

Resistors

R 8900 (WP 09-XY) Series

REACH Compliant Air Fired Resistor System / DPIS*

* Development Product Information Sheet

Description

The Heraeus resistor R 8900 (WP 09-XY) Series resistor materials are REACH compliant version of R 8900 Series which is part of complete thick film materials system. Materials in this system are designed for production of high reliability, commercial and industrial hybrid microcircuit and resistor networks. The Series is not only entirely free of cadmium and nickel, but also phthalate, and it shows additionally the following key benefits:

Key Benefits

- Excellent noise and STOL values
- Compatible with C 2000 Series (Ni and Cd-free)
- R 8900 (WP 09-XY) Series offers a range of $1 \Omega / \square$ - $1 M\Omega / \square$.
- Free of nickel, cadmium and phthalate
- REACH ¹¹ and RoHS ¹² compliant

Typical Fired Resistor Properties ¹⁾

R 8900 Series ^{2,3}	R 8911 (WP 09-56)	R 8921 (WP 09-81)	R 8931 (WP 09-42)	R 8935 L (WP 09-85)	R 8935 HN ¹⁰ (WP 09-86)	R 8941 N ¹⁰ (WP 09-82)	R 8951 N ¹⁰ (WP 09-43)	R 8961 N ¹⁰ (WP 09-83)
Resistivity ⁴ [Ω/\square]	$10 \pm 10\%$	$100 \pm 10\%$	$1 k \pm 10\%$	$5 k \pm 10\%$	$5 k \pm 10\%$	$10 k \pm 10\%$	$100 k \pm 10\%$	$1 M \pm 10\%$
Temperature coefficient of resistance ⁴ TCR [ppm/K]	0 ± 100	0 ± 100	0 ± 100	0 ± 100	0 ± 100	0 ± 100	0 ± 100	0 ± 100
Voltage coefficient of resistance ^{5,13} VCR [ppm/V/mm]	-	-	-	-	-	- 50	-	-
Short term overload voltage ^{6,13} [V/mm]	9	28	87	155	180	238	497	524
Standard working voltage ^{7,13} [V/mm]	3.6	11	35	62	72	95	199	209
Maximum rated power dissipation ^{8,13} [mW/mm ²]	1300	1280	1220	770	1040	910	395	44
Quantum noise ^{9,13} [dB]	-	- 32	- 21	- 10	- 13	- 10	- 3	-

1) Typical properties based on laboratory test methods. For optimum results all materials should be fired in a profiled furnace supplied by dried, hydrocarbon and other contaminant free air (PP-1).

2) Also available: R 8901 (WP 09-84) (Resistivity: $1 \Omega/\square \pm 20\%$; TCR: ± 250 ppm/K ³⁾; other resistivity values available on request.

3) Processing conditions: termination; Heraeus Silver / Palladium conductor composition C 1214, prefired at 850 °C; substrate: 96% alumina (Ceramtec, Rubalit 708 S); printing: 200 mesh stainless steel screen with 30 μ m emulsion, to a dried thickness of $25 \pm 3 \mu$ m (resistivity $\leq 10 \Omega/\square$: $22 \pm 3 \mu$ m); firing: 60 minute cycle (furnace entry to exit) to a peak temperature of 850 °C for 10 minutes.

4) Shipping specifications: Resistor geometry: 1.5 x 1.5 mm. Temperature coefficient of resistance: -55 °C to +25 °C and +25 °C to +125 °C.

5) Voltage coefficient of resistance: Resistor geometry 1 x 1 mm laser trimmed with P-cut to 1.5 x fired value. VCR measured from 5 - 50 VDC.

6) Short term overload voltage: voltage required (5 seconds duration) to induce a resistance change of 0.1% in a 1 x 1 mm resistor at 25 °C.

7) Standard working voltage: 0.4 x short term overload voltage.

8) Maximum rated power dissipation: (standard working voltage)²/resistance

9) Resistor geometry: 1 x 1 mm

10) Improved pastes with decreased firing sensitivities

11) REACH compliant according to the Commission Regulation (EU) No 143/2011 of 17 February 2011 amending Annex XIV to Regulation (EC) No 1907/2006 of the European Parliament and of the council on the Registration, Evaluation, Authorisation and Restriction of Chemicals ("REACH") by European Chemicals Agency and its subsequent amendments; we define a material as REACH compliant, as long as substances used are not recorded in the Annex XIV.

12) RoHS compliant according to the Directives (European Union) No 2011/65/EC of Restriction of Hazardous Substances ("RoHS") and its subsequent amendments including the exceptions No. 7.c. I of the EU Directive e.g. related to Pb

13) Test made with R 8900 Series

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Processing

1. Stir well prior to processing. When stored in a refrigerator allow paste to come to room temperature to avoid condensation.
2. Print through a 200 mesh stainless steel screen, 30 µm emulsion. Total screen thickness: 90 – 110 µm.
3. Level at room temperature for 5 – 10 minutes.
4. Dry at 150 °C for 10 minutes. Dried film thickness should be 25 ± 3 µm.
5. The electrical performance given in this data sheet refers to a 60 minute firing cycle, with a peak temperature of 850 °C for 10 minutes.

Thinner HVS 100

Typical Properties

Form:	Thixotropic paste
Viscosity:	20 - 50 Pas (25 °C, D = 100 s ⁻¹)
Coverage:	80 - 110 cm ² / g
Shelf life:	6 months from date of shipment with correct storage (in a dry, cool (5 – 25 °C) and dark place with container tightly shut)

Compatibilities

Conductors, various standard terminations:	
Ag	C 1075 S, C 1075 SD
AgPd	C 2000 Series, C 1214
AgPt	C 1076 SD
Au	C 5754 B, C 5007

Overglazes: IP 9025 ST (500 °C)
IP 9029 H (600 °C)

Dielectrics: IP 9117 Series

Blend Break

1. Adjacent decades may be blended to yield intermediate values that conform to R 8900 (WP 09-XY) Series specifications.
2. A blend break exists between R 8931 (WP 09-42) and R 8941 N (WP 09-82) which are not directly blendable, but for blending, two 5 kΩ/□ pastes are available, e.g. R 8935 L (WP 09-85) (compatible with the low-ohmic end R 8931 (WP 09-42)) and R 8935 HN (WP 09-86) (compatible with the high-ohmic end R 8941 N (WP 09-82)).

Laser Trim Stability

All tests were performed on 1 x 1 mm resistors, not overglazed, and terminated with C 1214 (Ag/Pd).

Trimming Parameters

Trimming to 1.5 times the fired value with a Nd-YAG-laser with a single plunge cut

Trim Speed:	10 - 30 mm/s
Q-Rate:	2 - 5 kHz
Average Power:	0.8 - 1.5 W

Trim Performance

Initial Accuracy: ± 0.1 %

Long Term Stability (1000 hrs):
85 °C/ 85 % RH: ± 0.2 %

150 °C aging: ± 0.2 %

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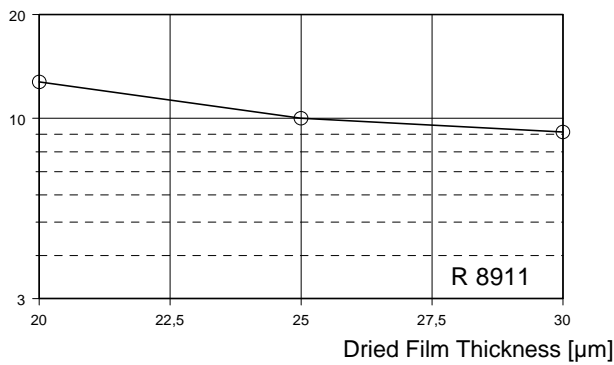
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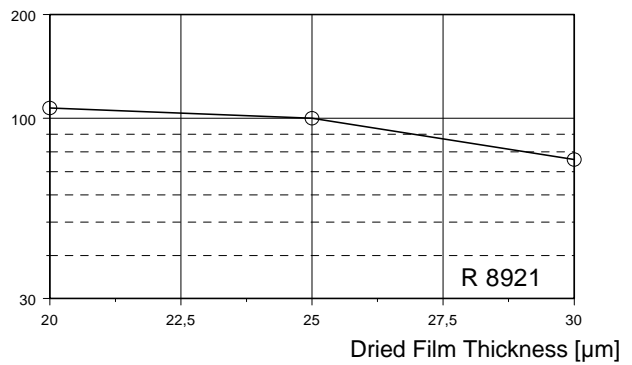
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Annex 1. Effect of Film Thickness on Resistivity

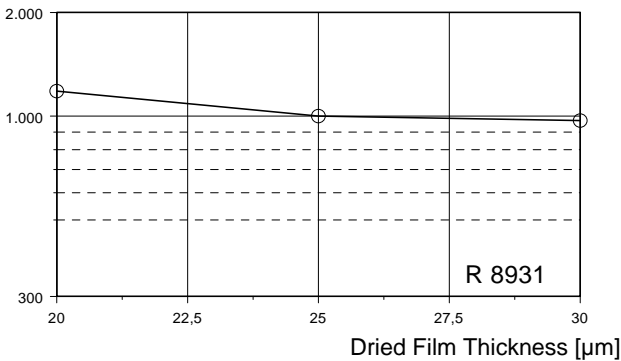
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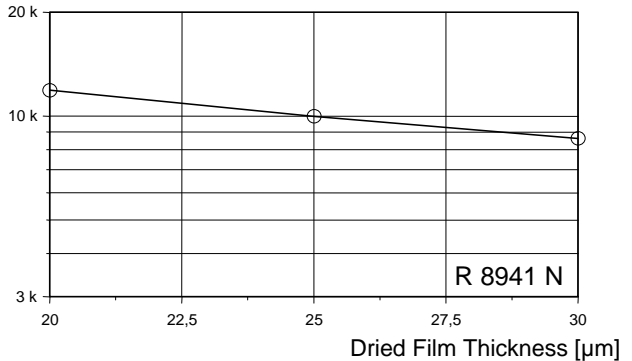
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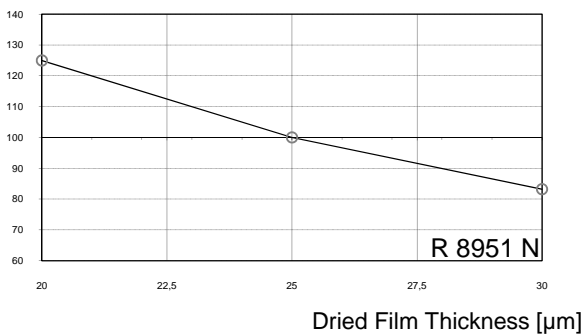
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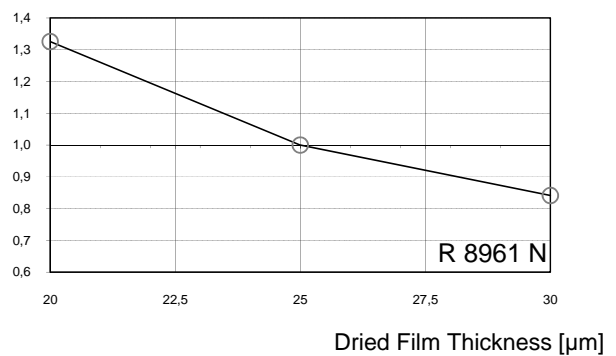
Resistivity [Ω/\square]



Resistivity [$\text{k}\Omega/\square$]



Resistivity [$\text{M}\Omega/\square$]



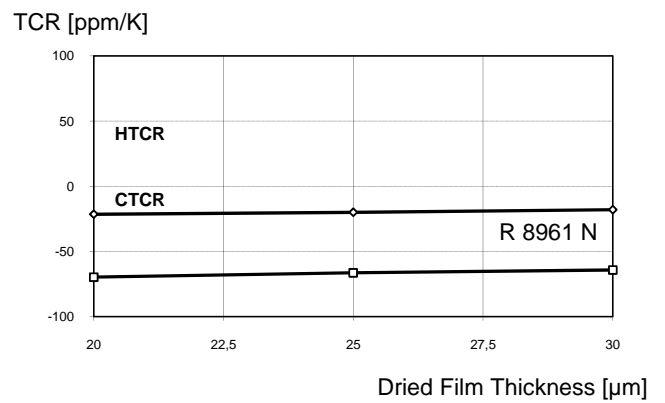
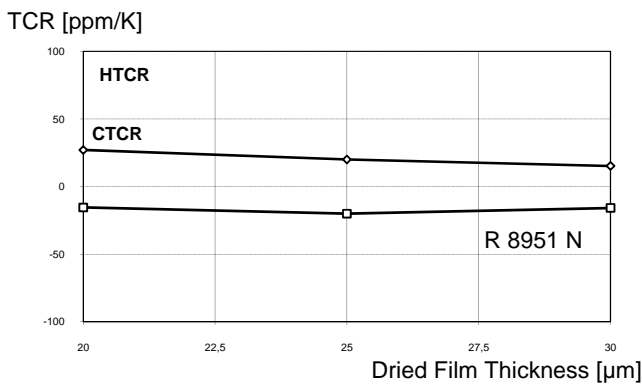
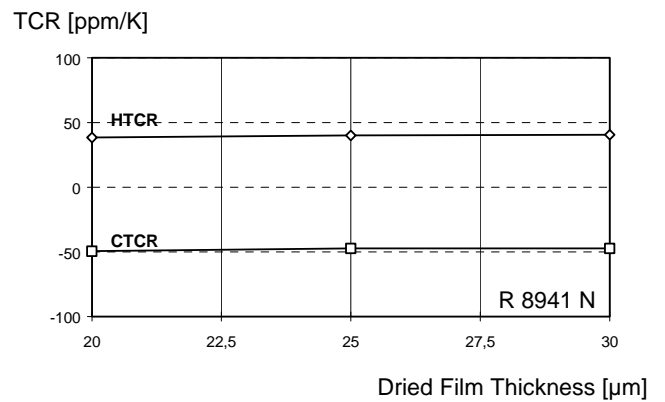
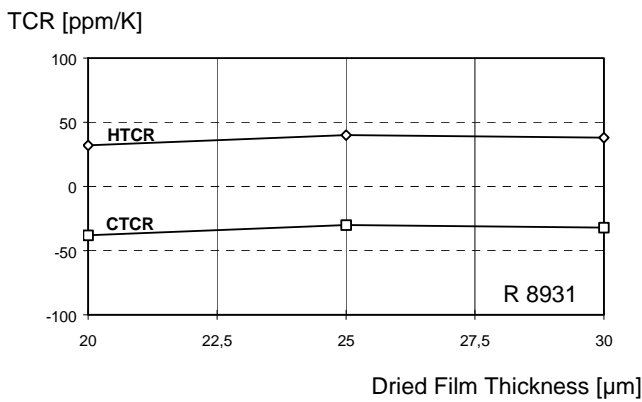
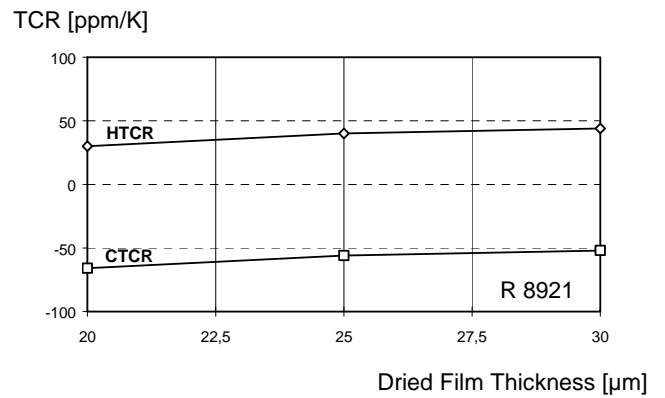
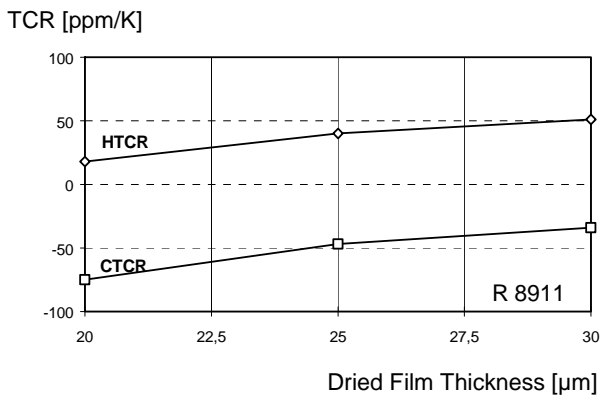
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Annex 2. Effect of Film Thickness on TCR



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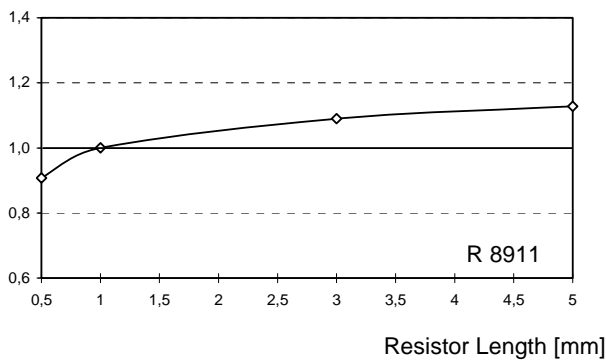
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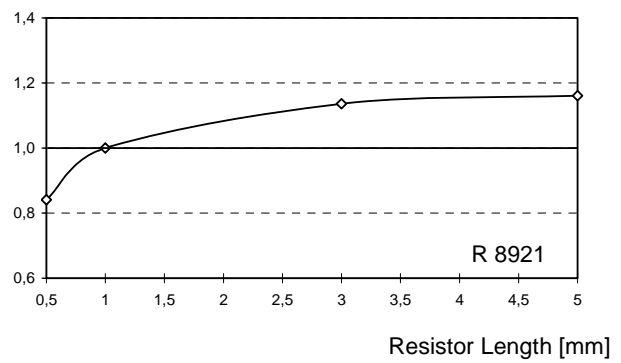
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Annex 3. Effect of Resistor Length on Resistivity

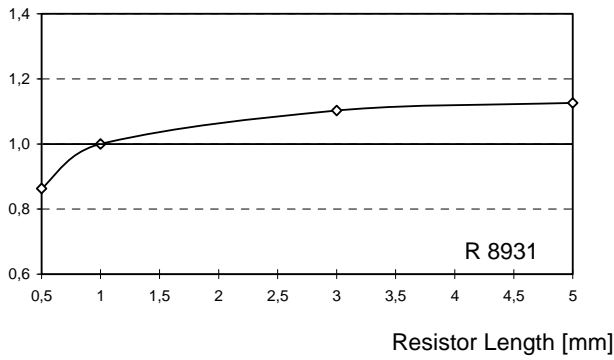
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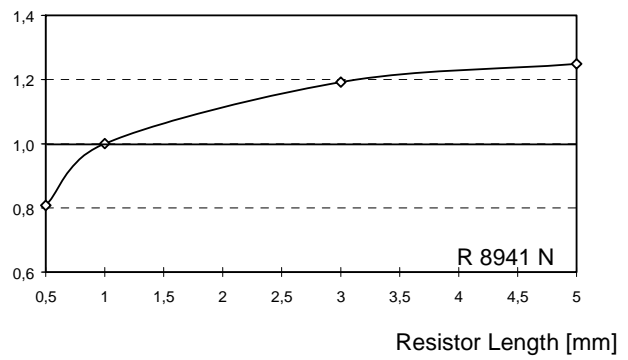
Rel. Resistivity



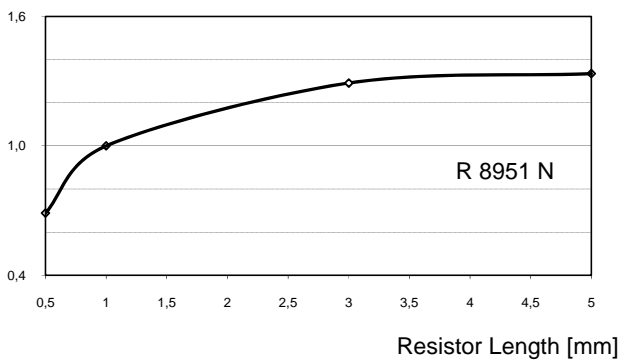
Rel. Resistivity



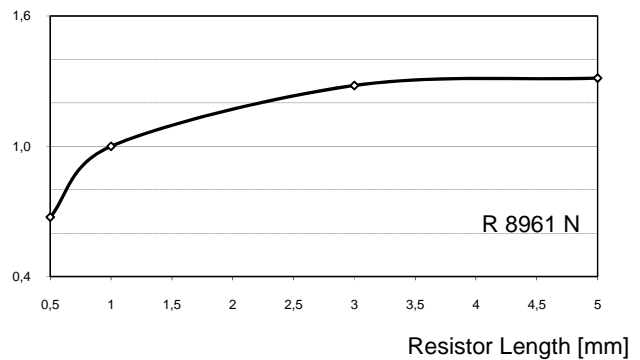
Rel. Resistivity



Rel. Resistivity



Rel. Resistivity



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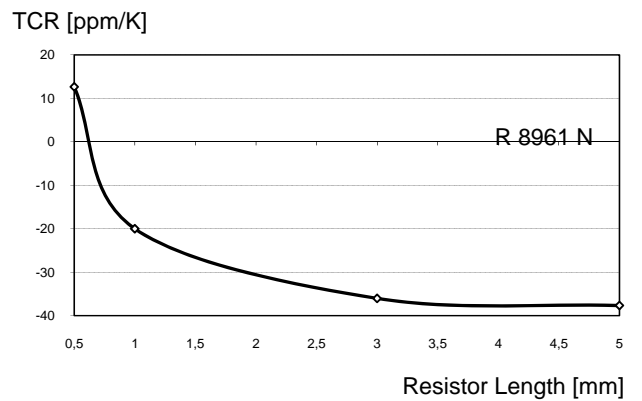
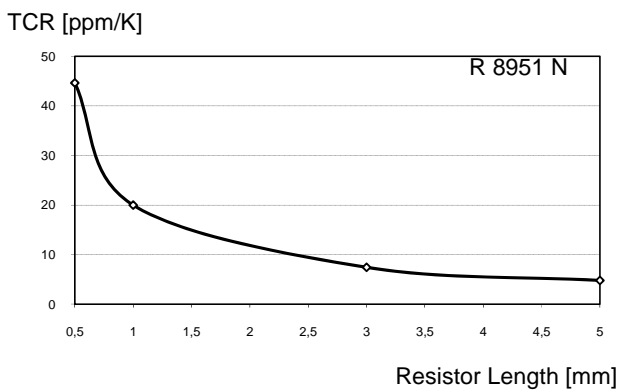
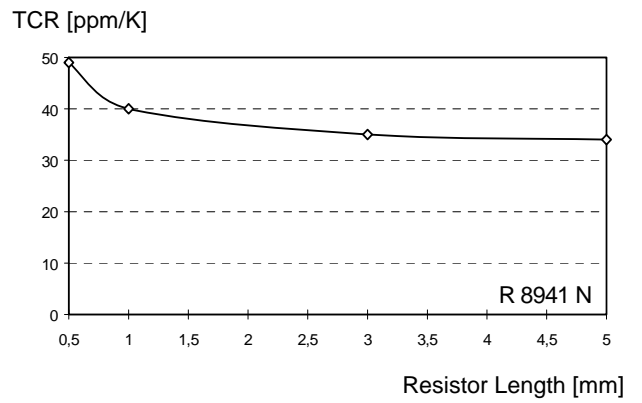
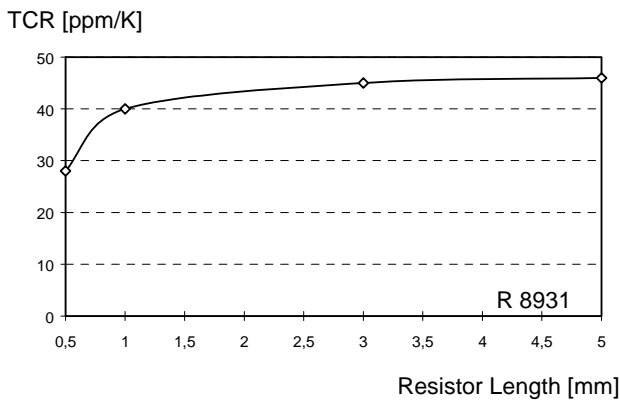
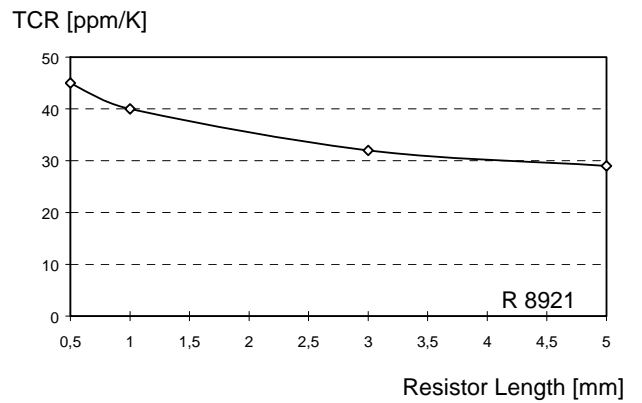
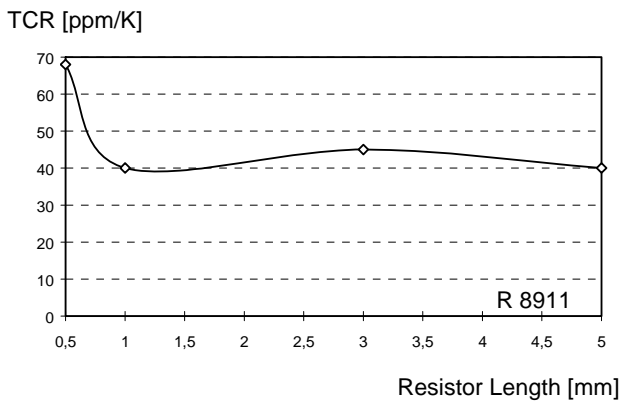
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Termination : C 1214 Ag/Pd ; Resistor width : 1.0 mm

Annex 4. Effect of Resistor Length on HTCR



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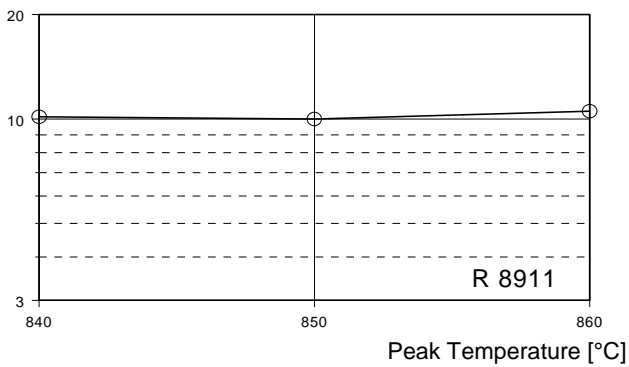
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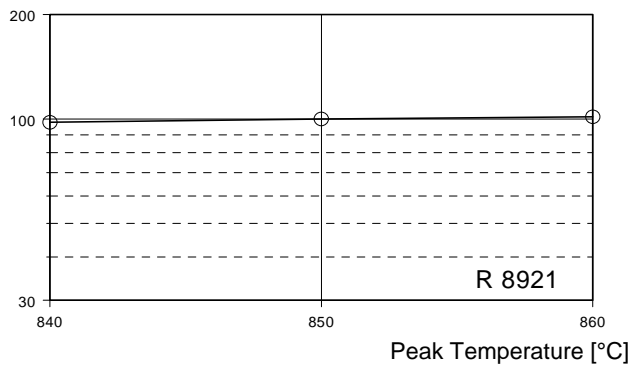
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Annex 5. Effect of Peak Temperature on Resistivity

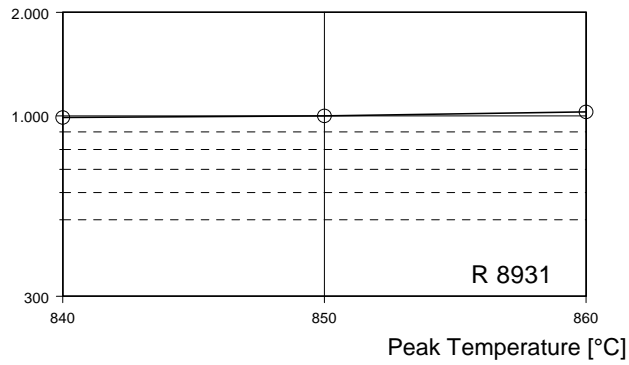
Resistivity [Ω/\square]



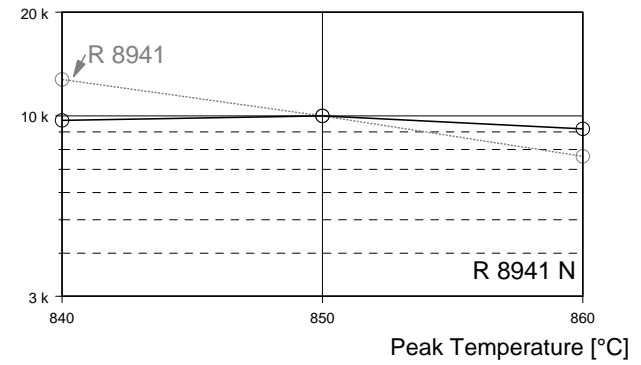
Resistivity [Ω/\square]



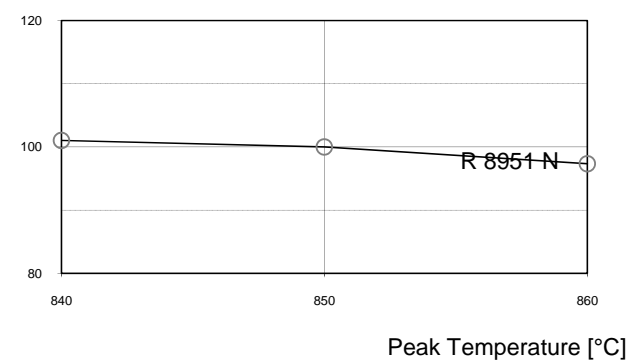
Resistivity [Ω/\square]



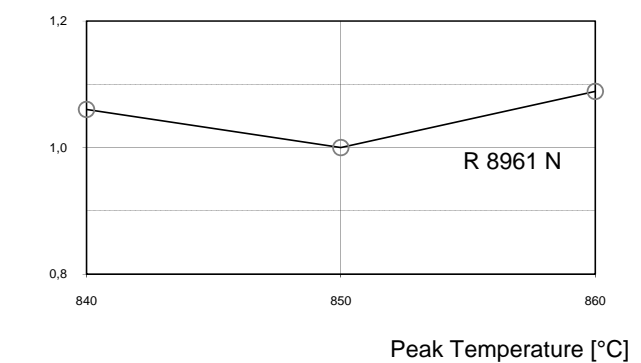
Resistivity [Ω/\square]



Resistivity [$k\Omega/\square$]



Resistivity [$M\Omega/\square$]



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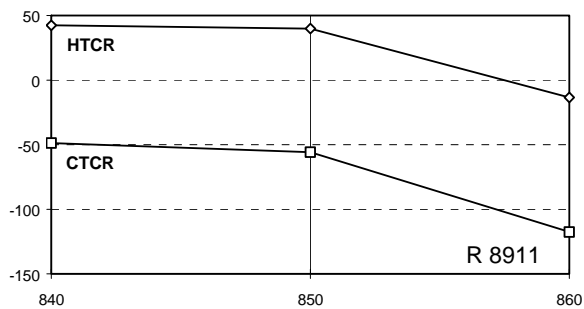
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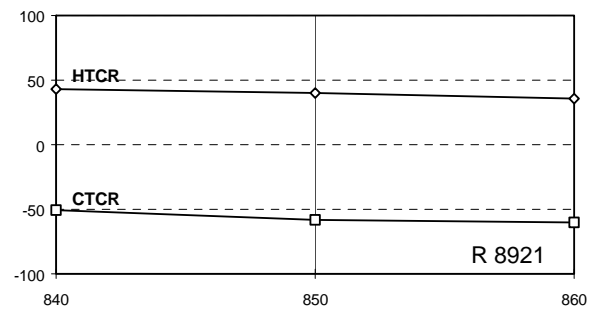
Annex 6. Effect of Peak Temperature on TCR

TCR [ppm/K]



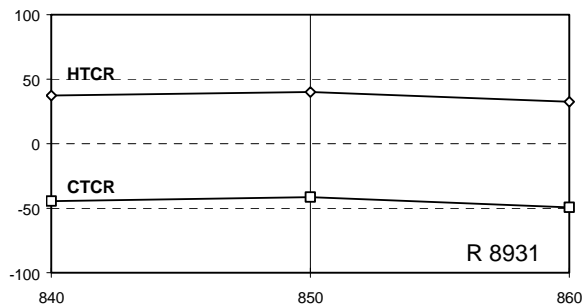
Peak Temperature [°C]

TCR [ppm/K]



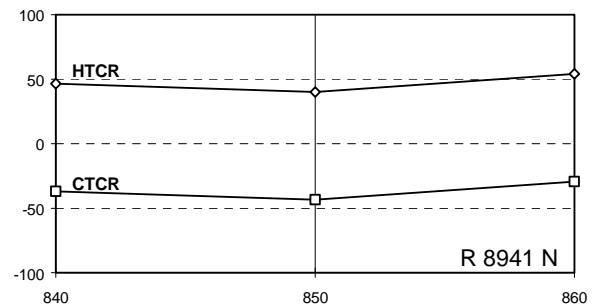
Peak Temperature [°C]

TCR [ppm/K]



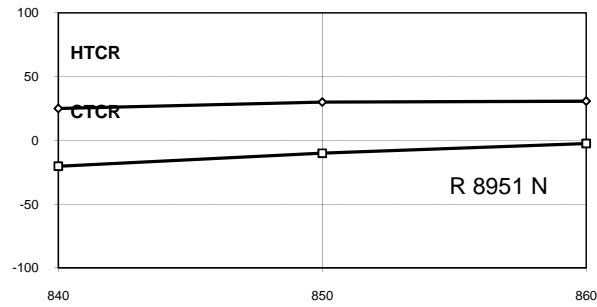
Peak Temperature [°C]

TCR [ppm/K]



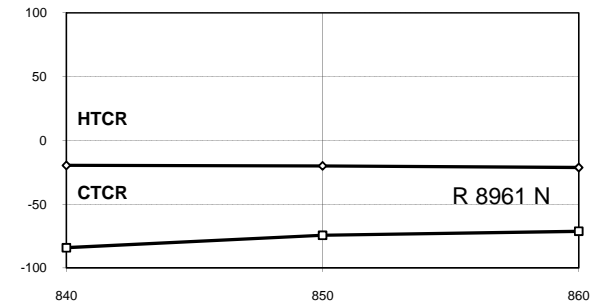
Peak Temperature [°C]

TCR [ppm/K]



Peak Temperature [°C]

TCR [ppm/K]



Peak Temperature [°C]

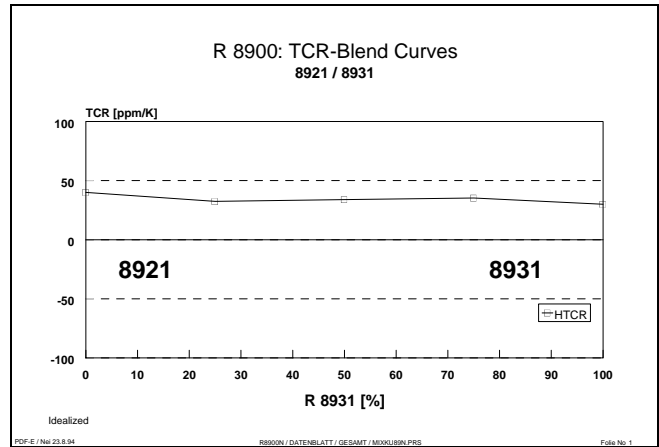
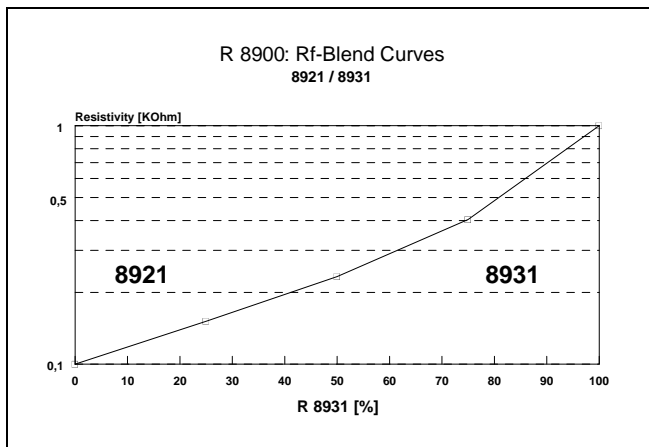
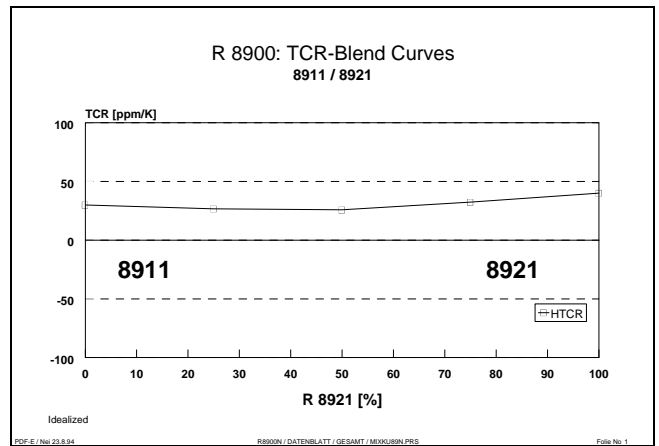
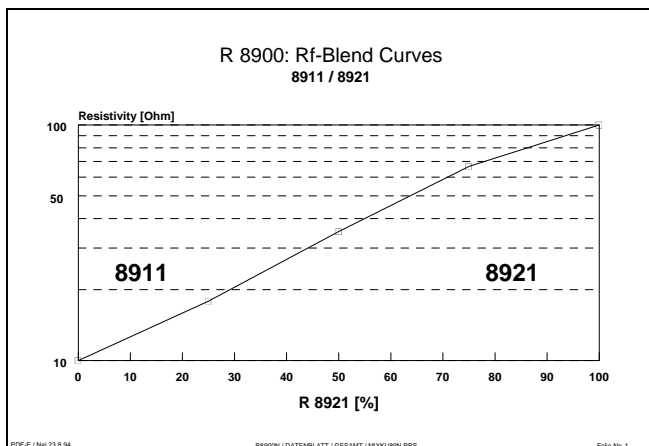
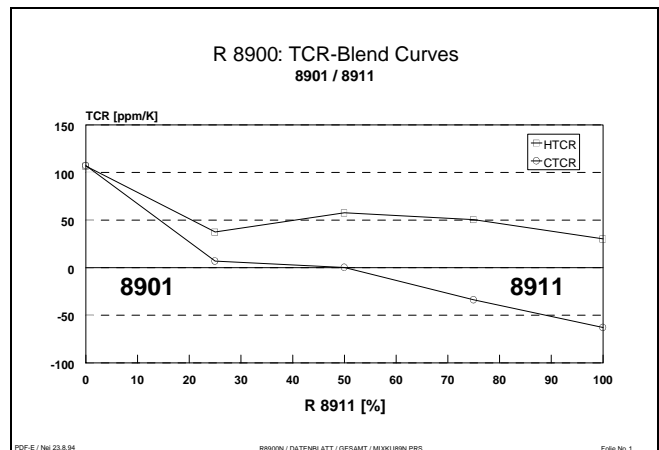
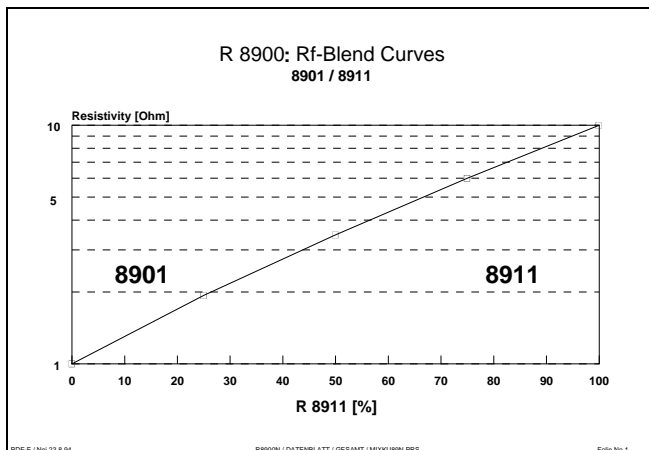
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Annex 7. Blend Curves – Resistance and TCR

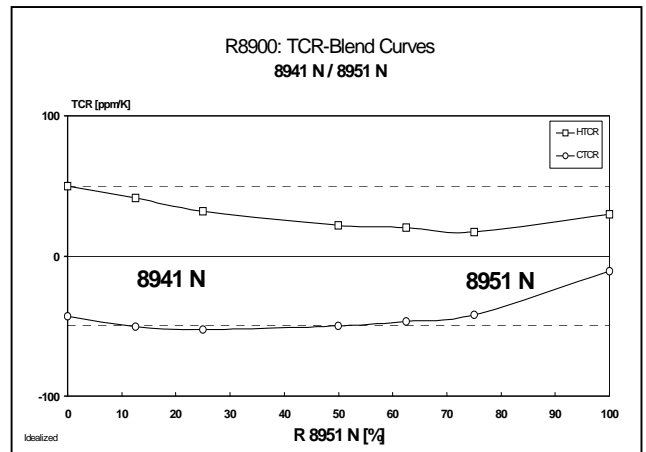
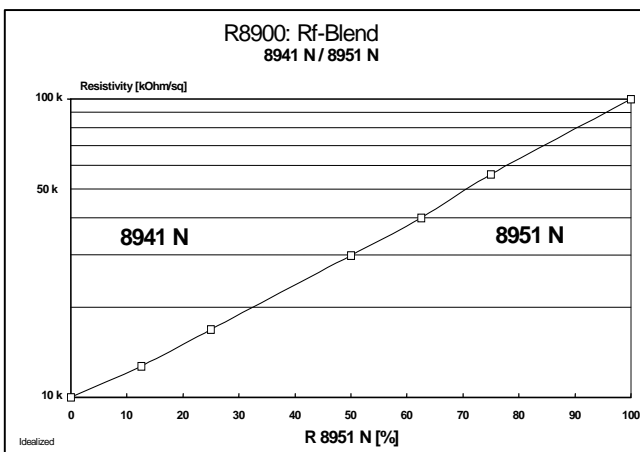
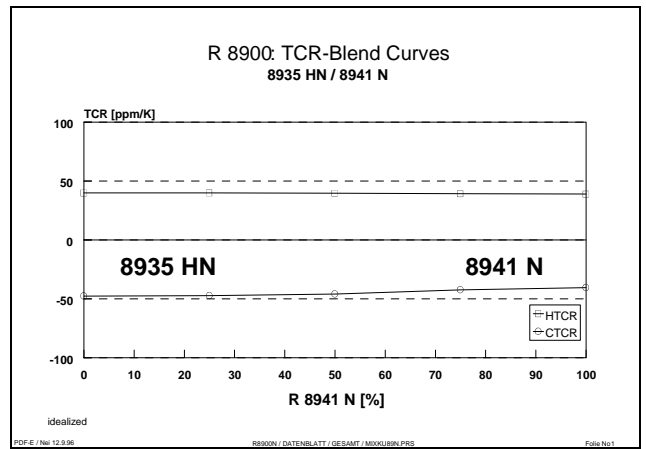
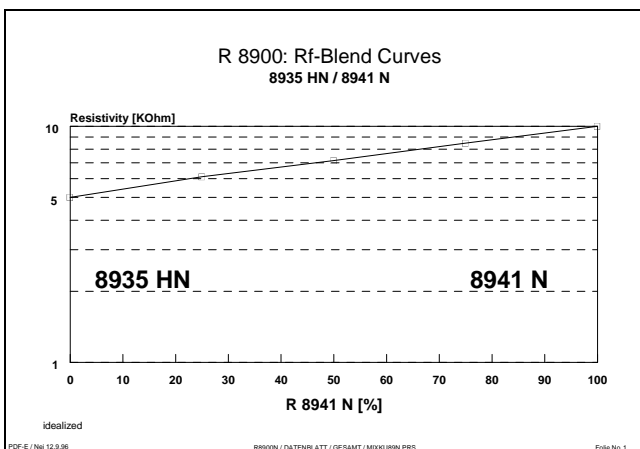
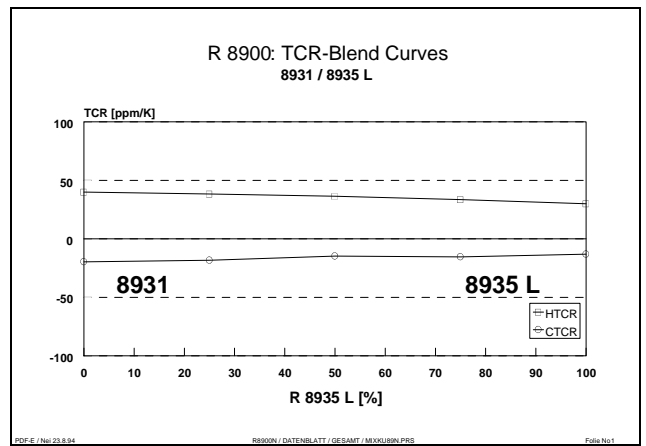
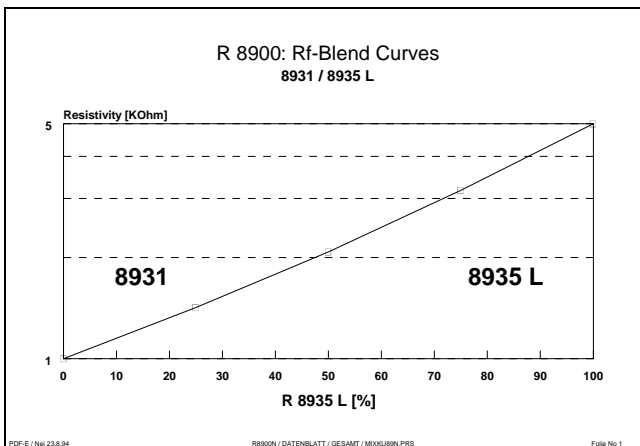


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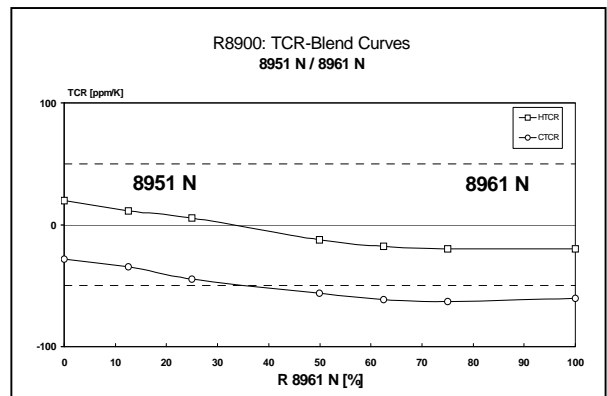
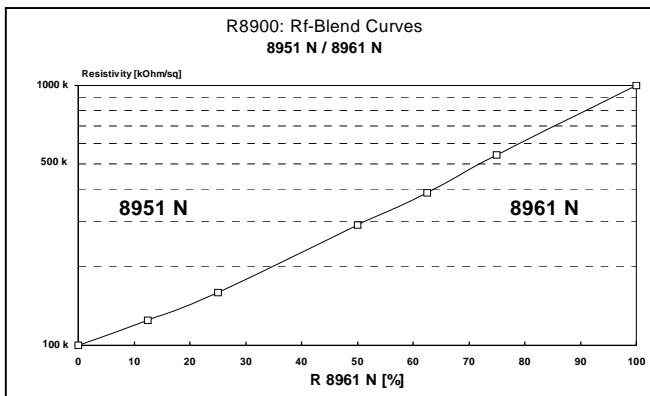


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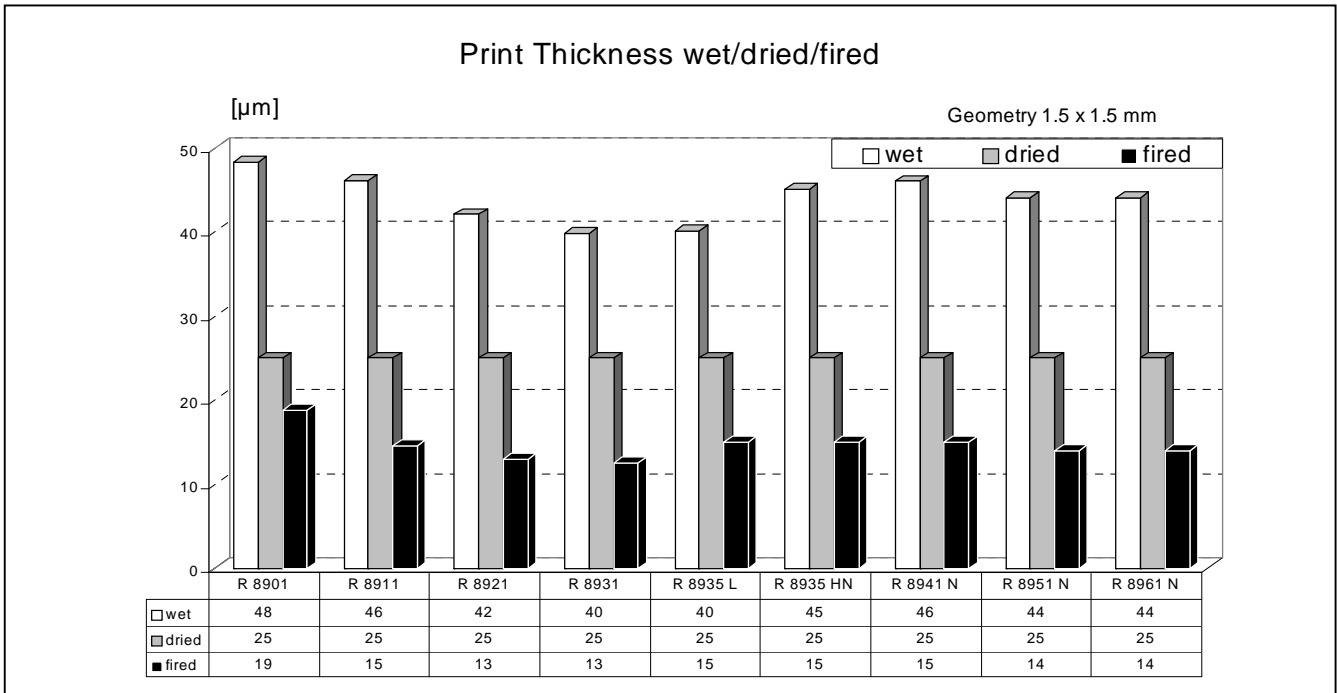
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Annex 8. Print Thickness - wet / dried / fired



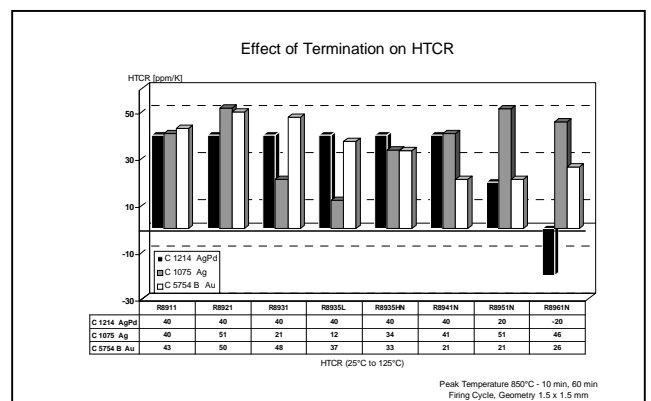
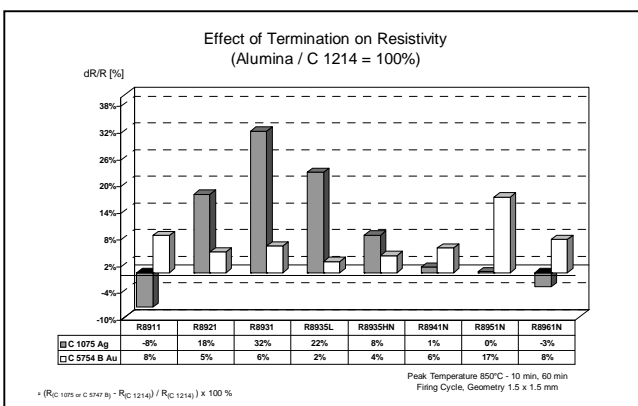
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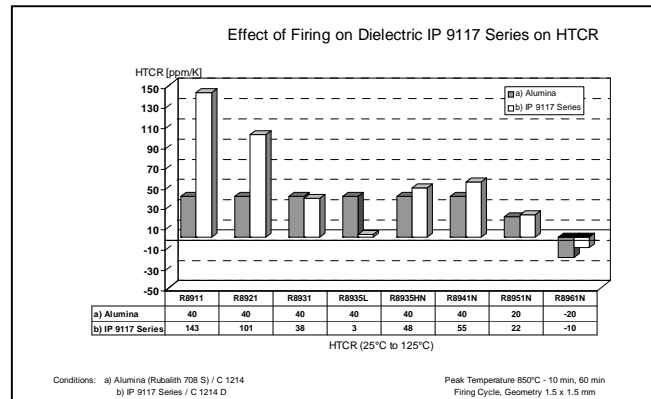
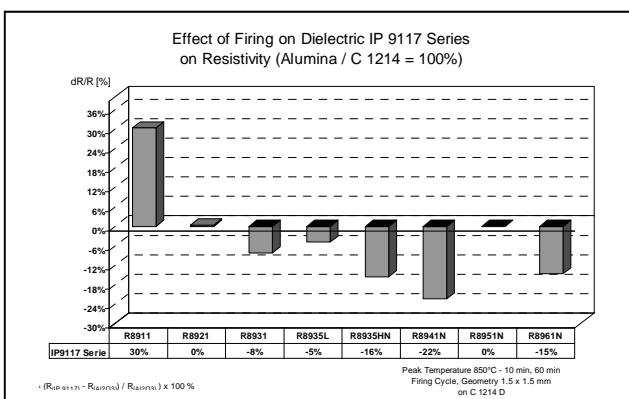
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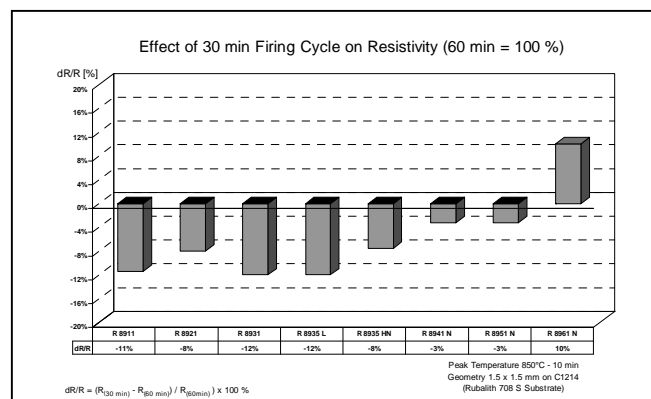
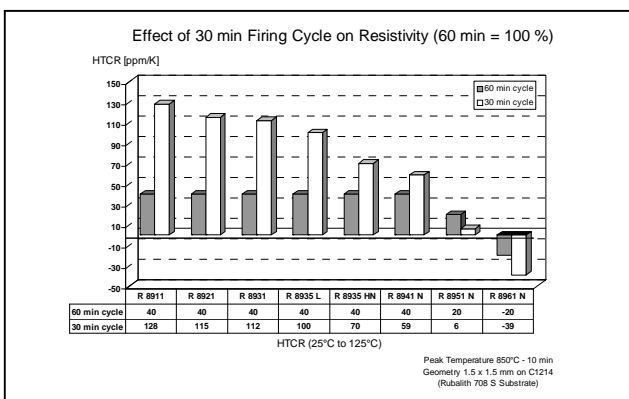
Annex 9. Effect of Termination on Resistivity



Annex 10. Effect of Firing on Dielectric



Annex 11. Effect of Firing Cycle on Resistivity



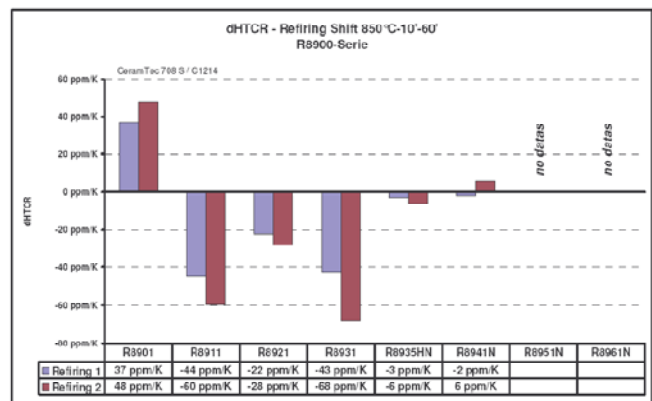
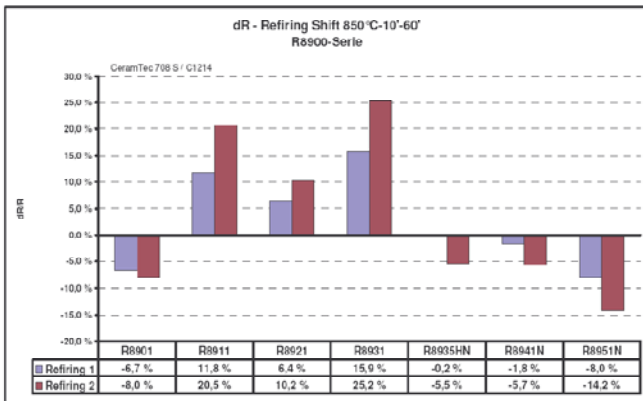
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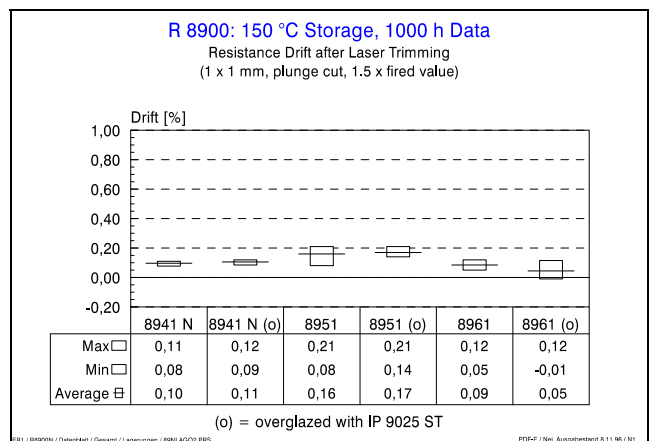
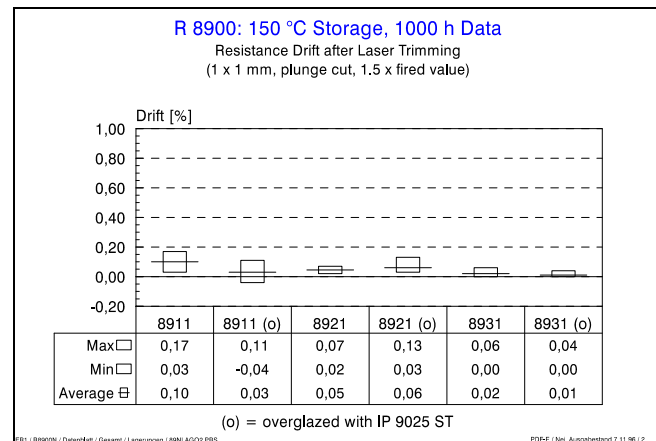
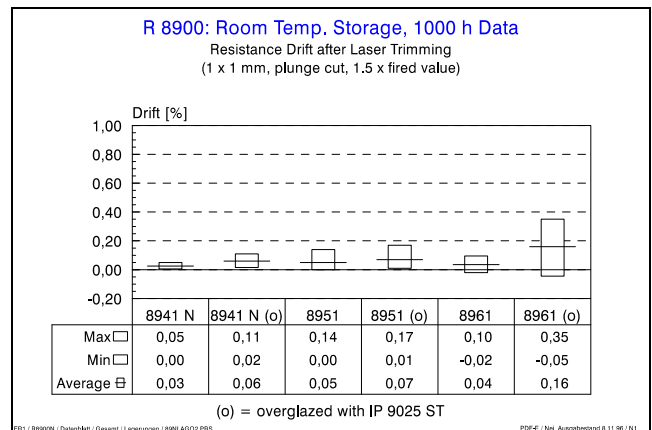
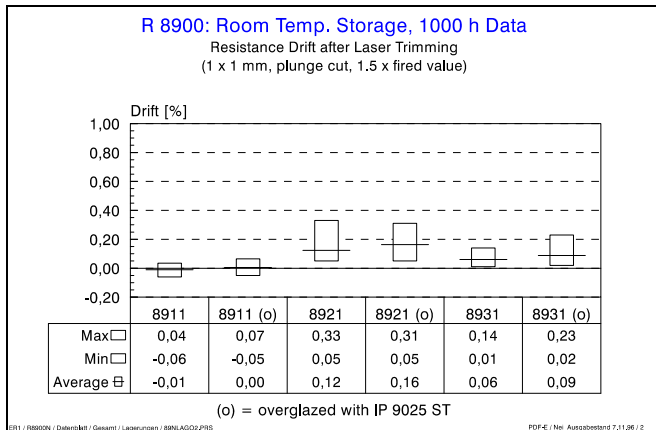
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Annex 12. Re-firing Shift - 850 °C / 10 min / 60 min



Annex 13. Stability with and without overglaze IP 9025 ST

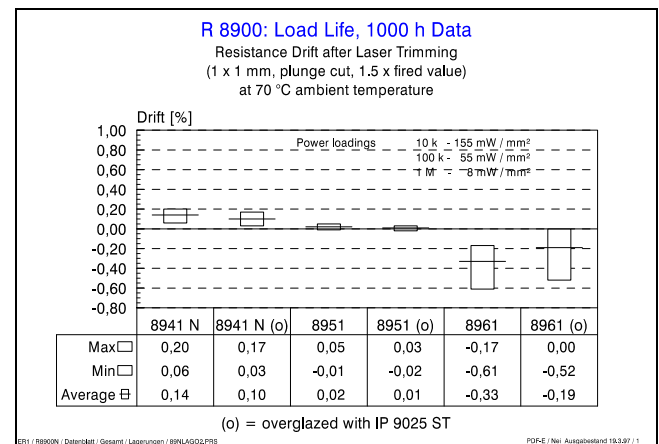
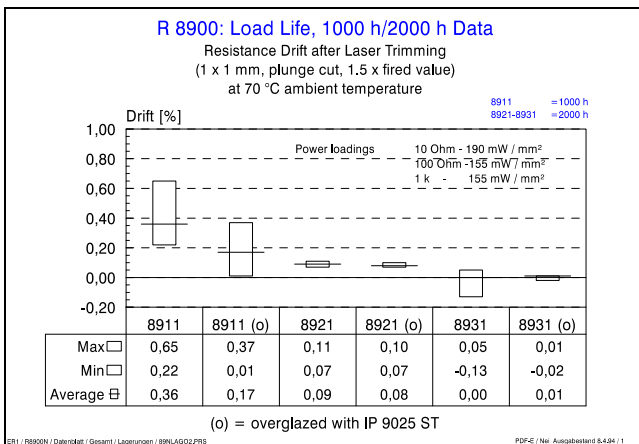
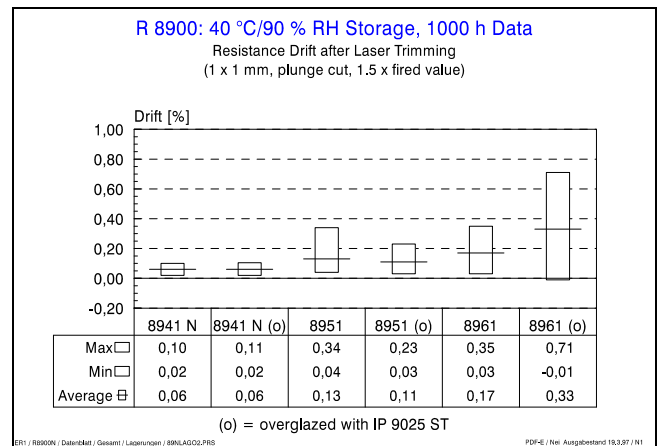
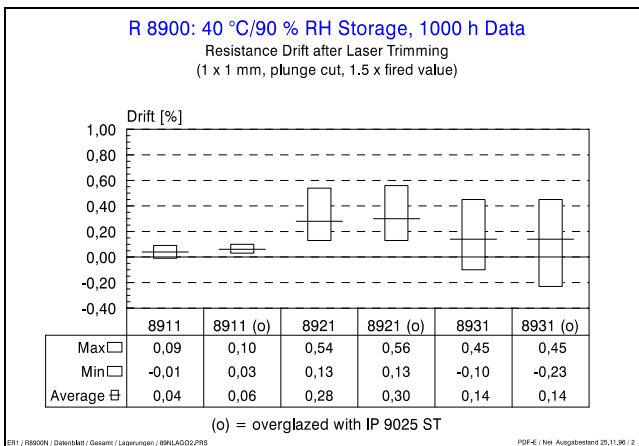
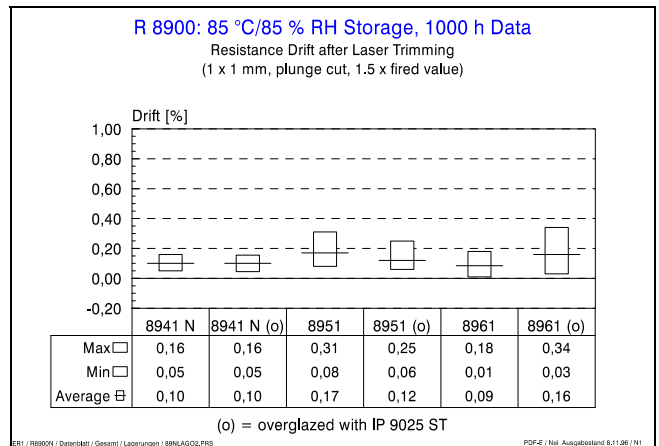
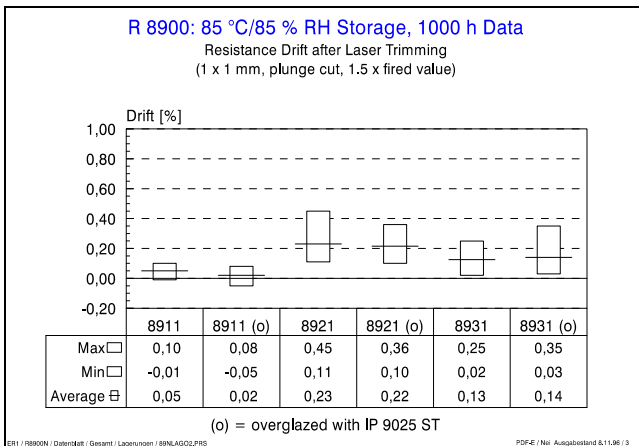


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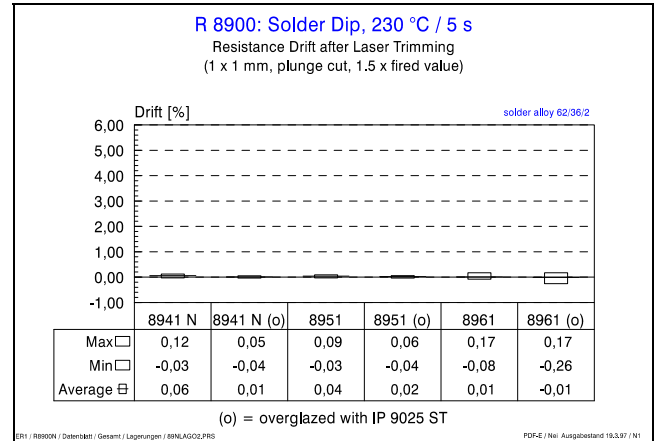
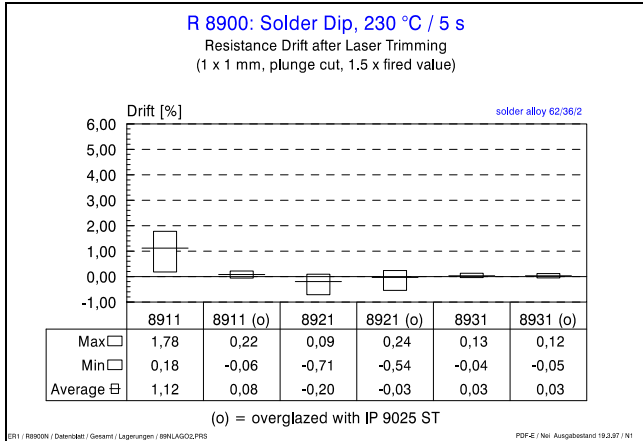
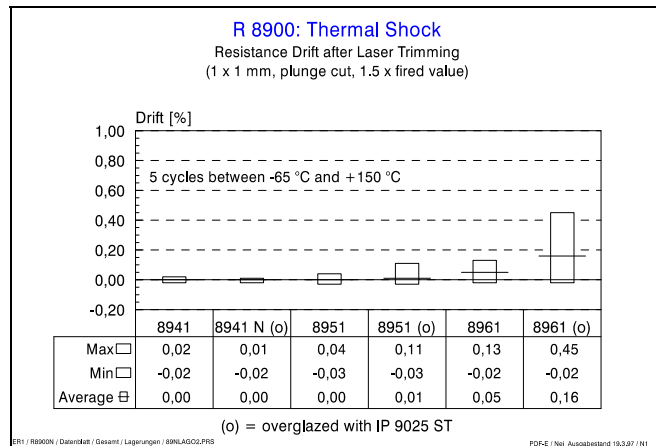
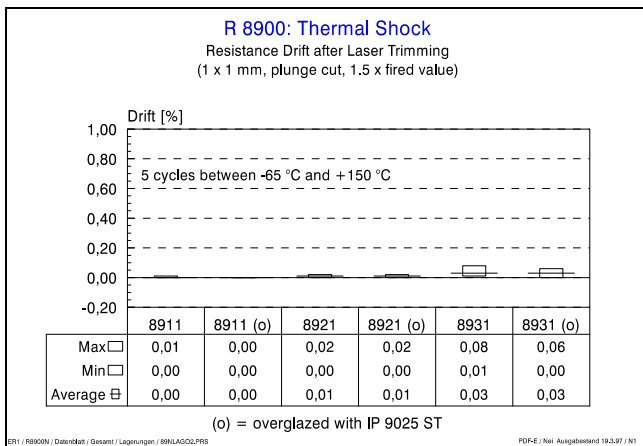


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The descriptions and engineering data shown here have been compiled by Heraeus using commonly-accepted procedures, in conjunction with modern testing equipment, and have been compiled as according to the latest factual knowledge in our possession. The information was up-to date on the date this document was printed (latest versions can always be supplied upon request). Although the data is considered accurate, we cannot guarantee accuracy, the results obtained from its use, or any patent infringement resulting from its use (unless this is contractually and explicitly agreed in writing, in advance). The data is supplied on the condition that the user shall conduct tests to determine materials suitability for a particular application.

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