IMPACT STUDY: DETERMINING CORROSION RESISTANCE BY EVALUATING PHYSICAL DAMAGE TO LININGS FOR DUCTILE IRON PIPE. MODIFIED ASTM 2497*

The film strength and adhesion properties of linings for ductile iron pipe are directly correlated to the success of protecting the interior pipe wall for the life of the pipe in sewer service. In aggressive sewer service, any exposed areas in the pipe lining caused by pipe deflection, over-homing, or damage during shipping will result in corrosion to the pipe wall. The oxide layer in ductile iron pipe created by the annealing process is a valuable asset when combined with Protecto 401's ability to prevent undercutting. Protecto 401 achieves an unparalleled level of protection by working in conjunction with the oxide layer.

Many linings have been tried in the past that called for a surface prep to "fully remove the oxide layer", or in steel surface prep terminology, "white blast" of the surface (SSPC SP 5, ISO SA 3, NACE 1, etc.). None of these surface prep standards are designed for ductile iron pipe. In fact, as a result the annealing process, the oxide layer of ductile, which has it's own measureable film strength, is integral to the pipe wall and cannot be completely removed in a repeatable manner from pipe to pipe. As a result, linings that do not take the oxide layer into account will fail. Deflection and impact occur from normal shipping, handling, installation, and buried service. If a lining shows undercutting or delamination from impact, the "lifting" mechanisms of corrosion (with a PSI of 1200-1400lbs) will continue to delaminate the lining and completely expose the interior pipe wall. Exposure of the bare pipe wall will result in corrosion failures in a sewer system over time.

In the following study, one each were used of both Protecto 401™ lined and Series 431 lined coupons cut out of production run, ductile iron pipe. The panels were all reverse-impacted (struck on the opposite side from the lining) with an impact hammer apparatus designed for a modified version of ASTM 2794. The strikes are intended to deflect the coupon so that the lining is severely compromised with a striking force of 1,344 in/lbs. The test was performed repeatedly on six coupons of each lining. All coupons exhibited the same results reported below. The lining was applied by an applicator approved by each lining manufacturer using the specification for each product. TESTING DATED 10/28/13

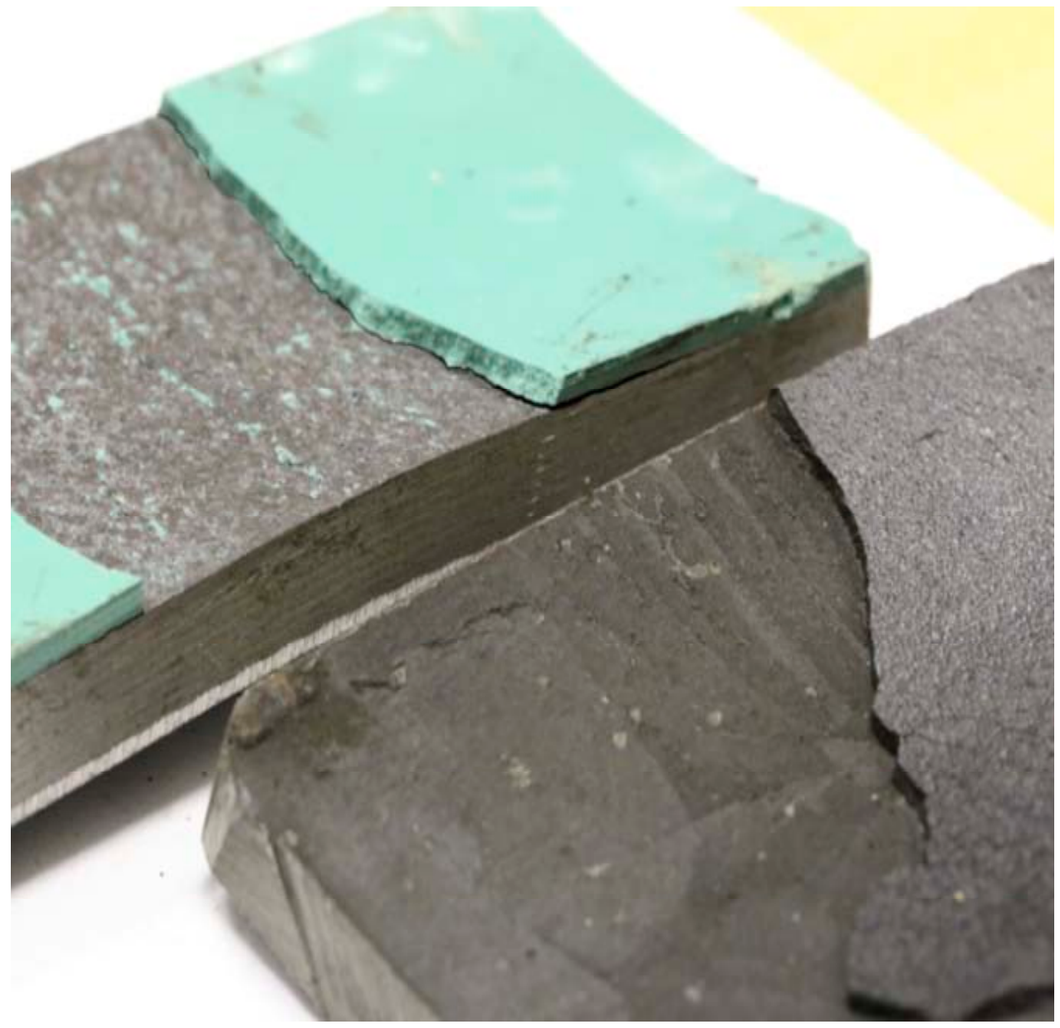
IMPACTED PANELS: SIDE-BY-SIDE COMPARISON- SERIES 431 and PROTECTO 401™

Ceramic Epoxy

COUPONS CUT FROM PRODUCTION-RUN DUCTILE IRON PIPE

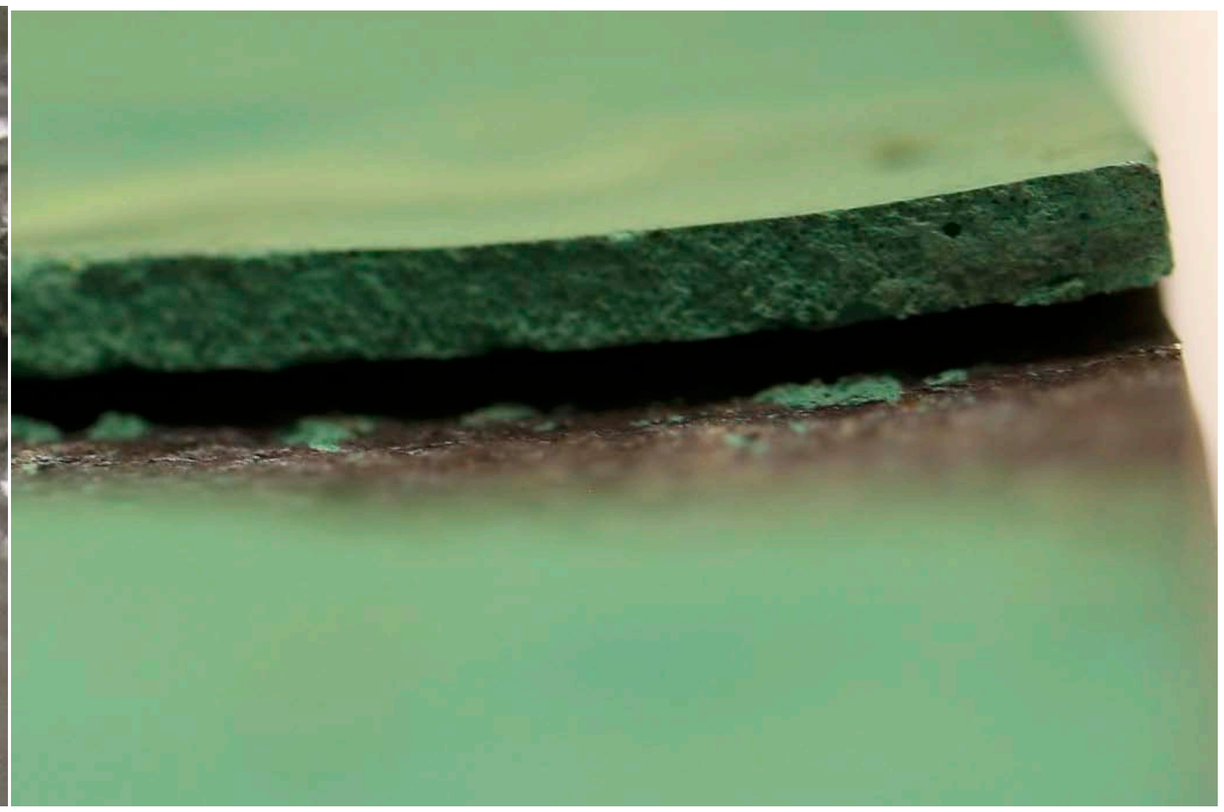
SERIES 431 (GREEN)	PROTECTO 401 (BLACK)

IMPACTED PANELS: SIDE-BY-SIDE COMPARISON



TOP LEFT PANEL: IMPACTED SERIES 431- EXPOSED METAL-OXIDE LAYER IS BROKEN AND NO FILM IS LEFT ON THE SURFACE	BOTTOM RIGHT PANEL: IMPACTED PROTECTO 401-PROTECTIVE FILM LEFT ON THE SURFACE

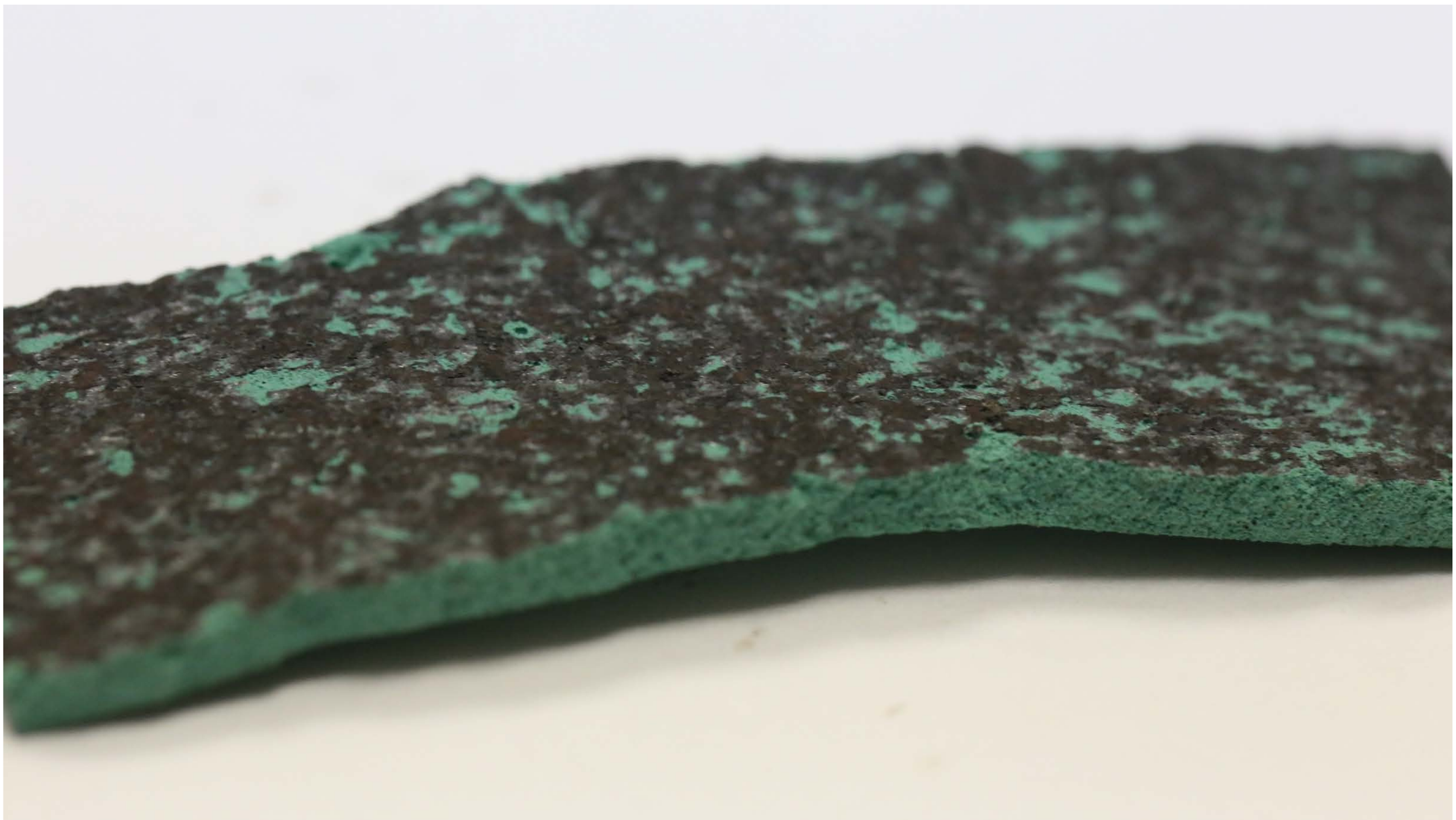
IMPACTED PANELS: UNDERCUTTING RESISTANCE



PROTECTO 401™: ZERO UNDERCUTTING AFTER IMPACT. **LINING IS LEFT ON SURFACE- CORROSION CANNOT LIFT THE LINING.**	**SERIES 431: UNDERCUTTING AND DELAMINATION FROM BROKEN OXIDE LAYER AFTER IMPACT.** **CORROSION WILL LIFT THE LINING AND CONTINUE TO DELAMINATE FURTHER.**

IMPACTED PANELS: OXIDE LAYER DAMAGE RESULTS

SERIES 431 PANEL: EXPOSED PIPE WALL (ABOVE).



SERIES 431 PANEL: BROKEN METAL OXIDE ON THE BACK SIDE OF THE GREEN DELAMINATED CHIP.

SERIES 431 POST IMPACT: DELAMINATED CHIP ON THE LEFT, EXPOSED PIPE SURFACE ON THE RIGHT. NOTICE THE DELAMINATED CHIP ON THE LEFT HAS BROKEN THE METAL OXIDE ON THE INTERIOR OF THE PIPE. THE METAL IS CLEARLY VISIBLE ON THE BACK OF THE DELAMINATED CHIP.

PROTECTO 401 POST IMPACT:

PROTECTO 401™ PANEL: WORKING WITH THE OXIDE LAYER- LINING REMAINS ON THE SURFACE PROTECTING THE IMPACTED AREA.

IMPACTED PROTECTO 401™: THE METAL SURFACE IS NOT EXPOSED. PROTECTO FILM (AND THE OXIDE LAYER) REMAINS ON THE SURFACE OF THE PIPE INTERIOR. PIPE SURFACE IS PROTECTED.

- **EXPLANATION OF *MODIFIED ASTM 2794 STANDARD TEST METHOD FOR RESISTANCE OF ORGANIC COATINGS TO THE EFFECTS OF RAPID DEFORMATION***

There are several parameters of the ASTM 2794 that must be modified to test linings for reverse impact on production-run Ductile Iron Pipe samples:

1. **Section 4.1 calls for "thin steel panels" for the test. Linings on steel will not react like they do on DI Pipe samples due to the difference in oxide layers.**
2. **Section 6.1.1 calls for the tube housing to be 24 to 48". The tube used in this impact apparatus is 64" due to the force required for deformation of the ductile iron coupons.**
3. **A 24lb weight is used in the apparatus falling from 56" to achieve the required force necessary for deformation.**
4. **The ductile iron pipe coupons used were from production run pressure class 350 8" pipe.**