

# Next generation coatings system

Conductive 24V, <200 Ohms

Discharge protection >2000V

Ultra protective barrier

Corrosion protection

Friction Control

No need for masking

# About Provexa Technology

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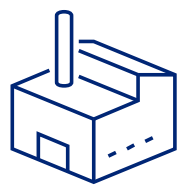
*Peter Stenquist*

*VD Provexa Technology AB*

*0736681170 [peter.stenquist@provexa.com](mailto:peter.stenquist@provexa.com)*



# About us



Est. 1881,  
forecast 2019 130 MSEK (115)



95 employees



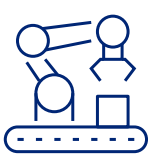
EBIT 10%  
(7%)



15 000 SQM & excellent environment



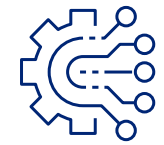
Provexa Technology  
R&D, licensing, LAB, testing and  
consulting



Broad Offer and high R&D  
spending on new technologies



Globally Patented  
Technologies



High level customer services +250  
customers



ISO 9001, ISO 14001,  
AFS 2001, OHSAS 18001

# EARTH

## Concept

**Define a better corrosion protection product** that is similar to aluminum or chromium “self protecting naturally by a thin oxide layer and durable”

**Extensive R&D process** - involving researchers and customers - EARTH was born and optimized to come close to the desired target

**Sacrificial anode**, but without affecting the paint coating

**Provexa EARTH** is a global patent

Paint (ED, Powder)

Conversion Coating

High Performance  
Zinc Iron Manganese Alloy

Steel

# EARTH properties

***Super stable, self repairing  
micro structure*** - multiple  
micro oxidation processes

***Low level of white corrosion -  
Low paint delamination***

***Generates low hydrogen  
levels*** – Few pin holes

***ZnFeMn*** - High alloy Zinc as in  
its natural state in nature

***Sustainable*** - low organic  
content, good metal  
distribution

***Non-toxic additives***, soft  
complexing agents  
(compared to ZnNi)

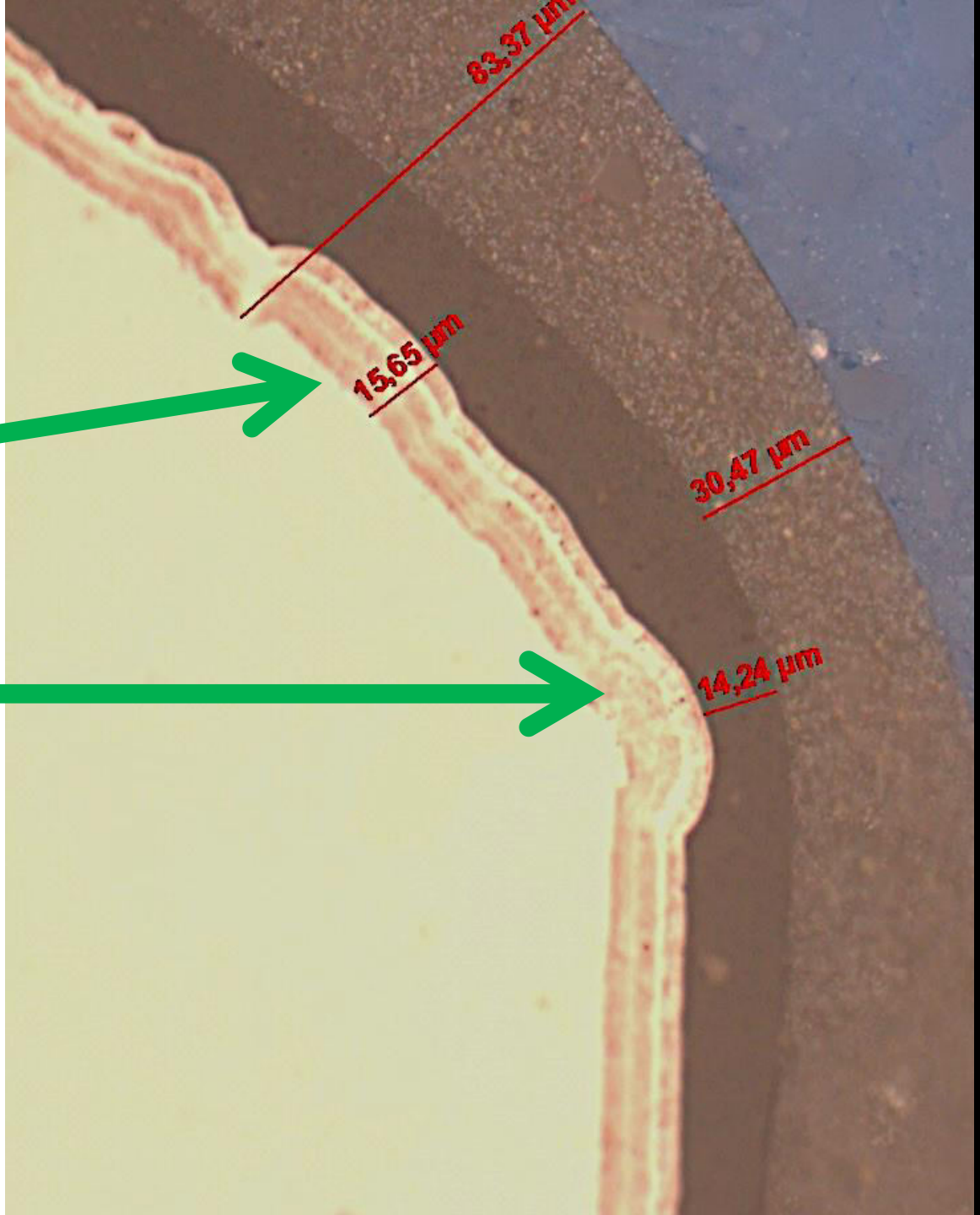
***Ni free***



# EARTH edge study

*Unique lamella micro structure  
inducing self repair by multiple micro  
oxidations*

*Even thickness and edge coverage –  
easy to process and layer gives an  
even thickness over the geometry  
including sharp edges and porosities*



# ZnNi edge study

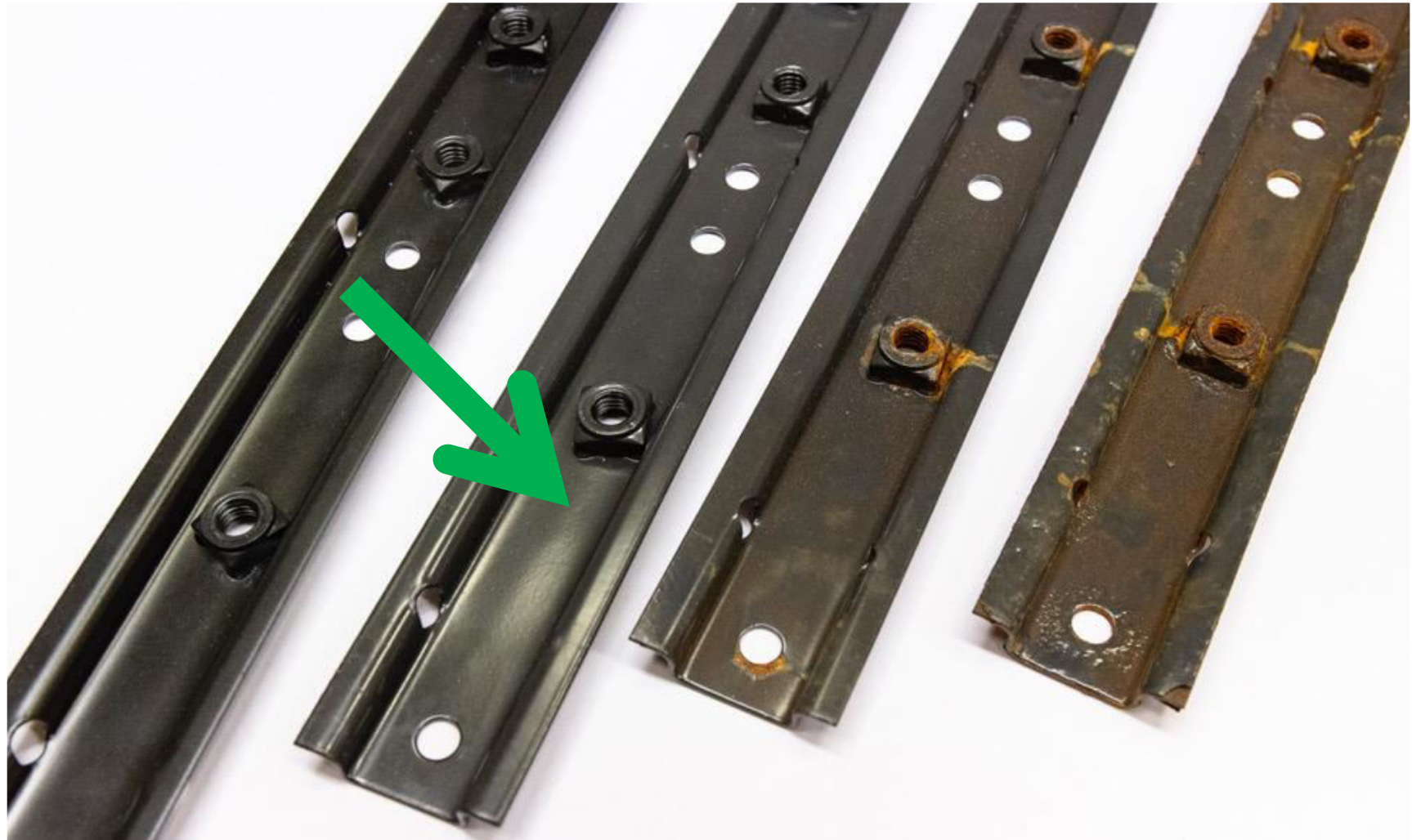
*Developed cracks*

*Uneven thickness and less coverage on edges*

*Difficult to control the process concentration, parameters, ageing*



# EARTH verification – corrosion resistance\*



**EARTH PLUTO**

**Earth ED powder**

**ZnNi ED Powder**

**Phos. ED Powder**

Protecting the Future

\*) Scania Truck head lamp brackets ACT chamber 6 weeks and equivalent to 3y field use



# Next Generation Coating Concept

*Strong need for better coatings.*

*Extensive research on coatings in general and low dimension carbon materials in particular.*

## ***R&D project***

*Customers, Chalmers Industriteknik and Chalmers University of Technology, Vinnova, RISE.*

*Defined a method to applying graphene and low dimensional carbon materials in coatings and achieve unique properties.*

*We named it **PLUTO**, that is the smallest planet far away from EARTH but despite the size of PLUTO planet - it's a true innovation.*



# PLUTO properties

*Appearance*

*Barrier*

*Corrosion protection*

*Electrical Conductivity*

*Friction control*



# PLUTO verification by SCANIA

Truck side lamp bracket in steel

Test performance after 6 weeks ACT II according to Scania STD4445:



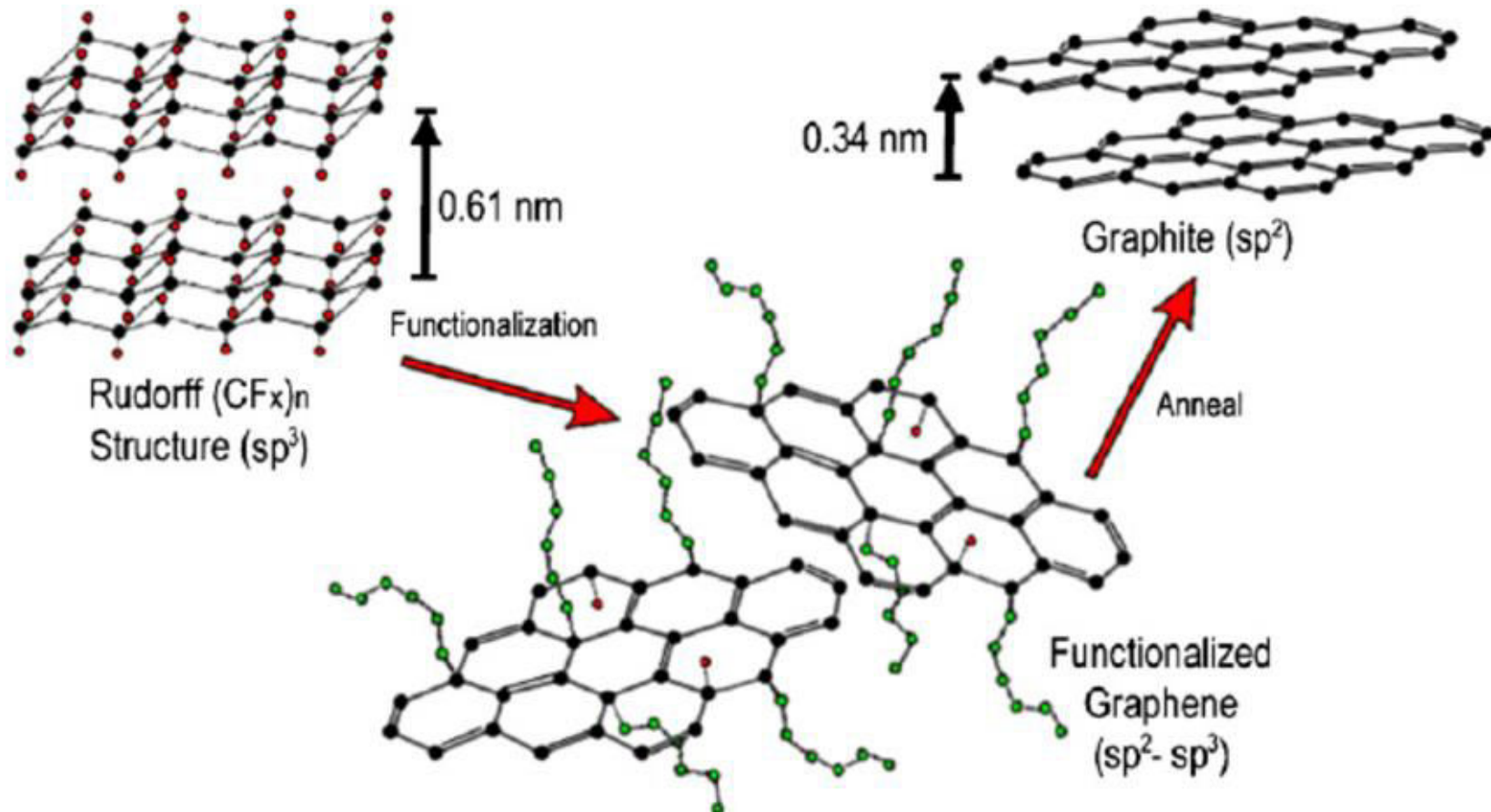
**PLUTO 811**

**EARTH Phosphate ED Powder**

**Zinc/Nickel Phosphate ED Powder**

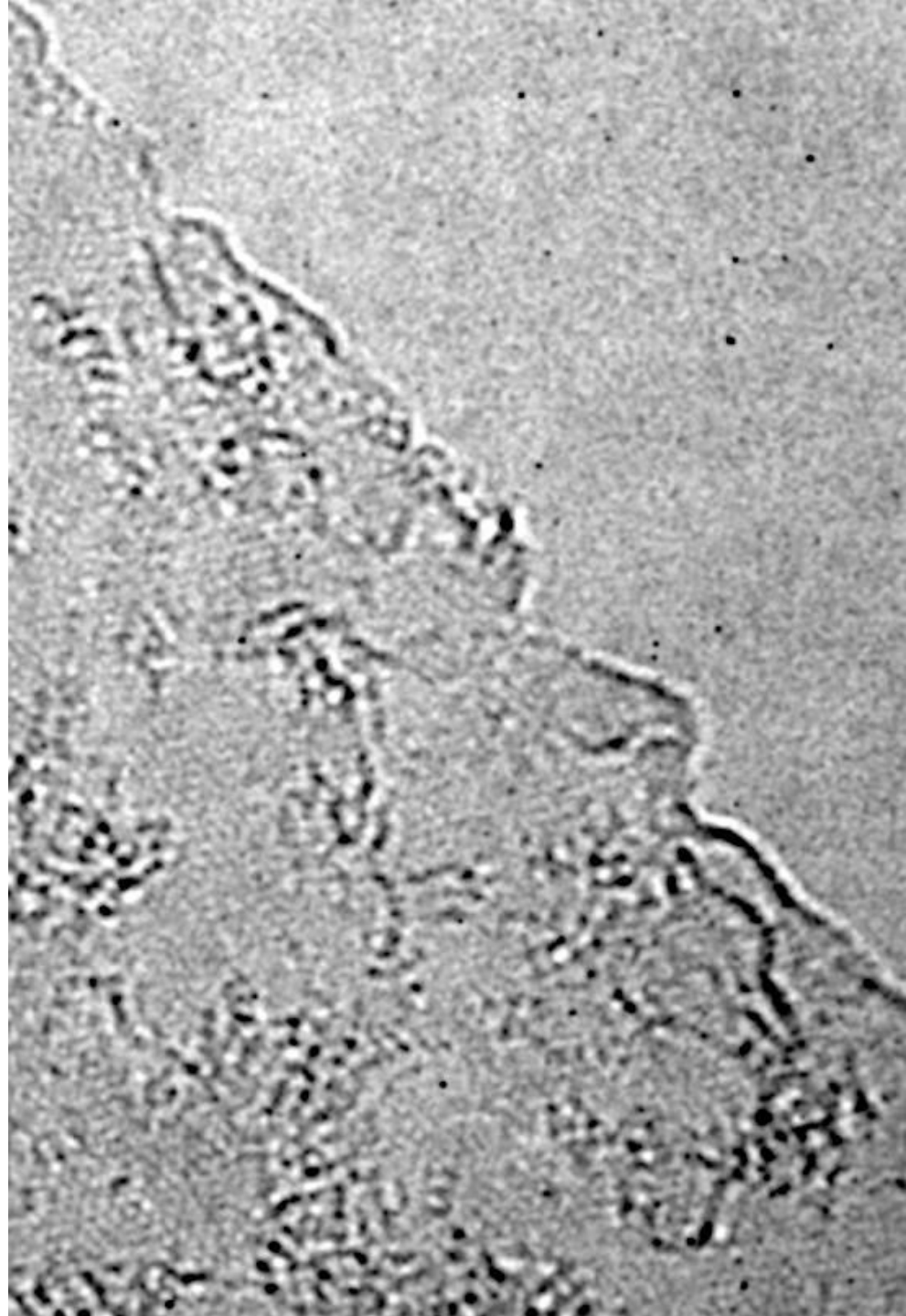
**Phosphate ED Powder**

# Graphene based surface technology



# Graphene structure

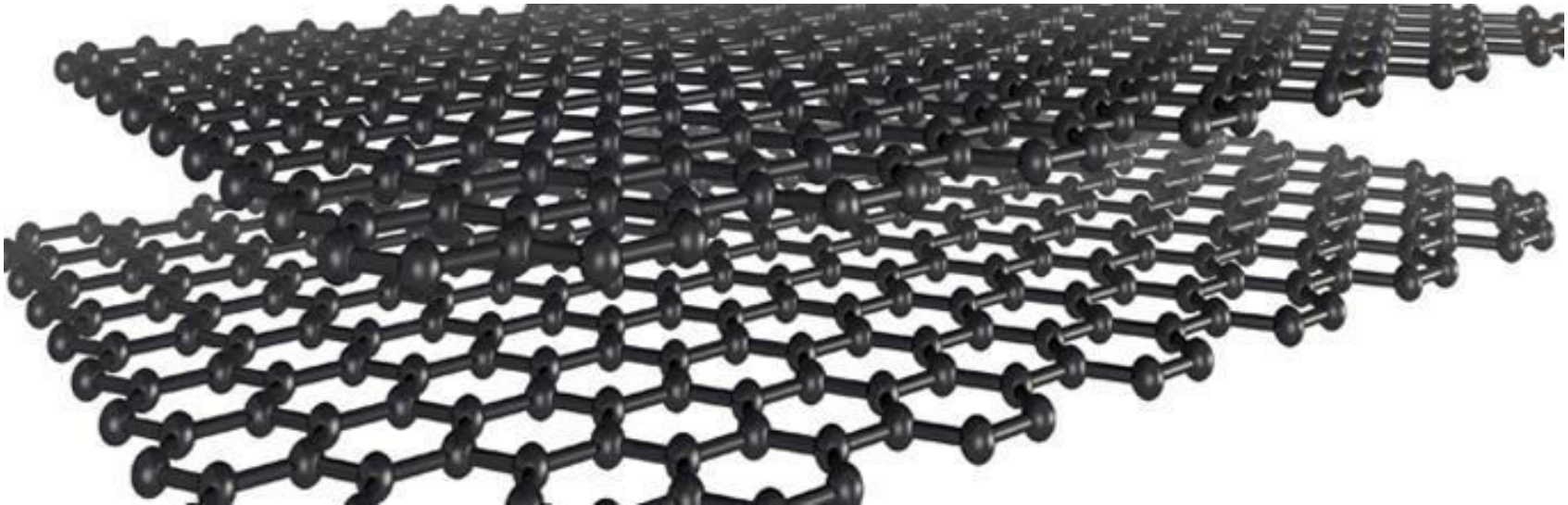
- "We approached the Graphene technology 3 years ago and we got friends with Graphene - and we want to build a better future"
- "Start of new PLUTO production line in Dec 2018 – applying the Graphene Technology in high volume industrial applications"



# About Graphene Composites

*"In PLUTO the Graphene nano layers are deposited in a way that creates:*

- ***Stronger** than steel*
- ***Harder** than a diamond*
- ***Excellent electrical** and heat conductive **properties***
- *We know how to control the depositing process in a way to create a **composite barrier** that gives an excellent advantage in protecting sharp edges*



# Excellence in properties

## *Appearance*

- *Top coat*
- *Full RAL span*
- *Gloss*
- *Possible to put a finish coat on top*

## *Corrosion protection*

- *edge protection*
- *discharge*
- *UV*
- *excellent barrier properties*
- *wear resistance*
- *no need for masking*

## *Electrical Conductivity*

- *Grounding and connecting electricity*
- *Discharge protection*

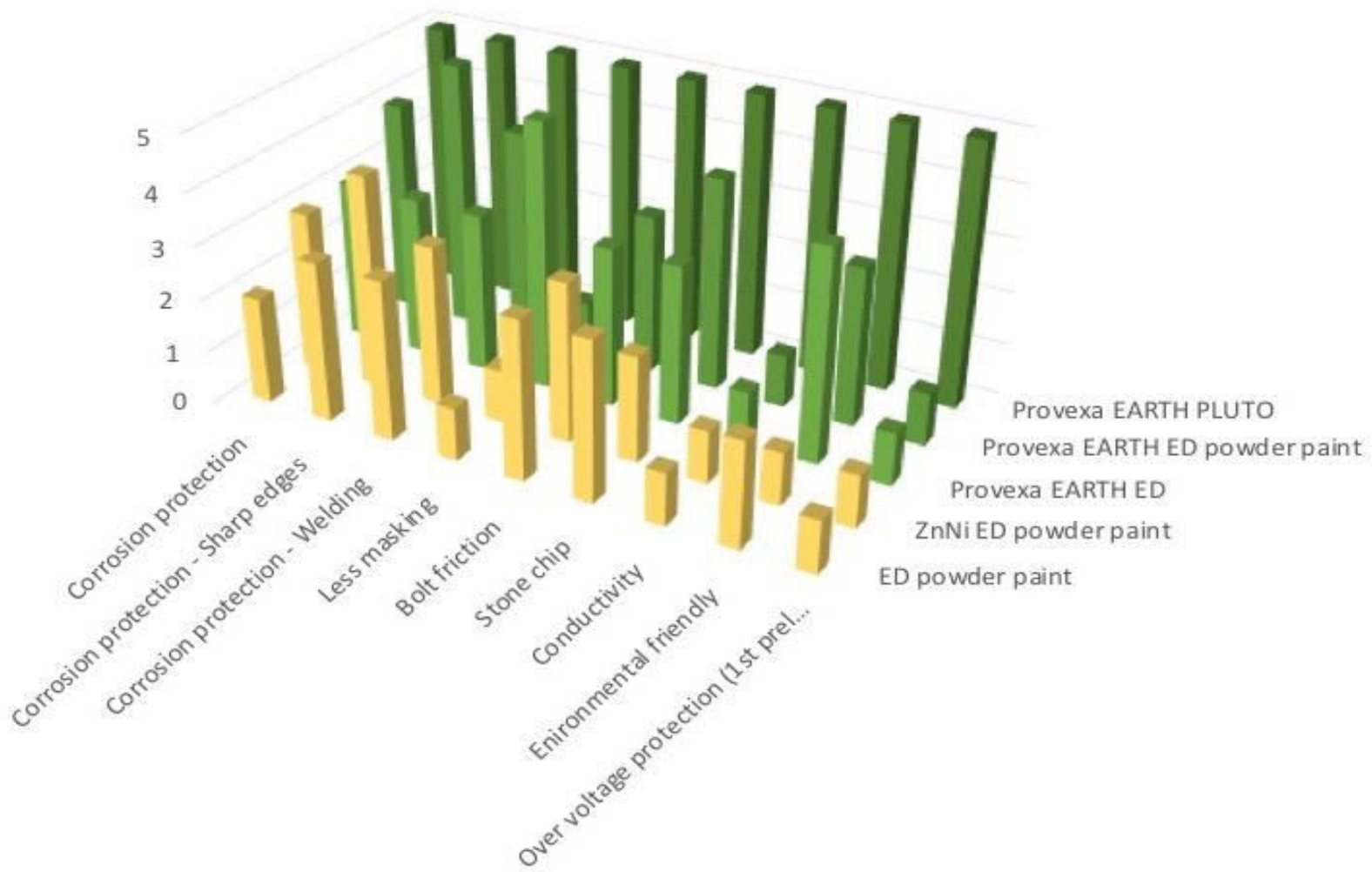
## *Friction control*

- *0.14 +/-0.02*
- *0.08-0.25 adjustable range*



# PLUTO benchmark

Property comparison - PROVEXA EARTH and PLUTO versus Competition  
5 = maximal test outcome

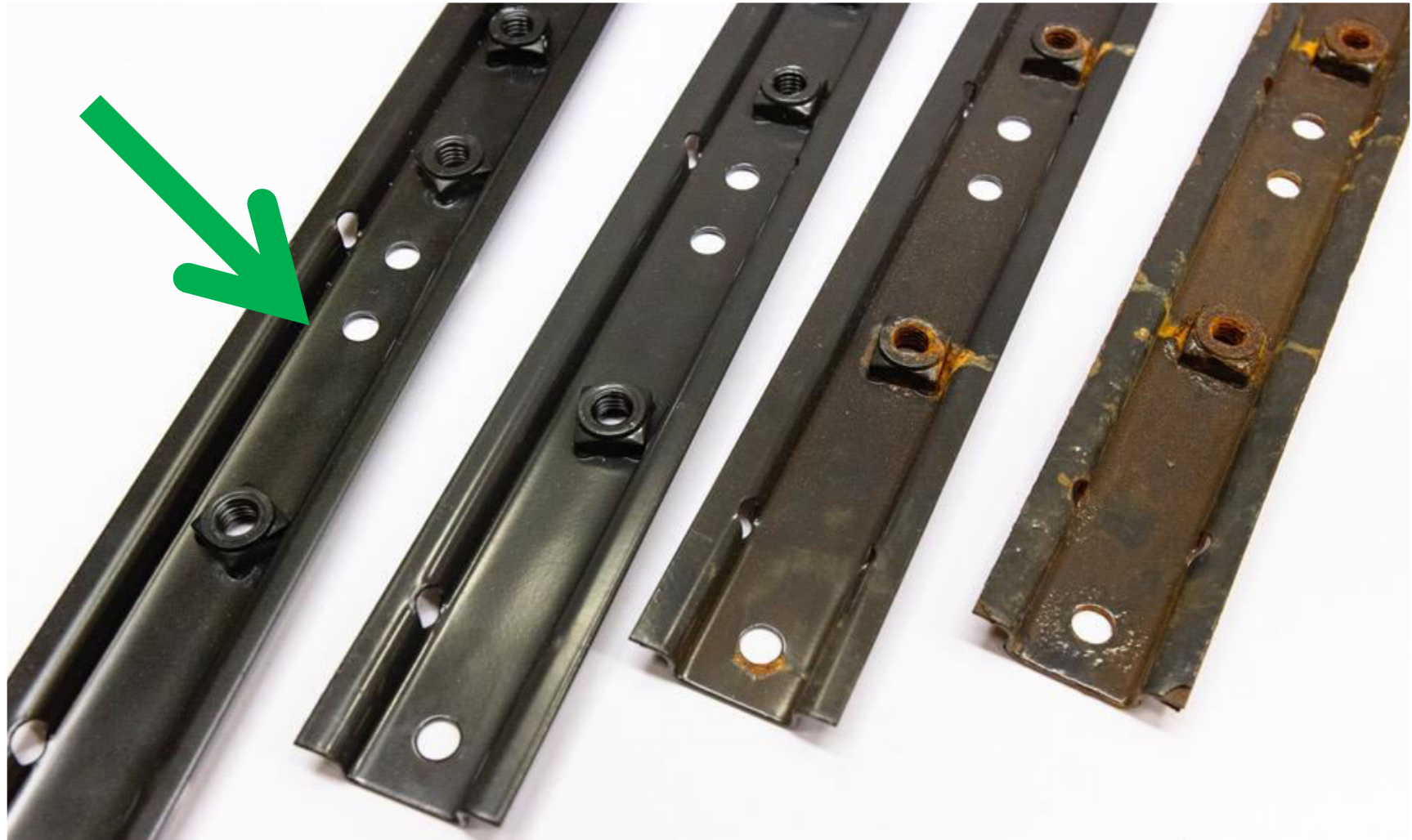






August 2018, 3 weeks outdoor exposure, west coast of Sweden  
RISE weathering test lab, Bohus Malmön Sweden, steel plates 45 degrees from vertical

# PLUTO verification – corrosion resistance\*



EARTH PLUTO

Earth ED powder

ZnNi ED Powder

Phosf ED Powder

\*) Scania head lamp brackets ACT chamber 6 weeks and equivalent to 3y field use

# Conductivity

## *Electrical Conductivity*

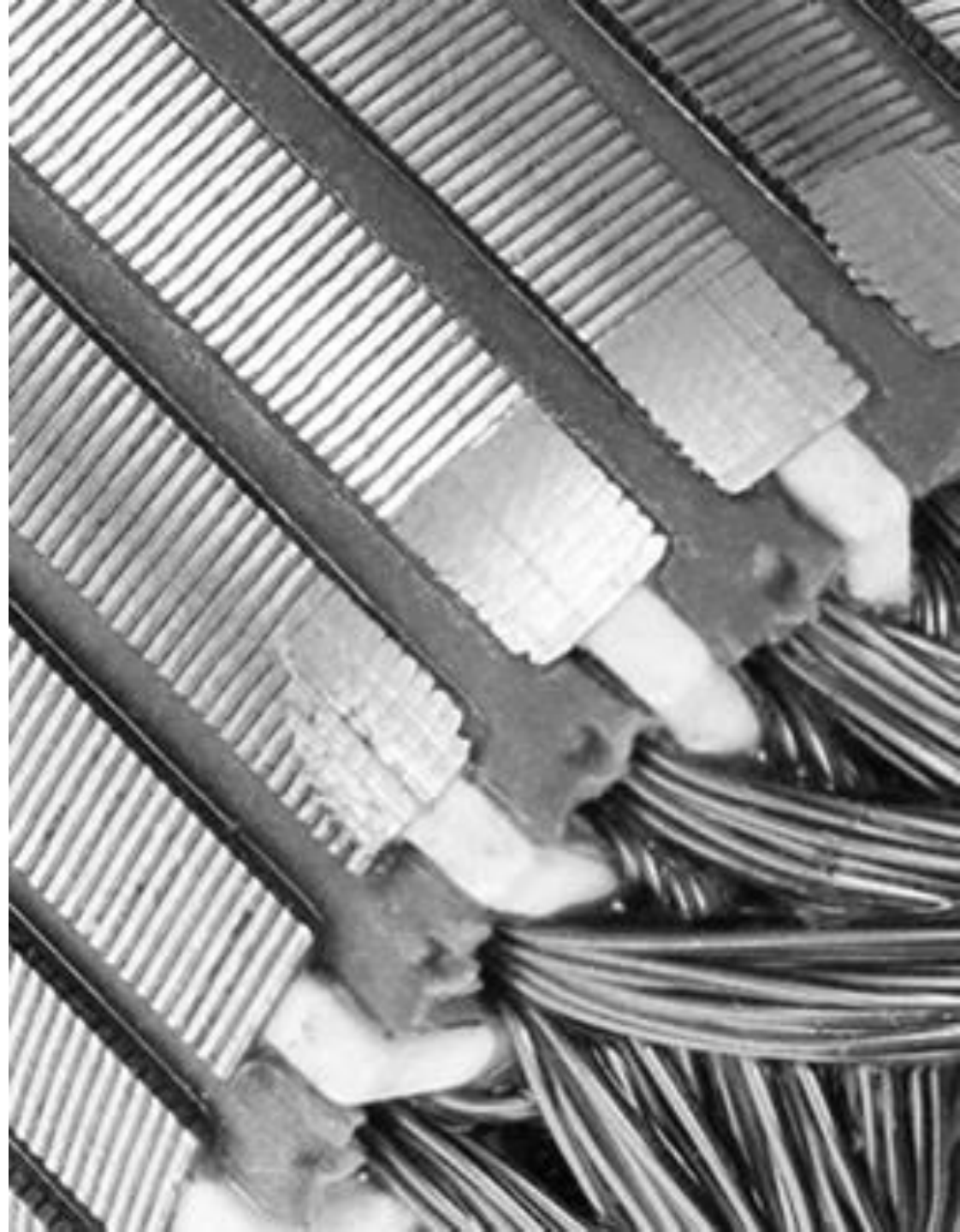
*Grounding and connecting*

*24V, < 200 Ohm*

## *Discharge Protection\**

*2000 V*

*No visible damage to coating*



# Principle - surface conductive

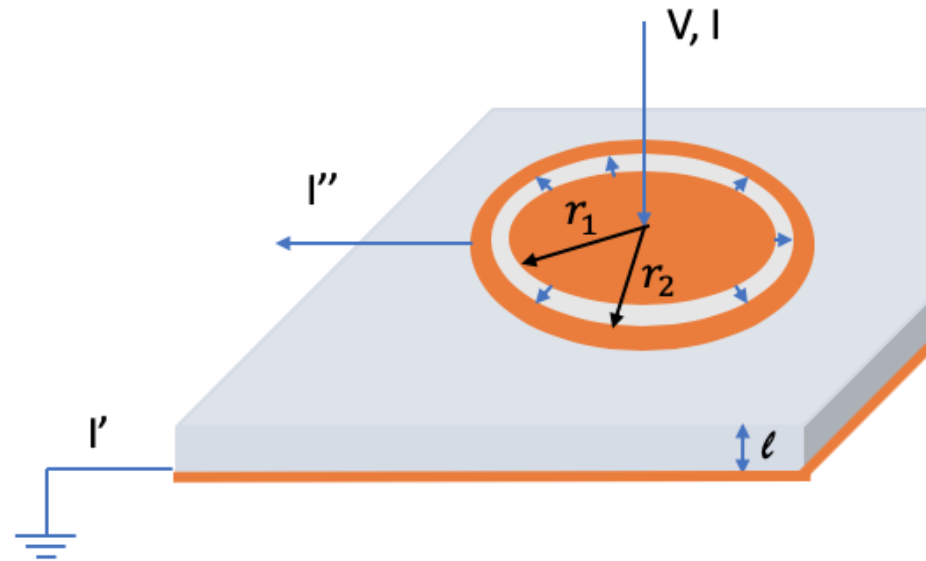
## Basics

Resistance:  $R_S = \frac{U}{I}$  ohm ( $\Omega$ )

Surface conductivity:

$$\sigma_S = \frac{1}{\rho_S} = \frac{\ln(r_2/r_1)}{2\pi R_S}$$

"siemens per metre" (S/m)



Surface conductivity / Resistivity

$r_1 = 25.4$  mm

$r_2 = 28.6$  mm

# PLUTO verification – principle **bulk conductivity**

## Basics

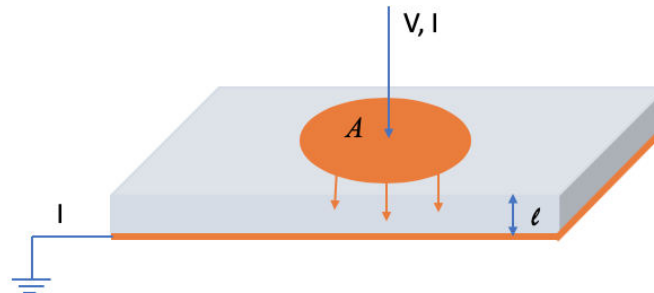
Resistance:  $R = \frac{U}{I}$  ohm ( $\Omega$ )

Resistivity:  $\rho = R \frac{A}{\ell}$  ohm·metre ( $\Omega \cdot m$ )

**Conductivity**,  $\sigma$ , is the inverse of resistivity:

$$\sigma = \frac{1}{\rho}$$

"siemens per metre" (S/m)



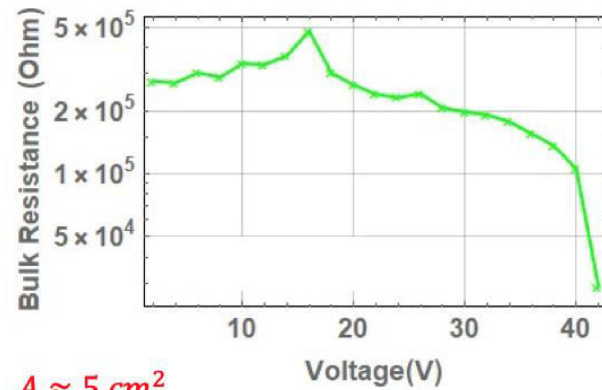
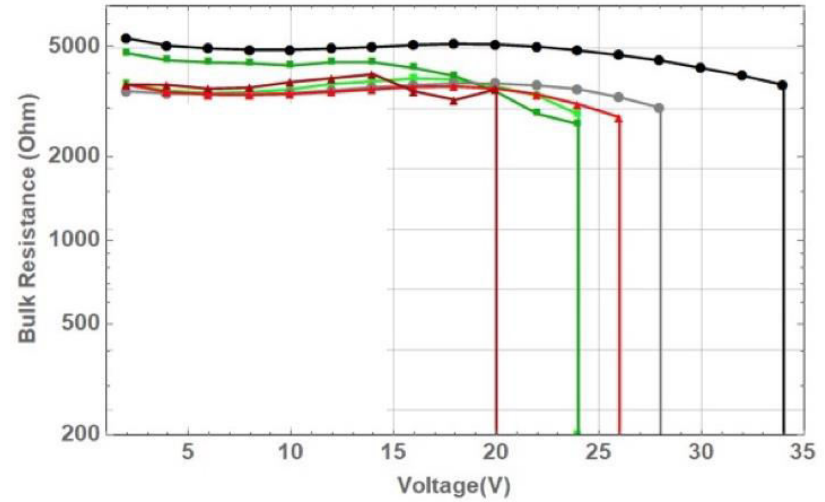
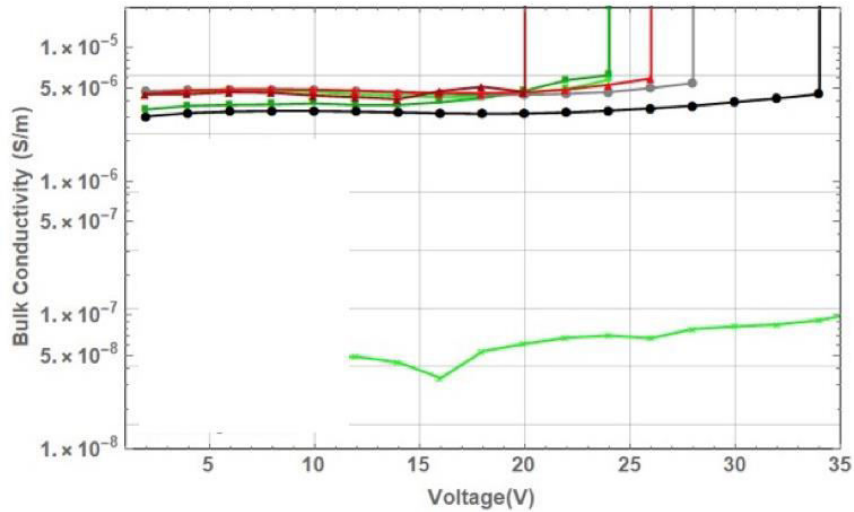
Bulk conductivity / Resistivity

d= 25mm

$A \approx 5 \text{ cm}^2$

# PLUTO verification – data on bulk conductivity

## Bulk conductivity/ resistance



$A \approx 5 \text{ cm}^2$

# Discharge protection

*Discharge Protection\**

*2000 V*

*2000W*

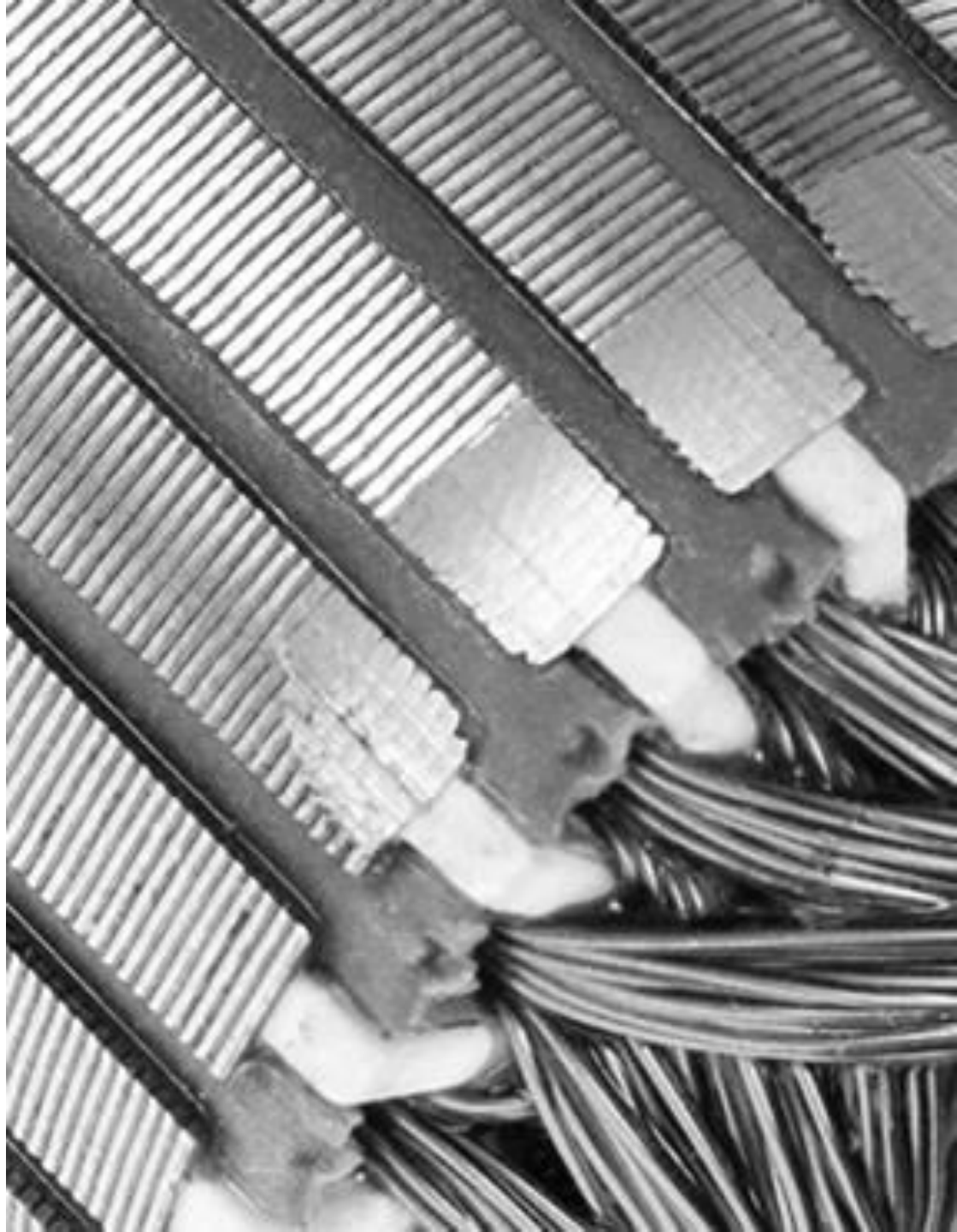
*10 A, <1 ms peak*

*Energy*

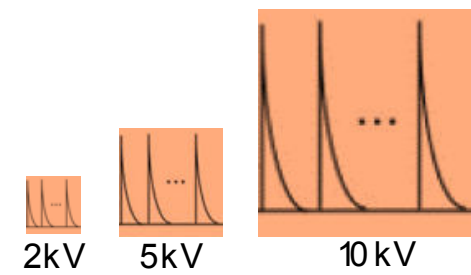
*No visible damage to coating*

*\*) Eq Human body discharge at 20 kV*

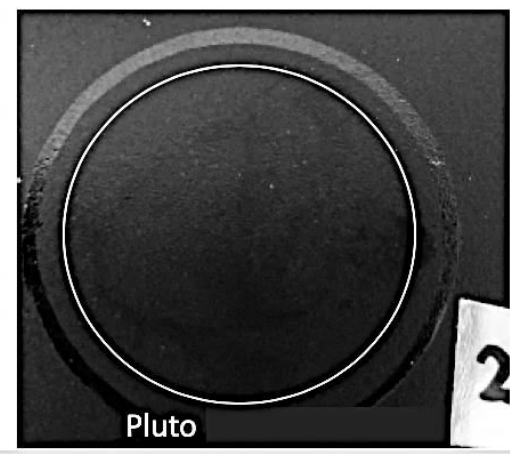
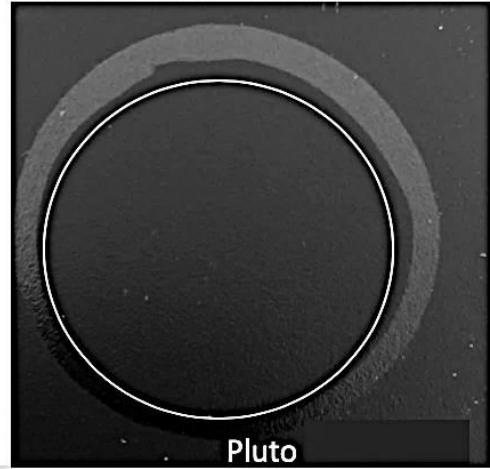
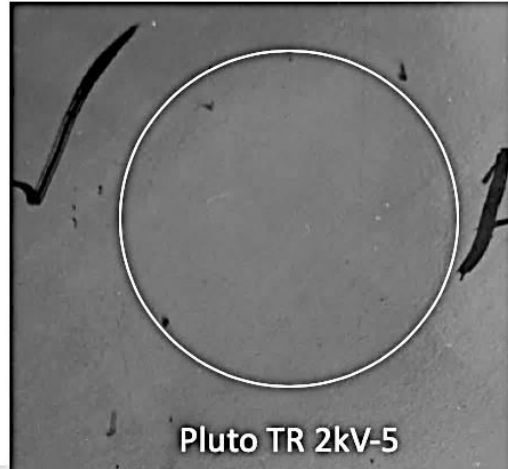
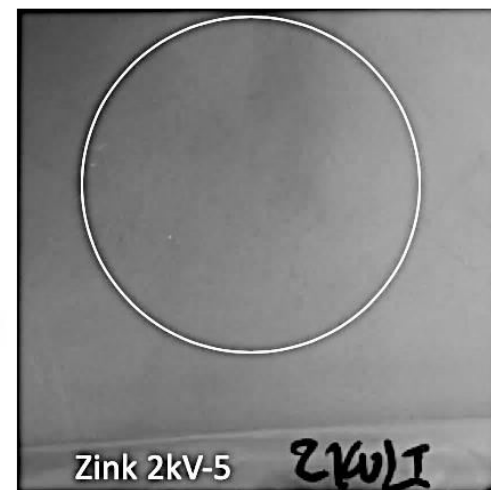
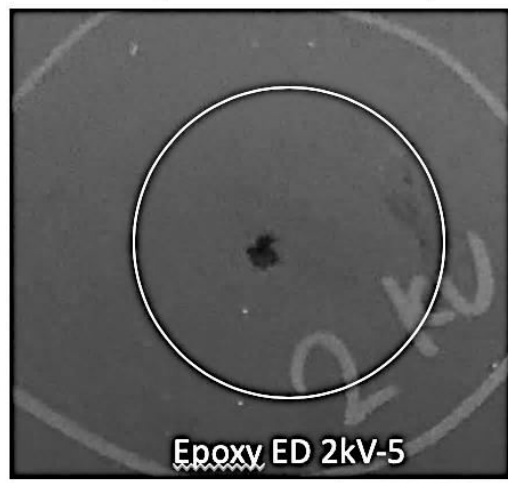
*(10-30 kV)*



# Light impulse testing 2kV



Cross comparison after 5 impulses of 2kV





# DESIGN challenge

Swedish truck after 3 months use

Increased electrification of products

Galvanic corrosion

Discharge behaviour

Multiplies speed of corrosion

Sharp edges

UV deterioration

-> barrier need

Grounding and electrical  
conductivity

Friction management

Wear



# Data sheet

PROPERTY	TEST METHOD	PERFORMANCE
Electrical conductivity	IEC 60093 DC bulk conductivity test	Conductive >20±4 and >24V Resistance < 200Ω
Electrical protection	IEC 61000-4-5 Surge protection test	2000V no visible damage to surface
Friction	Friction test ISO 16047:2005	0.14 +/- 0.02
Stone chip	ISO 20567-1:2017 Stone chip & ACT1	OK
Corrosion system resistance - steel	NSS ISO 10289:2001 ACT1 equivalent to SS EN ISO 16701:2008	> 1500h > 6 weeks
Tropical test	Hot water >50°CHPWT, < 5 mm delamination	No delamination
Colour	RAL	RAL 1000-9023
Gloss	ASTM D523	50-70 GU
UV resistance	ASTM G53	>2500h
Coat thickness	ISO 2178 magnetic induction	Components 12 ±4 μm Threaded parts 8 ±2 μm

## PRODUCT FUNCTIONS

PLUTO 811 is a surface technology system for STEEL. [Tip coat] Fine Global Industrial Application of Graphene Surface Technology [Barrier] [Conductive] [Anti Corrosion] [Friction Coating]

PLUTO 811 is a surface technology system for STEEL. [Tip coat] Fine Global Industrial Application of Graphene Surface Technology [Barrier] [Conductive] [Anti Corrosion] [Friction Coating]

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Developed by PLUTO

Provexa Technology AB Gårdsbodavägen 23 441 50 00130000 P.O. Box 10001 413 00 Sweden [provexa.com] [provexa.com]



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# SUSTAINABLE PRODUCTS NEED PLUTO

## *Appearance*

- *Top coat*
- *Full RAL colour support*
- *Gloss adj*
- *May put a finish coat on top*

## *Corrosion protection*

- *Edge protection*
- *Discharge protection*
- *UV*
- *Excellent barrier properties*
- *Wear resistance*
- *No masking*

## *Electrical Conductivity*

- *Connecting and grounding  
electricity*
- *Discharge protection*

## *Friction control*

- *0.14 +0.02*
- *0.08-0.25 adjustable range*



# Next generation coatings

Ultra protective barrier

Connective & conductive

+24V, <200hms

Discharge protection >2000V

Anti Corrosion

Friction Control

No need for masking