Trishield EMI gaskets

Trishield™

What is Trishield ?

- Trishield is the trademark for our patented dispensed gaskets based on conductive silicone from Nolato.
- We also produce the traditionally dispensed gasket for environmental sealing and shielding.

Trishield™

Why Use Silicone ?

- Unique properties.
- The only inorganic rubber.
- Unaffected by temperature. Operating temp from -60 to +250 C.
- Low compression set at high temperatures.
- Extremely durable material. Not aged by sun, ozone, heat or moisture.
- Non toxic and biologically inert.
- Can be mixed with conductive particles to become conductive.
- Good adhesion possible to metal and plastic.

Trishield™

Dispensed Gaskets

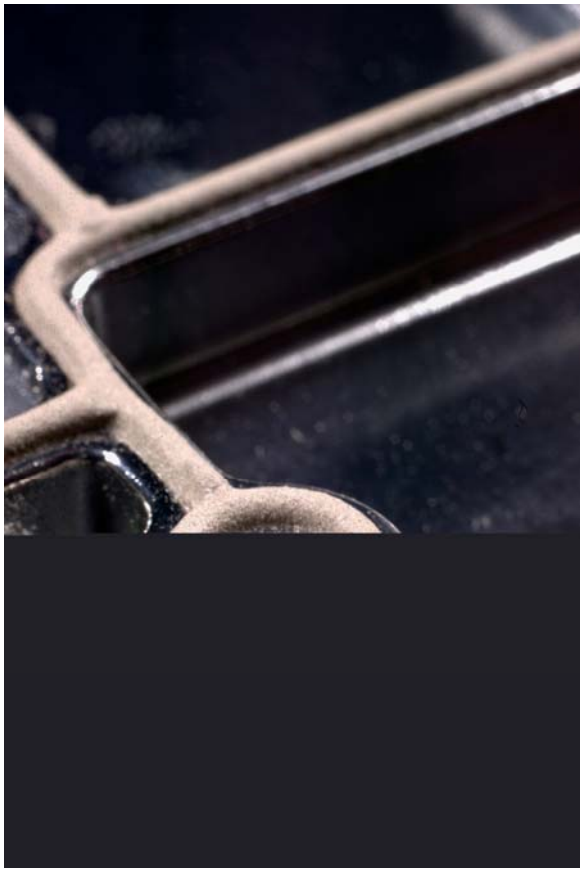
- Conductive gasket dispensed by high precision XYZ-robots on a carrier of aluminium, magnesium or metallized plastic.
- Bead height from 0,5 to 2,0 mm.
- No assembly work.
- No expensive tooling required.
- Rapid prototyping.
- Cost effective even in small series.

Trishield™

Dispensing with CNC-robot
Form-in-place gaskets

Trishield™

Dispensed Gaskets in Detail



Trishield™

Traditional materials

- **8520 is used for environmental sealings**
  8600 is used for traditional shielding gaskets

	Test procedure	Unit	8520	8700
Base material			Silicone rubber	Silicone rubber
Conductive filler			none	Ag / Cu
Volume resistivity	Mil-G-835388	mOhmcm	n.a.	2
Density	ISO 2781	g/cm^3	1,2	2,9
Hardness	ISO 7619	Shore A	40	55
Tensile strength	ISO 37	Mpa	6,2	2,1
Elongation at break	ISO 37	%	480	310
Tear strength	ISO 34-1C	N/mm	40	12
Compression set, 72 hours, 100 C 168 hours, 70 C	ISO 815	%	35 35	25 25
Avg. shielding effect, 0,3 – 9 GHz Gasket on Ni/Sn plated aluminium Gasket on untreated Al	Nolato, modified MIL STD 285	dB	 n.a. n.a.	 100 95
Flammability	UL 94		HB	HB
Compression modulus, 10% strain 20% strain	ISO 7743	MPa	3,8 3,5	3,6 9,3

Trishield™

8520

- 8520 is based on heat cured silicone.
- The material is 40 shore A.
- This is the standard material used for used for traditional dispensed environmental gaskets.
- Low compression force and good mechanical properties.

Trishield™

8700

- 8700 is based on Ag/Cu filler.
- This is the standard material used for traditional dispensed gaskets EMI gaskets.
- Excellent shielding properties.
- Low compression force and good mechanical properties.

Trishield™

Traditional Dispensing

- A limiting factor of this method is that the gasket profile can not be fully controlled.
- The gaskets are wider than what is required for shielding.
- A wide gasket requires more valuable silver filled material.
- A wide gasket requires high compression forces.
- To make high gaskets a double bead is required. This costs cycle time.
- Double bead gaskets may cause patent problems in the US and Germany.

Trishield™

Trishield: Dispensed Gasket Shaped Like an Triangel

- Patented method to produce high and narrower dispensed gaskets.

Trishield™

Trishield: The New Dispensed Gasket

- **Method invented and developed and patented.**

Offers many advantages:

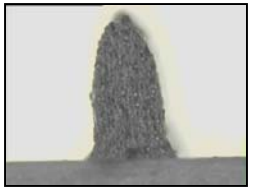
- **• Less material consumption**
- **• Shorter cycle times**
- **• Lower cost**
- **• Less compression force**
- **• No patent problems**

Trishield™

Trishield™

- **Application data for Nolato 8800.**

Height of bead [mm]	0.5	0.8	1.0	1,7
Width of bead [mm]	0.3	0.6	0.7	0.9
Width of track [mm]	0.7	1.0	1.1	1.3
Compr. 0.1mm F [N/cm]	2,9	2.9	3.1	5,3
Tolerance [mm]	h+/- 0.1	h+/- 0.1	h+/- 0.1	h+/- 0.1



Trishield Production

- Process flow is: dispensing → forming → curing.
- The forming step is done in line. Cycle time is 15 seconds.
- Trishield can be used on most applications that are designed for traditional dispensed gaskets.
- The advantages are most evident on high and long gaskets.

Trishield™

Conductive Silicone Rubber

- The silicone is developed and produced by Nolato in Sweden
- We mix silicone rubber and conductive silvered nickel particles and other additives
- Mixtures optimised for:
  - Shielding properties
  - Raw material cost
  - Mechanical properties such as hardness and compression set
  - Production efficiency

Trishield™

Curing Dispensed Gaskets

- Curing can be done over a longer period at room temp or shorter period by heat treating.
- Nolato materials are heat cured.
- Heat curing advantages.
  - Short lead time
  - Quick feed-back and quality control
  - Better compression set
  - No risk for silicone bleeding

Trishield™

Typical material data

	Test procedure	Unit	8800	8810	8811
Base material			Silicone rubber	Silicon rubber	Silicone rubber
Conductive filler			Silver / Nickel	Nickel / C	Nickel / C
Volume resistivity	Mil-G-835388	mOhmcm	15	150	15
Density	ISO 2781	g/cm^3	3,1	1,8	2,1
Hardness	ISO 7619	Shore A	55	60	70
Tensile strength	ISO 37	Mpa	2,9	3,6	3,3
Elongation at break	ISO 37	%	240	210	150
Tear strength	ISO 34-1C	N/mm	14	18	16
Compression set, 72 hours, 100 C 168 hours, 70 C	ISO 815	%	25 25	20 20	45 45
Avg. shielding effect, 0,3 – 9 GHz Gasket on Ni/Sn plated aluminium Gasket on untreated Al	Nolato, modified MIL STD 285	dB	 100 70	 60 65	 90 100
Flammability	UL 94		HB	HB	HB
Compression modulus, 10% strain 20% strain	ISO 7743	MPa	3,8 6,5	6,2 6,5	12,4 14,6

Trishield™

8800

- 8800 is based on Ag/Ni filler.
- This has been the standard material used for Trishield gaskets.
- Excellent shielding properties on highly conductive surfaces as Ni/Sn plated aluminum.
- Low compression force and good mechanical properties.
- Use 8800 and Ni/Sn plating when best possible shielding is required.

Trishield™

8810

- 8810 is based on Nickel / C.
- Low cost thanks to low density.
- Good shielding properties especially on coarse surfaces as pure or treated Al.
- Low compression forces and good mechanical properties.
- Enhanced galvanic corrosion resistance and ageing properties.
- Use 8810 when average shielding on Al surfaces is required.

Trishield™

8811

- 8811 is based on Nickel / C.
- Low cost thanks to low density.
- Excellent shielding properties especially on coarse surfaces as pure or treated Al.
- High compression forces and moderate mechanical properties.
- Enhanced galvanic corrosion resistance and ageing properties.
- Use 8811 when best possible shielding on Al surfaces is required.

Trishield™

New Ni/C materials

- 8813
  - Ni/C filled shielding gasket allowing smooth production of conductive gaskets down to 0,8 mm.
  - Could been seen as successor to 8811.
- 8812
  - Similar to 8813 but flame retardant and classified as UL94 V0.
- 8814 (To be launched in September)
  - Similar to 8813 but softer and less shielding.
  - Could been seen as successor to 8810.

Trishield™

8813

- 8813 is based on Nickel / C.
- Excellent shielding properties especially on coarse surfaces as pure or treated Al.
- Designed for smooth production of gaskets with low height in all types of machines.
- High compression forces and moderate mechanical properties.
- Enhanced galvanic corrosion resistance and ageing properties.

Trishield™

8812

- 8812 is based on Nickel / C.
- Flammability V0 according to UL 94
- Excellent shielding properties especially on coarse surfaces as pure or treated Al.
- Designed for smooth production of gaskets with low height in all types of machines.
- High compression forces and moderate mechanical properties.
- Enhanced galvanic corrosion resistance and ageing properties.

Trishield™

8814

- 8814 is based on Nickel / C.
- Low cost thanks to low density.
- Good shielding properties especially on coarse surfaces as pure or treated Al.
- Designed for smooth production of gaskets with low height in all types of machines.
- Moderate compression forces and mechanical properties.
- Enhanced galvanic corrosion resistance and ageing properties.

Trishield™

New Ni/C materials

- **8813 is the standard Ni/C material**
  8812 is a flame retardent version of 8813

	Test procedure	Unit	8813	8812
Base material			Silicone rubber	Silicone rubber
Conductive filler			Ni/C	Ni/C
Volume resistivity	Mil-G-835388	mOhmcm	15	15
Density	ISO 2781	g/cm^3	2,1	2,2
Hardness	ISO 7619	Shore A	75	80
Tensile strength	ISO 37	Mpa	2,5	2,8
Elongation at break	ISO 37	%	170	100
Tear strength	ISO 34-1C	N/mm	15	13
Compression set, 72 hours, 100 C	ISO 815	%	55	55
Avg. shielding effect, 0,3 – 9 GHz Gasket on untreated Al	Nolato, modified MIL STD 285	dB	105	105
Flammability	UL 94		HB	V0
Compression modulus, 10% strain 20% strain	ISO 7743	MPa	17,8 24,1	25,2 25,5

Trishield™

Designing a good shield

- Designing a good shield is not only a selection of gasket material.
- Important to consider.
  - Housing design
  - Surface treatment design
  - Gasket design
  - Gasket material

Trishield™

Housing design

- Can the part be fed into the forming unit ?
- Can the part stand 100 C for 30 minutes ?
- Is the part free from ferromagnetic material ?
- Trishield can be used on most applications that are designed for traditional dispensed gaskets
  - Is part part reproducibility in XYZ dimensions ok ?
  - How can the part be positioned and hold by vacuum?
  - Is the surface for gasket flat and width of ribs ok ?
  - Obstructions in dispensing route, slops etc ?

Trishield™

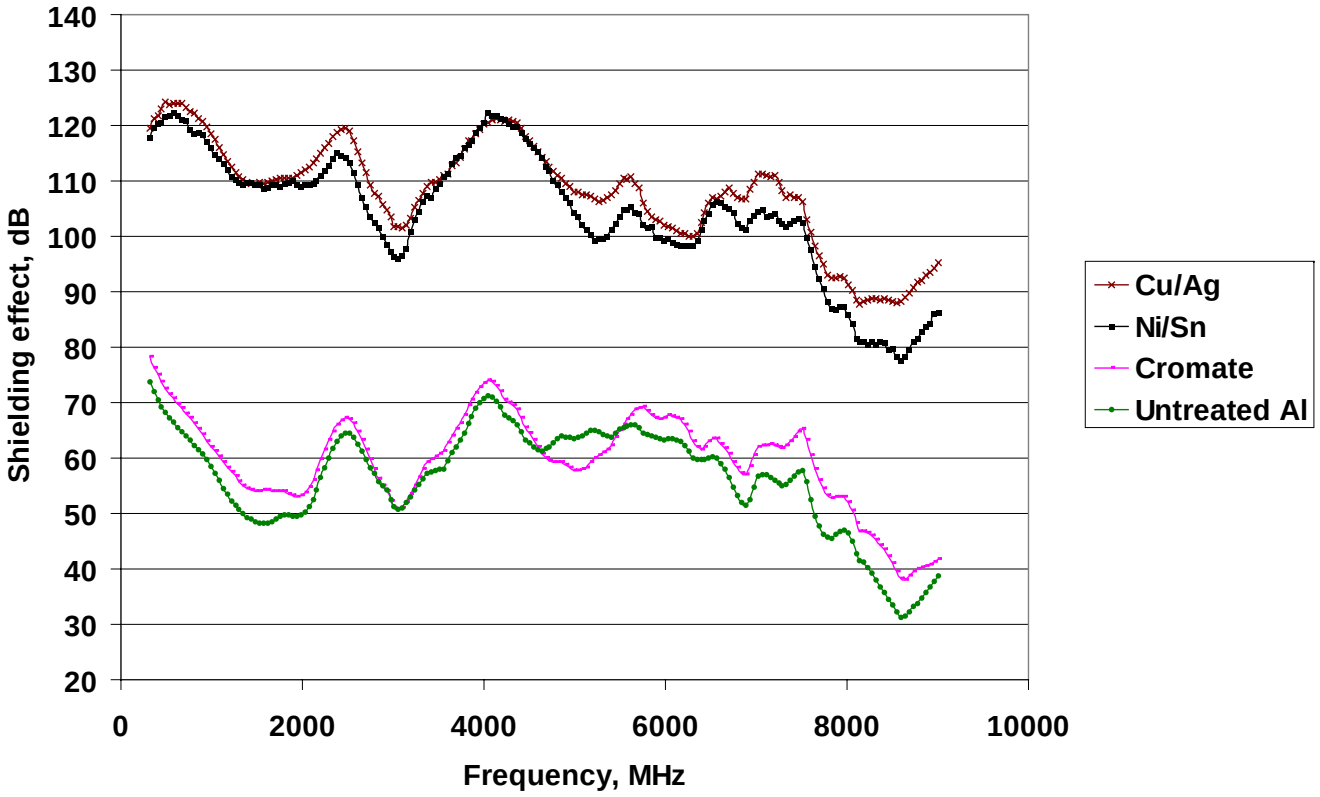
Surface Treatment Design

- Surface treatment is important for corrosion resistance as well as shielding performance.
- Treatment method is set by base material, shielding and ageing requirements, logistics and cost.
- Surface type and cleanliness is important for the adhesion of gasket.
- Nolato materials optimised for Ni/Sn plated Al.
- Good adhesion on clean aluminum, chromated surfaces and many painted and or plated plastic surfaces.

Trishield™

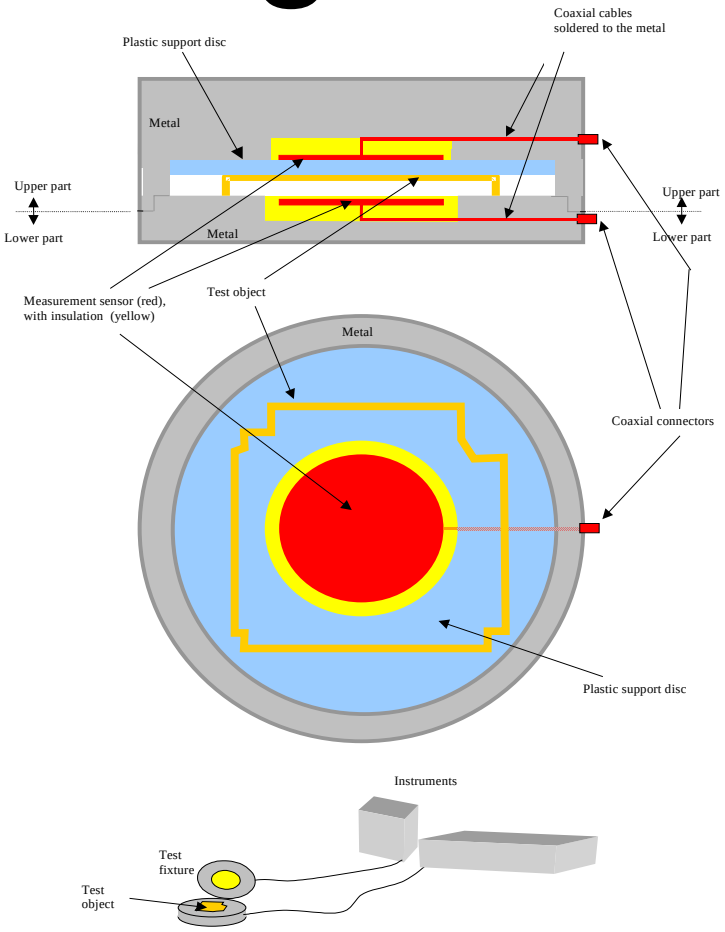
Shielding Effect of Al Plating

Measured on shieldcan ”Anna”. Can is made of aluminium. Gasket 8615. Comparing different plating material after ageing.



Trishield™

Shielding Effect Measurement



- Nolato standard test for shielding cans
- Modified MIL STD 285
- Network Analyzer Agilent PNA E8358AR
- $SE=20*\log(V_0/V_1)[dB]$
- Standard test can “Anna” 50x50x8 mm. Wall thickness 1,5 mm. Gasket 0,8 mm heigh.

Trishield™

Shielding effect

- Nolato modified MIL STD 285.
- Measured on shield can Anna.
- Average shielding effect 0,3-9 GHz in dB.

Sample	8800	8810	8811
	Shielding effect	Shielding effect	Shielding effect
Surface	dB	dB	dB
Ni/Sn	100	60	90
Al	70	65	100
E-CLPS 4600	68	69	100

Trishield™

Surface treatment

- A shield with Ni/Sn surface, shields better than Al surface as fresh.
- Shields with Ni/Sn keep shielding effect better than Al surface during ageing.
- All surface treatments costs. Do not use a more costly surface treatment than what is required in each application from a shielding and corrosion point of view.

Trishield™

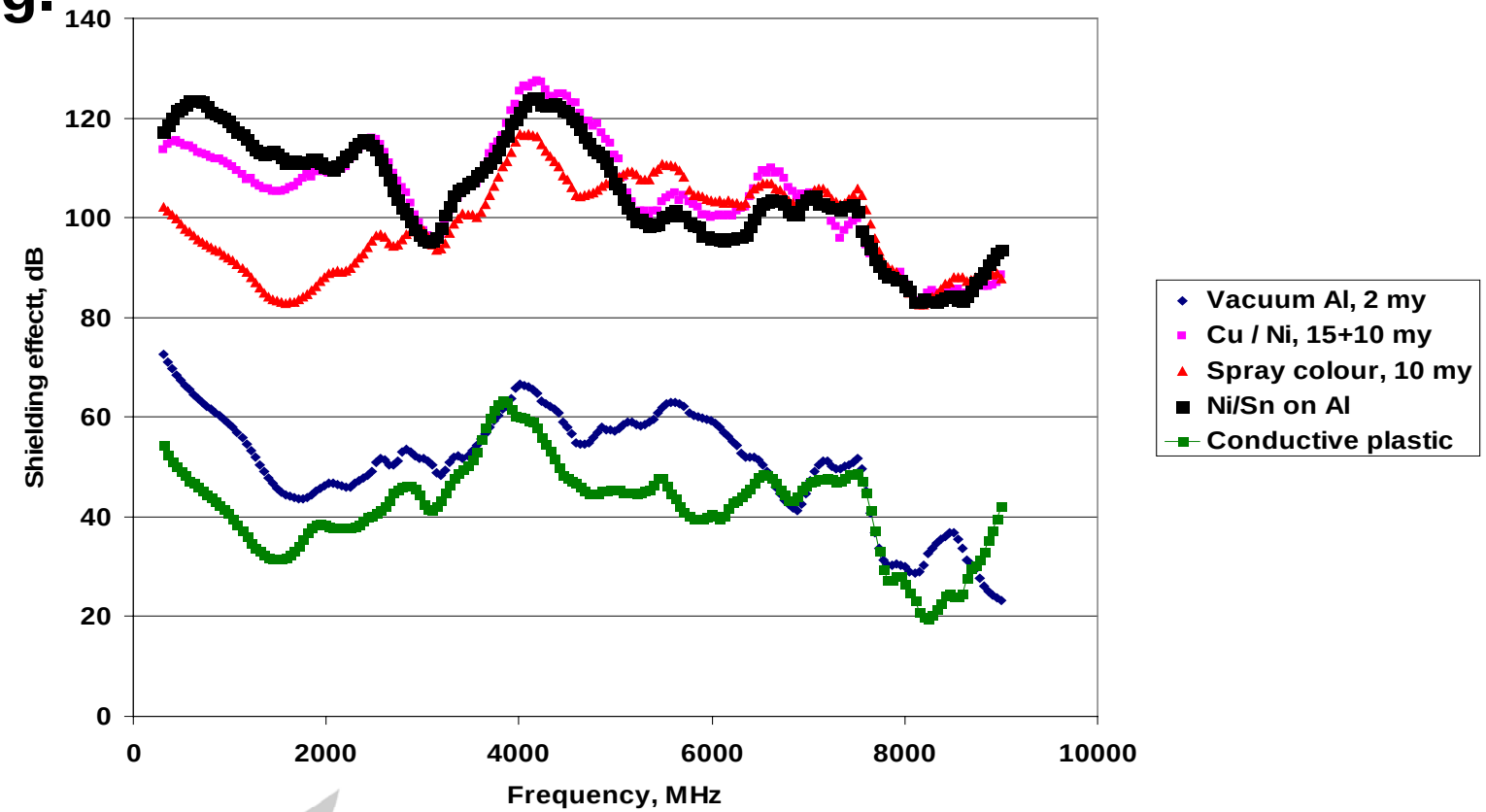
E-CLPS 4600

- Adhesion with Nolato materials are ok.
- Electrical resistance and shielding effect similar to chromated surfaces.
- The only “problem” we have seen is the fact that it, just as chromate do not “cover” inhomogenity in the surface. This gives a problem to measure and specify maximum electrical resistance for the gasket.

Trishield™

Shielding Effect Plastic Plating

Measured on shieldcan ”Anna”. Can is made of PC/ABS. Gasket Nolato 8800. Comparing different plating material before ageing.



Trishield™

Shielding Effect Plastic Plating

Measured on shieldcan ”Anna”. Can is made of PC/ABS. Gasket Nolato 8800. Comparing different plating material before ageing result as average shielding 0.3-9 GHz.

Material	Shielding effect
	dB
Conductive plastic A220HT	25
Conductive plastic A240HT	44
Plastic can vacuum metallised Al	51
Plastic can with conductive paint	98
Plastic can with chem. Cu/Ni	105
Al can with Ni/Sn plating	107
Al can without any plating	70

Trishield™

Gasket Design

- Gasket height should be enough to fill gap between housing and PCB.
- Min compression 5 % for electrical contact.
- Recommended compression 10-50%.
- Normal gasket height between 0,5 and 2 mm.
- The gasket width should be as narrow as possible but it is set by the gasket height.
- Stand off to control compression is required
- Our Engineers will assist you to make sure your design is optimized.

Trishield™

Dispensing design

- Plan for shortest and quickest needle travel.
- Start and stop against another gasket if possible.
- Minimise start and stop in “open air”. Can short gasket segments with open ends be avoided ?
- Place start and stop close to screws to minimise compression problems.

Trishield™

Electrical resistance and Adhesion Specifications

- Electrical resistant as measured on gasket depends on surface conductivity and method.
- Typical specification measured with Nolato R1.

Surface	Max resistance, mohm
Aluminium	50
Ni/Sn plated Al	50
Chromated Al	300-600

- Adhesion is normally specified as min 0,6 N/mm^2 in shear force. Min 7N to survive transportation.

Nominal gasket height, mm	Min adhesion, N/cm
0,8	7
1,3	7
1,8	10

Trishield™

QC in Production

- Nolato visually inspects 100% of production for gasket appearance.
- At Nolato once an hour, one part is taken out from production for measurements. Results stored in SPC database.
  - Gasket height and width
  - Gasket electrical resistance
  - Gasket adhesion

Trishield™

Height and Width

- **Dimensions are best measured using an optical measuring machine.**

Trishield™

Resistance Measurement

- Measured resistance depends on measuring method.
- Nolato R1 method is based on two square electrodes 10x10 mm with a distance of 10 mm. The electrodes are pressed to the gasket with 7,5 N.

Trishield™

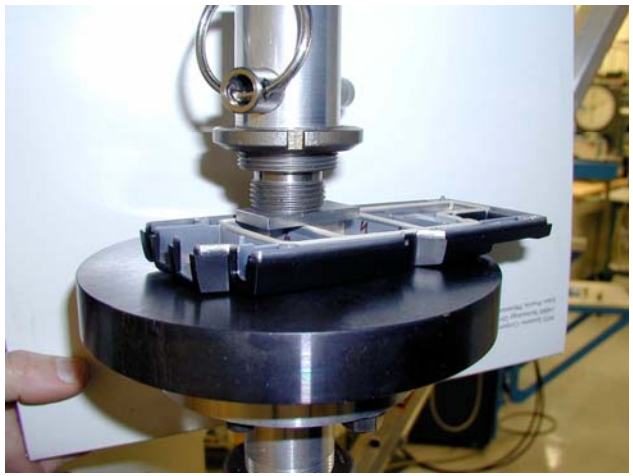
Adhesion Measurement

- Adhesion is measured with a push bar 10x10 mm in square on a Newton meter.
- The push bar is pressed to the gasket base until it is sheared off or bends over.

Trishield™

Compression Force

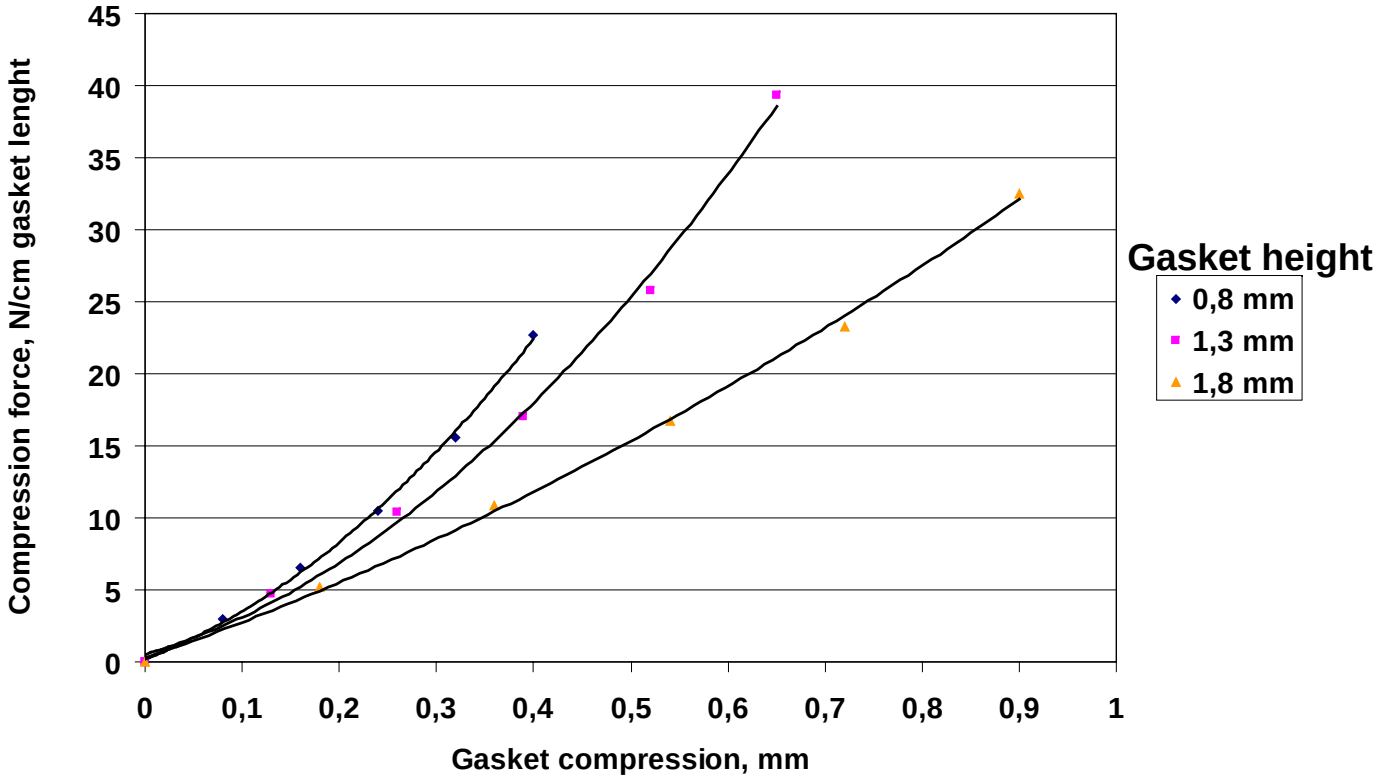
- The force needed to compress a gasket can be predicted by testing or simulation.
- Dispensed gaskets are typically compressed 25 %.
- Compression force depends on gasket height, gasket width and compressed height.



Trishield™

Compression Force

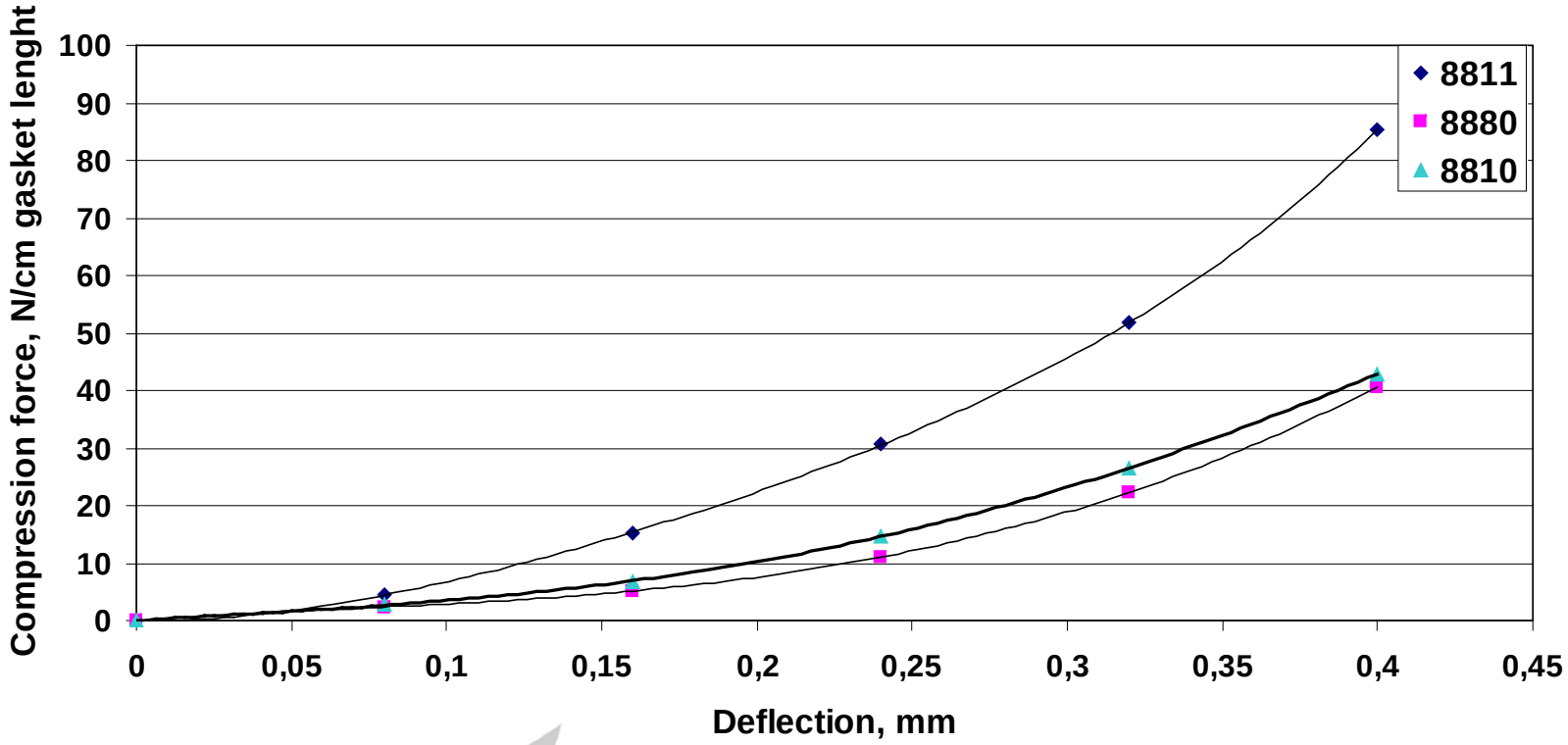
- Example of assembly force measured on three Trishield gaskets Nolato 8800 with different height.



Trishield™

Compression forces

- **Comparing compression force for different materials for 0,8 mm gasket.**



Trishield™

Relaxation

- The measured value of force depends also on measuring method due to the relaxation of the rubber.
- Relaxation is an internal rearrangement of the molecules after compression.
- An equilibrium is reached well within one hour.
- The relaxed force is 75% of original force.

Trishield™

Ageing Properties

- Customers typically age and approve our products as assembled in the application.
- Test method differs but often includes damp heat, dry heat, temperature cycling or acid gases.
- The most severe condition for conductive silicone is damp heat.
- Nolato standard test is 70C / 97%RH and 72 hours as well as dry heat 80 C for 72 hours.

Trishield™

Ageing properties

- Nolato modified MIL STD 285 on Ni/Sn.
- Measured on shield can Anna.
- Average shielding effect 0,3-9 GHz in dB.
- The requirement is checked in each project.

Ni/Sn surface			
Sample	8800	8810	8811
	Shielding effect	Shielding effect	Shielding effect
	dB	dB	dB
Before ageing	100	60	90
Dry heat	81	56	86
Damp heat	78	53	82

Trishield™

Ageing properties

Nolato modified MIL STD 285 on Al.

Al surface			
Sample	8800	8810	8811
	Shielding effect	Shielding effect	Shielding effect
	dB	dB	dB
Before ageing	70	65	100
Dry heat	56	60	100
Damp heat	44	56	101

E-CLPS 4600 surface			
Sample	8800	8810	8811
	Shielding effect	Shielding effect	Shielding effect
	dB	dB	dB
Before ageing	68	69	100
Dry heat	56	70	98
Damp heat	43	59	92

Trishield™

Environmental Ageing

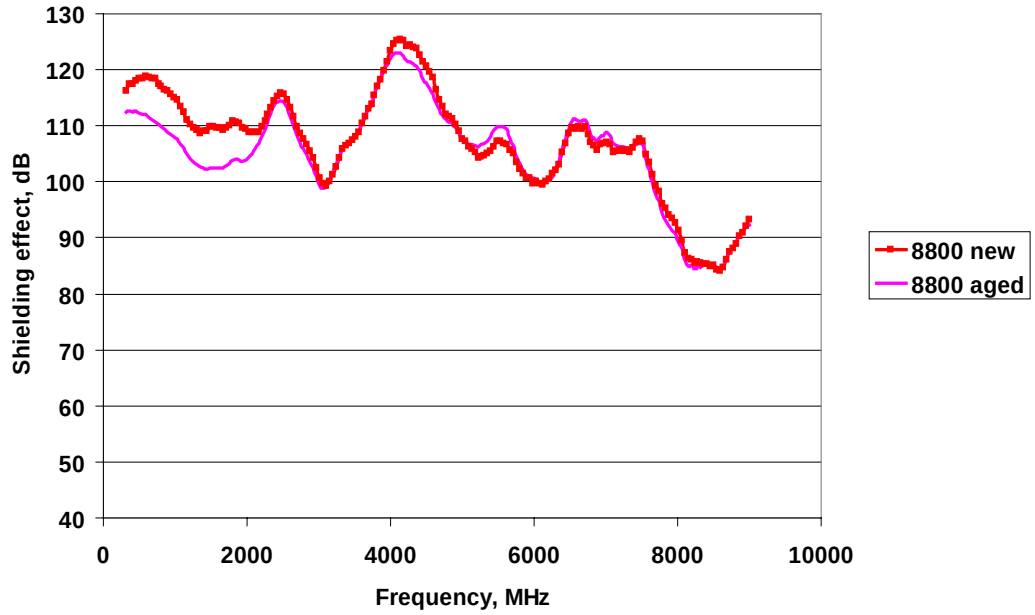
- **Corrosion test according to IEC 60068-2-60, method 2.**

Temperature	**30 +- 1C**
Relative humidity	**70 +- 3 %RH**
Cl2	**10 +- 5 ppb**
H2S	**10 +- 5 ppb**
N2O	**10 +- 5 ppb**
Exposure	**21 days**

Trishield™

Shielding Effect Dispensed Gasket

Measured on shieldcan ”Anna”made of Ni/Sn plated aluminium. Conductive silicone rubber 8800. Comparing new and aged can. Ageing in acid gases



Trishield™