Step Cooling Test; 2 1/4-3Cr (API RP934)

To evaluate temper embrittlement

Total 15 Days (Net)
Step Cooling Test Specimens (API RP934)

- 48 Impact specimens - each set of test specimens at 8* selected test temperatures/ 3 specimens at each test temperature (at least 2 temperatures <@-20°F < at least 2 temperatures/ min. 4 intermediate test temperatures)
  * 5~8 in some company spec.

- 24(min.) at Minimum PWHT to Establish Transition Curve before Step Cooling

- 24 (min.) at Minimum PWHT PLUS Step-Cooling to Establish Transition Curve

- Establish 40 ft-lb (55J) Transition Temperature
Step Cooling Test Result: 2 1/4-3Cr (Example)

Before Thermal Cycling (Welded + min. PWHT) (High Toughness Condition)

After Thermal Cycling (Welded + min. PWHT + Step Age) (Decreased Toughness)

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Image of a graph showing the impact energy vs. test temperature for submerged-arc welding, indicating changes before and after thermal cycling.
Step Cooling Test Result (Example)

**CvTr40 + 2.5ΔCvTr40 < 50°F (10°C), where**

- **CvTr40** = 40 ft-lb (55J) transition temperature (T1 = -63°F) of the base metal subjected to minimum PWHT only.
- **CvTr40** = the shift of the 40 ft-lb (55J) transition temperature (T2 = -49°F) of material subjected to minimum PWHT plus step cooling heat treatment.
- **ΔCvTr40** = the shift of the 40 ft-lb (55J) transition temperature (T2-T1) of material subjected to minimum PWHT plus step cooling heat treatment.

Example, 

-63 + 2.5 x (-49 - (-63)) = -28°F < 50°F --- OK

Or T2 ≤ 20 + 0.6T1 @ 40 ft-lb (55J) in °F

-49°F ≤ 20 + 0.6x(-63) = -18°F ------ OK