Practical Approaches for Successful Production Welding

For The NBBI General Meeting

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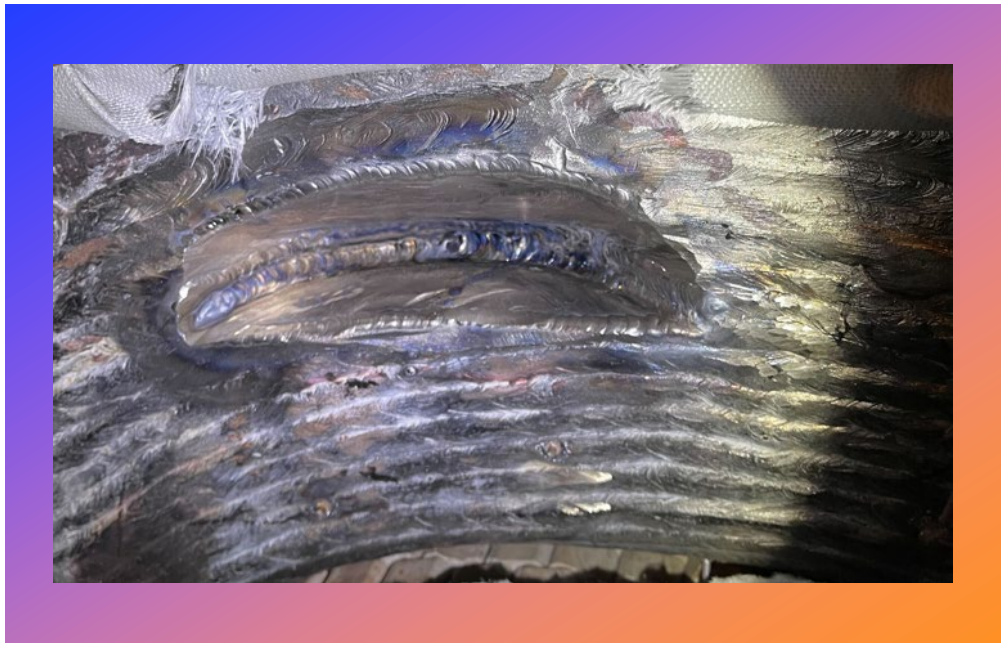
May 12, 2025



Agenda

- Welding, what is it?
- Meet the Team (WPS, PQR, WPQ)
- Welding Processes
- Intentions of welds
- Typical Challenges
- Welding Location
- Welders (They matter)
- Application of those WPS and PQR
- A Practical Approach
- Heat Input
- Heat treatment
- Summary

WELDING, WHAT IS IT?

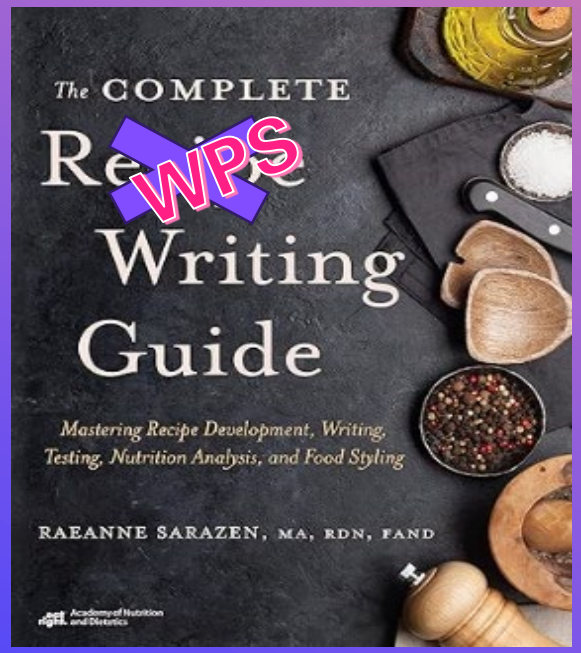
Weld:

A localized coalescence of metals or nonmetals produced either by heating the materials to the welding temperature, with or without the application of pressure, or by the application of pressure alone and with or without the use of filler material.

Essentially, welding is rapid heating of materials to their melting point then a rapid cooling to ambient temperature.

Meet the Team

PRACTICAL APPROACHES FOR SUCCESSFUL PRODUCTION WELDING



WELDING PROCEDURE SPECIFICATION:

A procedure specification is a written document providing direction to the person applying the material joining process.

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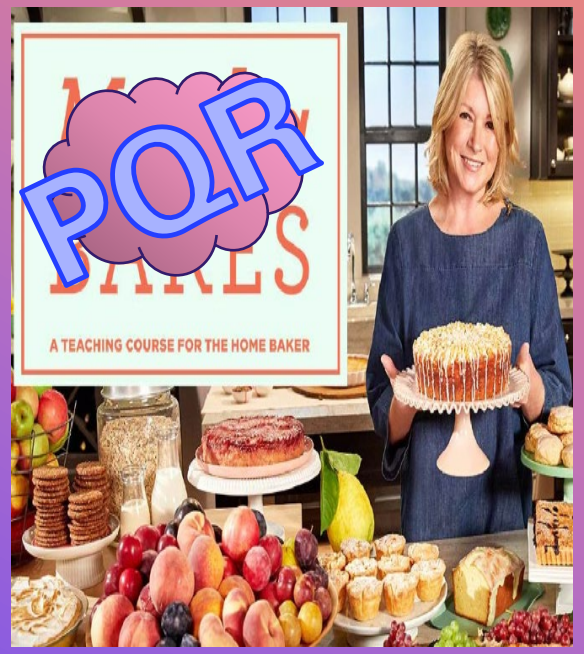


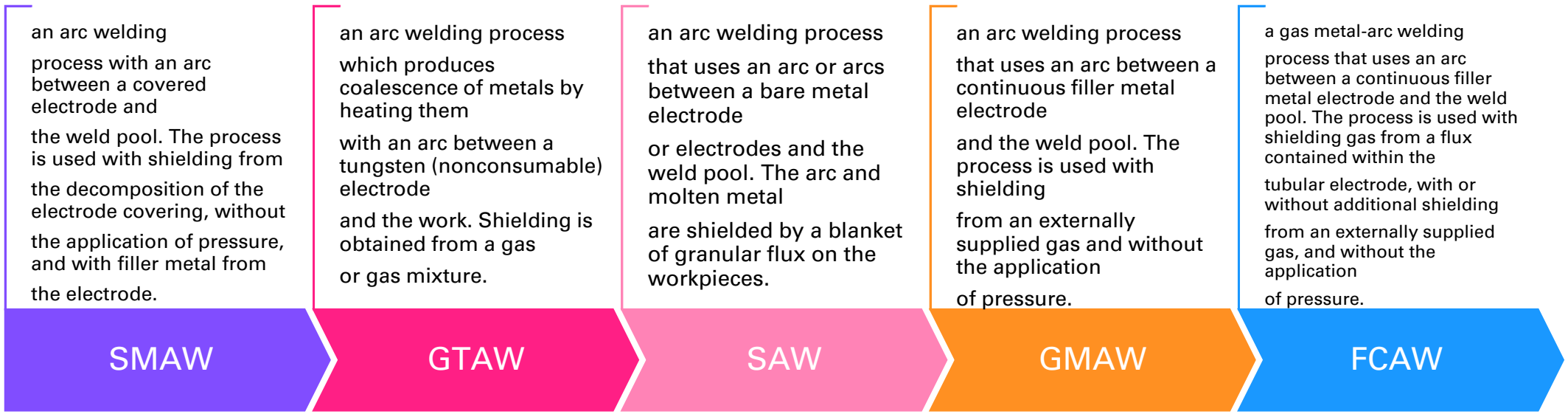
PROCEDURE QUALIFICATION RECORD

Demonstrates the mechanical properties of the joint made using a joining process, and not the skill of the person using the joining process.

WELDER PERFORMANCE QUALIFICATION

Qualification of the person who will use a joining process is to demonstrate that person's ability to produce a sound joint when using a procedure specification.

Welding Processes

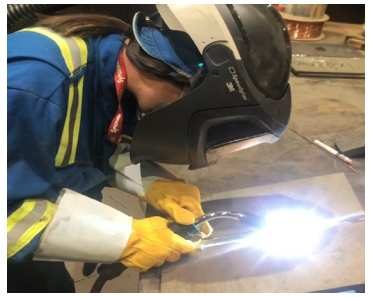


Welding Processes

SMAW

GTAW

SAW



GMAW

FCAW

What are the welds intended for?

Is the Code of construction known?

If not, you should probably find out…

- ASME - VIII Div. 1
- B31.1
- B31.3
- CSA - W59
- Z662
- API 1104
- AWS - D1.1
- etc.

Which standards and/or recommended practices are to be utilized?

- American Petroleum Institute (API) - 577, 582
- Association for Materials Protection and Performance (AMPP, formally NACE) - MR0175
- etc.

What are the welds intended for?

Are there internal specification requirements?

Tighter knit requirements typically based on previous learnings

What is the application or service?

Services such as Sour, Hydrogen, SCC, high temperature, cryogenic, etc.

Typical Challenges in Industry

- WPS approval prior to knowledge of scope
- Use of less suitable welding process(es)
- Preferred consumable(s) without application or service knowledge
- The right welder for the job
- Lack of communication & collaboration
- Experience and skill set

Where is the Welding Taking place?

Location, Location, Location

SHOP

Ferrous, Non-ferrous (white) area

Rollers, fixed, bay, booth

FIELD

What are the typical weather conditions?

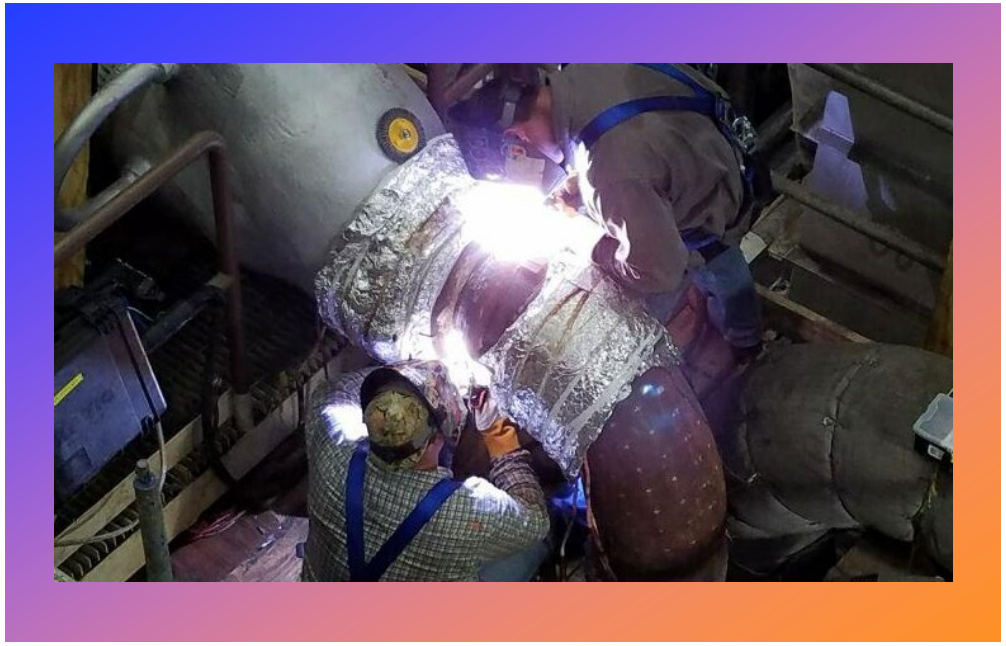
Cold, hot, humid, dry, rain, snow

INTERNAL

Confined space, cramped space, face mask, fall arrest, Tyvek

EXTERNAL

Structure, scaffolding, crane/JLG man basket, fall arrest, open area

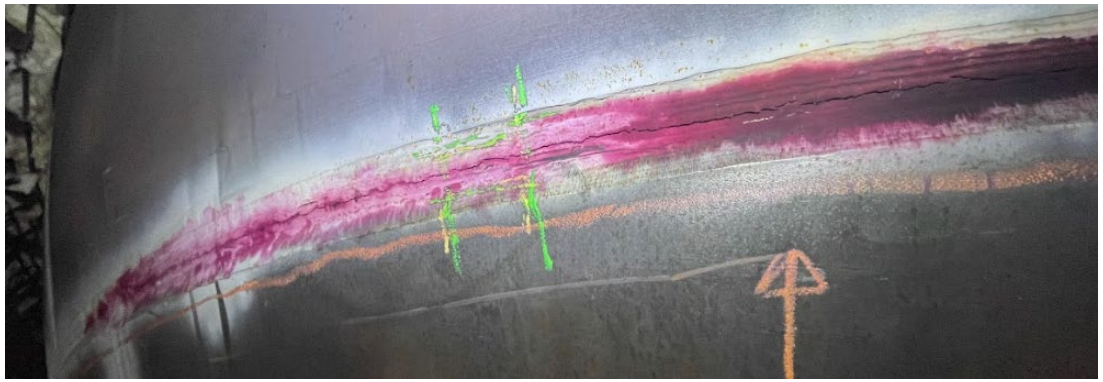


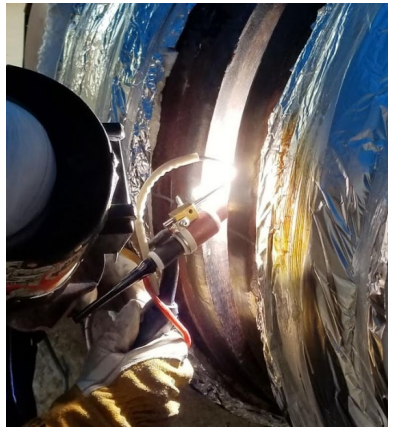
Let's Talk about the Welders

- What is the experience and skill level of the welder(s)?
- How many welders on the job… at the same weldment?
- What is the vibe of welders?

Are all personnel aware of the scope… does it make sense?

So, what about those WPS, PQR and WPQs?





The Approach Matters

PRACTICAL APPROACHES FOR
SUCCESSFUL PRODUCTION WELDING

FROM THIS

MEANINGFUL
APPLICATION

BEAD
SEQUENCING

TO THIS

Heat Input

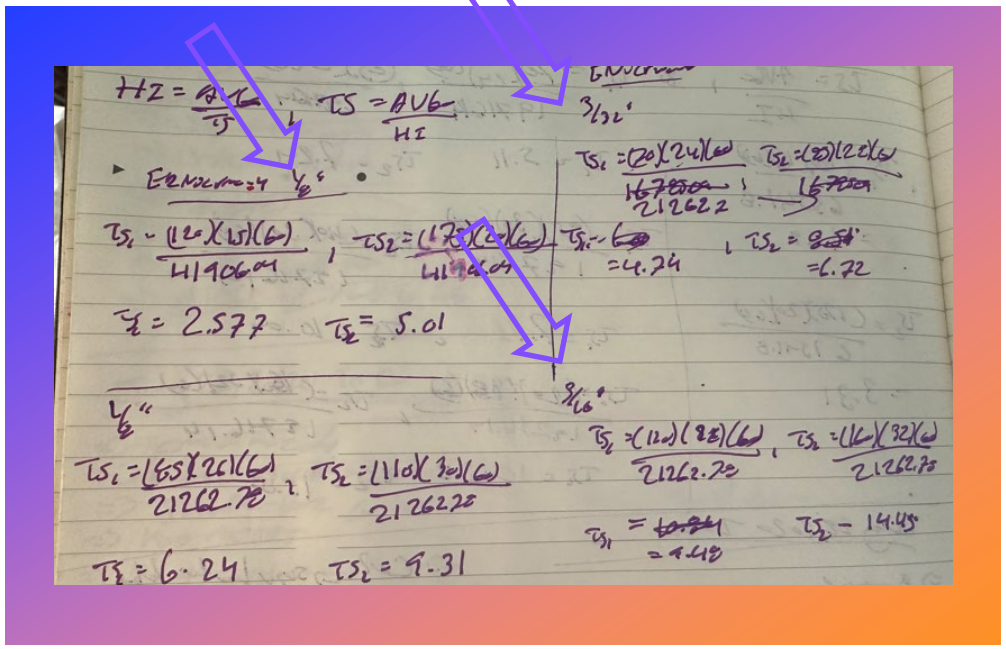
Is the heat input important?

How do we know when it is important?

- Supplementary Essential Variables invoked – toughness is a factor
- Some critical repairs
- Temper bead/controlled deposition welding

ASME IX Sec. 409.1 (a)

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



Heat Input, Practically

- What size of consumable is being used?
- Do we know?
- Are there multiple sizes?
- How does size affect heat input?
- How do we really get the heat input desired?

REV320

Pinnacle Alloys

ISO 9001:2015 REGISTERED
Certificate No.: 50040 & 50415

TYPICAL DEPOSIT COMPOSITION:

	AWS Spec	Weld Metal Analysis (%)
Carbon (C)	0.15	0.07
Chromium (Cr)	0.20	0.03
Manganese (Mn)	1.60	0.87
Molybdenum (Mo)	0.30	0.01
Nickel (Ni)	0.30	0.02
Phosphorus (P)	0.035	0.015
Silicon (Si)	0.75	0.61
Sulfur (S)	0.035	0.011
Vanadium (V)	0.08	0.01

NOTE: Single values are maximums.

TYPICAL MECHANICAL PROPERTIES:

Plastic Packaging (5# &10#)	AWS Spec (min)	As Welded
Ultimate Tensile Strength	70,000 psi (490 MPa)	82,000 psi (570 MPa)
Yield Strength	58,000 psi (400 MPa)	69,000 psi (480 MPa)
Percent Elongation in 2"	22%	30%
CVN @ -20°F (-30°C)	20 ft•lbf (27 Joules)	52 ft•lbf (70 Joules)

TYPICAL WELDING PARAMETERS:

Diameter	Type of Current	Amperage	Deposition Rate (lbs/hr)	Amperage Range	Voltage Range
3/32"	**DCEP or AC**	**85**	**1.8**	70-100	20-24
1/8"	**DCEP or AC**	**100**	**2.6**	90-130	24-28
5/32"	**DCEP or AC**	**150**	**3.9**	130-200	26-30
3/16"	**DCEP or AC**	**225**	**5.2**	200-250	27-31

NOTE: Optimum conditions are in boldface type. For out of position welding, decrease amperage by 15%. These values were calculated using optimum parameters and DCEP polarity. Allowance made for 2" stub loss. Maintaining a proper welding procedure, including pre-heat and interpass temperatures, may be critical depending on the type and thickness of steel being welded.

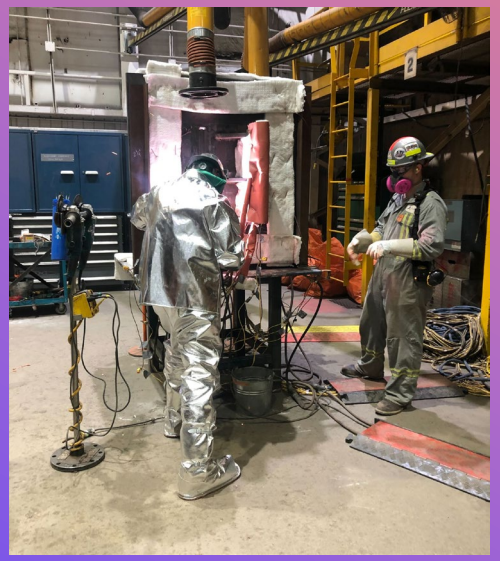
http://www.pinnaclealloys.com/products/

Heat Treatment

PRACTICAL APPROACHES FOR
SUCCESSFUL PRODUCTION WELDING

PREHEAT

Application of heat to the base metal immediately before welding



INTERPASS

The temperature in the previously deposited weld metal or adjacent base metal immediately before the next pass

PWHT

Application of heat subsequent to welding

SOLUTION ANNEAL

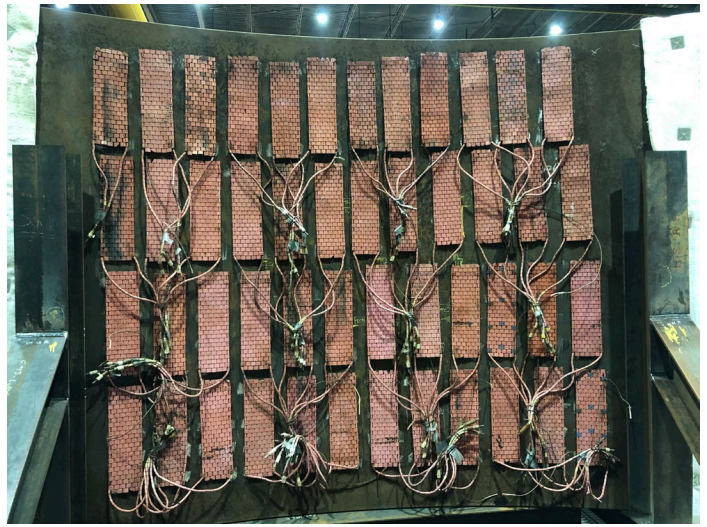
A Heat treatment service which alters the metallurgical structure of a material to change its mechanical or electrical properties.

Heat Treatment Methods

Flame

Induction

Electric Resistance



Summary

What are the intentions of the weldments?

- Codes, standards, recommended practices, services, etc.

Where is the welding taking place?

- Shop, field, internal, external, climate conditions, etc.

What welding process is being used?

- SMAW, GTAW, SAW, GMAW, FCAW, etc.

Do we care about heat input?

- Toughness concerns, remember how to communicate this!

What heat treatment is needed and what method is being used?

- Preheat, interpass, PWHT, solution anneal

Have y'all talked to the men and women doing the welding and other involved parties?

- Vibes matter!

The way to get started is to quit talking and begin doing.

~ Walt Disney

THANK YOU

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