gas	*	---	--
	Change in Flow Rate of Shielding / Backing Gas	---	---	*
	Deletion of Backing Gas	*	---	---

Procedure Qualification - QW- 255

GMAW & FCAW Variable

Group of Variables	Brief Of Variables	Essential	Supplementary Essential	Nonessential
QW 409 Electrical Characteristics	Increase in Heat Input	---	*	---
	Change in Metal Transfer Mode	*	---	---
	Change in Wire feed & Voltage	---	---	*
	Change in Current or Polarity	---	*	---
QW 410 Technique	Change in Nozzle / Gas Cup Size	---	---	*
	Method of Cleaning	---	---	*
	Change in Oscillation	---	---	*
	Method of Back Gouging	---	---	*
	Change From Single to Multi Electrode	---	*	---
	Change From Multiple to Single Pass per Side	---	*	---
	Change From Manual to Auto / Auto to Manual	---	---	*
	Addition or Deletion of Preheating	---	---	*

P Number & Group Number

- **P Numbers** assigned to all Materials Listed in ASME Sec. II – **Part A & B.** (P1, P3, P4, P5 ----)
- **S Numbers** are assigned to materials **not listed in ASME** Sec. II, but permitted to use in ASME jobs - ASTM Material (S1, S3, S4, S5 --)
- Assignment of P or S Number is based on Characteristic – **Composition, Weldability & Mechanical Properties**
- **Ferrous materials** (ASME Sec II – A & ASTM) further grouped to Sub Group Numbers based on **impact properties** (P1- Gr.2, P4 - Gr. 1, S8 - Gr. 2 ---)
- Grouping of Parent materials to P No or S No reduces the number of welding qualifications.

P – Number & Group Number (Base Metal For Qualification)

QW-422

P- No	Group No	Met. Spec.	Grade	Met. Quality & Form
P1	1	SA 515 / SA 516	60	CS – Plate
	2	SA 515 / SA 516	70	CS – Plate
P1	1	SA 106	A / B	CS – Pipe
	2	SA 106	C	CS - Pipe
P1	1	SA333	6	CS – Pipe
	3	SA 333	10	CS - Pipe
P1	1	SA 234	WPB	CS Pipe Fitting
	2	SA 234	WPC	CS Pipe Fitting
P1	1	SA 285	C / B	CS Plate
P1	1	SA 179	---	CS Tube
P1	1	SA 105	---	CS Forging
	2	SA 181	Cl 70	CS Forging

P – Number & Group Number (Base Metal For Qualification)

- QW-422

P- No	Group No	Met. Spec.	Grade	Met. Quality & Form
P3	2	SA 302	A	Mn – 0.5 Mo – Plate
	3	SA 302	B,C,D	Mn – 0.5 Mo – Plate
P3	1	SA 335	P1 / P2	C – 0.5 Mo – Pipe
P3	3	SA 533	TP- B, Cl- 1 or 2	C – 0.5 Mo – Plate
P3	1	SA 209	T1, T1a, T1b	C – 0.5 Mo – Tube
P3	2	SA 282	F1	C – 0.5 Mo – Forging

P – Number & Group Number (Base Metal For Qualification)

- QW-422

P- No	Group No	Met. Spec.	Grade	Met. Quality & Form
P4	1	SA 387	12, Cl -1 / 2	1Cr. 0.5 Mo – Plate
	3	SA 387	11, Cl -1 / 2	1.25 Cr. 0.5 Mo – Plate
P4	1	SA 335	P12 / P11	1Cr (1.25 Cr) – 0.5 Mo – Pipe
P4	2	SA 423	TP - 1 / 2	1.25 Cr. 0.5 Mo – Tube
P4	1	SA 282	F12, Cl- 1 / 2	1. Cr – 0.5 Mo – Forging
		SA 336	F11, Cl -1 / 2 / 3	1.25 Cr – 0.5 Mo – Forging

P – Number & Group Number (Base Metal For Qualification)

- QW-422

P- No	Group No	Met. Spec.	Grade	Met. Quality & Form
P5A	1	SA 387	22, Cl –1 / 2	2. 25 Cr. 1 Mo – Plate
P5B	1	SA 387	5, Cl - 2	5 Cr. 0.5 Mo - Plates
P5A	1	SA 335	P22	2. 25 Cr. 1 Mo – Pipe
P5A	1	SA 213	TP - 22	2. .25 Cr. 1 Mo – Tube
P5B	1	SA 182	F5	5 Cr – 0.5 Mo – Forging
P5C	1	SA 182	F22V	2. 25 Cr – 1 Mo,V – Forging
P5A	1	SA 336	F22, Cl –1 / 3	2. 25 Cr – 1 Mo – Forging

P – Number & Group Number (Base Metal For Qualification)

- QW-422

P- No	Group No	Met. Spec.	Grade	Met. Quality & Form
P6	2	SA 240	TP 429	15Cr. – Plate
P6	4	SA 731	S41500	13Cr., 4.5 Ni, Mo - Pipe
P6	1	SA 268	TP410	13Cr. – Tube
P6	3	SA 336	F6	13Gr.– Forging
P7	2	SA182	F430	17Cr. - Forging
P7	2	SA 240	TP 430	17Cr. - Plate
P7	2	SA 268	TP430	17Cr. Tube
P7	2	SA 731	TP439	18Cr., Ti – Pipe

P – Number & Group Number (Base Metal For Qualification)

- QW-422

P- No	Group No	Met. Spec.	Grade	Met. Quality & Form
P8	1	SA 312	TP321	18Cr., 10Ni, Ti - Pipe
	1	SA 312	TP347	18Cr., 10Ni, Cb - Pipe
P8	1	SA336	TP316	18Cr., 8 Ni, 2Mo -Forging
	1	SA 336	TP310	25Cr., 20 Ni, Forging
P8	1	SA 240	TP304	18Cr, 8Ni - Plates
	2	SA 204	TP309S	23Cr. 12Cr. - Plates
P8	1	SA 249	TP317	18Cr, 13Ni, 3Mo –Tube
	1	SA 249	TP316L	16Cr, 12Ni, 2Mo - Tube

P – Number & Group Number (Base Metal For Qualification)

- QW-422

P- No	Group No	Met. Spec.	Grade	Met. Quality & Form
P9B	1	SA 333	3	3.5Ni - Pipe
P9A	1	SA334	7	2.5Ni - Tube
P9A	1	SA 350	LF5, Cl. 2	1.5Ni - Forging
P9B	1	SA 350	LF3	3.5Ni. - Forging
P9A	1	SA 203	A	2.5Ni. - Plate
P9B	1	SA 203	E	3.3Ni. - Plate

P – Number & Group Number (Base Metal For Qualification)

- QW-422

P- No	Group No	Met. Spec.	Grade	Met. Quality & Form
P10H	1	SA240	S31803	22Cr, 5Ni, 3Mo, N - Plate
P10H	1	SA240	S32550	25Cr, 5Ni, 3Mo, 2Cu - Plate
P11A	1	SA 333	8	9Ni - Pipe
P11A	1	SA334	8	9Ni - Tube
P11A	5	SA 508	4N, Cl. 2	3.5Ni –1.75 Cr.-0.5Mo.- V, Forging
P11A	5	SA 508	5, Cl. 2	3.5Ni –1.75 Cr.-0.5Mo.- V, Forging
P11A	4	SA 533	TP B, Cl. 3	Mn, 0.5 Mo, 0.5Ni – Plate
P11A	4	SA 533	TP C, Cl. 3	Mn, 0.5 Mo, 0.75Ni - Plate

How To Qualify A Welder

1) Understand ASME Sec. IX - Welding Performance Qualifications

- Variables For Different Processes – QW 350
- Limits Of Positions Qualified & Dia – QW 461
- Testing Requirements – QW 304-1

How To Qualify A Welder

2) Train The Welder For The Process To Be Qualified

- Welder Shall Posses Adequate Skill In Performing the Process.
- He Shall have Necessary Knowledge In Operation Of Machine, Precautions In Storage & Usage Of Consumable, Defects In Welding, Their Causes And Remedy.
- He Shall Practice Welding In The Particular Position In Which He Is To Be Tested / Qualified

How To Qualify A Welder

3) Preparation Of Test Coupon

- Prepare A Test Coupon Out of 300 x 150 x 20 mm Plates Or Pipe Of 150mm long As Per Applicable WPS.
- WEP (Angle, Root Face & Root Opening) Shall Be As Per The WPS
- Provide Run in & Run Out Coupons on plate & Fix the Test Coupon In In Any One Of The Positions To Be Qualified.
- Weld The Groove Fully In The Position
- All Welding Variables Shall be Strictly Within The Qualified WPS

How To Qualify A Welder

4) Type Of Test Required On Welded Coupon (QW-302)

- Visual Examination – Qw 302.4

Completed Coupon Shall be Subjected To Visual Inspection

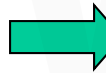
- Mechanical Test - QW 452

Root Bend :- 1 No 

Face Bend :-1 No 

< 19 mm Thick

Or

Side Bend :- 2 Nos 

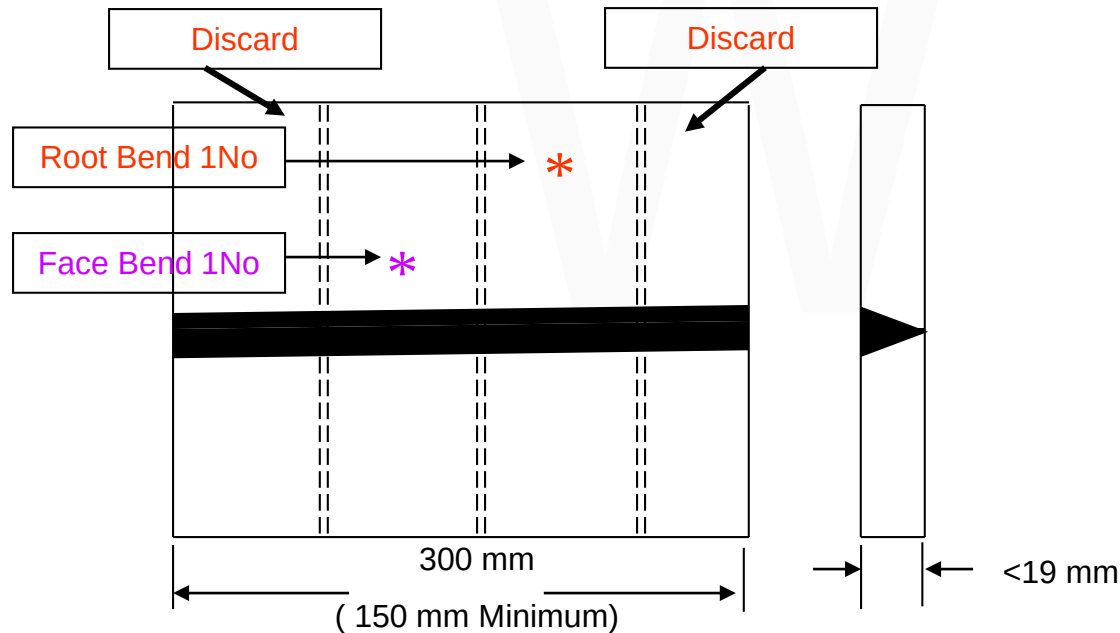
≥ 19 mm Thick

(For 5G / 6G – 2 Face & 2 Root Or 4 Side Bends)

- Alternate to Mechanical Tests, Radiograph the Coupon – 6 " Minimum Length

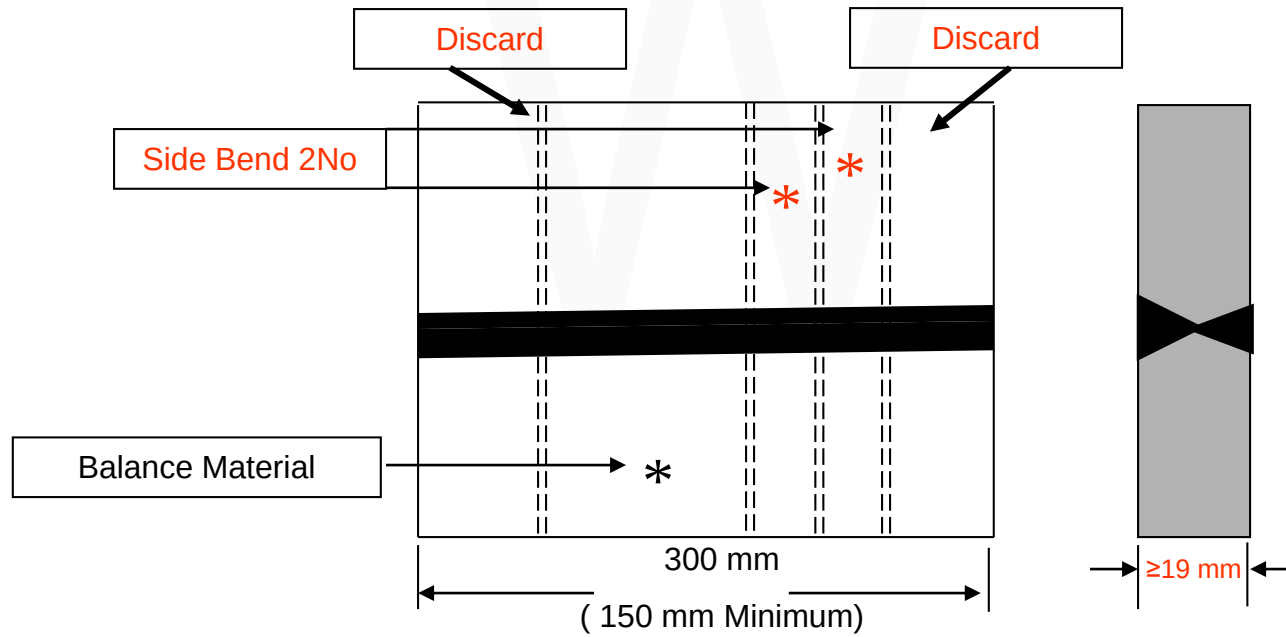
How To Qualify A Welder

Location of Test Specimens From Test coupon – QW 463.2
Plates Less Than 19 mm



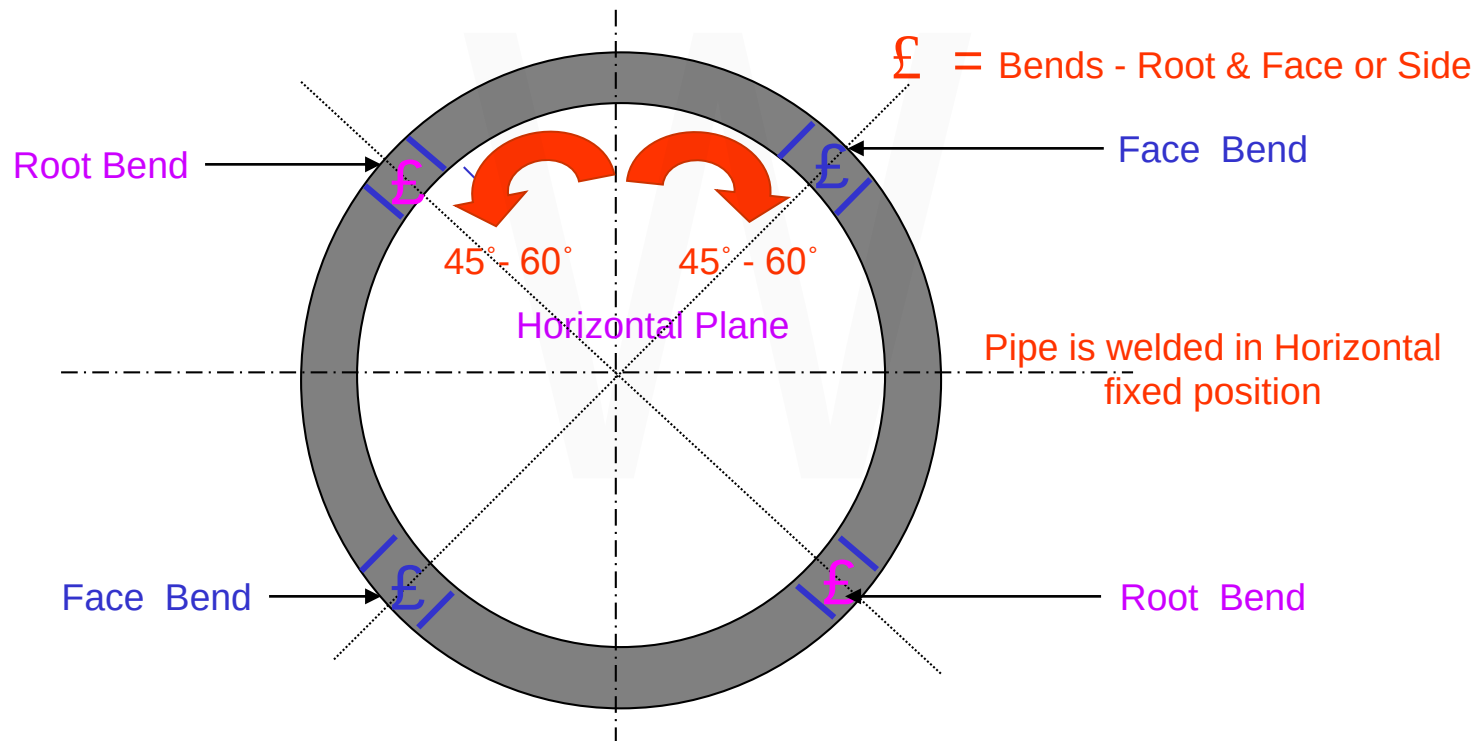
How To Qualify A Welder

Location of Test Specimens From Test coupon – QW 463.2
Plates - Thickness 19 mm & more



How To Qualify A Welder

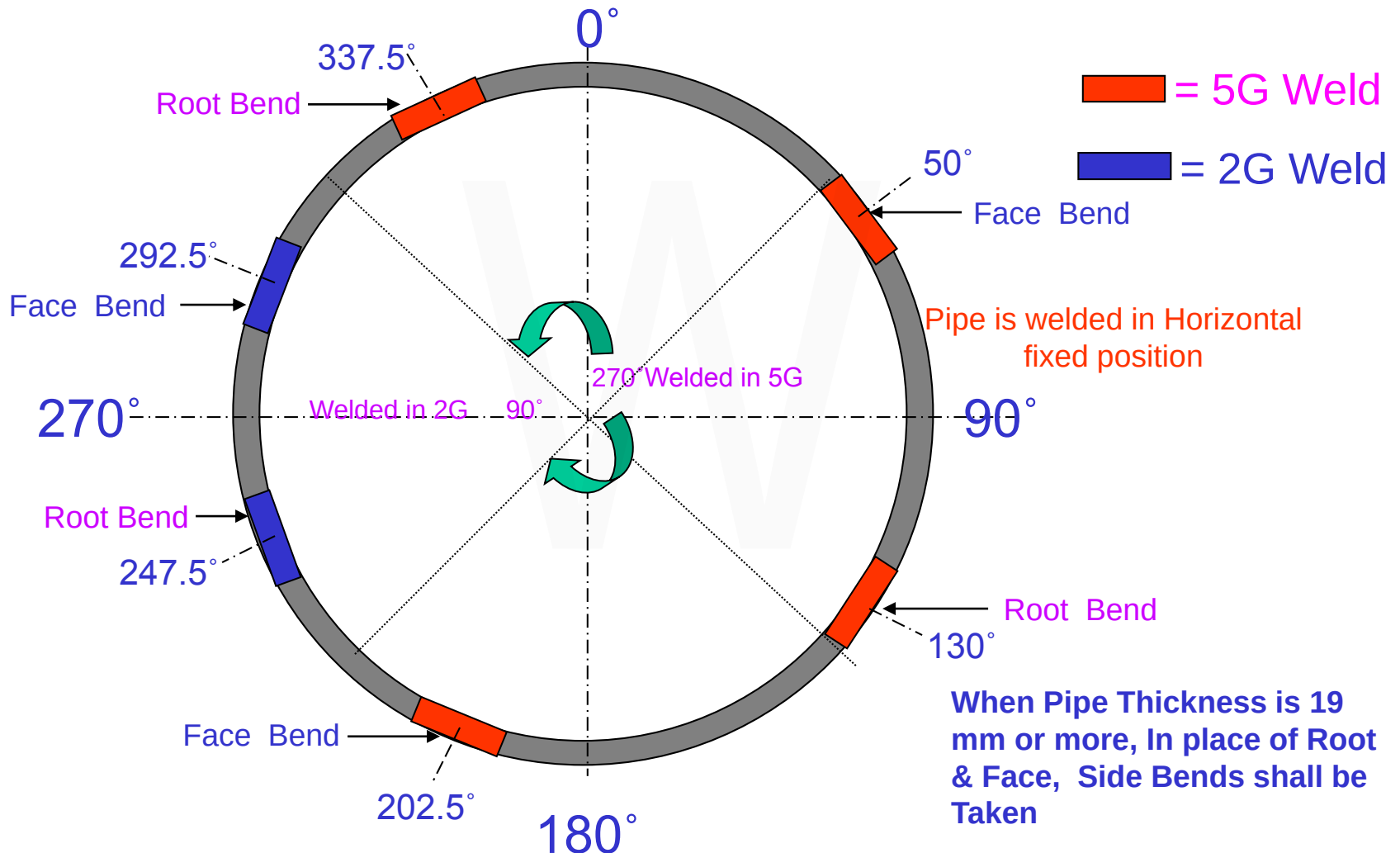
Location of Test Specimens From Test coupon – QW 463.2
Pipe in 5G or 6G Position



When Pipe Thickness is 19 mm or more, In place of Root & Face, 4 Side Bends shall be Taken

How To Qualify A Welder

Location of Test Specimens From Test Pipe 6 NPS Welded
in Combination of 5G & 2G – QW 463.2



How To Qualify A Welder

5) Acceptability Criteria For Tests

- Visual Examination – Qw 302.4

Free From Incomplete Fusion / Penetration and Surface Defect

- Bend Test - QW 163

Opening not more than 3 mm in any direction on Convex Surface Within the Weld & HAZ

- R T – Qw 91.2

No Crack, L/F & Incomplete Penetration

No Slag, Cluster Of Porosity & Other Inclusions Beyond Specified Limit

Performance Qualification Thickness Limits – QW 452.1(b)

Thickness “t” of Weld Metal in the Coupon in mm (in)	Thickness of Weld metal Qualified
All	2t
13 (1/2) and Over With Minimum Three Layers	Maximum To Be Welded

Groove Weld Positions – QW461

Sr No.	Groove Position	Base Metal Position		Inclination of Axis in °
		Plate	Pipe	
1	1G Flat	Horizontal	Pipe Axis Horizontal – in Rotation	0 -15
2	2G Horizontal	Vertical	Pipe Axis Vertical	0 - 15
3	3G Vertical	Vertical	NA	80 – 90 15 - 80
4	4G Over Head	Horizontal	NA	0 - 80
5	5G	NA	Pipe Axis Fixed Horizontally	0 -15
6	6G	NA	Pipe Axis Fixed 45° inclined	+ or - 5

Performance Qualification

Position & Dia Limits- QW461.9

Qualification Test		Position & Type of Weld Qualified		
Weld	Position	Plate & Pipe Over 24"	Pipe ≤ 24"	Fillet Plate & Pipe
Plate Groove	1G	F	F*	F
	2G	F, H	F*&H*	F,H
	3G	F,V	F*	F,H,V
	4G	F,O	F*	F,H,O
	2G, 3G &4G	ALL	F*&H*	ALL
	Spcl. Position	SP & F	SP & F	SP & F
Pipe\$ Groove	1G	F	F	F
	2G	F,H	F,H	F,H
	5G	F,V,O	F,V,O	ALL
	6G	ALL	ALL	ALL
	2G &5G	ALL	ALL	ALL
	Spcl. Position	SP,F	SP,F	SP&F

* Pipe 2 7/8" OD and Over, \$ Pipe OD Restrictions As Per QW 452.3, 452.4 & 452.6

Performance Qualification

Groove-Weld, Pipe Dia. Limits QW 452.3

Out Side Dia. Of Test Coupon in mm (in)	Out Side Dia. Qualified	
	Min.	Max.
Less Than 25 (1")	Size Welded	Unlimited
25 (1") to 73 (2 ⁷ / ₈ ")	25 (1")	Unlimited
Over 73 (2 ⁷ / ₈ ")	73 (2 ⁷ / ₈ ")	Unlimited
Notes:- 1) Type & Number of Tests as per QW-452.1 2) 73 mm OD is equivalent to 2 ¹ / ₂ " NB Pipe 3) Welders Qualified on Groove, Are Also Qualified for making Fillets of all Sizes on Any Thickness & Any Pipe Dia.		

Welding Variables- Qw 416

Performance Qualification

Group of Variables	Brief Of Variables	Essential Variables			
		SMAW QW -353	SAW. QW-354	GMAW QW-355	GTAW QW-356
QW 402 Joints	Deletion of Backing	+	+	+	+
QW 403 B M	Change in Pipe Dia.	+	+	+	+
	Change in P Number	+	+	+	+
QW 404 Filler Metal	Deletion /Addition of FM	---	---	---	+
	Change in F Number	+	+	+	+
	Dele. /Addi. of Consumable Insert	---	---	---	+
	Solid – Metal/Flux Cored	---	---	---	+
	Change in t deposit Qualified	+	+	+	+
	“t” deposit for Short Cir.Transfer	---	---	+	---

Welding Variables- Qw 416

Performance Qualification

Group of Variables	Brief Of Variables	Essential Variables			
		SMAW QW -353	SAW. QW-354	GMAW QW-355	GTAW QW-356
QW 405 Position	Addition of New Position	+	+	+	+
	Change from up hill to Down hill –3G	+	---	+	+
QW 408 Gas	Deletion of Inert Gas Backing	---	---	+	+
QW 409 Electric Charact.	Change in Mode of Metal Transfer	---	---	+	---
	Change in Type of Current / Polarity	---	---	---	+