Solutions Brochure

MacLean™ POWER SYSTEMS

MPS BIAXIAL COMPRESSION SEAL

GENERATION 2

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Sustainable Solutions

04 Composite Insulator End Fitting Seal Improvement

05 Purpose Behind the New Seal

07 PST Sealing System

08 Sealing Interface Comparison

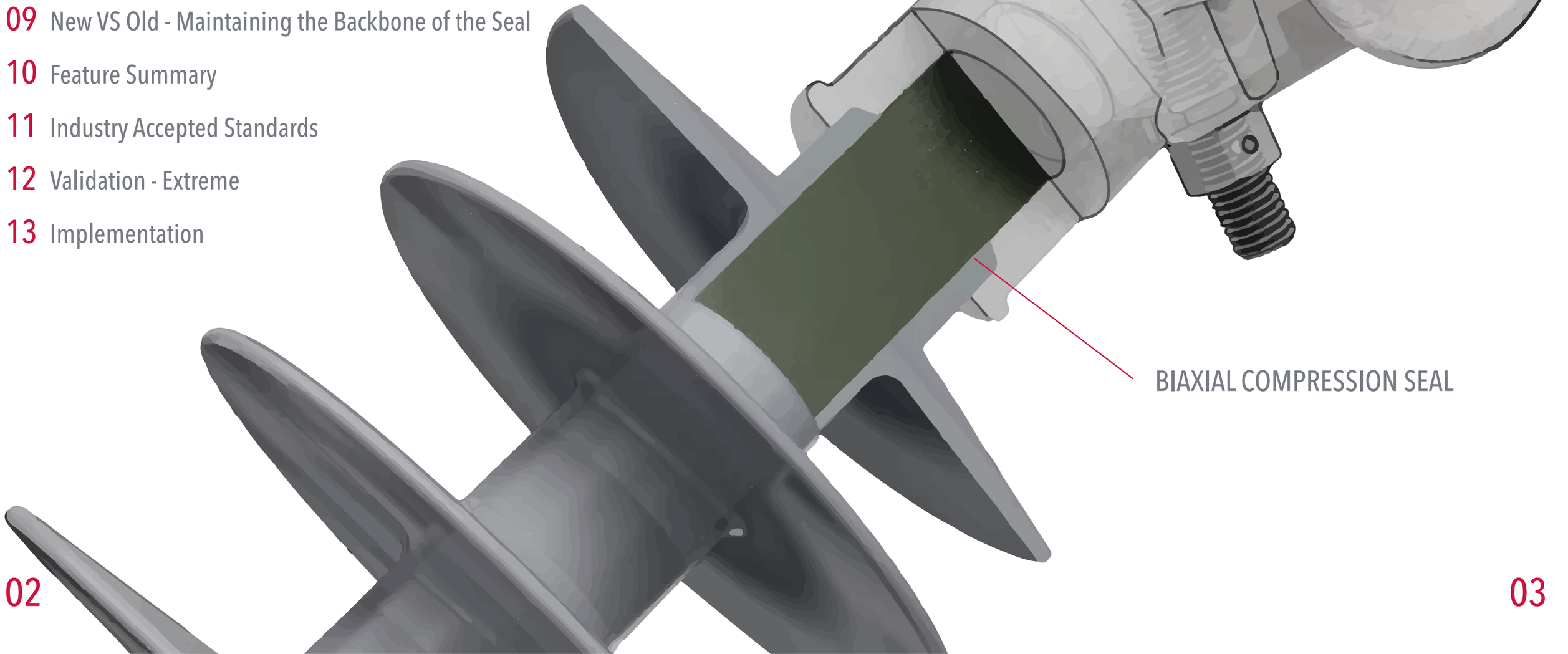
09 New VS Old - Maintaining the Backbone of the Seal

10 Feature Summary

11 Industry Accepted Standards

12 Validation - Extreme

13 Implementation



COMPOSITE INSULATOR END FITTING SEAL IMPROVEMENT

MacLean Power Systems is continuously pushing the performance envelope past required standards.

MPS is transitioning from its long-standing triple seal design (PST) to the next generation of seal technology.

The PST seal has proven its design through a long service life, but MacLean's total quality management process challenged our engineers to make it even better.

Through the continuous use of Design Failure Mode & Effect Analysis (DFMEA), MacLean engineers have discovered a way to further elevate our superior insulator performance.

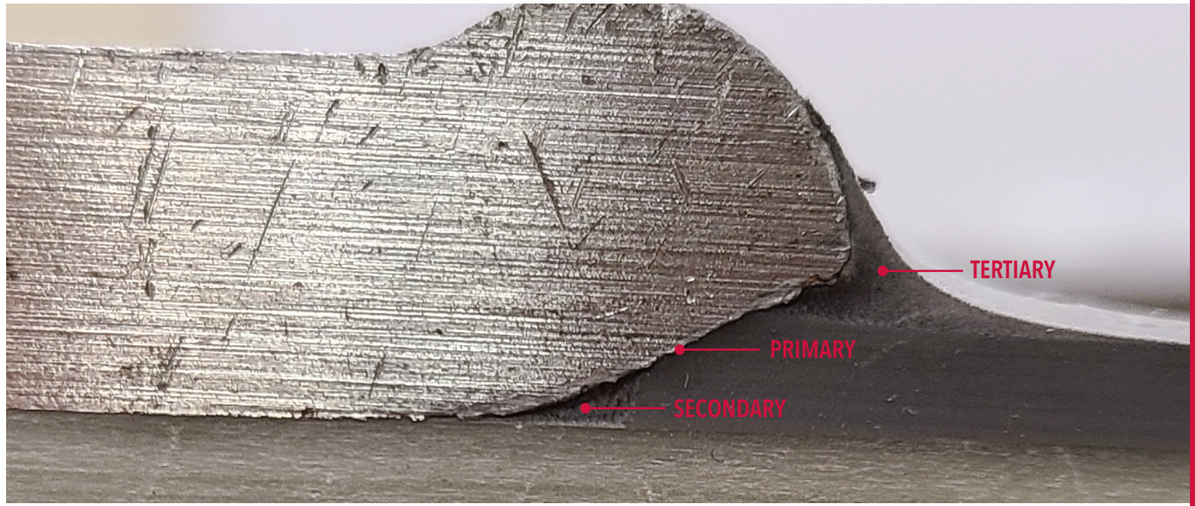
Zak Umansky
Product Manager
Transmission & Distribution Insulators

PURPOSE BEHIND THE NEW SEAL

Our Biaxial Compression Seal is designed to enhance our insulators' ability to withstand environmental impacts with improved protection against moisture ingress caused by salt, acid, water, and other natural elements.

PST SEALING SYSTEM

The PST design uses a three-seal system



PRIMARY COMPRESSION SEAL • SECONDARY INTERNAL RTV SEAL • TERTIARY EXTERNAL RTV SEAL

01

Seals shield the fiberglass core from moisture ingress, preventing flash events & the formation of corrosive acids

02

MPS introduced the PST seal in 1996 & has had 28 years of success within the industry

03

The backbone of the PST sealing interface is established through compression loading during assembly

SEALING INTERFACE COMPARISON

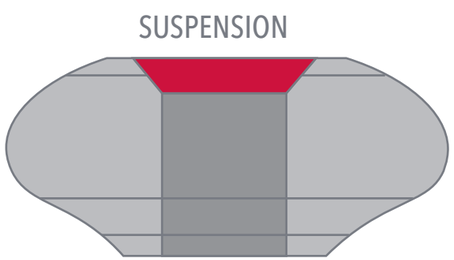
- Large increase in mechanical sealing area
  - RTV seals replaced by long lasting silicone compression
    - Suspension: +95% sealing area
    - Post: +140% sealing area

- Addition of second compression seal direction
  - Axial (original)
  - Circumferential (new)

- Addition of fully galvanized seal interfaces

Generation 1

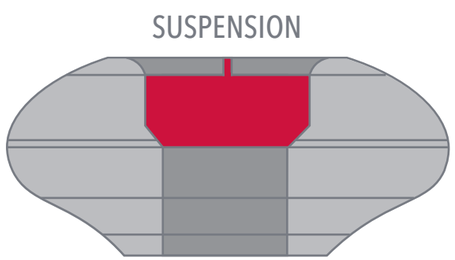
SUSPENSION



POST

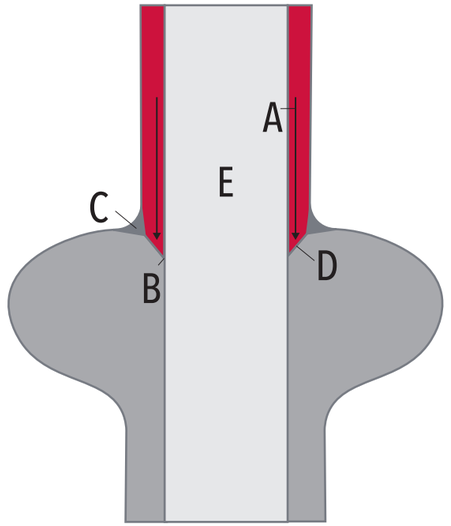
Generation 2

SUSPENSION



POST

NEW VS OLD
MAINTAINING THE BACKBONE OF THE PST SEAL



Generation 1 Features:
- 1 Compression seal
- 2 RTV seals

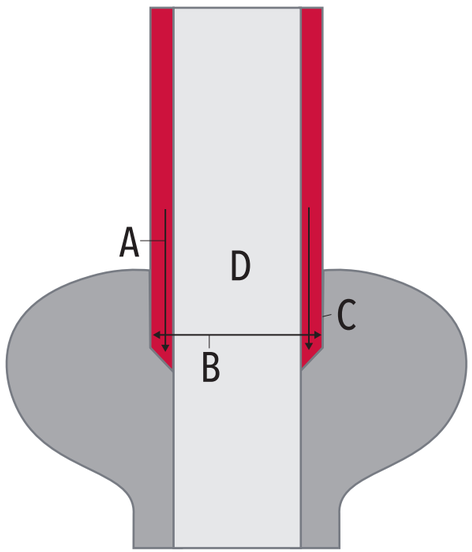
A. Compression Seal (Axial)

B. 2nd Seal (RTV)

C. 3rd Seal (RTV)

D. Bare Metal Interface

E. Fiberglass Core Rod



Generation 2 Features:
- 2 Compression seals (biaxial)

A. 1st Compression Seal (Axial)

B. 2nd Compression Seal (Circumferential)

C. Galvanized Interface

D. Fiberglass Core Rod

FEATURE SUMMARY

Sealing Surface
- Post sealing area increased by 140%
- Suspension sealing area increased by 95%
- Fully galvanized sealing interface
  - Corrosion resistance improves seal health and longevity

Embedded Triple Point
- Increased protection from corona and electrical activity
- Secluded position within end fitting safeguards from environmental effects
- Bending and uplift protection (post applications)

Manufacturability
- Increased efficiency and throughput by reducing number of manufacturing processes
  - Results in lower lead time

100% protection against water ingress.

INDUSTRY ACCEPTED STANDARDS

Standard Performance Tests Required by Governing Bodies
- ANSI C29.18
- CSA C411.6
- IEC 62217

Moisture Penetration Test after Power Arc (ANSI & CSA) - Submersion in dye penetrant

Water Penetration (ANSI & CSA) - Submersion in boiling water

Test on Interface and Connections of the End Fittings (IEC) - Submersion in boiling water

EXTREME VALIDATION

Powertech
The Power of Trust. **The Future of Energy.**

MPS partnered with Powertech labs to create and implement an industry leading biaxial compression seal torture test. The new Biaxial Compression Seal was placed head-to-head with the PST seal for performance evaluation.

- 48 h Cantilever withstand test (100% MDCL) > Tension (100% STL) > Dye penetration test and dissection
  - Base Line test to understand the seal at normal conditions and to have a comparison for the remaining tests

- 48 h Cantilever (100% MDCL) > 96 h Acid exposure tensioned (100% STL) > Dye penetration test and dissection
  - Understanding the effects of nitric acid, commonly found in the field and what impacts it has on the sealing surface

- 48 h Cantilever (100% MDCL) > 1000 h Salt fog (energized samples) > Tension (100% STL) > Dye penetration test and dissection
  - Understanding the effects of salt and corrosion, commonly found in the field and what impacts it has on the sealing surface

- 48 h Cantilever (100% MDCL) > 1000 h Salt fog (energized samples) > 1000 h Acid exposure tensioned (100% STL) > Dye penetration test and dissection
  - Combining both nitric acid and salt exposure to replicate the worst possible condition

- 48 h Cantilever (100% MDCL) > 96 h Acid exposure tensioned (100% STL) > Thermal mechanical > Tension (100% STL) > Dye penetration test and dissection
  - Thermal mechanical testing is introduced to understand the seal during temperature extremes while under load and exposure to nitric acid

IMPLEMENTATION OF BIAXIAL COMPRESSION SEAL

No samples showed complete failure of both secondary and primary seals.

After the moisture penetration test, there was no evidence that any moisture reached the core for either design in any of the test streams.

The Biaxial Compression Seal performed better than the secondary PST seals, particularly in stream 2, 3 and 5 which involved nitric acid exposure, salt fog or both.

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