Induction Heating Technique for Cold Pre-Heating and Post Curing of Liquid Epoxy Coatings on Gas Pipeline Girth Welds

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Typical PG&E Girthweld Coatings Application

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Typical Cold Weather Coatings Example

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Industry Findings

- Companies who regularly require cold weather applications use pipe preheat solutions and standard coatings. Induction, propane, infrared, environmental change are commonly used.
- Research indicates that epoxy coatings can not be used for cold cure (not suitable for <50^{o}F)
- Research indicates cold cure vinyl ester coatings are only used as a last resort when preheat is not feasible.

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Preheating Techniques

- Research indicates numerous permutations and combinations of induction, propane, infrared, and environmental change are used by different companies based on differing geo areas, climate, and pipeline installation programs.
- Research indicates induction has high quality control and reasonable cost.
- Induction preheating is considered optimum for PG&E.

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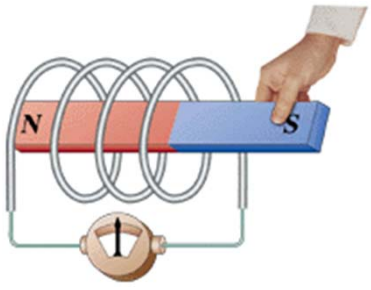
Technology Overview

What is Induction Heating?

- The process of heating an electrically conducting object (such as a metal) by electromagnetic induction
- “Eddy” currents are generated within the metal and resistance leads to heating



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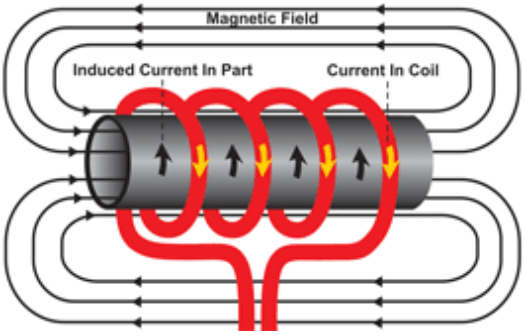
Technology Overview

- Eddy currents flow against the electrical resistivity of the metal, generating precise and localized heat
- Heating does not require any direct contact between the metal and the inductor



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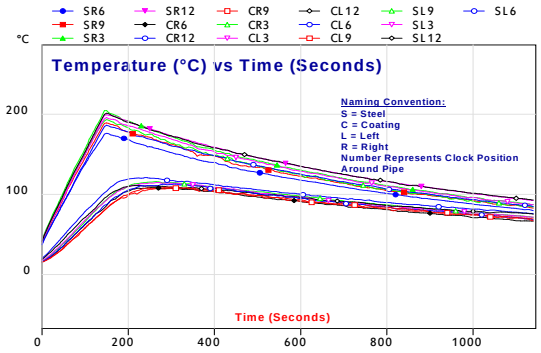
Key Advantages

1. Fast, accurate, consistent, reliable and cost effective
2. Uniform and localized heating over a controlled bandwidth and around the full pipe circumference
3. Removal of operator error from vital pre-heat step of field joint coating
4. Precise control over temperature/time parameters
5. Faster temperature rise over torch heating leading to increased productivity



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Induction Heating System with Coils

Induction Heating Coils

- Generates the alternating magnetic field to pre-heat the pipe cutback surface
- Important Aspects:
  - Heating width
  - Diameter
  - Clamp design
  - Minimal ground clearance requirements

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Cold Weather Pipeline Project

- **Pre-heat requirement:** 90°C
- Why induction heating was used:
  - Overcome pre-heating challenge at such low operating conditions
  - Ensure full heat penetration onto the steel surface

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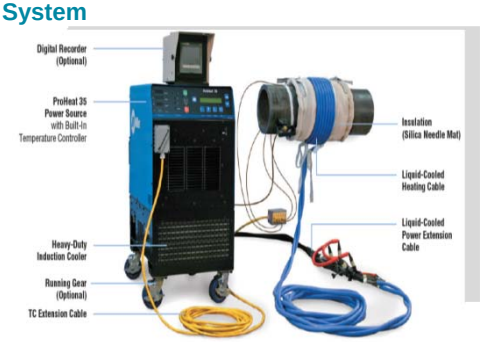
Induction Heating System with Blankets

ProHeat 35 Induction Heating System

MANUFACTURER/SUPPLIER

Miller Electric Mfg. Co. An ITW Company
5730 Technology Cir.
Appleton, WI 54914
www.MillerWelds.com



DESCRIPTION

The Air-Cooled Induction Heating System is specifically designed for preheating applications up to 400° Fahrenheit (204° C). The system can be operated in the Manual Programming mode where a power output is applied to a part for a specified time or in the Temperature Based Programming mode where part temperature is used to control power output. Air-cooled blankets are available for pipe diameters from 8–60 inches (20–152 cm) or in the case of plate, the lengths are 41–205 inches (1–5.2 m). A disadvantage of the system is that the blanket contacts the pipe surface and may get the surface dirty, so some degree of blasting or other cleaning may be required after heating.

Availability: TBD

Rental: TBD

Operating Costs & Considerations: Requires 480V 3ph, power (generator)

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TESTING OF INDUCTION BLANKET HEATING SYSTEM AT PG&E LABORATORY

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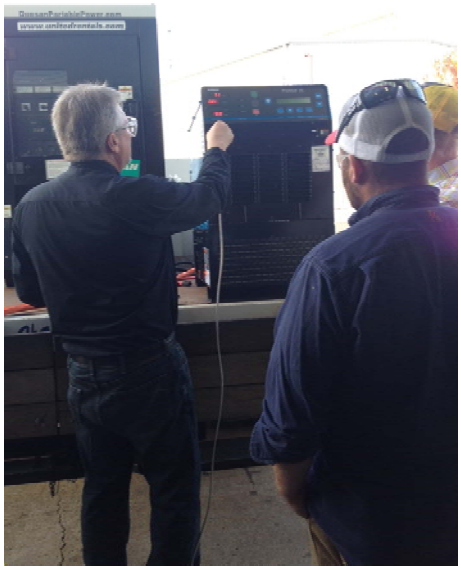
WARNING



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Results

- Cold weather coatings system selected is induction preheating using the Miller Blanket Induction System modified for PG&E use.
- Existing epoxy coatings to be used with induction preheating system.
- Used as pilot program for cold weather coatings application Winter 2014-2015.
- Cold weather coatings inspection form written

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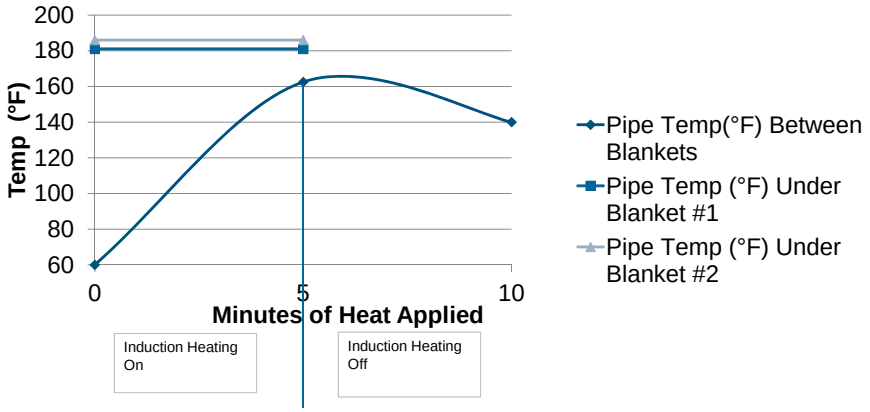
Pipe Temp. Profile with 3 Inches between Induction Blankets



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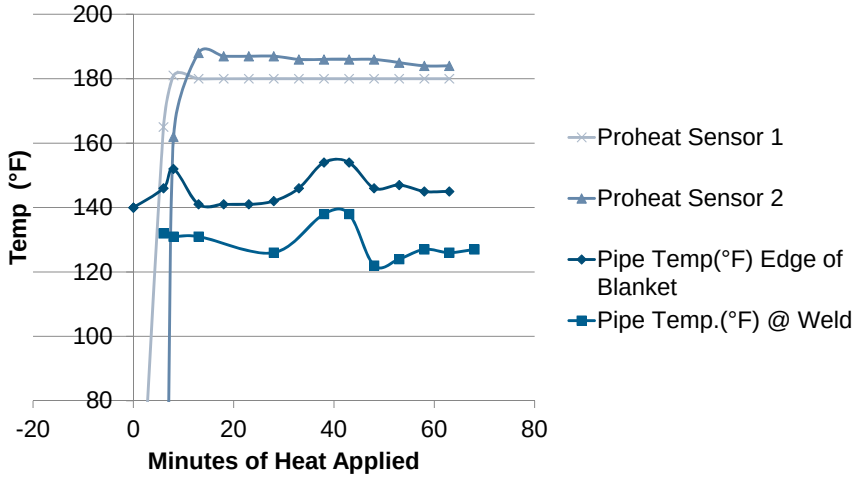
Pipe Temp. Profile with 11 Inches between Induction Blankets



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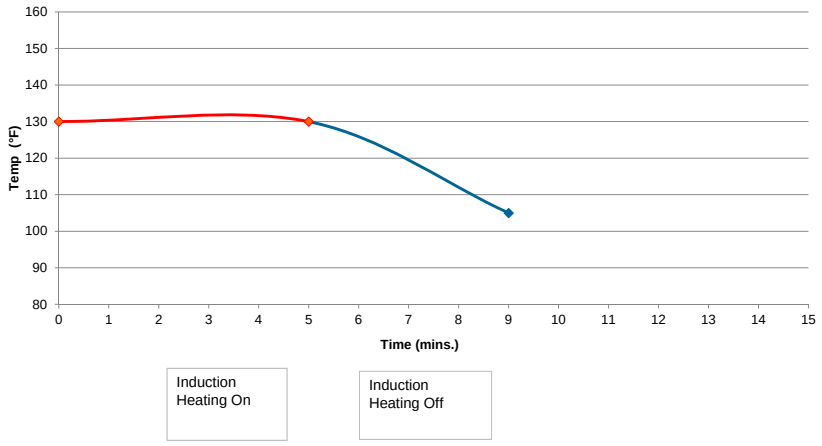
Pipe Temp. Profile Between Induction Blankets During Blasting Process on 24” Pipe



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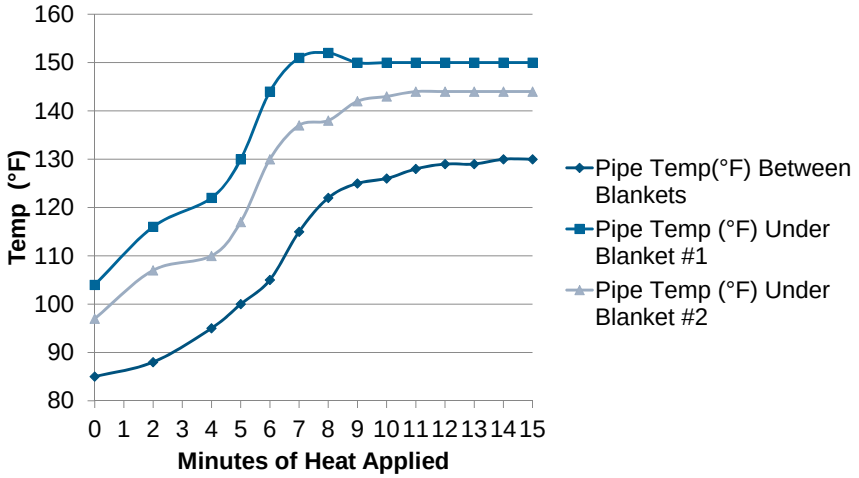
24” Pipe Temp. Profile with 3 Inches between Induction Blankets



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