Dissimilar Weld Decision Matrix

Procedure

1. List information for Material A & B columns and identify similarities and differences.
2. List details for a proposed weld metal. If a proper transition of properties or repair scenario cannot be done, consider buttering one or both materials or use a pup or transition piece.
3. A transition piece is usually required when substantially different material strengths or PWHT/lower critical transition temperatures are involved.
4. Buttering is oftentimes used when joining two materials of substantially different properties such as a CrMo to Stainless Steel.
5. When all the materials and details are listed above, review will either suggest that design, operation and fabrication or installation goals have been achieved or that a different approach is required.

	Material A	Butter	Pup or Transition	Weld Metal	Butter	Material B
Alloy						
P or A No,						
Thickness						
Yield, RT						
Coef Exp						
Lower Critical Trans. Temp.						
Operating Temp						
Yield Stress						
Allowable Stress						
Creep Range						
Toughness						
Corrosion						
Groove Geometry						
Restraint						
PWHT, Code						
Temp						
Time						
Restrictions						
Strain/Bending						
Carbon Migration						
Sensitization						
Hardness						

Definitions: Intent for the technical details are as follows:

- Alloy: ASTM, ASME, AWS, ISO, EN, designation for the alloy or weld metal.
- P-No. or A-No.: Designation assigned per ASME IX.
- Thickness: Thickness of weld metal. Sharp transitions should be considered.
- Yield, RT: Room Temperature yield strength.
- Coefficient of Expansion: Behavior at operating temperature.
- Lower Critical Transformation Temperature: Also referred to as the AC_1. PWHT should not exceed this value.
- Operating Temperature: System design operating temperature.
    a. Yield Stress: Yield stress at design operating temperature.
    b. Allowable Stress: At operating temperature, per ASME Section II, Part D or other applicable code.
- Creep Range: Is the material operating in it's creep range? If not, then alternate considerations may apply.
- Toughness: Is ductility needed during startup or shutdown or code?
- Corrosion: Will the choice of weld metal or transition materials impact corrosion considerations?
- Groove Geometry: Are welding process chosen and access to the groove affected?
- Restraint: Geometry will affect restrain which will affect issues such as crater and root cracking.
- PWHT, Code: ASME I, PW-39 or ASME B31.1, etc.
    a. Temperature: Code required temperature
    b. Time: Code minimum versus actual
- Restrictions
    a. Strain/Bending: Will PWHT have an adverse effect on material that has been strained?
    b. Carbon Migration: Given time and temperature, may be an issue.
    c. Sensitization: An issue where austenitic stainless steel involved.
    d. Hardness: Normally limited to weld metal or heat-affected zone where stress corrosion cracking is an issue.