

Technical Yarns and Fibers for Composites

EMS-GRILTECH





Introduction

Grilon is known worldwide as the tradename for specialty yarns and fibers from EMS-GRILTECH. For fiber reinforced composites we offer high performance Copolyamide, Copolyester and Phenoxy multifilament yarns and staple fibers. These multifunctional materials are used as binder and toughener in thermosetting composites and as matrix material in thermoplastic composites. Our materials are incorporated into the customer product during textile manufacturing of fiber reinforcements.

Grilon Yarns for Composites

Grilon yarns are available in different yarn counts and make-ups depending on the textile application and further processing. Different types of Grilon offer a broad range of properties.

Grilon KE–Type: Copolyester
Polyester based materials with low water uptake, exceptional bonding behavior, high resin compatibility and a broad range of melting temperatures for the use in thermosetting composites.

Grilon K–Type: Copolyamide
Polyamide based materials with high tenacity, high resin compatibility and a broad range of melting temperatures for the use in thermosetting and thermoplastic composites.

Grilon MS–Type: Phenoxy
Amorphous materials which are chemically similar to epoxy resins and thus soluble in those resin systems.

Grilon C–Type: Combi-Yarn
Combi-yarns with a non-melting core yarn and Grilon low-melt cover for the use in thermosetting and thermoplastic composites.

Application

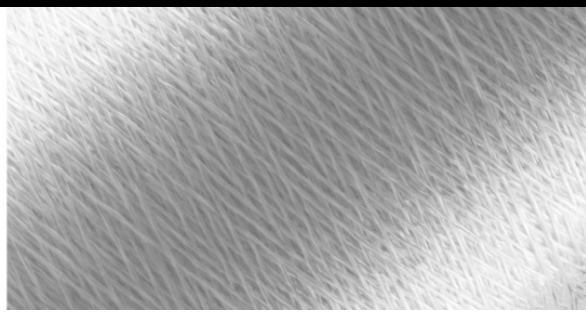
Textile Application Methods

- Stitching of Non-Crimp Fabrics (NCF)
- Weaving
- Braiding
- Knitting
- Sewing (i.e. Tailored Fiber Placement)
- Intermingling/ Comingling
- Spinning (staple fibers)
- Nonwoven manufacturing (staple fibers)

End Use Applications

- Aerospace
- Automotive & Transportation
- Technical Equipment & Plant Engineering
- Medical Equipment
- Sports Equipment
- Wind Energy
- Building & Construction





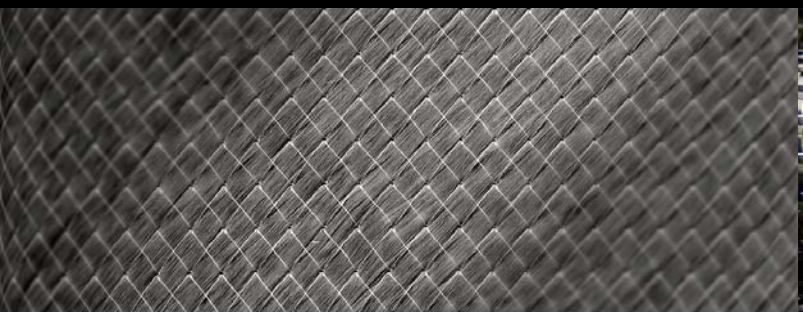
Product Portfolio / Technical Data

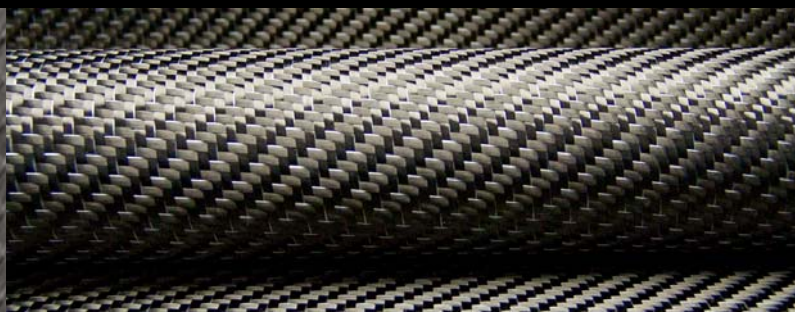
Polymer	Yarn type	T_m* [°C] / [°F]	T_{App}* [°C] / [°F]	Yarn count [dtex]	t_c [cN/dtex]	Recommended Applications
CoPES	KE-60	60 °C 140 °F	80–110 °C 176–230 °F	110–330	2.5	thermosetting resins
CoPES	KE-135	135 °C 275 °F	145–165 °C 293–329 °F	75–110	2.5	thermosetting resins
CoPES	KE-160	160 °C 320 °F	170–195 °C 338–383 °F	75–330	2.5	high temperature thermosetting resins
CoPA	K-85	85 °C 185 °F	95–120 °C 203–248 °F	75–840	2.8	thermosetting resins
CoPA	K-110	110 °C 230 °F	130–155 °C 266–311 °F	55–390	3.5	thermosetting resins
CoPA	K-140	140 °C 284 °F	150–170 °C 302–338 °F	55–167	3.5	high temperature thermosetting resins
PA12	K-178	178 °C 352 °F	200–250 °C 392–428 °F	55–200	3.5	high temp. thermosetting resins/ thermoplastic matrix material
PET/ CoPA	C-85	85 °C 185 °F	95–120 °C 203–248 °F	200–900	2.0	thermosetting resins
PET/ CoPA	C-140	140 °C 284 °F	150–170 °C 302–338 °F	200	3.0	high temperature thermosetting resins
PA66/ CoPA	C-140	140 °C 284 °F	150–170 °C 302–338 °F	45	4.0	high temp. thermosetting resins/ In-situ polymerization of PA
Phenoxy	MS	T_g 85 °C T_g 185 °F	110–140 °C 230–284 °F	150/300	1.0	high temperature thermosetting resins

*in case of C-products, temperatures applicable for the sheaths are stated

Density	PA66	PA12	CoPA	PET	CoPES	Phenoxy
ϱ [g/cm³]	1.15	1.01	1.05-1.15	1.38	1.15-1.25	1.2

Symbol	Unit	Description	Symbol	Unit	Description
T_m	°C / °F	Melting Point	T_g	°C / °F	Glass Transition Temperature
T_{App}	°C / °F	Application Temperature	t_c	cN/dtex	Tenacity (Breaking Tenacity)





Grilon KE

Low melting copolyester yarns offer a range of advantages in the manufacturing and further use of fiber reinforcements:

- Low melting point for easy preforming
- Exceptional bonding behavior to fibers
- Excellent compatibility to most resin systems
- Increased fatigue performance
- Very low water uptake
- Reduced "fish-eyes" leading to less "print-through"

Our KE-types are typically used for the production of multi-layer preforms for low and high pressure resin transfer molding (RTM) and for high fatigue components.

Grilon K

Copolyamide based yarns offer benefits especially for brittle high temperature resin systems and fatigue loaded components:

- High tenacity
- Good textile processing behavior even with low yarn counts
- Increased fracture toughness
- Increased mechanical performance under adverse conditions (hot/wet)
- Reduced micro-cracking

Our high temperature K-types are typically used to replace standard stitching yarn in Non-Crimp Fabrics (NCF) (i.e. Aerospace.) The low temperature K-types are typically used in woven fabrics for stabilization.

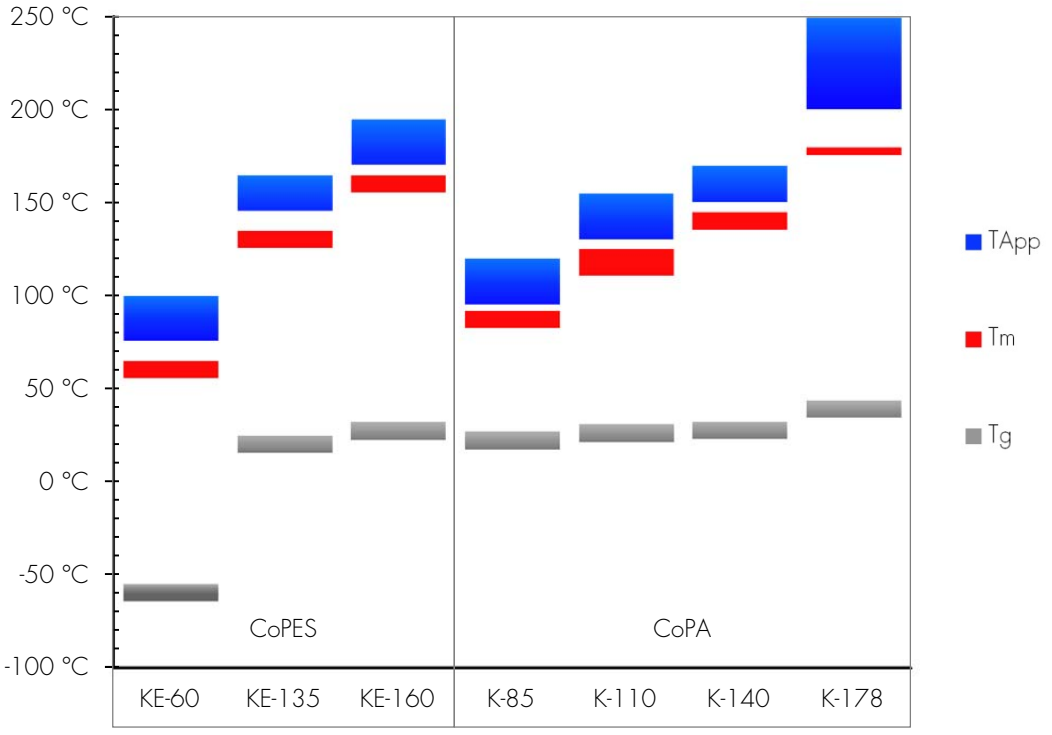
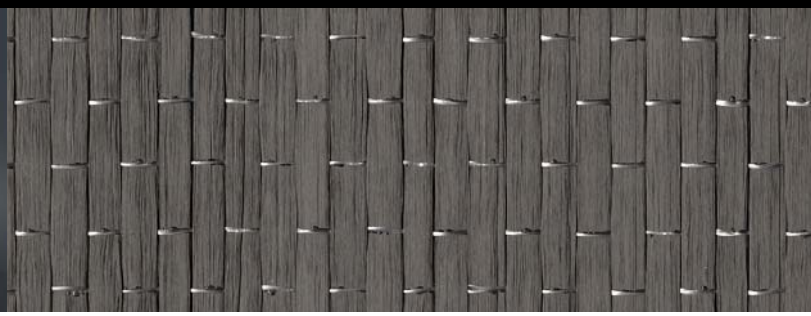


Fig 1: Chart of melting temperature and application temperature of standard products





Grilon MS

Grilon MS is chemically similar to epoxy resin systems and thus does not generate defects in cured components. Actually it is soluble in epoxy resins at elevated temperatures.

Grilon MS yarn is an award winning material that has been specifically developed to enhance the impact resistance of established high temperature resin systems while not affecting other physical properties such as glass transition (T_g).

The amorphous material has a T_g of 85 °C and allows for preforming at 110 °C to 150 °C.

Grilon MS yarn

Grilon MS yarn is available in 150 dtex and 300 dtex for the use in various textile processes. Incorporated in reinforcing fabrics, it aids as binder during preforming. Furthermore, it acts as an effective toughener for brittle resin systems.

Grilon MS web

In order to allow for even distribution between each layer of reinforcing fiber material, a light weight web is under development based on the same polymer utilized in Grilon MS yarn. The web enables the incorporation of Grilon MS in "off the shelf" fiber reinforcements.

The web is available with areal weights of 8, 12 and 20 g/m^2, at 1.27m (50 inch) width.

Grilon Combi-Yarns

Grilon combi-yarns combine a non-melting, high-tenacity core yarn, wrapped with a low-melting Grilon yarn. Combi-yarns are typically used for "unidirectional weaves" (UD-weaves), grids or other applications where a persistent, high strength core yarn is necessary or advantageous over mono-component melting yarns. Combi-yarns are a versatile alternative to coated bonding yarns.

Core yarns can be chosen from polyester or polyamide yarns in various counts.

Further combi-yarns with other core materials or other low-melt Grilon yarns can be supplied upon request.

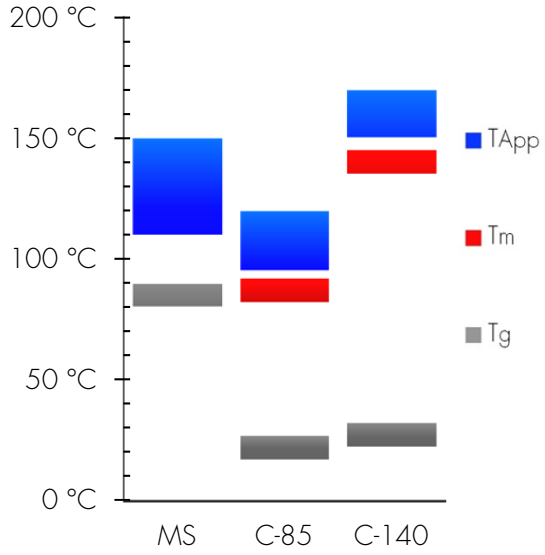
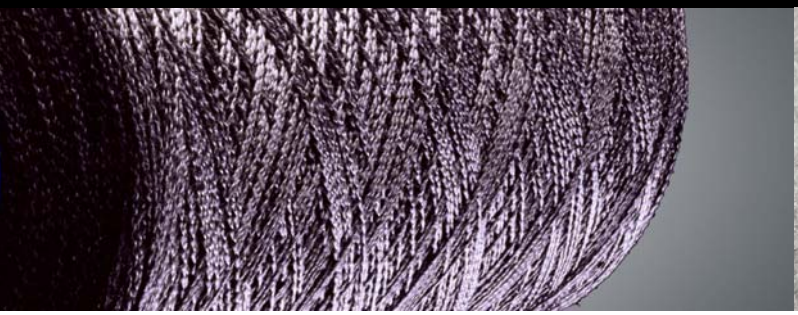


Fig 2: Chart of glass transition (T_g), melting (T_m) and application temperature (T_{App}) of Grilon MS and Grilon C* products.

*in case of C-products, temperatures applicable for the sheaths are stated





Grilon in Thermoplastic Composites

Thermoplastic composites have a number of advantages over thermosetting composites:

- High impact resistance
- High chemical resistance
- Shapeable and weldable through heat
- No curing time
- No hazardous substances, health- & environmentally friendly

These properties can be realized through the use of hybrid-materials (blends of reinforcing and thermoplastic fibers) or through in-situ polymerization of the thermoplastic resin.

Hybrid Yarns and Nonwovens

Grilon yarns and staple fibers made out of Polyamide (PA) or Copolyamide (CoPA) comprise high performance matrix properties designated for the production of hybrid yarns and fabrics for thermoplastic composite applications.

PA12 yarns and fibers exhibit good adhesion to carbon fibers. The melting point enables low process temperatures combined with good mechanical performance and excellent chemical resistance.

PA6 and PA6.6 staple fibers with suitable processing additives are used in combination with glass or carbon fibers for the manufacturing of hybrid nonwovens, especially with recycled carbon fiber.

Textile Application Techniques

- Intermingling/ Comingling
- Spinning
- Nonwovens

In-situ Polymerization

Grilon Polyamide (PA) or Copolyamide (CoPA) multifilament yarns and combi-yarns are highly compatible to other PA resins.

During in-situ polymerization the compatibility of the material composition is critical to the process and thus to the properties of the component. Incompatibility can inhibit or even end the polymerization process.

Grilon yarns are an ideal substitution for standard stitching yarns or other bonding materials in reinforcement fabrics and preforms intended for the use with in-situ polymerized polyamide resins.

Textile Application Techniques

- Stitching of Non-Crimp Fabrics (NCF)
- Weaving
- Braiding
- Knitting
- Sewing (i.e. Tailored Fiber Placement)





Research & Development

EMS-GRILTECH is internationally recognized for its extensive research and development experience, expert advice and consistent product quality. Customers benefit from our modern application and testing laboratories where new products and applications are developed continuously.

Samples for first application tests can be produced on our pilot line. The line is suitable for spinning staple fibers and continuous filaments in mono- or bi-component constructions. Our production plants are constructed for rapid product changes and different spinning conditions. The transfer of development products to large-scale production is possible in a short time frame.

Please get in contact with our customer service if you have specific requests.

Individualized Products

As our customers require specialized solutions we can deliver individual products upon request.

Individual Make-up

For applications where warping is required, EMS can deliver individual cone sizes and metered cones if necessary.

Specialized Twists

For applications where sewing threads are required, special thread constructions and twists can be designed and produced.

Combi-Yarns

Combi-yarns with specific requirements, i.e. core to sheath ratio, specialized core materials and yarn constructions can be produced upon request.

Staple Fibres

Most of our multifilament yarns and many more polymers can be supplied as staple fibers as well.

Under Development

A number of products are currently under development.

Copolyester Yarn

Copolyester yarn with a melting temperature of 85 °C to 110 °C for the use as binder yarn in thermosetting composites is being developed.

Combi-Yarns with low-melt Copolyester

Combi-yarns with KE-types as melting sheath are currently under development for use in thermosetting composites.

High T_g Polyamide Yarn

High temperature thermoplastic matrix material designed to withstand cataphoretic treatment for use in hybrid yarns and nonwovens.

Grilon MS Web

Web made from Grilon MS polymer with 8/12/20 g/m^2 for the use in thermosetting composites.



EMS-GRILTECH worldwide

www.emsgriltech.com

EMS-GRILTECH is a Business Unit of EMS-CHEMIE AG, which belongs to the EMS-CHEMIE HOLDING AG (www.ems-group.com).

We manufacture and sell Grilon yarns and fibres, Nexylon and Nexylene fibers, Griltex thermoplastic adhesives, Grilbond bonding agents, Primid crosslinkers for powder coatings and Grilonit reactive diluents. We have developed these materials and additives into outstanding specialty products for technically demanding applications. In this manner we create added value for our customers who enjoy success in their own markets through continuous improvement.

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