UL-WEBINAR:

FIRE RETARDANT POLYURETHANE, EPOXY AND SILICONE RESINS FOR PROTECTING AND INSULATING E & E COMPONENTS

WEVO-CHEMIE GmbH, Andreas Arlt, 15 April 2021

AGENDA

1. Brief introduction to the company
2. Comparison of different base chemistries
3. Overview of fire standards and our solutions
4. Thermal ageing testing
5. Thermal management – our thermally conductive solutions
6. E & E applications with a focus on megatrends
7. Summary/takeaways

01

BRIEF INTRODUCTION TO THE COMPANY

WEVO-CHEMIE GMBH

AN INDEPENDENT FAMILY-OWNED COMPANY WITH AN INTERNATIONAL PRESENCE

We are the experts for all encapsulation applications and for special-purpose bonding and sealing applications.

Our resin systems are mainly used in electrical and electronic components – especially in automotive electronics.

WEVO IN FIGURES

1st
IATF 16949 certified supplier in our sector

53
export countries served by Wevo

>75
years of experience in product development and application technology

> 400
Wevo resin formulations available worldwide

1200
customers use our systems

> 2 bn
components casted, bonded or sealed with Wevo products every year

02

COMPARISON OF DIFFERENT BASE CHEMISTRIES: GUIDELINES FOR CHOOSING THE RIGHT INSULATION MATERIAL

PRODUCT PORTFOLIO

THREE PRODUCT CHEMISTRIES FOR CUSTOMISED SOLUTIONS – FOR YOUR REQUIREMENTS

WEVOPUR

OUR VERSATILE
POLYURETHANE SYSTEMS

Balanced systems with
highly configurable profile.

WEVOPOX

OUR CUSTOMISABLE
EPOXY SYSTEMS

High-strength systems with
high thermal stability.

WEVOSIL

OUR HIGH-PERFORMANCE
SILICONE SYSTEMS

High-elasticity systems with
high thermal stability.

- ANTI-CORROSION
- CHEMICAL RESISTANCE
- CONDENSATION PROTECTION
- EX-PROOF
- HERMETIC SEALING
- MECHANICAL STABILITY
- MOISTURE PROTECTION
- MULTI-SUBSTRATE
- RTI
- THERMAL CONDUCTIVITY
- TRANSPARENT
- FLAME RETARDANT

COMPARISON OF PU, EP AND SIL

To help our customers select the right materials, we considered the generics of each chemistry.

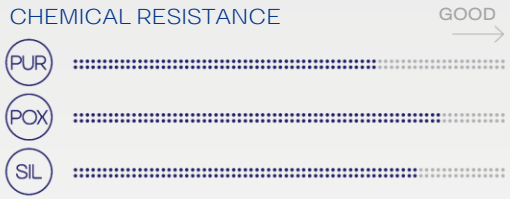
PARAMETER	POLYURETHANE	EPOXY	SILICONE
Room temp. cure	Yes	Yes	Yes
Heat temp. cure	Yes	Yes	Yes
Rigid (D90+)	No	Yes	No
Semi-rigid (D60–85)	Yes	Yes	No
Elastomeric (A60–80)	Yes	No	Yes
Gel (<A40)	Moderate	No	Yes
Thermal conductivity	Yes	Yes	Yes
Flame retardant	Yes	Yes	Yes
Electrical properties	Excellent	Excellent	Excellent
Repairability	Possible	Difficult/Impossible	Possible

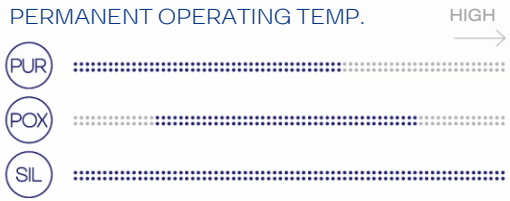
The table shows that today's advancement in material design has created a degree of parity across the three main base chemistries.

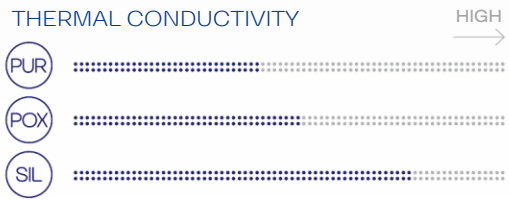
These base chemistries fulfil similar requirements, e.g. curing profiles, flame retardancy and electrical properties. However each chemistry typically incurs a technical trade-off to achieve certain specifications.

THE RIGHT SOLUTION FOR YOU

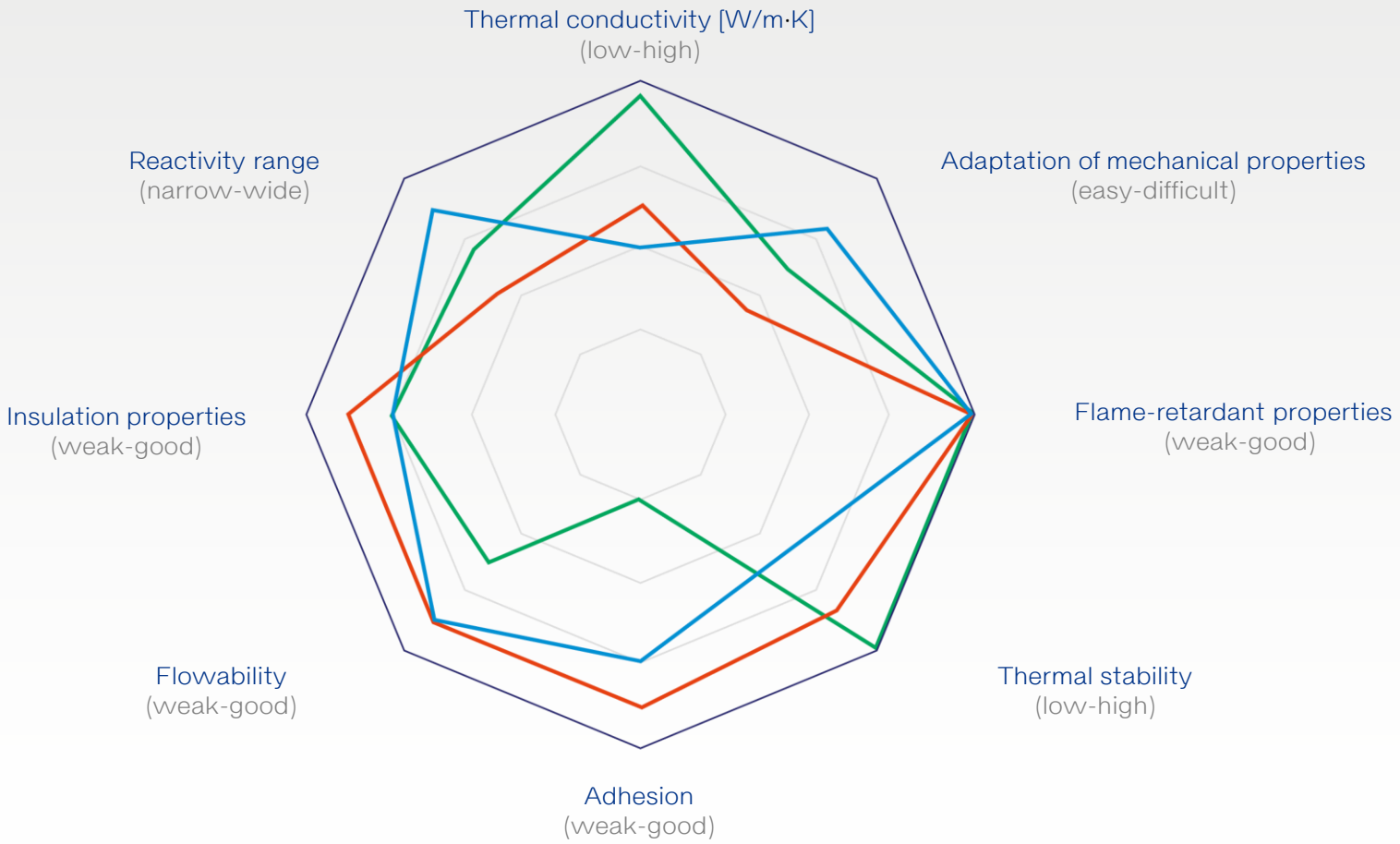
We highlight the typical characteristics that are influenced when modifying chemistries to meet certain challenges. These data can be found from various sources but this then raises the challenge of how the data can be interpreted. We undertook the challenge.







PUR, POX AND SIL: COMPARISON AT A GLANCE



03

OVERVIEW OF FIRE STANDARDS AND OUR SOLUTIONS

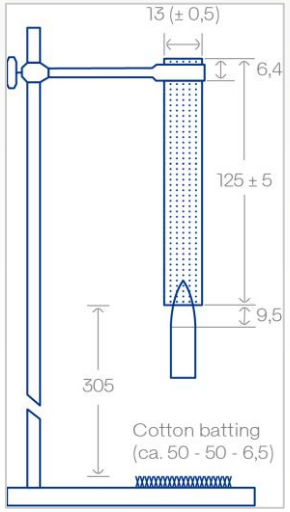
FIRE RESISTANCE UL 94 V

This method is used to determine the UL 94 V-0, V-1 and V-2 flammability ratings.

The test evaluates both the burning and afterglow times and dripping of the burning test specimen.

- Test specimen: 127 mm x 12.7 mm x 1–12 mm
- Test method of vertical test: 2x flame treatments of 10 s

	V0	V2
Burning period after each flame treatment:	≤ 10 s	≤ 30 s
Total burning period 10 specimens	≤ 50 s	≤ 250 s
Afterglow time after the second flame treatment	≤ 30 s	≤ 60 s
Ignition of cotton batting by dripping	no	yes

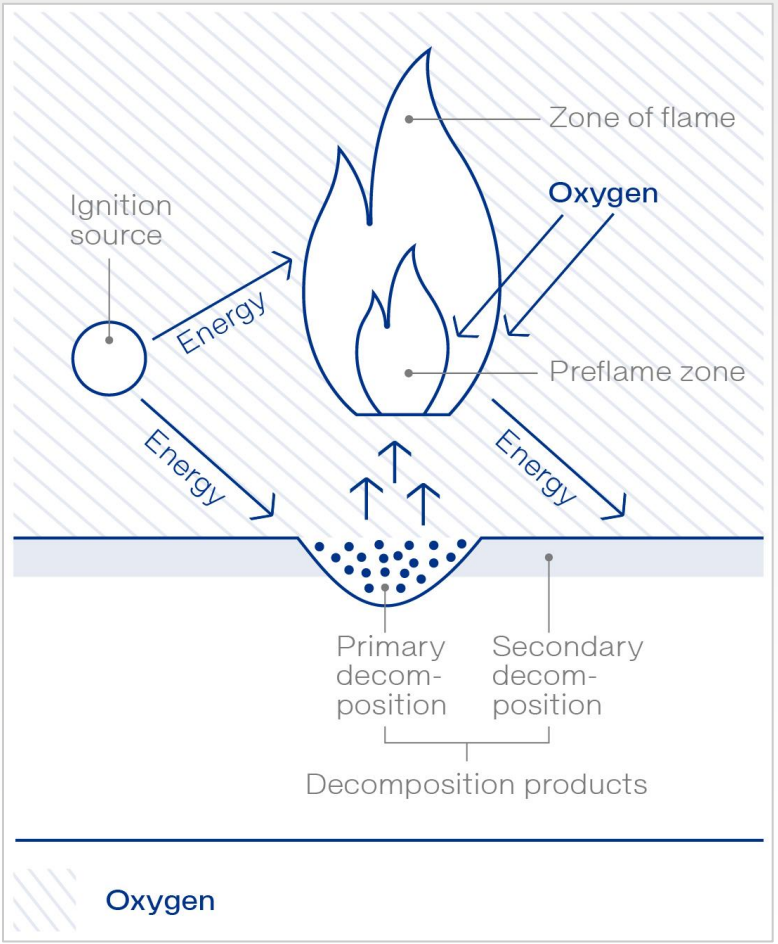


FLAME RETARDANT MECHANISM OF ALUMINUM TRIHYRDATE (ATH)

ATH decomposes at elevated temperatures:

$$Al(OH)_3 \rightarrow Al_2O_3 + 3\,H_2O$$

- Endothermic reaction: consumes energy and consequently cools the flame
- The formed water in addition “dilutes” the combustion gases and reduces the intensity of the flame and eventually extinguishes it
- Another positive effect is the increased thermal conductivity of the material due to the addition of ATH
- ATH can be used in combination with liquid halogene-free flame retardants
- At temperatures above 170–180 °C ATH typically decomposes extremely quickly and forms a lot of gas, so cannot be used in H class insulation systems



RAILWAY FIRE STANDARD EN 45545-2

The test-standard evaluates the fire risk of components and materials used for operating rolling stock in railway transportation systems. The standard and certification includes 3 tests:

1. Smoke density
2. Oxygen index
3. Smoke toxicity

Trains and wagons are categorized via a matrix according to operation categories 1–4 and design categories N, A, D, S and a hazardous level HL 1–3 is determined dependent on the operation and design category:

OPERATION CATEGORY	DESIGN CATEGORY			
	N (normal/standard)	A (automatic operation)	D (double check)	S (sleeping car)
1 Surface operation	HL1	HL1	HL1	HL2
2 Tunnel < 5 km	HL2	HL2	HL2	HL2
3 Tunnel > 5 km	HL2	HL2	HL2	HL3
4 No side evacuation possible	HL3	HL3	HL3	HL3

EN 45545-2: HAZARDOUS LEVELS AND ALLOWED LIMITS

For electrical and electronic components like chokes, transformers, circuit breakers and isolators there are different requirements phrases applicable dependent on their position for interior use (R 22) and exterior use (R 23):

The following matrix shows the allowed thresholds for the different hazardous levels in the applied tests: Oxygen Index, Smoke Density D_s max. and Smoke Toxicity CIT_{NLP}

				HL 1	HL 2	HL 3
R22 (interior use) (IN16, EL2, EL6A, EL7A, M2)	T01 / EN ISO 4589-2: OI	Oxygen content %	Minimum	28	28	32
	T10.03 / EN ISO 5659-2: 25 kWm^{-2}	D_s max. dimensionless	Maximum	600	300	150
	T12 / NF X70-100-1 and -2, 600 °C	CIT_{NLP} dimensionless	Maximum	1.2	0.9	0.75
R23 (exterior use) (EX12, EL2, EL5 EL6B, EL7B, M3)	T01 / EN ISO 4589-2: OI	Oxygen content %	Minimum	28	28	32
	T10.03 / EN ISO 5659-2: 25 kWm^{2}	D_s max. dimensionless	Maximum	–	600	300
	T12 / NF X70-100-1 and -2, 600 °C	CIT_{NLP} dimensionless	Maximum	–	1.8	1.5

EN 45545-2: APPROVED WEVO RESINS

	WEVOPUR 403 FL	WEVOPUR 9251 FL	WEVOPUR 552 FLX	WEVOPUR 552 FL	WEVOPUR 512FL/50	WEVOPUR 512 FLE	WEVOPUR 67210 FL	WEVOPOX 36001 FL
	WEVONAT 300 RE	WEVONAT 300 RE	WEVONAT 300	WEVONAT 300	WEVONAT 900 E	WEVONAT 900 E	WEVONAT 507	WEVODUR 5001
Sample thickness	2.1–9.9 mm	2.1–9.9 mm	2.2–10.1 mm	2.1–10.2 mm	3.0–10.0 mm	3.0–10.0 mm	10.0 mm	3.1–10.0 mm
Classification R22	HL2	HL2	HL3	HL2	HL1	HL2	HL3	HL2
Classification R23	HL3	HL3	HL3	HL3	HL2	HL3	HL3	HL3

04

THERMAL AGEING TESTING: OUR HEAT-RESISTANT SOLUTIONS

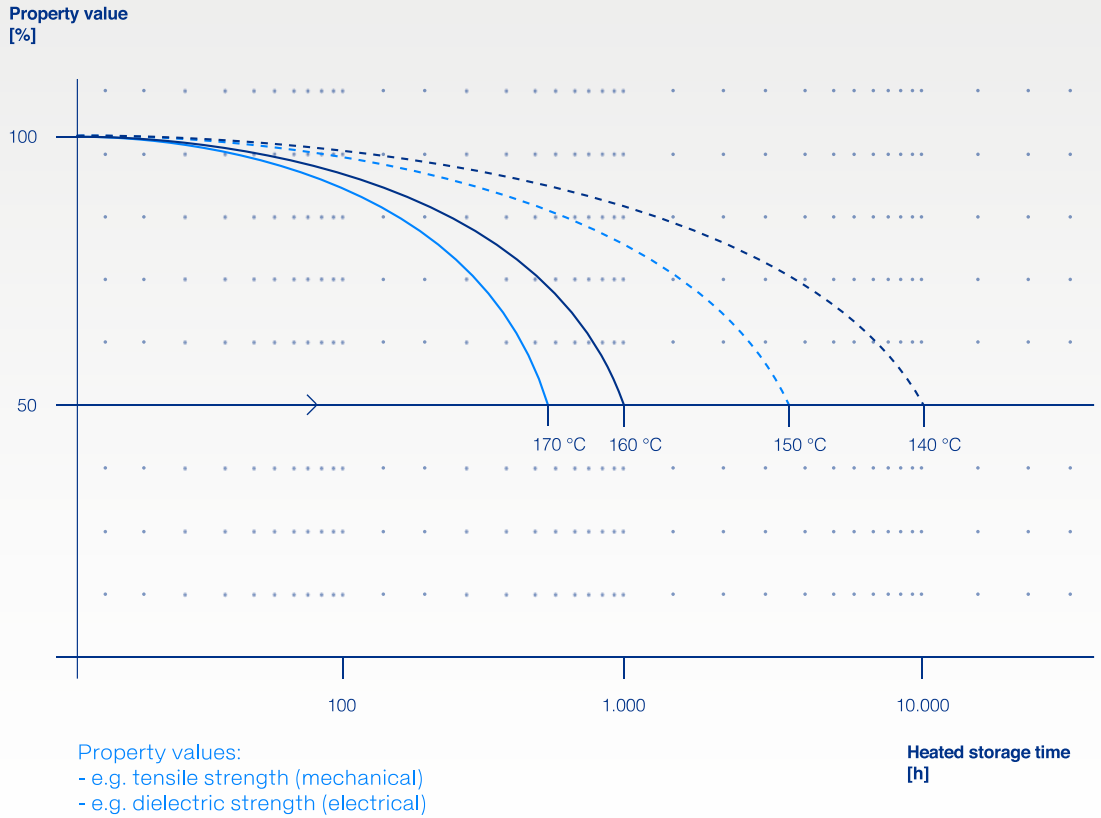
HOT AIR AGEING: RELATIVE TEMPERATURE INDEX (RTI)

The Relative temperature index (RTI) is a characteristic parameter related to the thermal degradation of plastic materials. The RTI is part of the thermal-aging program of the UL 746 B standard.

The degradation of certain properties of the material like the dielectric (RTI Elec) and mechanical strength (RTI Imp and RTI Str) is investigated in force-ventilated hot air cabinets in dependency on the required time.

The test ends when the property value falls below the minimum threshold (50% of the original value) compared to a comparable polymer with an already existing RTI. The time until the property limit is reached is calculated for each individual property (temperature/time pairs).

These pairs are then used to generate a thermal resistance diagram. By extrapolating the results over time, a temperature index (TI, normally after 5,000 and 20,000 hours) can be determined according to DIN EN 60216-1.

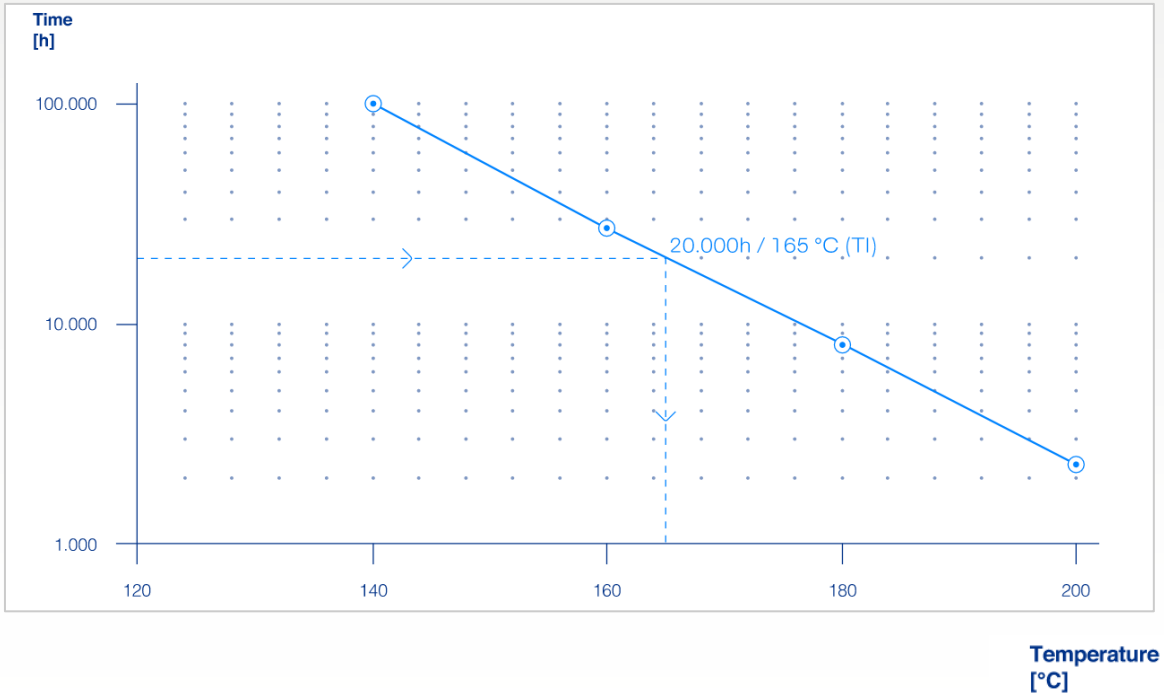


Property values:
- e.g. tensile strength (mechanical)
- e.g. dielectric strength (electrical)

TEMPERATURE INDEX ACCORDING TO DIN EN 60216-1

Example: Thermal Resistance Diagram (Arrhenius) for WEVOPUR 403 with WEVONAT 300

Temperature for 50 % tensile strength loss after 20,000 hours heat storage: 165 °C



THERMAL INSULATION CLASSES

Conventional polyurethane, cold cure epoxy:
Y up to +90 °C
A up to +105 °C
E up to +120 °C
B up to +130 °C

Cold/hot cure epoxy and hybrid polyurethane resin:
F up to +155°C

Hot cure epoxy, silicone and isocyanurate resin:
H up to +180°C

OUR ESTABLISHED AND TRUSTED PRODUCTS

WEVO-CHEMIE „YELLOW CARD"

UL Product iQ™

QMFZ2.E108835 - Plastics - Component

Plastics - Component

See General Information for Plastics - Component

WEVO-CHEMIE GMBH
SCHOENBERGSTRASSE 14
73760 OSTFILDERN-KEMNAT, GERMANY

E108835

Material Dsg	Color	Min. Thk mm	Flame Class	HWI	HAI	Elec	RTI Imp	RTI Str	HVTR	D495	CTI
Epoxy Casting Compound (EP - Casting), furnished as two liquid components.											
EP 8260FL w/Hardener 1018(d)											
	RD	6.0 - 6.6	V-0	-	-	90	90	90	-	-	-
EP 8260FL w/Hardener 520											
	RD	6.0 - 6.6	V-0	-	-	90	90	90	-	-	-
WEVOPOX 2003FL/(b) with WEVODUR 5004(d)											
	BK	6.0	V-0	0	0	-	-	-	-	-	0
		8.0	V-0	0	0	-	-	-			
WEVOPOX 36001FL/(b) with WEVODUR 5001(d)											
	NC, BK	2.0	V-0	0	0	-	-	-	-	-	0
		3.0	V-0	0	0	-	-	-			

(b)
Pot life variation possible

(d)
Hardener variation possible

Sours: https://yellowcards.ulprospector.com/certifications/4530/wevo-chemie-gmbh

WEVOPUR 512 FL, WEVONAT 900

- Low viscosity standard polyurethane potting resin, mixed viscosity: 500 mPas (22 °C)
- Insulation Class B (-40 to +130 °C)
- Elastic: Shore D 35
- Increased thermal conductivity: 0.8 W/m·K
- Railway fire standard EN 45545-2: HL2 (R22/R 23)
- Optimised for low e-corrosion

Typical applications:

- Transformers, inductors, chokes
- EMC filters
- Electronics (PCB potting)
- Capacitors
- Battery and supercapacitor packs and modules

Component - Plastics
File Number: E108835

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OSTFILDERN-KEMNAT, 73760 Germany

PU 512 FL/(b), Hardener 900(c)

Polyurethane (PUR), two liquid components
(b) - May be followed by one or two digits (1-90), denoting potlife
(c) - may be followed by A-ZZ, denoting hardener viscosity

Flammability	Value	Test Method
Flame Rating		UL 94
1.5 mm, NC	V-2	IEC 60695-11-10, -20
4.0 mm, ALL	V-0	
Glow Wire Flammability Index (4.0 mm)	960 °C	IEC 60695-2-12
Glow Wire Ignition Temperature (4.0 mm)	825 °C	IEC 60695-2-13
Electrical	**Value**	**Test Method**
Hot-wire Ignition (HWI) (4.0 mm)	PLC 0	UL 746
High Amp Arc Ignition (HAI) (4.0 mm)	PLC 0	UL 746
Comparative Tracking Index (CTI)	PLC 0	UL 746
Thermal	**Value**	**Test Method**
RTI Elec (4.0 mm)	130 °C	UL 746
RTI Str (4.0 mm)	130 °C	UL 746

WEVOPUR 552 FLX, WEVONAT 300

- Standard polyurethane resin Insulation Class B
- Operating temperature: -40 to +130 °C
- Semi-rigid: Shore D 65–70
- Thermal conductivity: 0.7 W/m·K
- Railway fire standard EN 45545-2: HL 3 (R22/R 23)

Typical applications:

- Transformers, inductors, chokes
- DC-DC converters
- Sensors
- Capacitors
- Battery and supercpacitor packs and modules

Component - Plastics
File Number: E108835

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PU 552 FLX/(b), Hardener 300(c)
Polyurethane (PUR), two liquid components
(b) - May be followed by one or two digits (1-90), denoting potlife
(c) - may be followed by A-ZZ, denoting hardener viscosity

Flammability	Value	Test Method
Flame Rating		UL 94
1.5 mm, ALL	V-0	IEC 60695-11-10, -20
3.0 mm, ALL	V-0	
Electrical	**Value**	**Test Method**
Hot-wire Ignition (HWI)		UL 746
1.5 mm	PLC 0	
3.0 mm	PLC 0	
High Amp Arc Ignition (HAI)		UL 746
1.5 mm	PLC 0	
3.0 mm	PLC 0	
Comparative Tracking Index (CTI)	PLC 0	UL 746
Thermal	**Value**	**Test Method**
RTI Elec		UL 746
1.5 mm	130 °C	
3.0 mm	130 °C	
RTI Str		UL 746
1.5 mm	130 °C	
3.0 mm	130 °C	

WEVOPUR 403 FL/XX, WEVONAT 300 RE

- Standard polyurethane resin Insulation Class F
- Special resin formulation for achieving the high temperature resistance
- Operating temperature: - 50 to +165 °C
- Semi-Elastic: Shore D 40–50, Tg: - 6 °C
- Thermal conductivity: 0.75 W/mK
- Good chemical resistance
- Railway standard EN 45545-2 R22: HL2, R23: HL3

Typical applications:

- Transformers, inductors, chokes
- Automotive electronics
- Motors
- Sensors
- Capacitors

Component - Plastics
File Number: E108835

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PU 403 FL/(b), Hardener 300(c)

Polyurethane (PUR), two liquid components
(b) - May be followed by one or two digits (1-90), denoting potlife
(c) - may be followed by A-ZZ, denoting hardener viscosity

Flammability	Value	Test Method
Flame Rating		UL 94 IEC 60695-11-10, -20
1.5 mm, BK	V-0	
1.9 to 2.0 mm, ALL	V-0	
3.0 mm, BK	V-0	
Electrical	**Value**	**Test Method**
Hot-wire Ignition (HWI)		UL 746
1.5 mm	PLC 0	
1.9 to 2.0 mm	PLC 0	
3.0 mm	PLC 0	
High Amp Arc Ignition (HAI)		UL 746
1.5 mm	PLC 0	
1.9 to 2.0 mm	PLC 0	
3.0 mm	PLC 0	
Comparative Tracking Index (CTI)	PLC 0	UL 746
Dielectric Strength	33 kV/mm	ASTM D149
Thermal	**Value**	**Test Method**
RTI Elec		UL 746
1.5 mm	155 °C	
1.9 to 2.0 mm	155 °C	
3.0 mm	155 °C	

WEVOPUR 60416 FL, WEVONAT 300 RE

- High temperature resistant polyurethane resin (160 °C), Insulation Class F
- Special resin formulation and filler package for achieving the high TC and temperature resistance
- High thermal conductivity: 1.6 W/m·K
- Low CTE: 35/105 ppm/K
- Good thermal shock and tear resistance

Typical applications:

- Transformers, inductors, chokes
- DC-DC converters, OBC
- Powder core chokes
- Power electronics
- Motors
- Automotive sensors and other electronics
- Battery packs and modules

Component - Plastics
File Number: E108835

WEVO-CHEMIE GMBH
SCHOENBERGSTRASSE 14
OSTFILDERN-KEMNAT, 73760 Germany

WEVOPUR 60416 FL / (b) with WEVONAT 300(c)

Polyurethane (PUR), two liquid components
(b) - May be followed by one or two digits (1-90), denoting potlife
(c) - may be followed by A-ZZ, denoting hardener viscosity

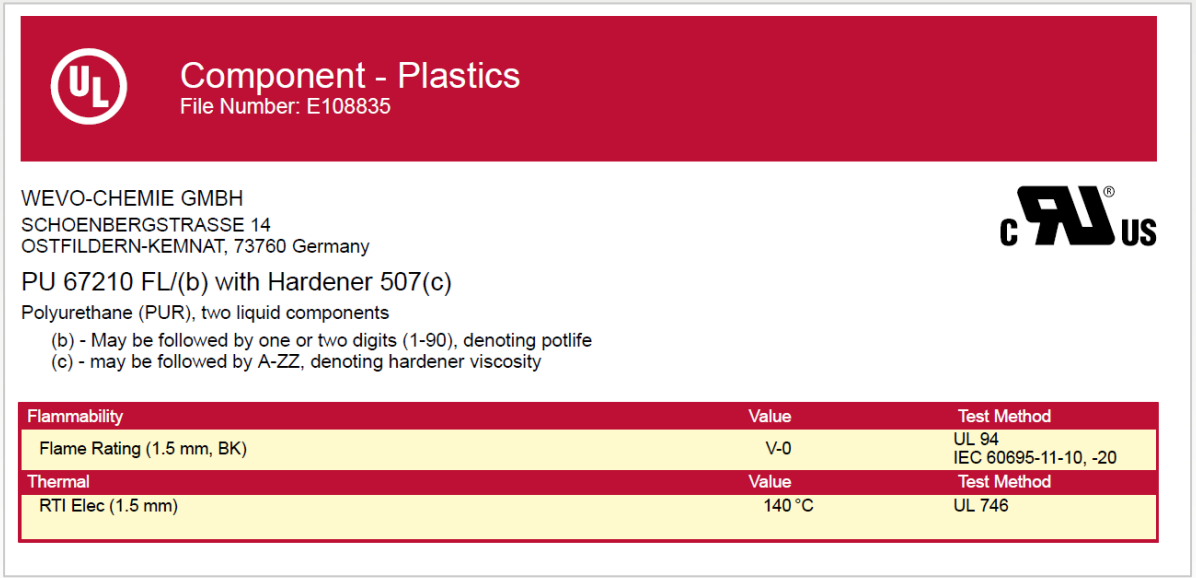
Flammability	Value	Test Method
Flame Rating (1.5 to 1.7 mm, ALL)	V-0	UL 94 IEC 60695-11-10, -20
Electrical	**Value**	**Test Method**
Hot-wire Ignition (HWI) (1.5 to 1.7 mm)	PLC 0	UL 746
High Amp Arc Ignition (HAI) (1.5 to 1.7 mm)	PLC 0	UL 746
Comparative Tracking Index (CTI)	PLC 0	UL 746
Thermal	**Value**	**Test Method**
RTI Elec (1.5 to 1.7 mm)	160 °C	UL 746

WEVOPUR 67210 FL, WEVONAT 507

- Rigid polyurethane resin with increased temperature resistance
- Operating temperature: -40 to +145 (+150) °C
- High thermal conductivity: 1.0 W/m·K
- Low CTE: 55/120 ppm/K
- Railway fire standard EN 45545-2, R 22 (HL 2) and R23 (HL 3) rating
- Low water absorption (excellent resistance in damp-heat conditions (85 °C/85 % r.H.)

Typical applications:

- Transformers, inductors, chokes
- Film Capacitors, power electronics
- Motors (stator potting)
- Automotive sensors
- Battery packs and modules



Component - Plastics
File Number: E108835

WEVO-CHEMIE GMBH
SCHOENBERGSTRASSE 14
OSTFILDERN-KEMNAT, 73760 Germany

PU 67210 FL/(b) with Hardener 507(c)

Polyurethane (PUR), two liquid components
(b) - May be followed by one or two digits (1-90), denoting potlife
(c) - may be followed by A-ZZ, denoting hardener viscosity

Flammability	Value	Test Method
Flame Rating (1.5 mm, BK)	V-0	UL 94 IEC 60695-11-10, -20
Thermal	**Value**	**Test Method**
RTI Elec (1.5 mm)	140 °C	UL 746

05

THERMAL MANAGEMENT: OUR THERMALLY CONDUCTIVE SOLUTIONS

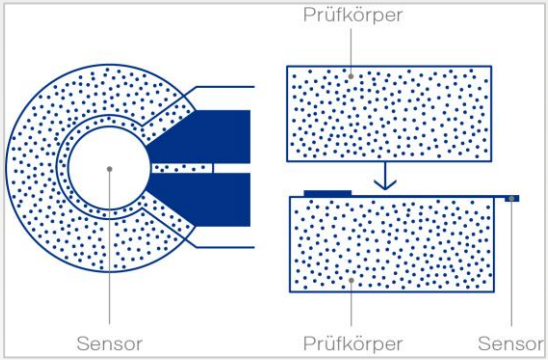
THERMAL CONDUCTIVITY

The thermal conductivity of a material, as for example a polymer, is a measure of its ability to conduct heat. The unit measuring is W/m·K.

We measure the thermal conductivity according to ISO standard 22007–2:2008 with using the so-called hot disc method. The sensor is a double layer nickel coil embedded between an electrically insulating encapsulant (the polymer to be measured) .

Encapsulating materials with high thermal conductivity can reliably absorb
and dissipate the heat generated by coils, circuit boards, ICs or motors during operation and therefore prolong component life and allow smaller components to be designed.

The thermal conductivities of specially optimised high filler content resins exceed 1.5 W/m·K, while those of unfilled resins are only about 0.2 W/m·K. These optimised materials are available as liquids suitable for encapsulation
and as thermal interface material (TIM) pastes.



Sensor

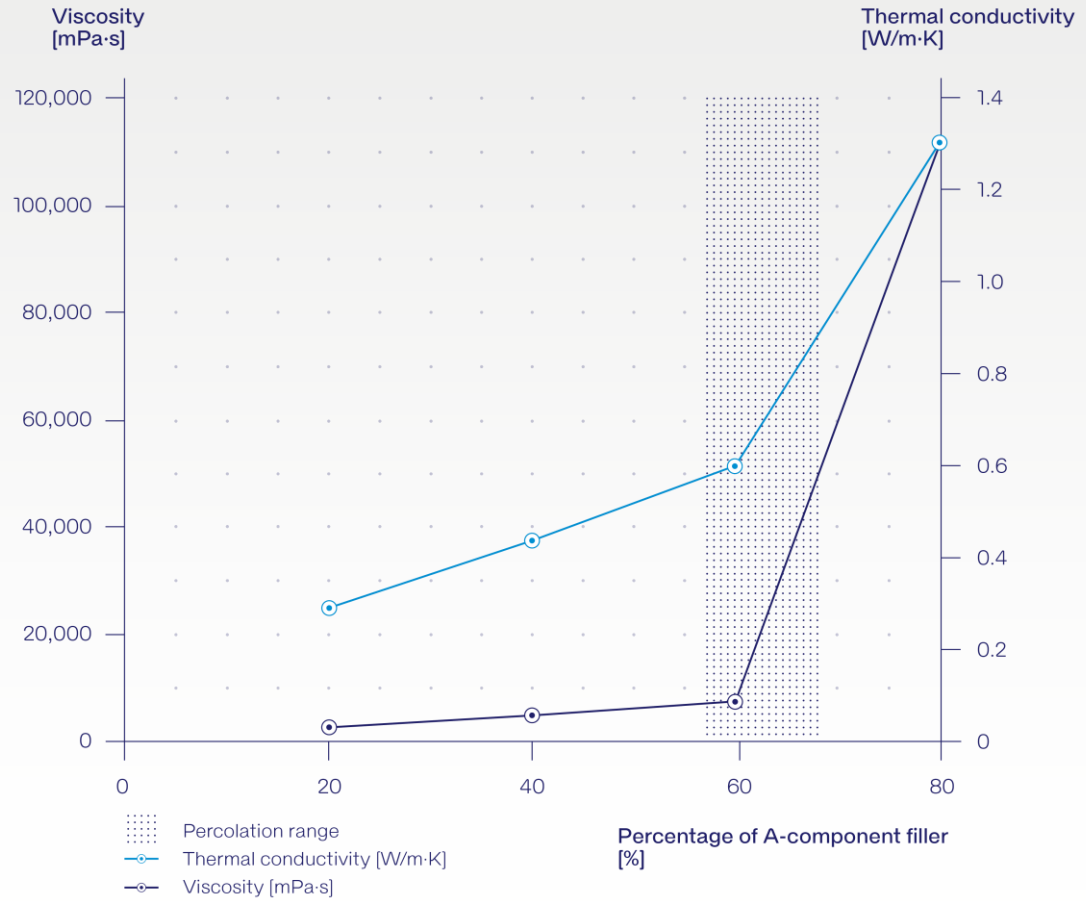
Sensor embedded between 2 polymer samples

DEVELOPMEMT OF THERMALLY CONDUCTIVE POLYMERS

Development approaches:

- Special fillers with a high specific thermal conductivity
- Low abrasiveness
- Low sedimentation tendency, high storage stability
- Stable pot life
- Acceptable flow behaviour (mix viscosity ideally not higher than 3,000–4,000 mPa·s)
- Flame-retardant versions
- Competitive costs

The percolation rate is the ability to highly fill a material while ensuring processability. Here we show a graph of research data compiled via a German government funded project.



POLYURETHANE

Wevo polyurethane thermal interface material systems offer easy processing, good temperature stability from -60 °C to +165 °C, excellent flowability for highly filled systems, high adhesion and mechanical integrity

Product	Description	Thermal conductivity	UL	Main application
WEVOPUR 512 FL	Semi-soft, low viscosity all purpose potting and adhesive resin (-40 °C to +130 °C)	0.8 W/m·K	V-0: 4 mm RTI 130 (Elec, Str)	Adhesive for batteries and supercaps potting ferrites and transformers
WEVOPUR 552 FL	All-purpose standard potting resin, semi-rigid, various modifications, (-40 °C to +130 °C)	0.6 W/m·K	V-0: 1.5 mm RTI 130 (Elec, Str)	Potting of all kind of E & E applications
WEVOPUR 403 FL	Semi-rigid, high temperature resistant, F class, low viscosity, (-50 °C to +165 °C)	0.8 W/m·K	V-0: 1.5 mm RTI 155 (Elec)	Potting of all kind of E & E applications
WEVOPUR 60416 FL	Semi-rigid, high temperature resistant, F class, high TC, (-50 °C to +165 °C)	1.7 W/m·K	V-0: 1.5 mm RTI 160 (Elec)	Thermally conductive potting resin for transformers, OBC, chokes
WEVOPUR 60910 FL	Semi-rigid adhesive and potting resin (-40 °C to +130 °C)	1.0 W/m·K	V-0: 3 mm	Thermally conductive for adhesion and battery potting, OBC
WEVOPUR PD 64515 FL	Soft, low Tg, -60 °C, low water absorption, low gas permeability, (-60 °C to +120 °C)	1.45 W/m·K	V-0: 4 mm	Thermally conductive TIM for battery potting and power electronics
WEVOPUR 67210 FL	Rigid, high Tg, resistant against damp-heat, very low viscosity, (-40 °C to +145 °C)	1.0 W/m·K	V-0: 1.5 mm RTI 140 (Elec)	Thermally conductive potting resin for electronics and capacitors

EPOXY

Wevo epoxy thermal interface material systems offer easy processing, high temperature stability from -40 °C up to +180 °C, hot and cold curing systems also for vacuum potting.

Product	Description	Thermal conductivity	UL	Main application
WEVOPOX 8260 FL/60 with WEVODUR 1018/25	Hot curing epoxy resin, good impregnation (-40 °C to +165 °C), F-class system	0.94 W/m·K	V-0: 6 mm RTI 90 (Elec, Str)	Potting resin for inductive components, transformers etc.
WEVOPOX 8260 FL/60 with WEVODUR 520	Cold curing epoxy resin, good impregnation (-40 °C to +130°C), B-class system	0.94 W/m·K	V-0: 6 mm	Potting resin for all kinds of electronic applications
WEVOPOX 2003 FL	Flexibilised cold curing epoxy resin, Shore D 45–50, (-40 °C to +130°C), B-class system	0.7 W/m·K	V-0: 6 mm	Potting resin for all kinds of electronic applications, print transformers
WEVOPOX 36001 FL	Hot curing epoxy resin, good impregnation (-40 °C to +180 °C), H-class system	1.1 W/m·K	V-0: 6 mm	Motor and transformer potting
WEVOPOX 34001 FL	Hot curing epoxy, good temperature shock resistance, (-40 °C to +165 °C)	0.7 W/m·K	V-0: 4 mm (not certified)	Motor (linear) potting, ignition coils
WEVOPOX 2513	Suitable for vacuum pressure potting. (-40 °C to +180 °C)	1.4 W/m·K	HB (not certified)	Motor potting
WEVOPOX 32703	Hot curing, high chemical resistant adhesive. (-40 °C to +155 °C)	0.6 W/m·K	HB (not certified)	Chemical resistant battery adhesive, also for flow batteries
WEVOPOX 34020	Cold curing, 180 °C, good crack resistant resin. (-40 °C to +180 °C)	0.8 W/m·K	HB (not certified)	Winding heads (stator) potting

SILICONE

Wevo silicone thermal interface material systems offer easy processing, high temperature stability from -60 °C to > +200 °C, low shrinkage, 1:1 mix ratio, excellent elastomeric properties.

Product	Description	Thermal conductivity	Viscosity & Density (mixed)	Main application
WEVOSIL 22006 FL	General all purpose potting resin, low viscosity (-60 °C to +180 °C)	0.5 W/m·K	V-0: 4 mm RTI 150 (Elec, Str)	Pressure-sensitive electrical components, transformers
WEVOSIL 22002 FL	Increased thermal conductivity potting resin, (-60 °C to +180 °C)	1.1 W/m·K	V-0: 2 mm	Pressure-sensitive electrical components, motors
WEVOSIL 28001 FL	Multi substrate sealant, very good chemical resistance, (-60 °C to +200 °C)	0.4 W/m·K	HB (not certified)	All purpose sealant, batteries including flow batteries and fuel-cells
WEVOSIL 22007 FL	Very elastic and soft material, Shore 00: 60 – 80, (-60 °C to +165 °C)	2.0 W/m·K	V-0: 1 mm (not certified)	Pressure-sensitive electronic and electrical components
WEVOSIL 26010 FL	Low density gap filler (-60 °C to +165 °C)	2.5 W/m·K	V-0: 1 mm (not certified)	A soft gap fill for battery and high-power electrics
WEVOSIL 26007 FL	High thermal conductivity with excellent flow properties. (-60 °C to +200 °C)	3.0 W/m·K	V-0: 1 mm (not certified)	Encapsulation, coating and adhesive of pressure sensitive electrical and electronic components
UNDER DEVELOPMENT:				
WEVOSIL R20-17-1-1-2-2	High thermal conductivity with excellent flow properties. (-60 °C to +200 °C)	approx. 2.8 W/m·K	-	Battery potting

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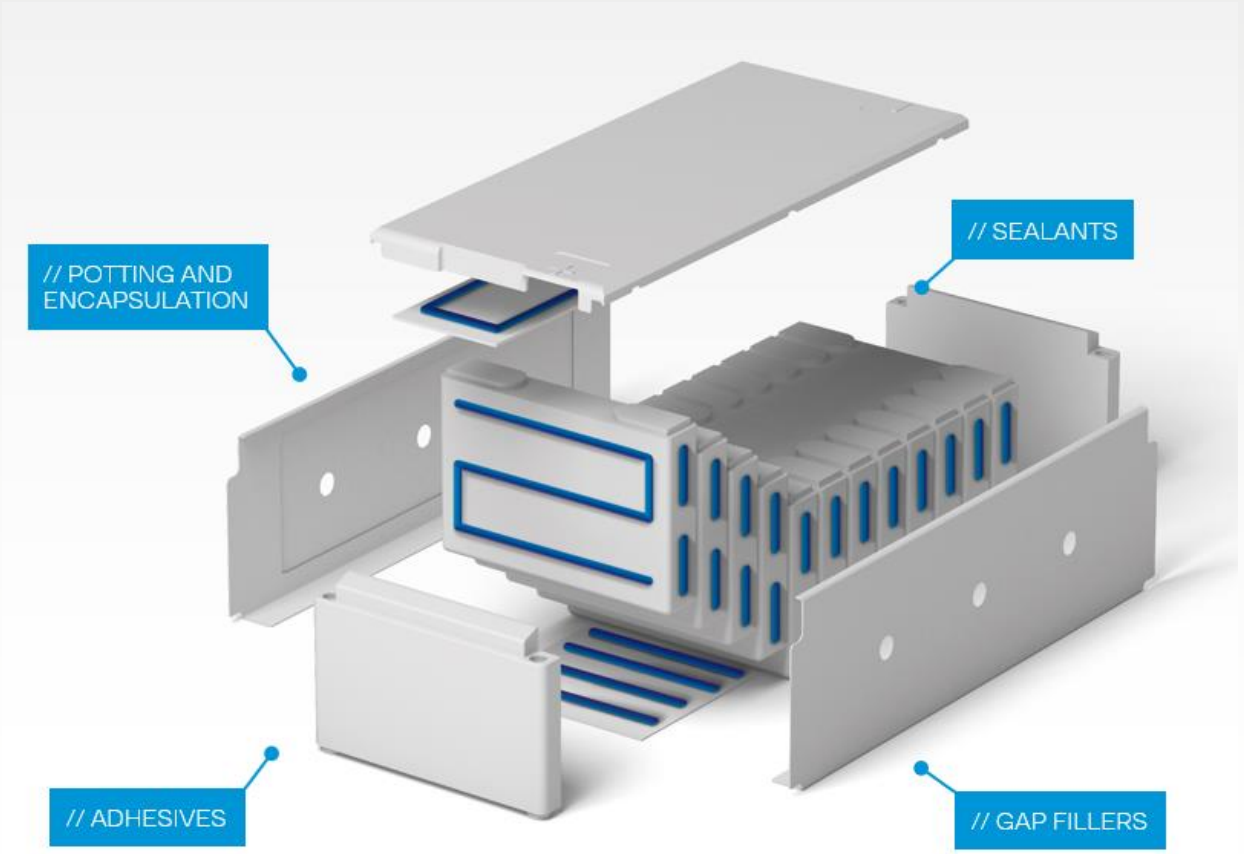
E & E APPLICATIONS, WITH A FOCUS ON MEGATRENDS: E-MOBILITY, ENERGY TRANSITION, ENERGY STORAGE, SMART HOME

BATTERY PACK AND MODULE ASSEMBLY FOR E-MOBILITY AND STATIONARY ENERGY STORAGE

The exponential growth of e-mobility and stationary energy storage is giving rise to demand for economic and fully automated production lines for the assembly of battery packs and modules. Wevo's high performance adhesives, potting compounds, encapsulants and thermal interface materials are used in these applications, e.g.:

WEVOPUR 60910 FL / WEVONAT 900

- Tough-elastic thermally conductive polyurethane adhesive
- Thermal conductivity: 1.0 W/m·K
- Shore D 35–45
- Flame retardant: UL 94 V-0 (3 mm), all colour
- HAI, HWI, CTI: PLC 0



SUPERCAPACITOR PACK ASSEMBLY

Supercapacitors or power caps can withstand more charge and discharge cycles than rechargeable batteries. They are typically used in energy storage applications where fast delivery of high power is needed, as for example in hybrid vehicles such as diesel locomotives or heavy-duty vehicles.

Wevo's tailor made and highly engineered Wevopur, Wevopox and Wevosil potting compounds and adhesives are used to assemble the supercap cells in packs and modules, for example:

Source: WIMA GmbH & Co. KG

WEVOPUR 512 FL / WEVONAT 900

- Polyurethane potting compound
- Low viscosity (500 mPas @ room temperature)
- Elastic (Shore D 30–40) and therefore shock and vibration resistant
- Thermal conductivity: 0.8 W/m·K
- Self extinguishing acc. to UL 94 V-0 (4 mm), all colour, RTI elec and Str 130 °C
- HWI, HAI, CTI: PLC 0
- Railway fire standard EN 45545-2 HL 2 rating (R 22/R23)
- Version WEVOPUR 512 FLE / WEVONAT 900 E: HL 3 rating

APPLICATIONS FOR E-MACHINES

Higher energy density and the compact design of modern e-machines result in increased temperatures of the windings and the laminated cores in stators.

Thermally conductive Wevopur and Wevopox potting compounds with thermal conductivities up to 1.5 W/m·K help to dissipate the heat in the stator and therefore ensure a longer lifetime. The adjusted low viscosities ensure full and void-free encapsulation and protect the motor against partial discharges, for example:

WEVOPOX 36001 FL / WEVODUR 5001

- Cold curing epoxy resin
- Thermal conductivity 1.1 W/m·K
- Insulation class H (180 °C)
- Self-extinguishing, UL 94 V-0 in 2 mm
- Railway fire standard EN 45545-2, R 22 (HL 2) and R23 (HL 3) rating
- HWI, HAI, CTI: PLC 0
- Low CTE (40/110 ppm/K)
- Low mixed viscosity, good impregnation characteristics

POWER ELECTRONICS APPLICATIONS FOR EV

ONBOARD CHARGERS (OBC)

High energy density and compact design result in high temperature exposure and mechanical stresses to the electronics and inductive components in the OBC.

Thermally conductive and elastic Wevopur potting compounds and Wevosil gap fillers with thermal conductivities up to 4 W/m·K help to dissipate the heat, e.g.:

WEVOPUR 60416 FL / WEVONAT 300 RE

- Tough-elastic polyurethane resin
- High thermal conductivity: 1.6 W/m·K
- High temperature resistance 165 °C (Insulation Class F), RTI elec 160 °C
- Flame retardant acc. to UL 94 V-0 (1.5 mm), all colour
- HAI, HWI, CTI: PLC 0

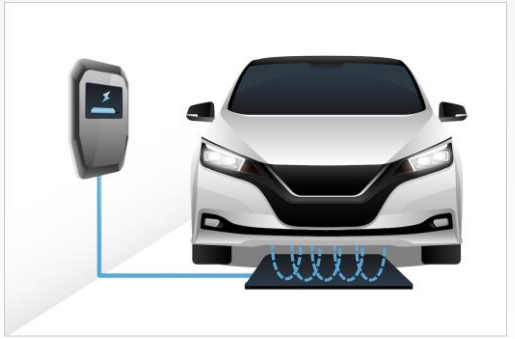
CHARGING INFRASTRUCTURE

DC FAST CHARGING AND AC WALLBOXES

High power and fast energy flow result in high temperature exposure of the components (plug, cable, power electronics, inductive components, current sensors) used in DC fast charging stations. Thermally conductive Wevopur and Wevopox potting compounds and Wevosil gap fillers with thermal conductivities up to 4 W/m·K help to dissipate the heat and ensure a longer life-time.

INDUCTIVE CHARGING

Wevopur and Wevopox potting compounds protect the sensitive and fragile ferrites and coils in the sender and receiver plates against mechanical shocks and water ingress, for example:



WEVOPUR 67210 FL / WEVONAT 507

- Low viscosity polyurethane resin (1000 mPas @ RT)
- Rigid material (Shore D 80–90), high Tg
- High thermal conductivity (1 W/m·K)
- High heat resistance (145 °C long term, short term > 150 °C)
- Low CTE (55/120 ppm/K), Flame retardant UL 94 V-0 (1.5 mm), RTI elec 140 °C

ELECTRONIC CONTROL UNIT (ECU)

Thermal management plays a decisive role in the longevity of electronic components which are mounted near the engine such as ECU's. Thermally conductive Wevopur potting compounds and Wevosil gap fillers with thermal conductivities up to 4 W/m·K help to dissipate the heat from the hot spots in the ECU:

WEVOPUR PD 64510 FL / WEVONAT 385

- Thermally conductive polybutadiene-based resin
- Thixotropic, applied as bead
- Low Tg (-60 °C), alternative to silicone-based gap fillers
- Thermal conductivity 1.0 W/m·K
- Self-extinguishing, UL 94 V-0 in 4 mm
- HAI, CTI: PLC 0; HWI: PLC 1

WEVOSIL 22002 FL A/B

- 2 component silicone potting resin, thermal conductivity 1.0 W/m·K
- Self-extinguishing, UL 94 V-0 in 2 mm
- HAI, CTI: PLC 0 ; HWI: PLC 1

PV ROOFTOP AND HOME STORAGE APPLICATIONS

Modern residential homes nowadays often generate their energy by means of rooftop photovoltaic or solar systems. In order to respond flexibly to the electricity demand, the generated energy may be stored with battery systems.

Modern encapsulation solutions from Wevo protect the sensitive electronics in micro-inverters and ensure proper heat dissipation for chokes, transformers and batteries in string-inverters and hybrid inverters, as for example:

WEVOPUR 403 FL/33 / WEVONAT 300 RE

- Tough-elastic polyurethane resin
- Increased thermal conductivity: 0.8 W/m·K
- High temperature resistance 165 °C (Insulation Class F), RTI elec 155
- Flame retardant UL 94 V-0 (1.5 mm black, 2 mm all colour)
- HWI, HAI, CTI: PLC 0

HVDC POWER TRANSMISSION FOR THE ENERGY TRANSITION

Increasing global power demand and the energy transition e.g. by integration of renewable energy sources requires the transmission of large amounts of energy over long distances with low losses. High-voltage DC transmission (HVDC) is the key technology for this purpose and requires components with low fire risk. So-called dry-type power capacitors are used in substations as power-banks. The metallised film is protected with flexible polyurethane potting resins, e.g.

WEVOPUR 3025 / WEVONAT 9015

- Very soft polyurethane resin, Shore A 35
- Easy to dispense, mixed viscosity at 22 °C: 600 – 800 mPas
- Potting under vacuum for void-free encapsulation
- Low exotherm during curing
- Dielectric strength: > 20 KV/mm

CURRENT SENSORS FOR THE ENERGY TRANSITION AND SMART GRID

Increasing deployment of renewable energy sources, energy storage, public transport systems and smart grid and smart city applications resulting in flexible energy demand and supply such as charging stations and emerging technologies using reverse power flow, requires the reliable and distinct measurements of current and voltage. These sensor devices such as current sensors need to be protected with elastic UL approved resin solutions, e.g.

Source: Harting Electric

WEVOPUR 9251 FL / WEVONAT 300 RE

- Elastic polyurethane resin (Shore A 85)
- Low Tg: -20 °C
- Flame retardant UL 94 V-0, 5 VA (6 mm)
- Railway fire standard EN 45545-2, R 22 (HL 2) and R23 (HL 3) rating

SMART METERING

The connected home and modern electricity and heat generation technologies require distinct digital measurement devices for electricity, gas and water consumption. New national regulations and laws for the deployment of digital metering systems will lead to a phase-out of traditional measuring devices. New solutions involve communication modules using wireless data transfer. In order to prevent manipulation and ingress of insects, water and dust, these components are often protected with potting compounds such as:

Electricity meter

Gas meter

Water meter

WEVOPUR 552 FL / WEVONAT 300

- Tough-elastic polyurethane resin
- Standard UL resin, available in various modifications (pot-life, colors, viscosities, different hardeners)
- Insulation Class B, RTI elec and str 130°C
- Flame retardant acc. UL 94 V-0 (1.5 mm), all-colour
- HWI, HAI, CTI: PLC 0

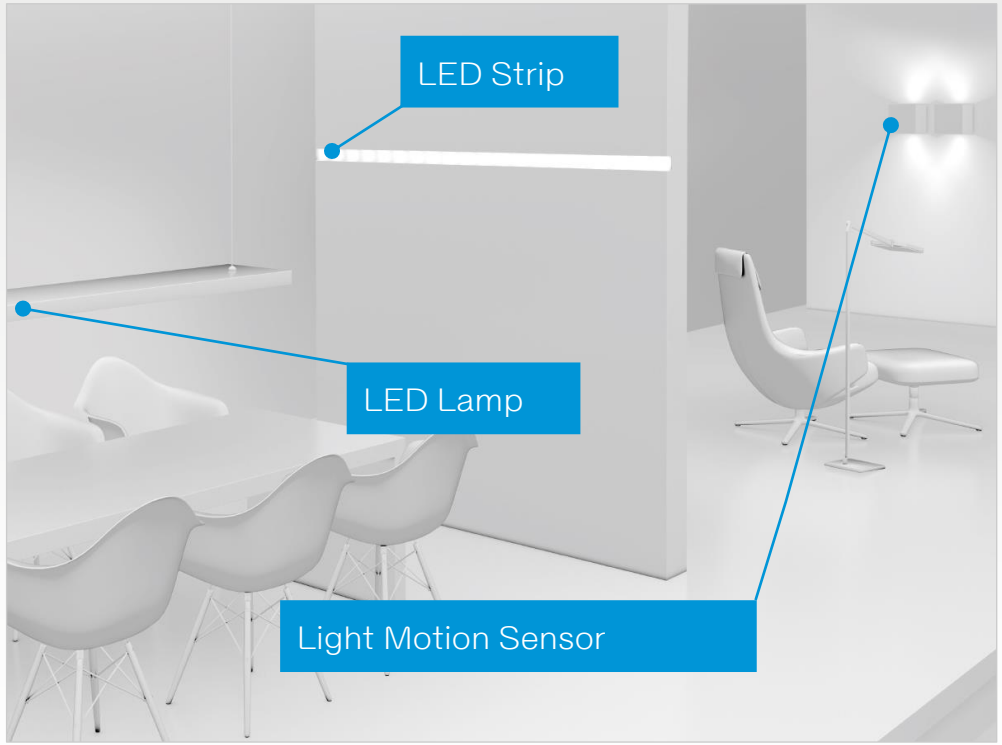
Modifications with increased thermal conductivity:
WEVOPUR 60512 FL/WEVONAT 507: Thermal conductivity: 1.2 W/m·K, UL 94 V-0 (1.5 mm)
WEVOPUR 60515 FL/WEVONAT 507: Thermal conductivity: 1.5 W/m·K, UL 94 V-0 (1.5 mm)

LIGHTING FOR SMART HOMES

Modern lighting technologies for homes are designed with LEDs to reduce energy consumption, and luminaires are typically connected with control devices and various sensors using wireless communication technologies such as Wifi and Li-Fi (Light Fidelity). LED luminaires and strips are protected with transparent potting resins against moisture, dust and mechanical stresses, as for example:

WEVOPUR 50001 / WEVONAT 356

- Transparent clear polyurethane resin
- Flexible elastic (Shore A 65–75)
- High transmission above 450 nm: > 90%
- Flame retardant UL 94 HB (2 mm)

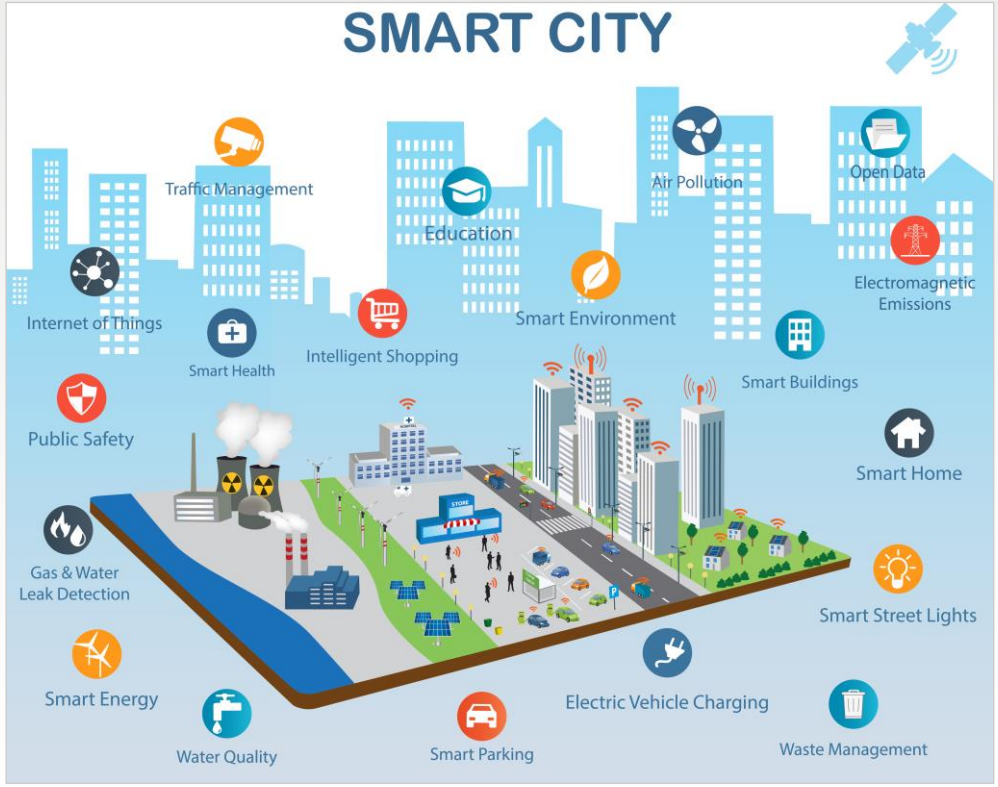


SMART CITIES

Smart and connected cities offer multiple opportunities for monitoring and sensing applications.

Electronic and electrical components such as meters, sensors, IoT devices, RFID tags and charging devices need to be protected against environmental influences by means of modern insulation materials, ensuring safe operation.

Tailor-made flame retardant UL approved resins from Wevo support the fast deployment of these emerging technologies.



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SUMMARY/ TAKEAWAYS

TAKEAWAYS

- Wevo-Chemie is your reliable partner for electronic and electrical insulation solutions based on polyurethane, epoxy and silicones
- Each chemistry is characterised by its individual advantages and limits
- Wevo offers a great variety of tailor-made solutions for safe operation of your E & E components
- Choose from our extended list of self-extinguishing UL 94 V approved and RTI listed resins
- Adapted thermo-mechanical properties such as increased temperature resistance and thermal conductivity of our high performance materials are able to cope with the increasing technical demands of emerging technologies like e-mobility, energy-storage and smart grid applications
- Ask our global experts to discuss your individual projects and needs

THANK YOU FOR YOUR ATTENTION!

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