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Subject: **GC-13006**
Tools and Procedures to Characterize Type 2 Aluminized Steel
Corrugated Steel Pipes in Service

Kelly,

The objective of this summary is to provide some guidance to our Type 2 Aluminized customers so that they are better equipped to characterize a project's condition. Locally generated information can be provided to engineers responsible for establishing material specifications. Providing guidelines to our customers to characterize older projects in their geographic regions will add sources of data supporting the product. This report is composed of three sections: tools, calibration, and procedures. These procedures should be made available to our customers and the NCSIPA (National Corrugated Steel Pipe Association). The NCSIPA is compiling inputs for this activity and portions of this will likely be incorporated into their more generic pipe assessment recommendations. This information is not intended to supplant the safety protocols of the NCSIPA or a customer. These are general procedures based on AK Steel's experience.

TOOLS

This list could vary depending on the scope of the assessment. For instance, if the objective is only to show the remnant pipe thickness, this list could be reduced to the first seven items.

- 1) Project inspection notebook – recommend a permanently bound book with numbered pages that is used only for on-site comments, raw data collection and site location information.

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AK Steel Corporation

March 13, 2013

Page 2

- 2-5) Ultrasonic thickness gauge and coupling gel, scotch-bright pads, paper towels
NCSPA uses Check Line's TI-25M (approximate cost \$1500) to measure total pipe wall thickness.
- 6) Representative reference coupon(s) - see section on calibration.
- 7) Digital Camera
- 8) Check Line's DCF 3000FX (approximate cost \$1200) coating thickness gauge is used to approximate the thickness of non-magnetic coatings on ferrous substrates. This is not a calibrated instrument; it only measures and compares water-side metallic coating thickness. A useful comparison results when performed near the invert (corroded or abraded) and the crown (assumed to be pristine).
- 9) Quart size zip-loc freezer bags for representative soil samples
- 10) 250 ml sample bottles for water samples
- 11-13) Shovel, Garden Spade, and sickle
- 14) Water Test Kit: pH test strips (range 2 to 11), free-chlorine test strips (both 120 or 750 ppm max), total alkalinity test strips (up to 400 mg/liter), can be obtained for less than \$100
- 15-18) Waterless hand sanitizer, insect repellent, bottled water and paper towels
- 19-26) If you plan to cut core samples from the pipes, you will need:
 - 18V (or stronger) cordless drill,
 - 1.5" diameter hole saw(s),
 - 1/4" drill bits,
 - center punch,
 - hammer,
 - spare battery pack,
 - charger,
 - power inverter that plugs into a cigarette lighter.

Site inspection experiences may modify this list.

CALIBRATION

A reference coupon of Type 2 that is comparable in thickness to the pipe being inspected is helpful. Most projects are made of 16, 14, 12 or 10 gauge material or 0.064", 0.079", 0.109" or 0.138" nominal thickness, respectively. A flat-head micrometer that has been calibrated using standards that are traceable to NIST should be used to measure the

March 13, 2013

Page 3

thickness of the reference coupons. This thickness, scribed onto the coupon, can then be used to verify the ultrasonic thickness gauge in the field prior to each use. The reference coupons should be sheathed to protect them from abrasion or rough handling and carefully packed along with the ultrasonic thickness gauge. Enter data and comments referencing field calibration results into the project inspection notebook.

PROCEDURES

To measure the remaining pipe thickness after a number of years of service, enter the title and location of the project via map, GPS, or driving instructions in the inspection book. Try to use landmarks and details that will survive the test of time.

The ultrasonic thickness gauge should be field calibrated (inspection notebook entry) and the surfaces to be measured should be wiped clean of debris, thus allowing firm steady contact with the probe head and the pipe surface. Gentle repetitive rubs with a scotch-bright pad will easily remove any crust or debris from the metallic coating, then wipe clean with a paper towel.

Photograph the freshly cleaned metallic coating at/near the invert to document the coating condition.

Take digital images documenting the project's location, and thickness testing positions.

Record multiple total thickness readings at/near the crown and at/near the invert. A minimum of three readings is sufficient if there is reasonable agreement (less than 0.002" or 50 microns variation between the highest and lowest reading).

If the corrugations are annular, then thickness testing should be on the flatter upstream portion of the annular corrugation. If the pipe is spiral rib, then the large flat regions should be representative.

In the inspection notebook, write down the condition of the upstream-facing edge of the spiral ribs; whether abraded, pitted or smooth. Record these observations and ultrasonic thickness readings and average this raw data in the inspection notebook. Take digital images to support the comments recorded.

The crown of the pipe is assumed to represent the pipe's original thickness. The difference between the average thicknesses (crown vs. invert) would represent the material consumed during service.

If the surfaces at the invert and crown have aluminized coating intact, and the invert is dry, use the DCF-3000FX to **compare** the thickness of the metallic coatings on the water

March 13, 2013

Page 4

side of the pipe. Several rubs with a scotch-bright may be needed to remove buildup on the coating near the invert to determine if metallic coating remains.

Water (if available) and soil samples should be collected and labeled by site. One soil sample should be representative of the backfill in contact with the soil side of the pipe, if soil/sediment is present in the invert this should be sampled as well and labeled accordingly. These samples should be submitted to an independent lab with the credentials to test the soil and water for pH, resistivity (units: ohm-cm) and test for the presence of sulfates (ppm) and chlorides (ppm).

Field testing the water can be done using test strips available online. Free chlorine, pH range 2 to 11, total alkalinity should be sufficient. Record results in the inspection book.

If the inspector plans to procure coupons, the following instructions are subordinate to normal safety procedures that govern work involving power tools at remote locations outlined by the inspector's employer.

Select a representative location as near to the invert as possible/practical. Use the hammer and center punch to designate a starting point to drill. If the pipe is annular, select a peak, if it is spiral rib, select a flat adjacent to the rib in order to represent that portion of the spiral rib that faces upstream.

Drill a 1/4" hole first, then replace the 1/4" drill bit with a hole saw equipped with a solid center shaft having 1/4" diameter. This technique will prevent breaking drill bits in the hole saw while drilling cores in steel pipe. This two-stage practice may seem time consuming, but changing broken drill bits on a hole saw or running out of drill bits in the field is much more time consuming.

Remove the core from the hole saw, label the downstream portion and insert in a labeled bag. These cores can be measured, photographed and mounted metallographically to assess the condition of the metallic coating.

AK Steel Research has mounted metallographic sections that customers have submitted in order to characterize the pipe and coating condition at the location of the core. If necessary, clues regarding failure modes or corrosion products can be gathered and summarized in a brief report.

SUMMARY

The outlined procedures should be performed objectively such that an independent observer could repeat the same steps and arrive at comparable conclusions. These summaries should be beneficial for promoting Aluminized Type 2 CSP because the data

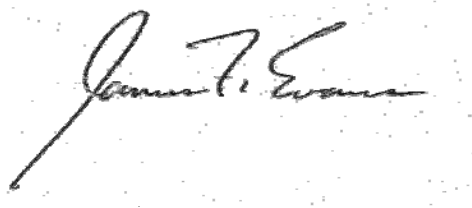
AK Steel Corporation

March 13, 2013

Page 5

collected is from sites with more regional significance or environmental relevance to the owners and engineers responsible for establishing project material specifications. If pipes experience premature failure, then the information gathered can help establish the failure mode and expedite problem solving activities.

Sincerely,

A handwritten signature in black ink, appearing to read "James F. Evans". The signature is written in a cursive style and is surrounded by a faint, dotted rectangular border.

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REFERENCE

50 year Durability Study for Aluminized Type 2

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