HIGH-TEMPERATURE MAGNETOSTRICTIVE SENSOR INSTALLATION PROCEDURE

The following is a procedure that was developed during the qualification of the magnetostrictive sensor (MsS) technology for high-temperature applications. These instructions cover bonding of the MsS strips to a pipe, but not installation of wire coils over the strips. These instructions reference the use of Aremco-Bond 570 as the applied epoxy, and include the recommended cure temperatures and times provided by Aremco Products, Inc. For other epoxies, adjust the procedure accordingly.

(1) Clean the surface of the pipe where the FeCo strips will be bonded. Be sure that the pipe surface is free of rust, dirt and moisture before applying the strip.

(2) Mix the approximately 16 grams of Aremco 570 epoxy for each meter of MsS strip in a disposable cup. A minimum of 20 total grams of epoxy (resin and hardener) should be mixed at any one time to ensure the parts are mixed in appropriate proportions.

(3) Lay the FeCo strip on a flat surface and apply approximately a 0.5-mm coating of the mixed epoxy to the entire inner surface of the strip.

(4) Lift the FeCo strip off the flat surface, rotate the strip so that the epoxy side is toward the pipe surface, and apply the strip to the pipe, ensuring that a gap of about 3-mm remains between the two ends of the strip and that the leading corners of the strip ends are flush with each other. (See Figure 1).

(5) Secure the strip to the pipe with a metallic hose clamp. (See Figure 2). Wipe off any excess epoxy.

(6) Wrap a heating pad (Watlow) around the pipe over the strip. Secure the pad to the pipe with the supplied ties to ensure contact around the full circumference of the pipe. (See Figure 3).

(7) Wrap a 60-cm piece of insulating material (Unifrax, Durablanket-S 8#) around the pipe with the insulation centered over the heating pad. Secure the insulating material to the pipe with wire.

(8) Heat the MsS sensor, epoxy (Aremco 570), and surrounding material to 82°C and allow the epoxy to soak the heat for 18 minutes. Then, increase the temperature to 177°C and allow the epoxy to soak for another 12 minutes. After heat treatment,

allow the pipe to cool to ambient temperature before removing the insulating material. A varistor was used to regulate the power to the heating pad.

(9) After the proper curing has been accomplished, remove the insulation and the heating pad. Loosen the hose clamp and slowly separate the clamp from the pipe, pulling away from the strip. Do not pull the clamp in a shear direction to the MsS strip.

(10) Inspect the entire contact surface of the MsS strip to ensure no gaps formed between the pipe surface and the strip. Magnetize the strip by rolling a magnet over the strip at a steady rate, with the north-to-south pole axis of the magnet aligned along the strip length.

(11) Place a ribbon cable over the bonded FeCo strip and ensure that the bond is good by looking at the MsS signal. Figure 4 shows a signal taken with a ribbon cable on the 4-inch pipe with a properly bonded MsS sensor.

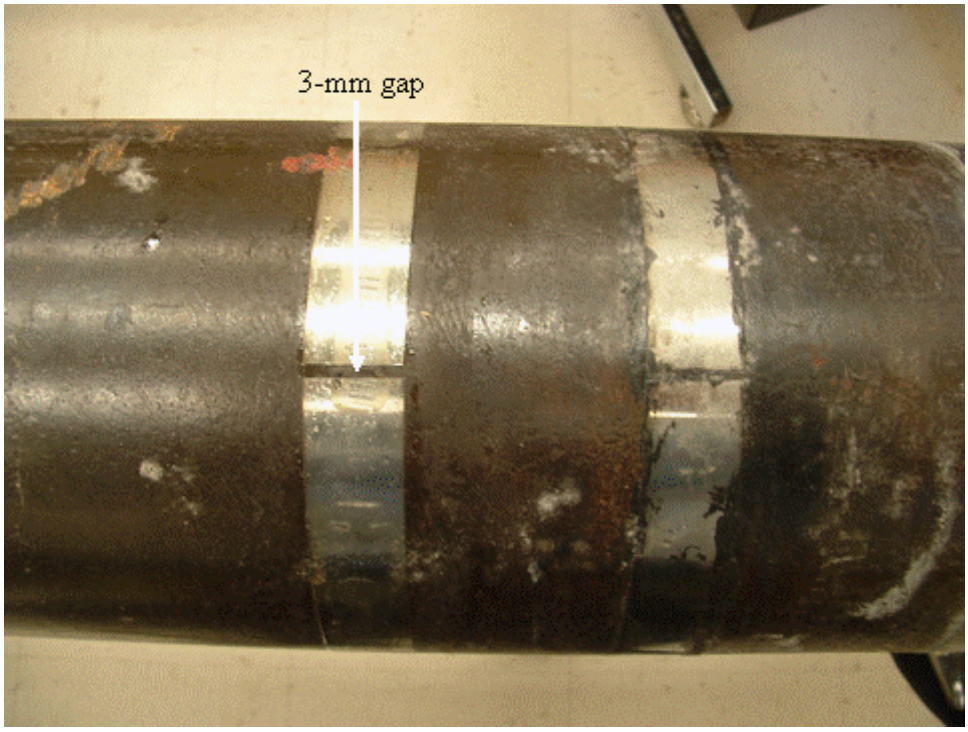

Figure 1. Photograph of properly applied MsS strip. The corners of the strip are flush with each other and a 3 mm gap remains between the ends.

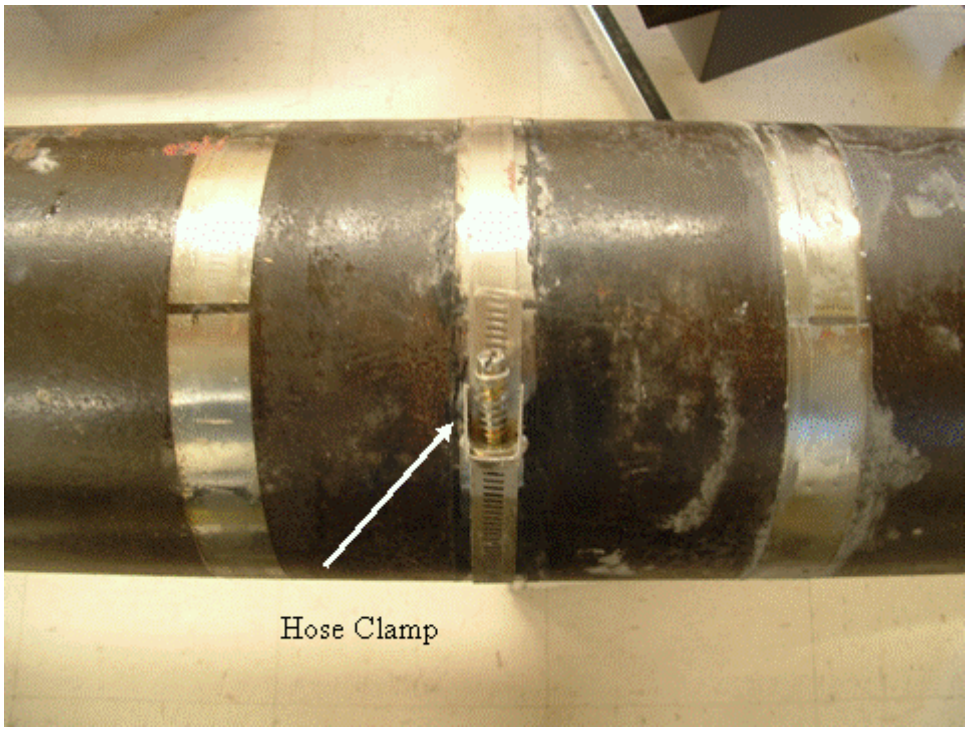

Figure 2. Photograph of the MsS strip secured with a hose clamp for heat treatment

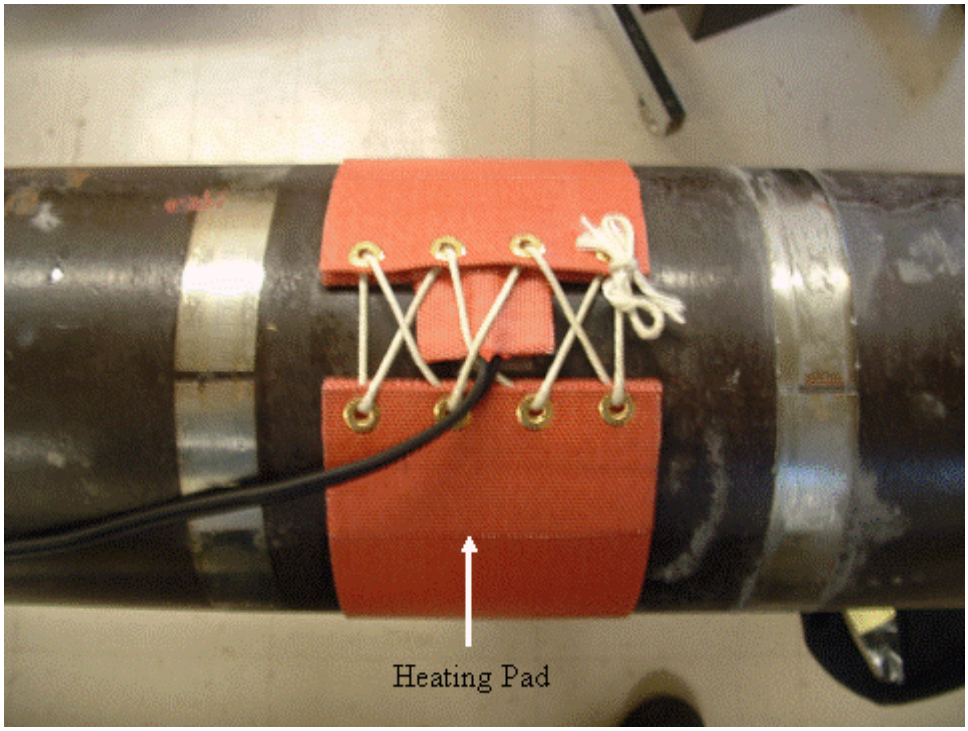

Figure 3. Photograph of MsS strip wrapped in Watlow heating pad

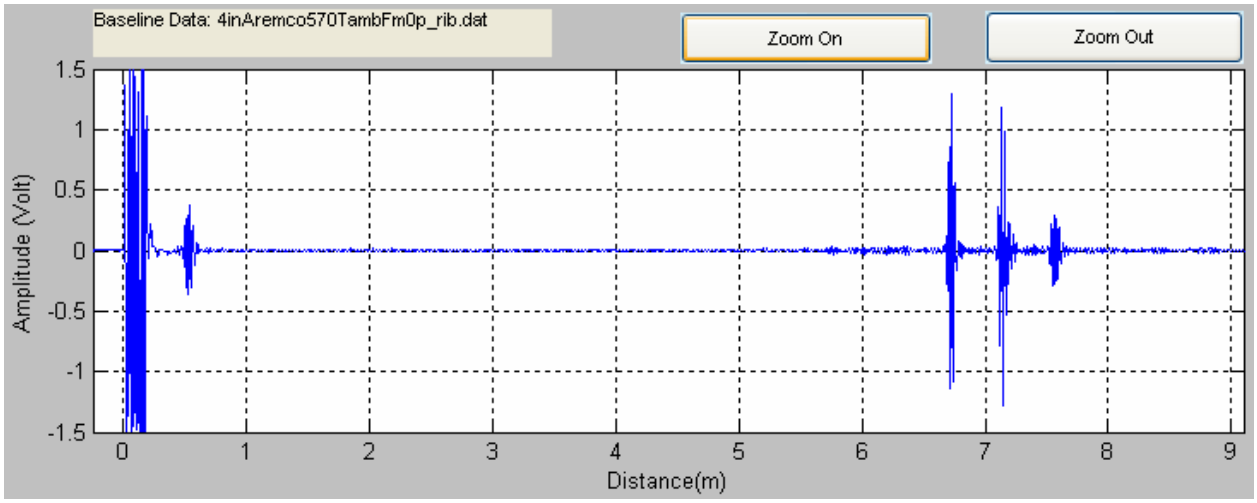

Figure 4. Sensor quality inspection data taken on the 4-inch pipe with the sensor bonded with Aremco 570. Minimal noise is returned from the pipe and the end wall indications are narrow, showing no ringing.