SIMONA

tech.info

SIMONA® Electrically Conductive (EL) Plastics

GLOBAL THERMOPLASTIC SOLUTIONS

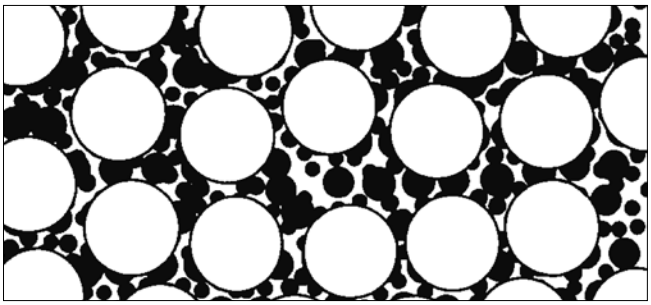
Contents

1 General

1.1 Classification

1.1.1 Conductivity of plastics

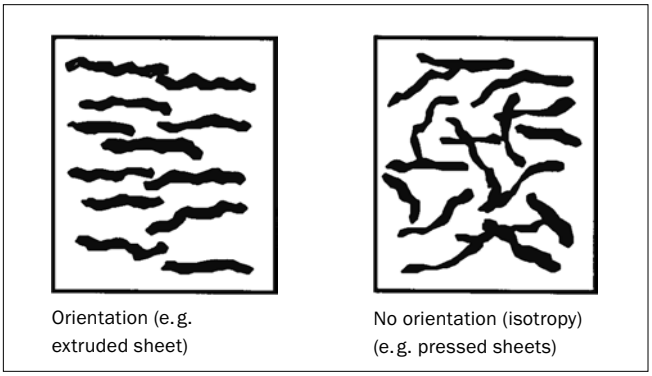
Plastics are contributing to an ever-increasing range of applications in our modern-day life. They are deployed in the chemical industry and the manufacture of tanks, apparatus and pipelines. There they are used not only because of their good cost/benefit ratio but also because of their high chemical resistance and excellent processing capabilities. In those sectors the plastics primarily used are polyethylene (PE) and polypropylene (PP). There is no doubt, therefore, that plastics have many advantages. Due to their non-conductive properties, however, there is a risk of static accumulating, which is of particular relevance to use in explosive environments. If electrostatically charged materials discharge by sparking, they can cause explosive atmospheres, such as mixtures of solvents and air or mixtures of dust and air, to explode. To be able to exploit the advantages of plastics for those fields of application as well, special types of carbon are added (so-called conductivity carbons), thus significantly increasing their conductivity and considerably reducing their electrical resistance. On account of this precaution the volume resistivity of PE, for example, can be reduced from > 10^{14} Ω to < 10^{6} Ω and the plastics become electrically conductive. If they are earthed, an electrostatic charge can be reliably prevented. In addition to a decrease in volume resistivity, black staining (conductivity carbon) also provides excellent UV protection, as in the case of electrically conductive polyethylene (PE-EL).



Carbon distribution in SIMONA® PE-EL Sheets that have been modified to make them electrically conductive (illustrated)

1.1.2 Influences of processing

Conductivity properties are highly dependent on the orientation of the individual particles of the conductivity additive. As such particles generally do not have an ideal spherical shape, they are subject to orientation, e.g. during extrusion, in a plastic melt due to influences of processing. Isotropically distributed particles create conductivity which is statistically uniform in all directions. Oriented particles chiefly conduct in the direction of orientation, albeit less efficiently than isotropically distributed particles. Pressed SIMONA® PE-EL Sheets exhibit isotropic behaviour and hence more homogeneous electrical conductivity than extruded sheets and pipes.



Influence of the fabrication process on carbon orientation (illustrated)

1.1.3 ATEX Directive 2014/34/EU (ATEX 95)

ATEX means **At**mosphère **Ex**plosible. Directive 2014/34/EU regulates explosion protection in mining and in industry and applies to any products (products = equipment and protective systems, safety, monitoring and control systems, and any components that are built into equipment and protective systems) which are used in potentially explosive atmospheres. ATEX Directive 2014/34/EU is applicable to manufacturers of equipment and protective systems. In the past each country had its own requirements and regulations for operating equipment in potentially explosive atmospheres. This situation was a hindrance to the freedom of movement of such products throughout Europe. In the light of European unity and harmonisation of the internal market specific EU directives were developed. In the field of explosion protection Directive 94/9/EC (ATEX 100a being the previous working title, ATEX 95 after renumbering), updated by Directive 2014/34/EU, has been mandatory and in force since 1 July 2003. That directive now also includes for the first time essential safety and health requirements for those products and non-electrical equipment (e.g. pneumatic actuators). In Directive 2014/34/EU the products to which the directive applies are classified in equipment groups and categories, according to hazard potential. The requirements for equipment and protective systems also depend on this.

You will find more information about ATEX Directive 2014/34/EU on our website: www.simona.de/atex.

1.1.4 Measurement of surface and volume resistivity

In some cases, the result of measurements of electrical resistance (surface and volume resistivity) is substantially influenced by several determining factors. The "coupling" of the measuring electrodes to the surface of the semi-finished product being tested is of major importance for accurate measurement of electrical resistance. If unsuitable electrodes are used, measuring errors can occur in the order of approx. 10,000 Ω. For this reason we recommend using adhesive electrodes made of conductive silver, ensuring that coupling remains good and the test results can be reproduced at any time. Surface resistivity can be considerably increased by machining, e.g. roughening the surface, so when checking the produced design it may be necessary to use a larger electrode gap.

1.1.5 Potential explosion hazards

Potentially explosive atmospheres (explosive zones) are characterised by a mixture of air and combustible gases, vapours, mists or dusts. The latter can in principle occur wherever combustible liquids, gases or dusts are manufactured, filled into containers, transported or stored.

Potentially explosive mixtures with gases, mists or vapours

- Chemical factories
- Tank storage depots
- Refineries
- Sewage treatment plants
- Airports
- Power plants
- Paint factories
- Paint spraying shops
- Port installations

Potentially explosive mixtures with dusts

- Chemical factories
- Power plants
- Paint factories
- Grain mills
- Cement factories
- Port installations
- Feedstuff factories
- Wood-processing companies
- Metal-processing companies
- Companies that process plastic granules

Ignition sources

- Hot surfaces
- Flames
- Hot gases
- Mechanically generated sparks
- Electrical equipment (sparks)
- Electrical equalising currents
- Electrostatic discharges
- Shock waves in flowing gases
- Chemical reactions
- Ionising radiation
- Ultrasound
- Lightning strike

1.2 Product types/explanations

SIMONA® PE-EL

PE-EL is a high-heat-resistant, UV-stabilised product provided with electrical conductivity for explosion protection against static. Consequently, PE-EL can be used not only in chemical tank and apparatus manufacture but also with regard to applications in the electrical industry and all other potentially explosive atmospheres where sparks can be caused by static. For solutions in composite construction we also offer electrically conductive PE sheets in the form of backed sheets (SIMONA® PE-EL-SK).

SIMONA® PE 1000 EL

PE-EL is an ultra-high-molecular-weight product provided with electrical conductivity for explosion protection against static. As a result, PE 1000 EL is ideal for lining the interior surfaces of silos and channels and for abrasion protection in the bulk materials industry.

SIMONA® PP-EL/PP-EL-S

PP-EL is an electrically conductive homopolymeric polypropylene. This material features electrically conductive particles that discharge static. PP-EL has low surface resistivity and is ideal for use in potentially explosive atmospheres. In the form of PP-EL-S the material has a flame-retardant additive. For solutions in composite construction we also offer electrically conductive PE sheets in the form of backed sheets (SIMONA® PP-EL-SK, SIMONA® PP-EL-GK).

SIMONA® PVDF-EL

PVDF ranks among the high-performance materials. In the form of PVDF-EL the material is provided with electrically conductive particles and has low surface resistivity. Areas of use include not only chemical tank and apparatus construction but also the electrical industry and all other potentially explosive atmospheres. For solutions in composite construction we also offer electrically conductive PVDF sheets in the form of backed sheets (SIMONA® PVDF-EL-SK, SIMONA® PVDF-EL-GK).

1.3 Special Properties

SIMONA® PE-EL

- Electrically conductive
- Good impact resistance
- High abrasion resistance
- Good chemical resistance
- Weldable and capable of warm bending and thermoforming
- High resistance to UV rays
- Normal flammability in accordance with DIN 4102 B2 (own assessment without test certificate)
- Service temperature range –20 °C to +80 °C

SIMONA® PE 1000 EL

- Electrically conductive
- Ultra-high molecular weight
- High impact strength
- High wear resistance
- Good chemical resistance
- Satisfactory resistance to UV rays
- Normal flammability in accordance with DIN 4102 B2 (own assessment without test certificate)
- Service temperature range –260 °C to +80 °C
- Physiologically safe in accordance with BfR and food compliant in accordance with FDA

SIMONA® PP-EL/PP-EL-S

- Electrically conductive
- Permanent-heat resistance
- High corrosion resistance
- High chemical resistance
- Excellent processing capabilities
- Weldable and capable of warm bending and thermoforming
- Satisfactory resistance to UV rays
- Normal flammability in accordance with DIN 4102 B2 (own assessment without test certificate)/low flammability in accordance with UL 94 V0 (PP-EL-S)
- Service temperature range +5 °C to +100 °C (PP-EL)/0 °C to +80 °C (PP-EL-S)

SIMONA® PVDF-EL

- Electrically conductive
- High-performance material
- High rigidity, in conjunction with high impact strength, even at low temperatures
- Exceptional ageing resistance
- Excellent chemical resistance
- Weldable and capable of warm bending and thermoforming
- High resistance to UV rays
- Low flammability in accordance with DIN 4102 B1 (own assessment without test certificate)
- Service temperature range –20 °C to +140 °C

1.4 Areas of use

SIMONA® PE-EL

- Electrical industry
- Chemical apparatus and tank construction
- Bulk materials industry

SIMONA® PE 1000 EL

- Bulk material sector
- Electrical industry
- Packaging industry
- Mechanical engineering (e.g. sliding rails)

SIMONA® PP-EL/PP-EL-S

- Tank construction
- Linings
- Laboratory construction
- Packaging industry

SIMONA® PVDF-EL

- Chemical apparatus and tank construction
- Electrical industry
- Nuclear industry
- Ventilation industry

Examples of applications of electrically conductive plastics

- Packagings and transport pallets in order to prevent static for high-quality products endangered by dust
- Tanks with fire-hazard contents
- Pipelines for conveying combustible liquids, solvents, vapours and acid mixtures thereof
- Laboratory hood pipes
- Pipelines for conveying combustible gases
- Gas collection pipes on landfill sites
- Tanks and parts of machinery in explosion-proof rooms
- Tank linings for storage and filling of powders
- Vent pipes at coal-processing plants
- Tanks and linings for fire-hazard contents
- Pipelines for conveying combustible liquids, solvents, vapours and mixtures thereof
- Laboratory hood ducts
- Packagings and transport pallets for sensitive products (in conjunction with combustible materials an approval certificate may be required)

1.5 Range of products

You will find detailed information on the current product range of SIMONA® EL plastics and our other products at www.simona.de.

Our staff in Sales will be pleased to advise you:
Phone +49 (0) 67 52 14-0
Fax +49 (0) 67 52 14-211
sales@simona.de

2 Technical information

2.1 Material specifications

Material specifications

		SIMONA® PE-EL	SIMONA® PE 1000 EL	SIMONA® PP-EL	SIMONA® PP-EL-S	SIMONA® PVDF-EL
Processes		extruded, pressed	pressed	extruded, pressed	extruded, pressed	extruded, pressed
Moulding compound		PE,ECYL,45 G 045, PE,QCYL,45 G 045	PE,QCY,33 G 000	PP-H,ECLY,16-05-003, PP-H,QCLY,16-05-003	PP-R,ECFY,16-05-003, PP-R,QCFY,16-05-003	PVDF-E, GG1Z, P. ?.6E6.G.D.C.,4, ?
Moulding compound standard		DIN EN ISO 17855-1	DIN EN ISO 17855-1	DIN EN ISO 19069-1	DIN EN ISO 19069-1	DIN EN ISO 12086-1
Density, g/cm³, DIN EN ISO 1183		0.99	0.95	0.94	1.17	1.78
Tensile modulus of elasticity, MPa, DIN EN ISO 527		1,300	800	1,400	1,400	1,800
Yield stress, MPa, DIN EN ISO 527		26	20	28	25	45
Elongation at yield, %, DIN EN ISO 527		7	10	6	7	5
Impact strength, kJ/m², DIN EN ISO 179		without break	without break	without break	without break	without break
Notched impact strength, kJ/m², DIN EN ISO 179		6	–	4	5	6
Ball indentation hardness, MPa, DIN EN ISO 2039-1		50	31	66	66	110
Shore hardness D (15 s), DIN EN ISO 868		67	64	72	70	78
Vicat B, °C, DIN EN ISO 306		–	88	–	–	132
Mean coefficient of linear thermal expansion, K^{-1}, ISO 11359-2		1.8×10^{-4}	1.8×10^{-4}	1.6×10^{-4}	1.6×10^{-4}	1.3×10^{-4}
Surface resistivity, Ω, DIN IEC 60093		$\leq 10^6$	$\leq 10^6$	$\leq 10^6$	$\leq 10^6$	$\leq 10^6$
Volume resistivity, Ω · cm, DIN IEC 60093		$\leq 10^6$	$\leq 10^6$	$\leq 10^6$	$\leq 10^6$	$\leq 10^6$
Water absorption, %/24 h, DIN EN ISO 62899		< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Fire behaviour	DIN 4102	B2 normal flammability (own assessment without test certificate)	B2 normal flammability (own assessment without test certificate)	B2 normal flammability (own assessment without test certificate)	B2 normal flammability (own assessment without test certificate)	B1 low flammability (own assessment without test certificate)
	UL 94	–	–	–	V0: ≥ 4 mm (test certificate available)	–
Temperature range, °C		–20 to +80	–260 to +80	+5 to +100	0 to +80	–20 to +140
Physiological safety	BfR	No	Yes	No	No	No
Food conformity	EU	No	No	No	No	No
	FDA	No	Yes	No	No	No

The figures are approximate, relate to the particular material and may vary depending on the fabrication process and how test specimens are made. They are usually averages of measurements on extruded sheets of 4 mm thickness. In the case of sheets solely manufactured by the pressing method they are usually measurements on sheets with a thickness of 20 mm. There may be discrepancies if sheets are not available in those thicknesses. In the case of backed sheets the specifications relate to unbacked basic sheets. The figures cannot necessarily be applied to other product types (e. g. pipes, solid rods) made of the same material or to products that have been subjected to further processing. It is the processing company or user who is responsible for checking whether materials are suitable for a specific application. The specifications are merely a planning aid. In particular, they are not guaranteed properties. You can obtain further information from our Technical Service Centre at tsc@simona.de.

2.2 Fire behaviour

SIMONA® PE-EL

- DIN 4102 normal flammability B2
  (own assessment without test certificate)

SIMONA® PE 1000 EL

- DIN 4102 normal flammability B2
  (own assessment without test certificate)

SIMONA® PP-EL

- DIN 4102 normal flammability B2
  (own assessment without test certificate)

SIMONA® PP-EL-S

- DIN 4102 normal flammability B2
  (own assessment without test certificate)
- UL 94 low flammability V0
  (as of material thickness 4 mm) (test certificate available)

SIMONA® PVDF-EL

- DIN 4102 low flammability B1
  (own assessment without test certificate)

2.3 Performance in outdoor use

In relation to SIMONA standard products SIMONA® PE-HD and SIMONA® PVDF, SIMONA® PE-EL and SIMONA® PVDF-EL have comparatively good UV resistance. Owing to modification with conductivity carbon, SIMONA® PP-EL, PP-EL-S and PE 1000 EL reach satisfactory UV resistance in outdoor applications.

2.4 Chemical resistance

Like the base materials, SIMONA® EL plastics are resistant to many chemicals. In specific applications usability depends on the medium and temperature as well as the concentration of the medium. In such cases we therefore recommend contacting our Applications Technology Department.

Technical Service Center
Phone +49 (0) 67 52 14-587
tsc@simona.de

2.5 Physiological safety

SIMONA® EL plastics do not meet the requirements of the European Food Directive (EU 10/2011), i.e. they must not be brought into direct contact with food.

SIMONA® PE 1000 EL is the only EL material to be physiologically safe in accordance with BfR and food compliant in accordance with FDA.

3 Processing instructions

3.1 Welding/thermoforming

The partially crystalline materials SIMONA® PE-EL, PP-EL, PP-EL-S and PVDF-EL are just as easy to weld as the respective base materials. Especially when performing heated-tool butt welding (HS) and hot-gas extrusion welding (WE) on SIMONA® PE-EL in accordance with DVS Guideline 2201, Part 2, it is possible to reach short-time welding factors and V-die bending angles that are comparable with those of SIMONA® PE 100.

The electrically conductive PP types and PVDF-EL are also easy to join by heated-tool butt welding, hot-gas extrusion welding and hot-gas string bead welding. The mechanical short-time figures for PE-EL and PVDF-EL specimens immersed in water and subjected to heated-tool butt welding are not significantly different from those of untreated samples. Blistering near the weld seam or during vacuum thermoforming may occur, depending on the level of moisture. It may therefore be necessary to pre-dry SIMONA® EL plastics.

SIMONA® PE 1000 EL can only be welded with limitations so the weld seam should not be subjected to mechanical loads.

3.1.1 Processing parameters and resistance measurements

SIMONA® EL plastics can always be welded with the same parameters as those applicable to their base materials. Exception: for hot-gas welding, please use a special EL welding rod.

The surface and volume resistivity figures for SIMONA® EL plastics thermoformed and welded with the same welding filler are comparable with the measurements for unprocessed EL plastics. The excellent electrical conductivity of SIMONA® EL plastics always remains intact after processing by standard methods of welding and forming. Electrical conductivity can be impaired by excessive orientation due to deformation.

For further processing information, please refer to our work. infos "Welding" and "Thermoforming, Hot Forming, Bending" or contact our Technical Service Center.

Technical Service Center
Phone +49 (0) 67 52 14-587
tsc@simona.de

3.1.2 Moisture/pretreatment

Owing to its chemical and physical properties, the carbon added to the respective plastic tends to absorb a slight amount of moisture if subjected to lengthy storage or unfavourable conditions. However, tests on PE-EL/PVDF-EL specimens immersed in water for 14 days did not show any significant differences in processing by comparison with the original samples. In practice the absorption of (atmospheric) moisture is essentially influenced by handling and logistics so under the above circumstances pre-drying may be advisable (see also work.info "Welding").

4 Storage

General information about the storage of SIMONA® Semi-Finished Plastic Products

- The storage of SIMONA® Semi-Finished Plastic Products should always take place in a building devoid of moisture, sudden temperature fluctuations and direct sunlight.
- Packaging straps should, if possible, be removed after transport. In the event of repackaging it is better not to use steel straps.
- One-sided heating by a heat source should be avoided.
- PVC products, welding rods and electrically conductive plastics should be protected against moisture.
- Non-UV-stabilised materials should be protected against direct sunlight.
- In storage it is advisable to use plastic film for dust protection. Sheets should be stored on a stable, flat pallet that provides adequate support and is at least as large as the sheet itself. Individual sheets should be stored flat.
- It is recommended that an intermediate liner (e. g. cardboard) be placed between the pallet and the semi-finished plastic product.
- In the case of block storage with multiple pallets stacked on top of one another we recommend using a pallet upside down as an intermediate liner in each case in order to ensure a better distribution of load.
- Special caution is required with block storage if the items are relatively thin sheets and/or foamed material.

5 Legal note and advice

Legal note

Upon publication of a new edition all previous editions shall become void. The authoritative version of this publication can be found on our website at www.simona.de.

All information furnished in this publication reflects our current scope of knowledge on the date of publication and is designed to provide details of our products and potential fields of application (errors and omissions excepted, including typographical mistakes). This shall not be deemed as constituting the provision of legally binding guarantees or warranties as to specific properties of the products or their suitability for specific areas of application.

We provide warranty for the faultless quality of our products solely within the framework of our Standard Terms and Conditions of Business and only within the scope specified therein.

We shall assume no liability for the application, utilisation, processing or other use of this information or of our products. Furthermore, we shall assume no liability for any consequences related thereto. The purchaser is obliged to examine the quality and properties of these products; he shall be responsible in full for selecting, applying, utilising and processing said products as well as applying any information relating thereto, which shall also include all consequences associated with such actions. Third-party property rights shall be observed accordingly.

Advice

Our applied technical advice is given according to our best knowledge and is based on the information you have provided and the state of the art known to us at the time such advice is furnished. The advice shall not constitute a guarantee or warranty of specific characteristics or qualities and shall not establish an independent contractual legal relationship.

We shall only be liable for cases of intent or gross negligence. Under no circumstances shall we be held liable for the correctness or completeness of information you have provided or the advisory/consulting services rendered by us on the basis of such information. Any information provided by us shall not release you from your obligation to conduct your own assessments and evaluations.

We reserve the right to update information without notice as part of our continuous research and development programme.

Our staff at the Technical Service Centre and Customer Service will be pleased to advise you on the processing and use of semi-finished thermoplastic products and the availability of our products.

Technical Service Center
Phone +49 (0) 67 52 14-587
tsc@simona.de

Customer Service
Phone +49 (0) 67 52 14-926
sales@simona.de

6 EC Safety Data Sheet

according to 1907/2006/EG Article 31

Trade name: **SIMONA® PE-EL, SIMONA® PE 1000 EL, SIMONA® PP-EL, SIMONA® PP-EL-S, SIMONA® PVDF-EL**

1. Identification of substance/preparation and company

- Manufacturer details:
  SIMONA AG
  Teichweg 16
  55606 Kirn
  Germany
  Phone +49 (0) 67 52 14-0
  Fax +49 (0) 67 52 14-211

2. Hazards identification

- Unknown

3. Composition/information on ingredients

- Chemical characteristics:
  - PE-EL: polymer of ethylene
  - PE 1000 EL: polymer of ethylene
  - PP-EL: polymer of propylene
  - PP-EL-S: polymer of propylene with flame protection
  - PVDF-EL: polymer of polyvinylidenefluoride
- CAS-Nummer: not applicable

4. First-aid measures

- General comment:
  medical aid is not necessary
- First-aid measures: none
- Routes of exposure: none
- Symptoms/effects: none

5. Firefighting measures

- In case of fire please use gas mask and breathing equipment independing of circulating air. Fire residues must be disposed of according to the local instructions (only PVDF-EL).
- Suitable fire-fighting appliance: water fog, foam, fire fighting powder, carbon dioxide
- Hazard warning notice: not applicable

6. Accidental release measures

- Person-related measures: none
- Environmental protection measures: not applicable
- Cleaning equipment: not applicable
- Unsuitable cleaning products: not applicable

7. Handling and storage

- Handling:
  - PE-EL/PE 1000 EL/PP-EL/PP-EL-S:
    no special regulations to be observed
  - PVDF-EL:
    1. Working rooms must dispose of good ventilation, separate flue has to be installed.
    2. Do not expose to open flame.
    3. Do not smoke in such areas where an accumulation of PVDF dust has to be expected.
    4. When welding please avoid an exceeding of the recommended air and tool temperature. When not observing these safety instructions people can suffer from teflon fever (high fever with symptoms of influenza). Medical aid is necessary.
- Storage: storable for an unlimited period

8. Exposure controls/personal protection

- Special design of technical processing facilities:
  not required
- Tolerance levels: none
- Exposure assessment: none
- Respiratory protection: not required
- Eye protection: not required
- Body protection: not required

9. Physical and chemical properties

- Physical state: semi-finished product, solid state
- Colour: black
- Odour: not applicable
- Crystalline melting range:
  - PE-EL: 126 – 130 °C
  - PE 1000 EL: 130 – 135 °C
  - PP-EL: 160 – 165 °C
  - PP-EL-S: 160 – 165 °C
  - PVDF-EL: 170 – 174 °C
- Flash point: not applicable
- Density:
  - PE-EL: 0.99 g/cm^3
  - PE 1000 EL: 0.95 g/cm^3
  - PP-EL: 0.94 g/cm^3
  - PP-EL-S: 1.17 g/cm^3
  - PVDF-EL: 1.78 g/cm^3

10. Stability and reactivity

- Thermal decomposition:
  - PE-EL/PE 1000 EL/PP-EL/PP-EL-S: above appr. 300 °C
  - PVDF-EL: from 350 °C
- Hazardous decomposition products:
  - PE-EL/PE 1000 EL/PP-EL: Besides carbon black also carbon dioxide and water as well as low molecular parts of PE/PP will develop during the burning process. In case of incomplete burning also carbon monoxide may arise.
  - PP-EL-S: In case of exceeding temperatures the material develops halogen hydrogen. Besides carbon black also carbon dioxide and water as well as low molecular parts of PP will develop during the burning process. In case of incomplete burning also carbon monoxide may arise.
  - PVDF-EL: Above 350 °C decomposition in toxic fluor containing substances. During the burning process hydrofluoric acid, carbon dioxide and water will develop, in case of incomplete burning also carbon monoxide and low molecular fluorocarbons may arise.
- Use of stabilisers: none
- Exothermic reactions: none
- Notices regarding state of aggregation: none
- Conditions to be avoided: none
- Substances/media to be avoided: none

11. Toxicological information

No hazardous effects on health were observed over several years of usage.

12. Ecological information

No biodegradation, no solubility in water, no hazardous effects on the environment are to be expected.

- Mobility: not applicable
- Accumulation: not applicable
- Eco-toxicity: not applicable

13. Disposal considerations

- Can be recycled or can be disposed of together with household rubbish (acc. to local regulations).
- Waste key for the unused product: EAK-Code 120 105
- Waste name:
  - PE-EL/PE 1000 EL/PP-EL/PP-EL-S: waste of polyolefine
  - PVDF-EL: waste of fluoro-plastics

14. Transport information

- No dangerous product in respect to / according to transport regulations
- Notice/symbol transport containers: none
- Special marking for containers: none

15. Regulatory information

- Marking according to GefStoffV/EG: no obligation for marking
- Water danger class: class 0 (self classification)
- Domestic requirements to be observed: none

16. Other information

This information solely describes the safety requirements of the product(s) and is based on our current state of knowledge. It does not give any assurance concerning the product(s) described within the meaning of statutory warranty regulations.

SIMONA worldwide

SIMONA AG

Teichweg 16
55606 Kirn
Germany
Phone +49 (0) 67 52 14-0
Fax +49 (0) 67 52 14-211
mail@simona.de
www.simona.de

PRODUCTION SITES

Plant I
Teichweg 16
55606 Kirn
Germany

Plant II
Sulzbacher Straße 77
55606 Kirn
Germany

Plant III
Gewerbestraße 1–2
77975 Ringsheim
Germany

SIMONA Plast-Technik s.r.o.
U Autodílen č.p. 23
43603 Litvínov-Chudeřín
Czech Republic

SIMONA ENGINEERING PLASTICS (Guangdong) Co. Ltd.
No. 368 Jinou Road
High & New Technology Industrial Development Zone
Jiangmen, Guangdong
China 529000

SIMONA AMERICA INC.
101 Power Boulevard
Archbald, PA 18403
USA

Boltaron Inc.
A SIMONA Company
1 General Street
Newcomerstown, OH 43832
USA

SALES OFFICES

SIMONA S.A.S. FRANCE
43, avenue de l'Europe
95330 Domont
France
Phone +33 (0) 1 39 35 49 49
Fax +33 (0) 1 39 91 05 58
mail@simona-fr.com
www.simona-fr.com

SIMONA UK LIMITED
Telford Drive
Brookmead Industrial Park
Stafford ST16 3ST
Great Britain
Phone +44 (0) 1785 22 24 44
Fax +44 (0) 1785 22 20 80
mail@simona-uk.com
www.simona-uk.com

SIMONA AG SWITZERLAND
Industriezone
Bäumlimattstrasse 16
4313 Möhlin
Switzerland
Phone +41 (0) 61 855 90 70
Fax +41 (0) 61 855 90 75
mail@simona-ch.com
www.simona-ch.com

SIMONA S.r.l. SOCIETÀ UNIPERSONALE
Via Volontari del Sangue 54a
20093 Cologno Monzese (MI)
Italy
Phone +39 02 2 50 85 1
Fax +39 02 2 50 85 20
commerciale@simona-it.com
www.simona-it.com

SIMONA IBERICA SEMIELABORADOS S.L.
Doctor Josep Castells, 26–30
Polígono Industrial Fonollar
08830 Sant Boi de Llobregat
Spain
Phone +34 93 635 41 03
Fax +34 93 630 88 90
mail@simona-es.com
www.simona-es.com

SIMONA Plast-Technik s.r.o.
Paříkova 910/11a
19000 Praha 9 – Vysočany
Czech Republic
Phone +420 236 160 701
Fax +420 476 767 313
mail@simona-cz.com
www.simona-cz.com

SIMONA POLSKA Sp. z o. o.
ul. Wrocławska 36
Wojkowice k / Wrocławia
55-020 Żórawina
Poland
Phone +48 (0) 71 352 80 20
Fax +48 (0) 71 352 81 40
mail@simona-pl.com
www.simona-pl.com

OOO "SIMONA RUS"
Projektiruemy proezd No. 4062,
d. 6, str. 16
BC PORTPLAZA
115432 Moscow
Russian Federation
Phone +7 (499) 683 00 41
Fax +7 (499) 683 00 42
mail@simona-ru.com
www.simona-ru.com

SIMONA FAR EAST LIMITED
Room 501, 5/F
CCT Telecom Building
11 Wo Shing Street
Fo Tan, Hong Kong
China
Phone +852 29 47 01 93
Fax +852 29 47 01 98
sales@simona-hk.com
www.simona-cn.com

SIMONA ENGINEERING PLASTICS TRADING (Shanghai) Co. Ltd.
Room 5, 19/F, Block B
Hongqiao Nanfeng Town
No. 100 Zunyi Road
Changning District
Shanghai
China 200051
Phone +86 21 6267 0881
Fax +86 21 6267 0885
shanghai@simona-cn.com
www.simona-cn.com

SIMONA INDIA PRIVATE LIMITED
Star Hub, Unit No. 204,
2nd Floor, Building No. 1,
Sahar Road, Andheri East,
Mumbai 400099
India
Phone +91 (0) 22 66 197 100
Fax +91 (0) 22 66 197 105
sales@simona-in.com

SIMONA AMERICA INC.
101 Power Boulevard
Archbald, PA 18403
USA
Phone +1 866 501 2992
Fax +1 800 522 4857
mail@simona-america.com
www.simona-america.com

Boltaron Inc.
A SIMONA Company
1 General Street
Newcomerstown, OH 43832
USA
Phone +1 800 342 7444
Fax +1 740 498 5448
info@boltaron.com
www.boltaron.com

SIMONA AG
Teichweg 16
55606 Kirn
Germany

Phone +49 (0) 67 52 14-0
Fax +49 (0) 67 52 14-211
mail@simona.de
www.simona.de

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