

Kundenseminar der Dolder AG

26. September 2019 in der V8 Motorworld Böblingen



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VESTAKEEP® Segment

Product Line Engineered Products

Volker Strohm

Böblingen, September 26th, 2019



Agenda

- **Evonik at a glance**
- Segment VESTAKEEP
- Evonik customer support

Evonik at a glance

Global Player with Local Customer Focus

15

Billion Euro sales in 2018

>80%

Of turnover gained from
leading market positions

104

Employees from 104 different
nations are working for Evonik

>36,000

Employees in over 100 countries

2.6 billion Euro

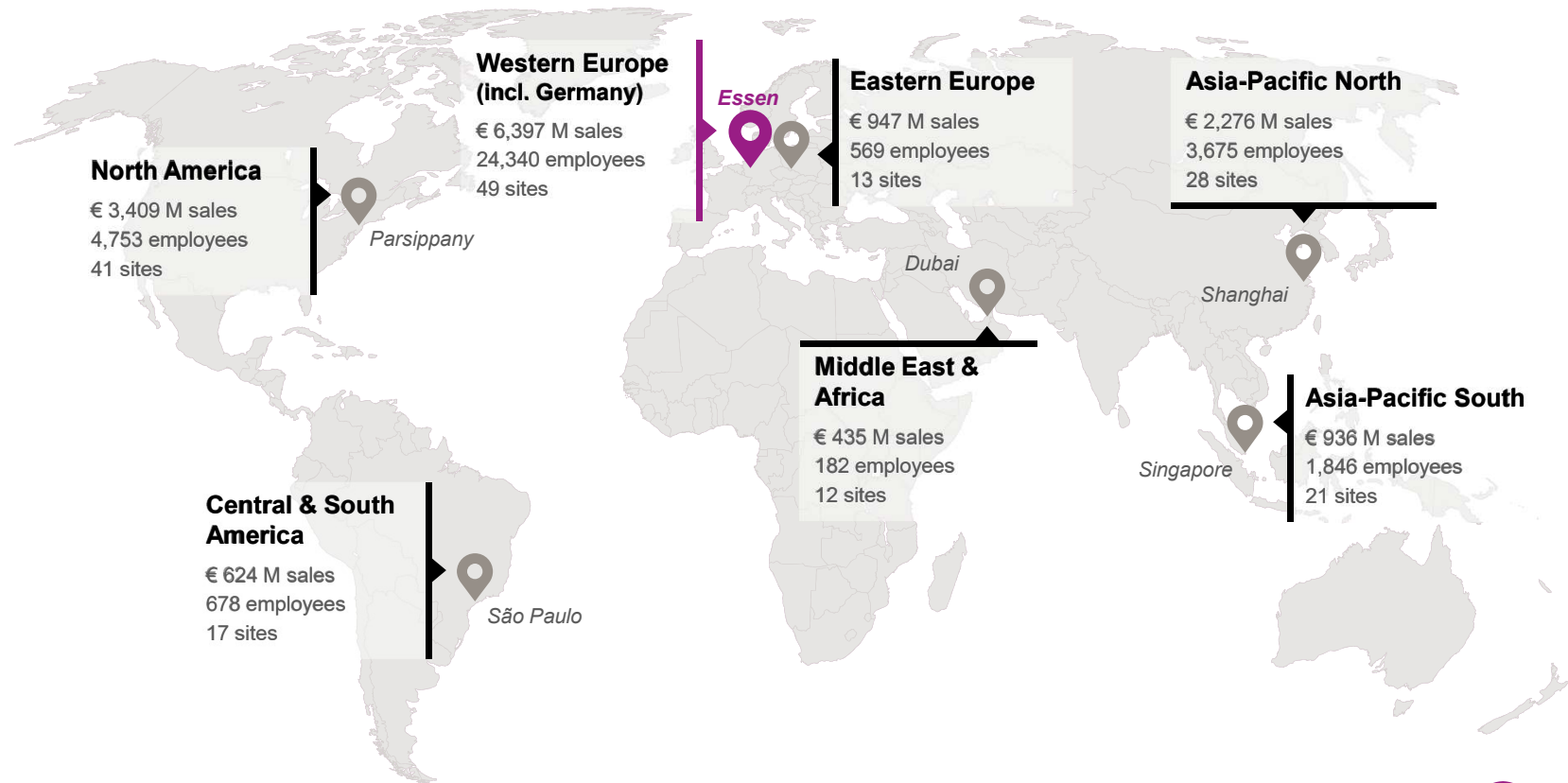
Adjusted EBITDA 2018

~240

New patent applications

Where Evonik can be found ...

~ 36,000 employees operating worldwide and generating ~ €15 billion sales



Our Strategy

Growth and Balance



Evonik is based on three pillars ...

... enabling strategic concentration and operative independence

Strategic Management Holding



Segments



Nutrition & Care

Products for use in the areas consumer goods, nutrition and health



Resource Efficiency

Environmentally friendly and energy-efficient systems as solutions for several industries



Performance Materials

Polymer materials and intermediates mainly for the rubber, plastics and agriculture industries

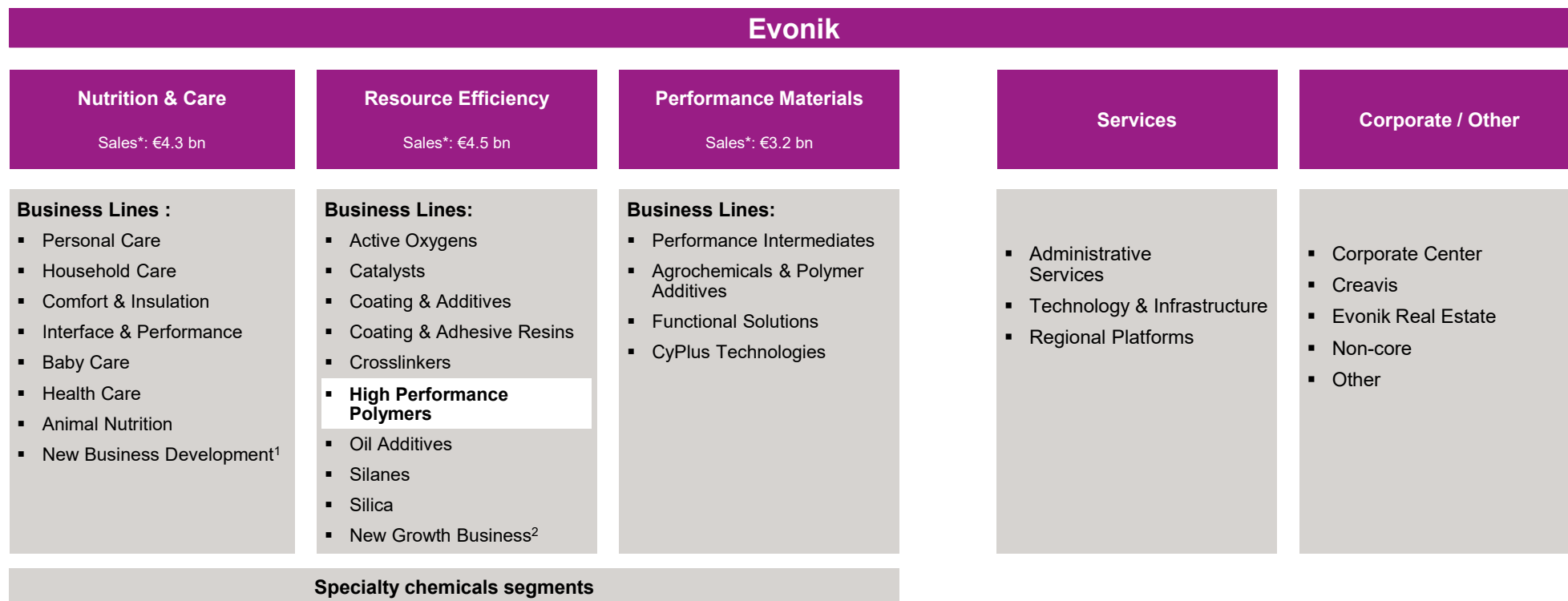


Technology & Infrastructure

Site operation, energy & utilities, technical services, logistics, process technology and engineering

Evonik corporate structure ...

... enables local customer focus



High Performance Polymers

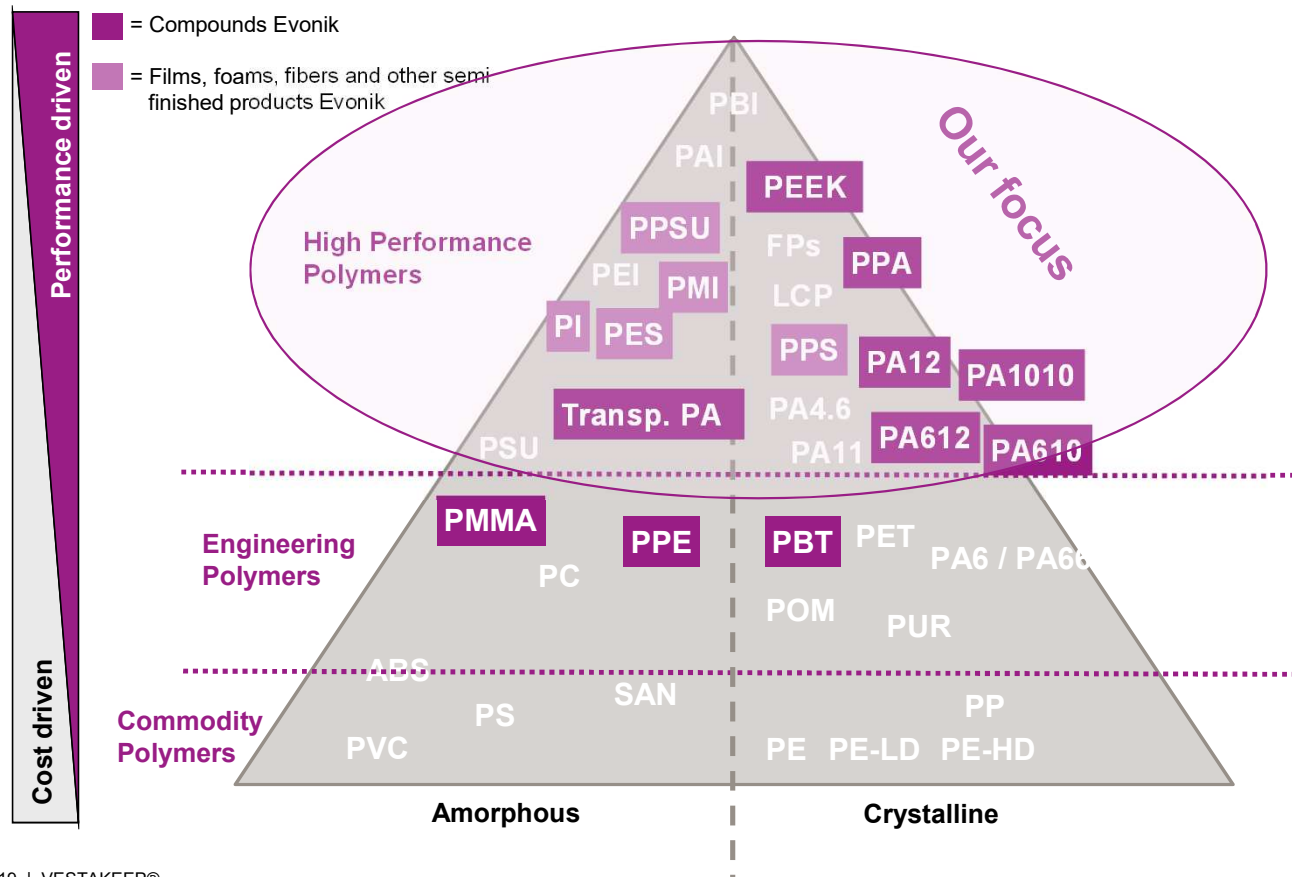
We take you to the top!

Our goal is to be the most creative company in polyamide 12-based applications driven by our innovation capability.

We aim to strengthen our leading position in the PEEK, powder, foam and membrane business by continuously optimizing our product portfolio.



Evonik High Performance Polymer Product Portfolio



Our brands

Compounds	Powders, Rubber	Foams, Composite Tapes	Fibers, Membranes
VESTAMID® VESTAMID® NRG VESTAMID® Terra VESTAMID® Care	VESTOSINT®	ROHACELL® ROHACELL® HERO ROHACELL® Triple F	SEPURAN® SEPURAN® Green SEPURAN® Noble SEPURAN® N ₂ SEPURAN® NG
VESTAKEEP® VESTAKEEP® Care	VESTAMELT®	VESTAPE®	DuraMem® PuraMem®
TROGAMID® TROGAMID® CX TROGAMID® T TROGAMID® Care TROGAMID® Terra	VESTENAMER®		P84®
VESTODUR®			

Outline

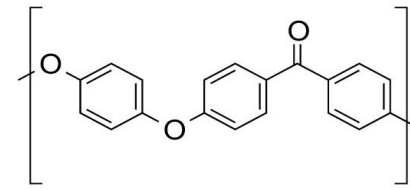
- Evonik at a glance
- **Segment VESTAKEEP**
- Evonik customer support

VESTAKEEP® PEEK semi-crystallin thermoplastic polymer ...

... with outstanding material properties

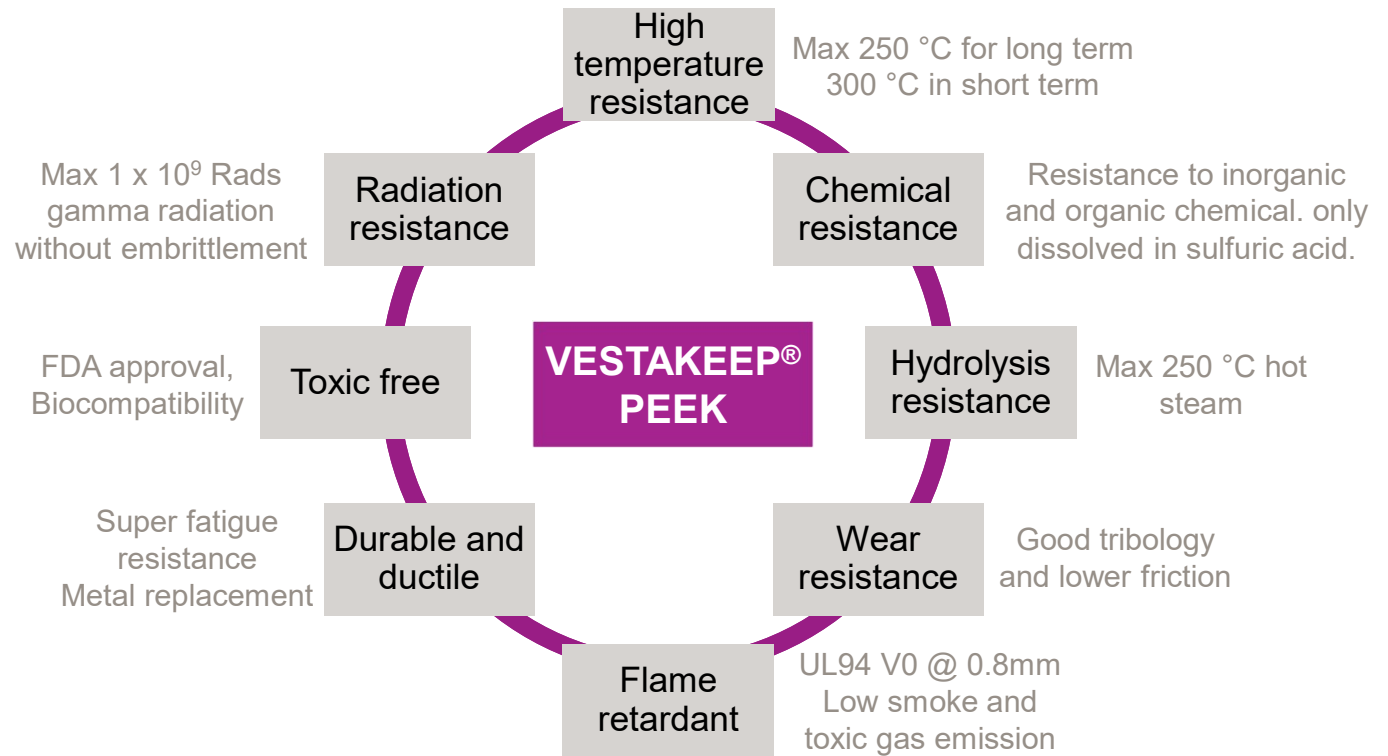


- **VESTAKEEP® PEEK** is a member of semi-crystallin thermoplastics family...
- ... generally referred to as polyaryletherketone (PAEK)
- Polymers of this family mainly include PEK, PEEK, PEKK, PEEKK and PEKEKK
- Among them, PEEK is most widely used due to its balanced properties and excellent processability
- PEEK chemical structure:

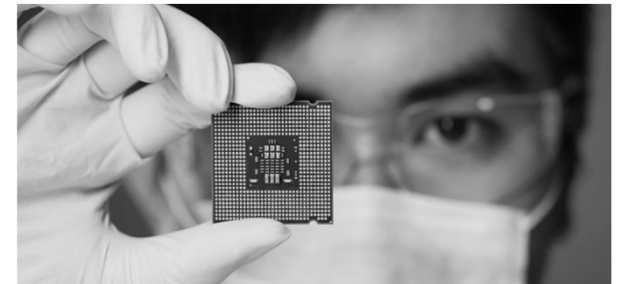


PEEK is composed of repeating units of three phenyl rings, two ester groups and one keto group.

VESTAKEEP® PEEK Key Properties



Our main markets



**Oil & Gas, Automotive, Composite, Aerospace, Stock shape
Electrical & Electronics, Semiconductor, Additive Manufacturing**



VESTAKEEP® Standard Grades



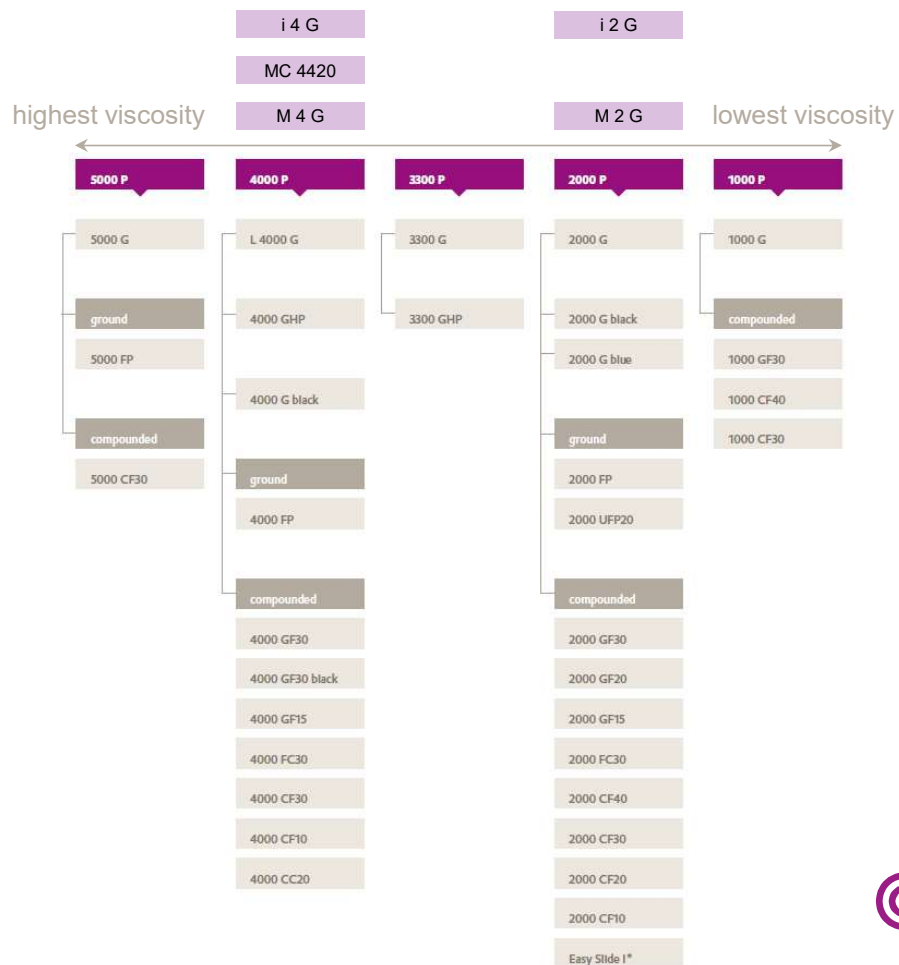
M = medical
I = implant

Medical application

Industry application



G = Granules
P = Powder
FP = Fine powder
GHP = High purity granules
UFP = Ultrafine powder
GF = Glass fiber
FC30 = PTFE/graphene/carbon fiber(10:10:10)
CF = Carbon fiber
CC20 = Ceramic-filled 20%
* *modified for low friction*



VESTAKEEP® Components for O&G...

... Ensuring Long Life in the Extreme Environments



Seals, Backup Rings, Valve Parts, Compressor plates, Connectors, Frac Parts, Packers, and pipes/liners for high pressure, high temperature service environments.

Requirements:

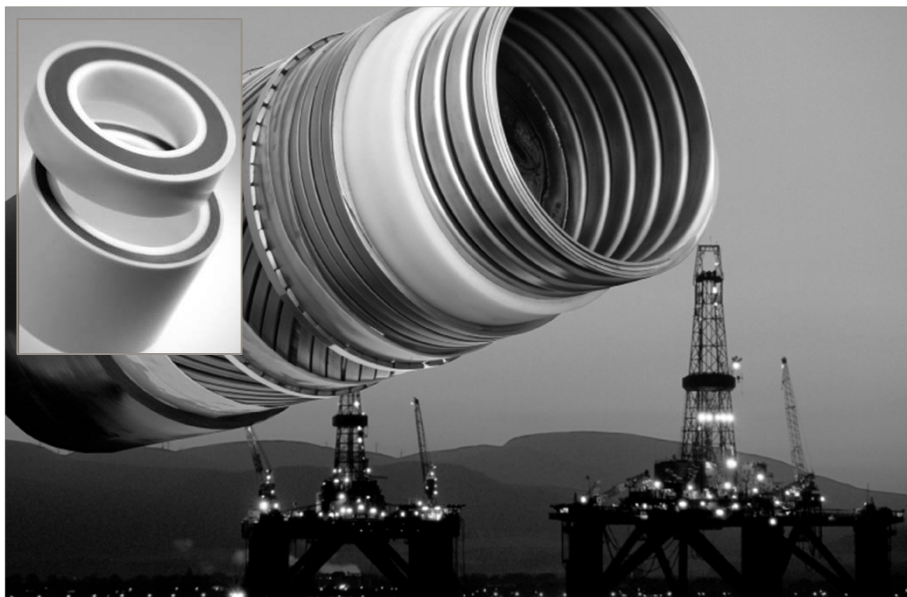
- Range of static and dynamic conditions,
- High Pressure, High temperature (450°F, up to 30K psi)
- Aggressive chemicals resistance - Sour Gas (H₂S), steam, acids, and other chemicals
- High life expectancy up to 20+ years with ZERO failure rates

Evonik support:

- Strategic Approach throughout the value chain based on expertise
- Solutions provider for HPHT requirements
- Deliver USP via XPEEK for extreme working environment

VESTAKEEP® Tape, Liner, Pipe...

...the High-end Solution for the O&G Industry



VESTAPE® UD-tapes for replacing reinforcing metal layers in flexibles (Full-TCP or Hybrids) and VESTAKEEP® 5000G for liners and anti-wear tapes

Requirements:

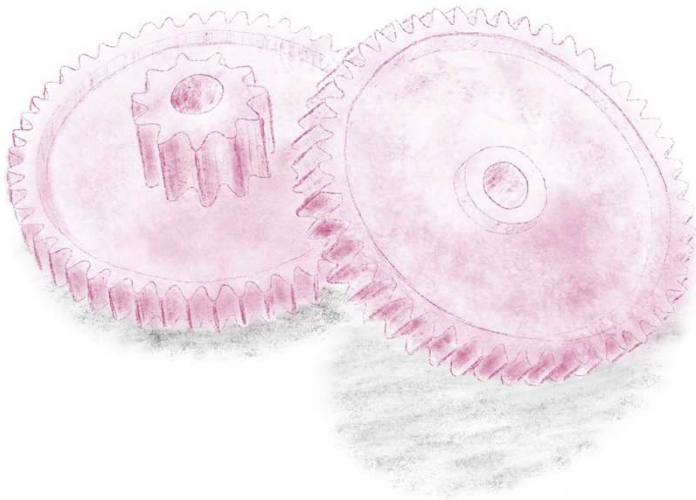
- Very good extrudability and processability
- High temperature resistance
- High burst pressure ratings
- Superior ductility
- Chemical resistance
- Outstanding mechanical performance

Evonik support:

- Full qualification of VESTAPE at DNVGL
- Full material data package

VESTAKEEP® Gears ...

... Wide Temperature Range, High Chemical Resistant, Long Lasting



Gear application for use in automotive, medical and industrial applications

Requirements:

- Temperature from -40 °C up to +150 °C
- Excellent fatigue properties and wear resistance
- High ductility in combination with higher modulus
- Strongest chemical resistance
- Low swelling in different fluids

Evonik support:

- Gear evaluation support in Evonik Friction & Motion Center
- CAE gear dimensioning support
- Mold design support
- Molding process development support
- Provide material data for gear simulation software

VESTAKEEP® for New & Future Mobility

Interior Gear & Sliding Systems

Low Friction & High Crash Toughness

Valves in Life Cell Airbags

Ductility, Precision & Reliability

Battery Separator Sheets

Electrical Strength & Flame Retardancy

Steering Systems

Ductility & Extreme Temperature Resistance

Brake System

Durability & Extreme Temperature Resistance

Door Systems

High Friction & Low Wear Rate

Expected
PEEK
in
Electric
Vehicles

VESTAKEEP® E&E ...

... Lighter and Thinner, Extremely durable



E&E Applications for mobile, home appliances, speaker, etc.

Requirements:

- High modulus for thinner and lighter structure
- Excellent weatherproof and durability
- Wide temperature from -40 °C to +150 °C
- Superior chemical resistance
- Flame retardant (UL94 V-0)

Evonik support:

- Wide range of product portfolio to fulfil
- Technical support for design, development and production
- Customized product for special requirements

VESTAKEEP® for Semiconductor Industry ...

... Providing High Purity and Production Yield



Significant applications in semicon fabrication like mask carrier, CMP retainer ring as well as various wafer carriers.

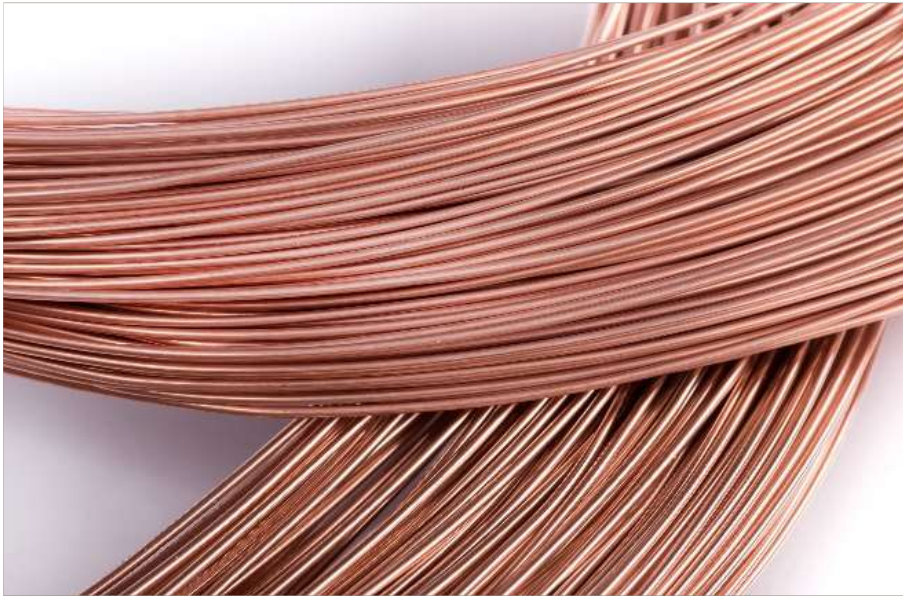
Requirements:

- High purity for low particle and contamination
- Low wear rate for long life cycle
- Excellent resistance for processing chemicals
- Stable ESD property of injection molding parts

Evonik support:

- Adjustable product design for applications
- Multiple solutions for variable ESD requirement
- Provide prompt service with rich processing experiences
- Flexible product strategy for potential cooperation

VESTAKEEP® in Cable Coating Applications Protects and Insulate the Electric Power



Cable application for use in automotive and industrial applications, wire coating as replacement for fluoropolymer and as substitution of lacquer / epoxy, thickwalled coating of wires for e-mobility

Requirements:

- Excellent electrical properties for temperature up to +150 °C
- Very good extrudability and processability also for very thin coatings
- High peel strength and scratch resistance
- Less defects on surface because of very high purity
- Crosslinked version for good mechanical properties at temperature > +220 °C

Evonik support:

- Customized solutions for different requirement in cable coating
- Special grades with high purity for trouble-free production
- Expert's assessment for design, development and production
- Material evaluation & analysis

VESTAKEEP Powder...

...Enabling Large-Scale Composite-Production for Aircraft Applications



Clips and other parts for the primary structure of civil aircrafts

Requirements:

- High Performance Mechanical Properties (Structural)
- Automated Production (Lay-up, Forming, Welding)
- Short Cycle Time & Rework Compliant
- Welding Technologies to Compliment Design/ Shape
- Opportunities for Automated Repair Techniques
- Recycle, Reuse, Repurpose Opprotunities

Evonik support:

- Financial support for qualification of TPUD at Boeing and Airbus
- Offering grinding technology for ultra fine powder
- Material data and ESHQ paperwork



VESTAKEEP® Stock Shapes Delivering Reliability in Semi-Finished Products



Stock shapes as rods or plates for usage in all industrial applications, special grades available for FDM filament production

Requirements:

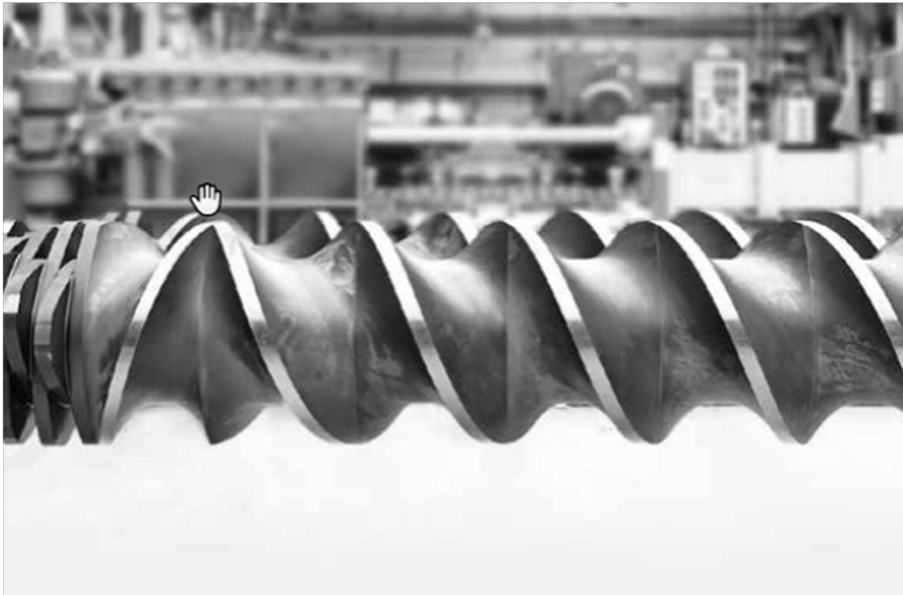
- Excellent mechanical properties for temperature up to +150 °C
- Very good extrudability and processability also for very thin coatings
- Outstanding ductility with VESTAKEEP® 5000G
- Crosslinked version VESTAKEEP® 50001XT for good mechanical properties at temperature > +220 °C

Evonik support:

- Customized solutions for different requirements in stock shape production
- Special grades for stock shape production
- Expert's assessment for material selection, development and production

VESTAKEEP® Base-Resins ...

... for Custom-made Compounds with Unique Requirements



Evonik supports external compounders generating custom-made compounds for high-end applications

Requirements:

- Very high heat resistance
- Excellent sliding friction behavior
- High rigidity
- Excellent chemical resistance
- Good processability
- Good mechanical properties

Evonik support:

- Delivery of base polymer (powder or granules)
- Support in the development of recipes
- Processing-support
- Help with trouble-shooting

VESTAKEEP® General Industrial Applications

... Chemical Resistant, Wide Temperature Range, Long-Term Mechanical Stability



PEEK general industrial applications in bearing cage, pump rotor, electroplating ring, connector, power tool connecting rods, gear, cable tie, dental device casing, RFID tag sealing, etc.

Requirements:

- High continuous working temperature
- Excellent fatigue and wear resistance
- Strongest chemical resistance

Evonik support:

- CAE support
- Tooling design support
- Molding process on-site support
- Product failure analysis support
- Gear evaluation support utilizing Evonik Friction and Motion Competence Center

VESTAKEEP® Care Grades for medical devices with up to 30 days of body or blood contact

Advantages for medical devices

- Excellent chemical resistance (e.g. disinfectants)
- Excellent mechanical properties (metal replacement)
- Excellent serializability (>> 500 cycles steam sterilization=



Product offering

- Granules of different viscosities
- Stock shapes VESTAKEEP® Care M40 R

Biocompatibility test reports availability

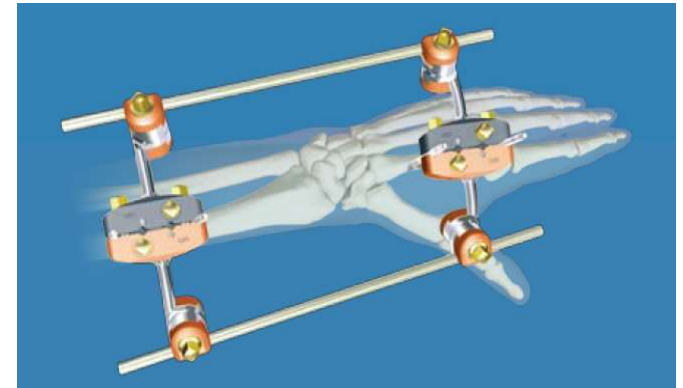
VESTAKEEP® Care		M20 G	M33 G-HP*	M40 G / M40 R
Viscosity		Standard	Standard	Standard
Sterilization Autoclave Cycles		> 500	> 500	> 500
USP Class VI	Acute systemic toxicity, Intracutaneous reactivity, Muscle implantation	+	+	+
ASTM F756-08	Haemolysis	+	+	+
ISO 10993-5	Cytotoxicity	+	+	+
ISO 10993-10	Sensitization: maximization test according to Magnusson and Kligman	+	+	+
ISO 10993-10	Irritation: intracutaneous reactivity	+	+	+
ISO 10993-11	Acute Toxicity	+	+	+

G = granules R = rods

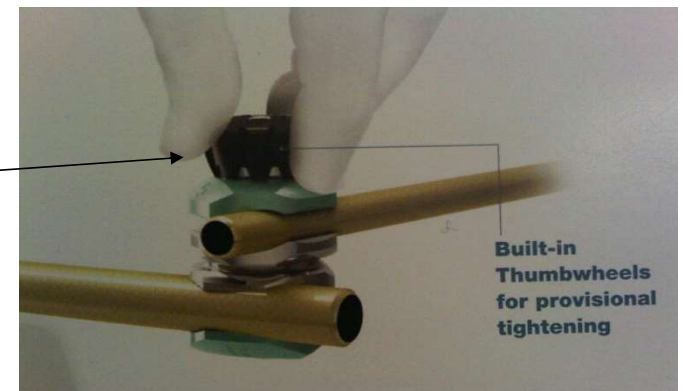
*melt filtrated high purity grade

External fixation system

- **Product:** VESTAKEEP® M2 G black
- **Properties:** Biocompatible, biostabile, metal-free, modulus similar to bone, no x-ray artifacts, ...
- **Customers:** Dolder AG (CH)



Disposable product made from VESTAKEEP® M2G



Outline

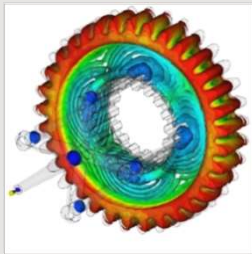
- Evonik at a glance
- Segment VESTAKEEP
- **Evonik customer support**

Evonik Computer Aided Engineering supports ...

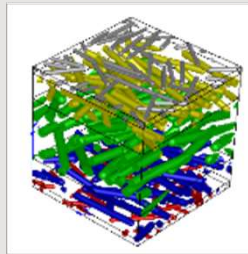
Part, Injection Mold/ Extrusion Die Design as well as Production Process Evaluation



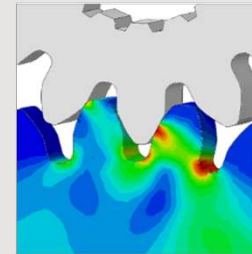
- Global analysis of drivetrain, bearing & gear systems
- Prediction of lifetime, fatigue, wear & tear
- Evonik material database



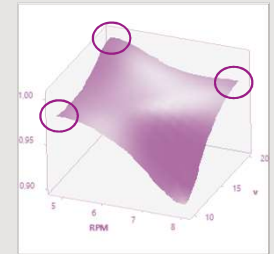
- Processing simulation
- Optimization of part and mold part design
- Evonik material database



- Material modeling & virtual compounding by variation of matrix & filler
- Considering fiber orientation in FEA
- Evonik material database



- Thermal & mechanical FEA
- Detailed analysis of stress & strain distribution
- NVH (under development)
- Material data by CAMPUS

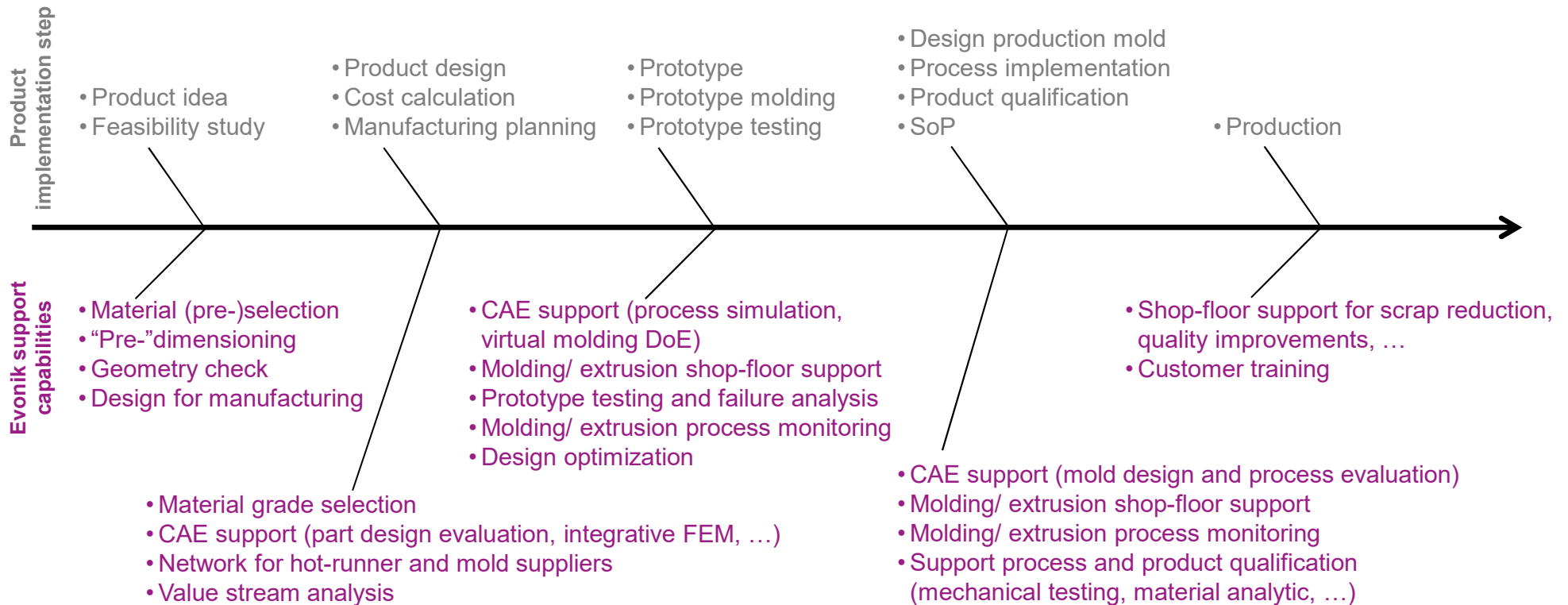


- Virtual DoE
- Optimization utilizing injection molding process simulation

Evonik offers a wide range of CAE services dedicated to real world success.

Evonik Technical Customer Support ...

... Helps Customers Succeeding in First Place



We love helping our customers to succeed...
Living better with Evonik



Nothing is perfect.

There is always room for improvement.

