



*Compose a New World*

*Ensinger Compounds  
What you can expect from us*

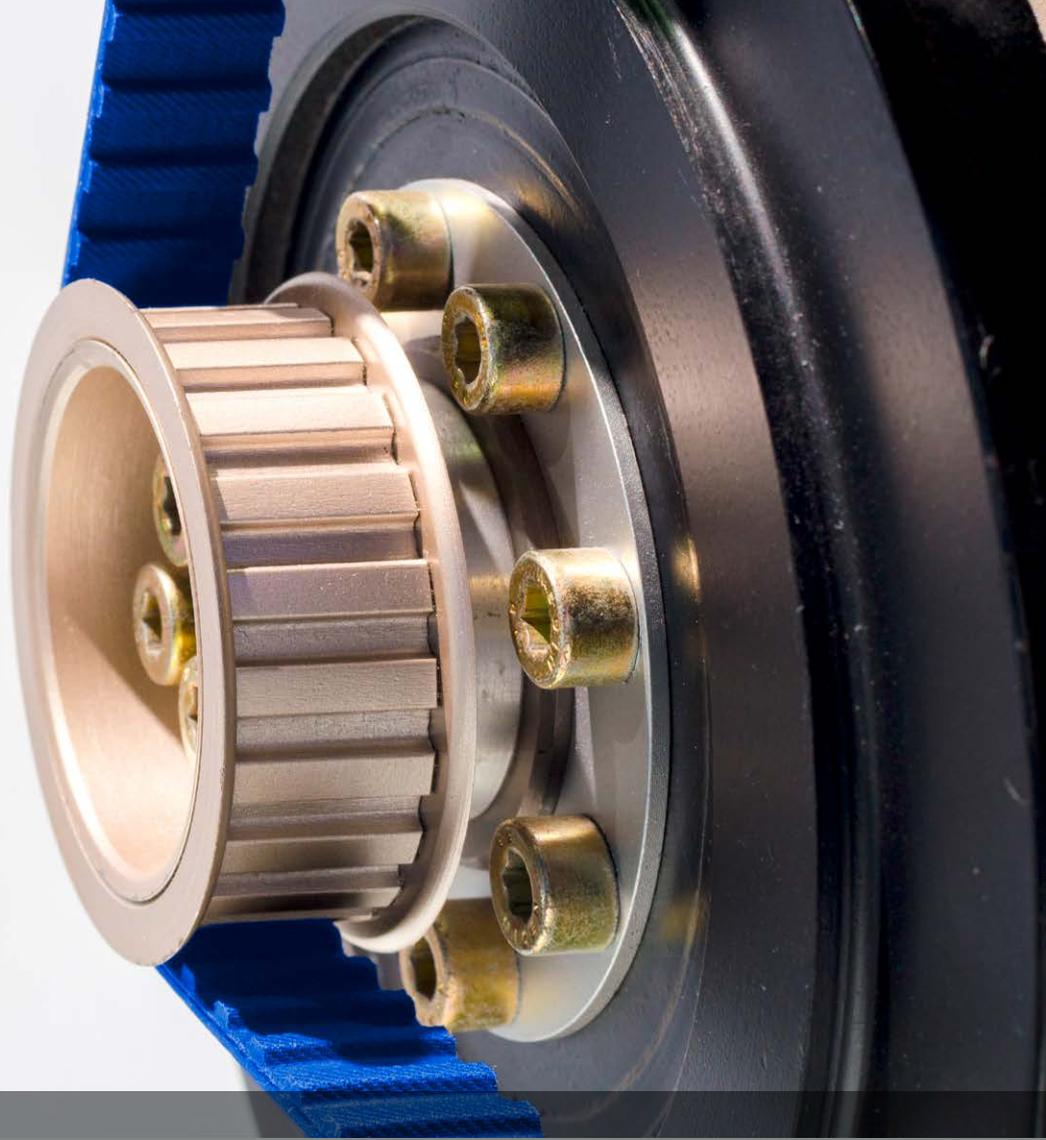
A hand is shown from the bottom, holding a large, dark blue circular disc. The disc features five lines of white, bold, sans-serif text. To the right of the disc, a large quantity of small, blue, rectangular particles is piled up, appearing to spill out from behind the disc. The background is a soft, out-of-focus light grey.

LASER-DIRECTED  
THERMAL CONDUCTIVE  
ELECTRICALLY CONDUCTIVE  
TRIBO-OPTIMIZED  
EASILY DETECTABLE



	<i>TECACOMP® TRM Optimized for tribology and mechanics</i>
	<i>TECACOMP® TC Thermally conducting plastics</i>
	<i>TECACOMP® LDS Compounds for laser direct structuring</i>
	<i>TECACOMP® ELC Electrically conductive compounds</i>
	<i>TECACOMP® ID Safety through detectable plastics</i>

THE PLASTIC GRANULES OF ENSINGER COMPOUNDS ARE THE CULMINATION OF DECADES OF EXPERIENCE IN THE PRODUCTION OF HIGH-PERFORMANCE PLASTICS. WHETHER VOLUME OR SPECIFICATION, WE COVER THE REQUIREMENTS OF ALL IMPORTANT SECTORS OF INDUSTRY. WITH PROVEN STANDARDS AND INDIVIDUAL CREATIONS.



*TECACOMP® TRM*  
*Optimized for tribology and mechanics*

ELECTR. COND  
TRIBO-OPTIMI  
DETECTAB





Piston sleeve DSG gearbox



Sliding block for vehicle seat adjustment



Divert air valve

*The tribologically optimized and mechanically reinforced compounds of the TECACOMP® TRM product series were developed for applications requiring optimum sliding properties, maximum strength and minimal wear. Engineering and high-temperature plastics are responsible for providing the relevant temperature properties, while specially developed fillers improve sliding properties and wear behaviour. Components used particularly in the automotive as well as the mechanical and apparatus engineering industries have been produced over many decades using compounds from Ensinger adapted specifically to these special demands.*

#### **Selection scope base polymers + fillers**

- Base polymers:  
PK, PA, PBT, PPA, PPS, PEEK
- Additives for enhanced mechanical strength: Carbon fibres, minerals, glass fibres, glass beads
- Additives for improved sliding properties: PTFE, inorganic solid lubricants, oils, minerals

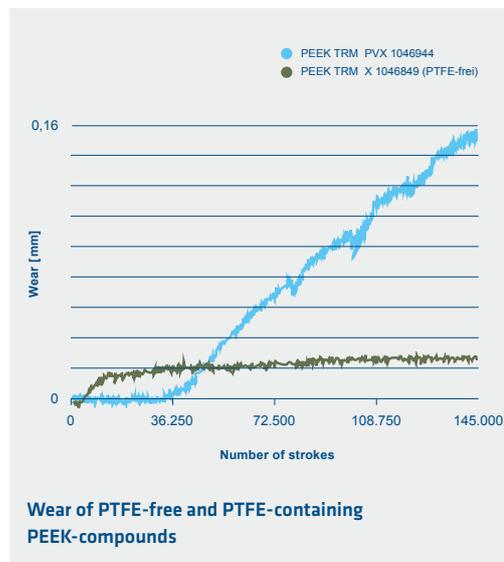
#### **TECACOMP® TRM X: 70% lower wear**

TECACOMP® TRM X compounds are designed for plastic components exposed to high levels of mechanical stress. Instead of PTFE, special minerals ensure optimum sliding and friction properties. The compounds developed by Ensinger demonstrate up to 70% less wear than plastics with added PTFE, and ensure an efficient end product manufacturing process with minimal downtimes. The PTFE-free mineral-filled compounds are the right choice for applications involving higher speeds, high levels of mechanical stress and high temperature conditions. Typical applications involving extreme friction and sliding stress include components in engines, high-performance gears or vehicle drive trains.

#### **Compounds with PTFE**

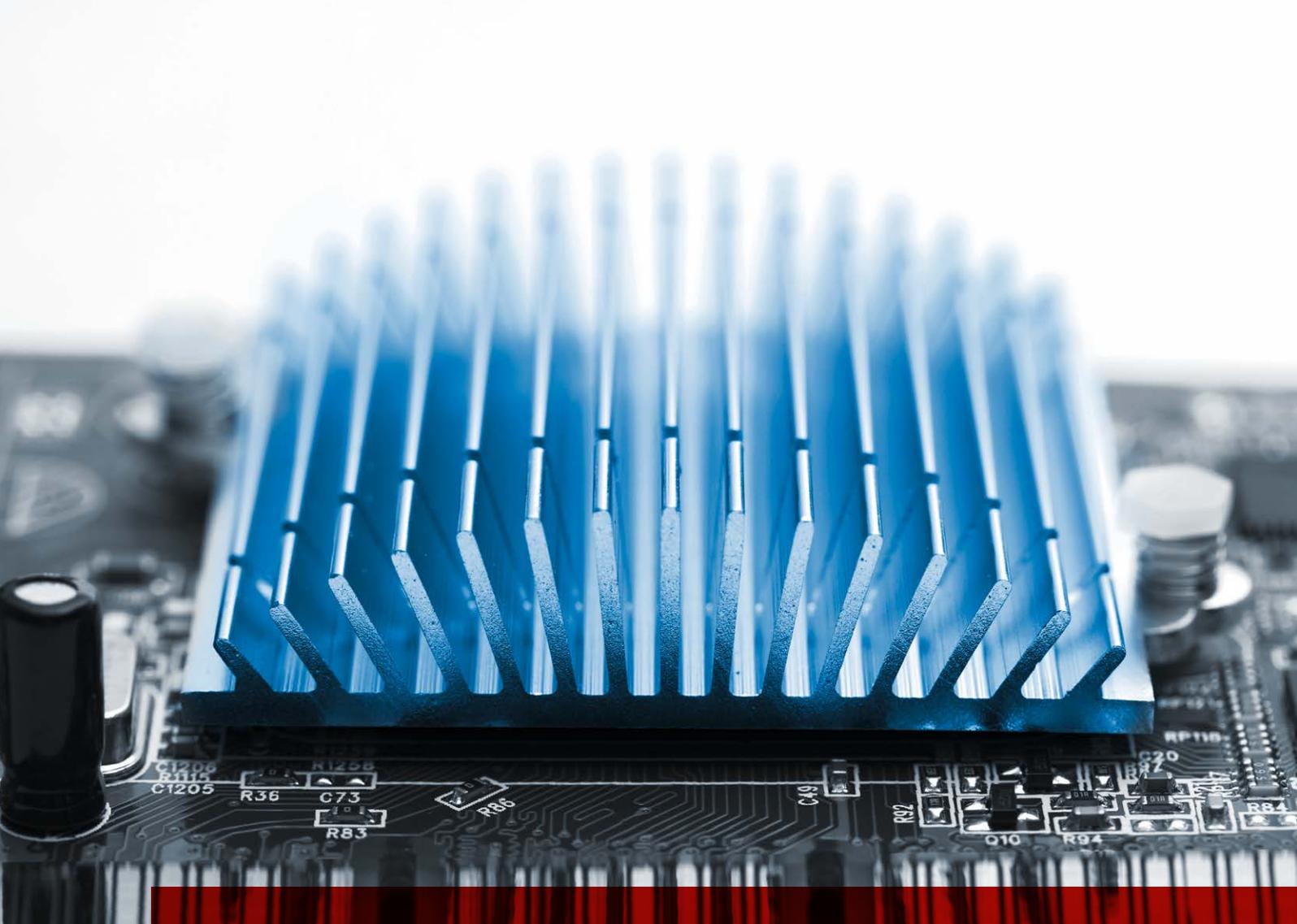
PTFE-modified materials are well known for their excellent friction and sliding properties. Ensinger compounds with PTFE are the right

choice for applications involving moderate loads and high speeds.



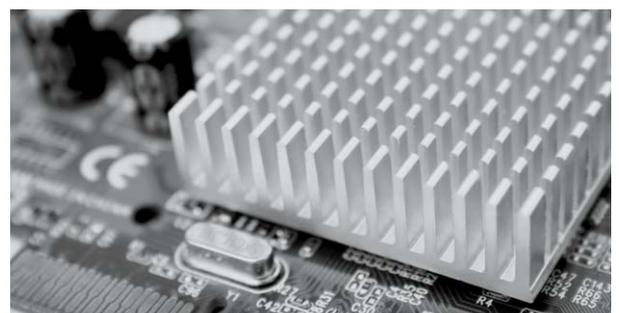
#### **Benefits of TECACOMP® TRM X:**

- The selected fillers significantly increase the creep strength of components subject to loads and high temperatures
- The additives used are stably embedded in the plastic matrix
- A consistent property profile and stable surface structure, as well as an absence of optical faults in applications subject to high loads
- No deposits on the tool and minimal maintenance work required



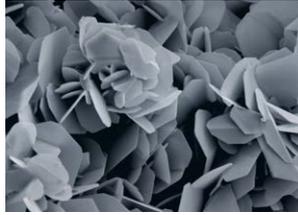
*TECACOMP® TC  
Thermally conducting plastics*

LASER-DIRECT  
THERM. CONDUCTIVE  
THERM. CONDUCTIVE





Headup display and interior lighting of vehicles



Structure of the additive



Heat sink of LED lamps

### **More than just one option**

*Plastics have always been considered more as insulators, while metals are seen as better conductors of heat. However, in applications involving natural convection, thermally conducting plastics have been proven to offer cooling performance comparable to that of metals. This makes them a true alternative or an ideal way of supplementing conventional solutions. Thermally conductive plastics from Ensinger come into their own in applications where metals have distinct drawbacks. Their free formability allows heat sink structures to be configured to provide precisely the required heat distribution. Materials which also provide electrical insulating properties can help to reduce the need for TIMs (thermal interface materials). The results: fewer disruptive heat transfers and even more efficient cooling.*

### **Optimum heat dissipation**

The thermal conductivity of a component made of TECACOMP® TC is between 1 and 25 W/(m·K) depending on the filler used. This makes them ideally suited for applications such as heat dissipation in electronic components.

### **Formability and functionality**

Thermally conductive plastics from Ensinger Compounds can be freely formed by injection moulding. As a result, they open up completely new possibilities in terms of product development and product design. Another advantage over using metal is the facility to equip TECACOMP® TC plastics with electrically isolating properties. In this way, a single plastic component can be used to cool several different electronic components. Insert moulding of assemblies allows several functions to be performed in one: Mechanical fixture, protection against environmental influences, electrical isolation, heat dissipation.

### **Added fillers determine the properties**

A wide selection of base polymers such as PA, PBT, PP, PPS, and PEEK can be adjusted for heat conduction using specific fillers. The filler also lends the material electrically isolating or electrically conductive properties.

In order to affect the characteristics of the base polymer as little as possible, we only use fillers which require a relatively low filling ratio for these fields of application.

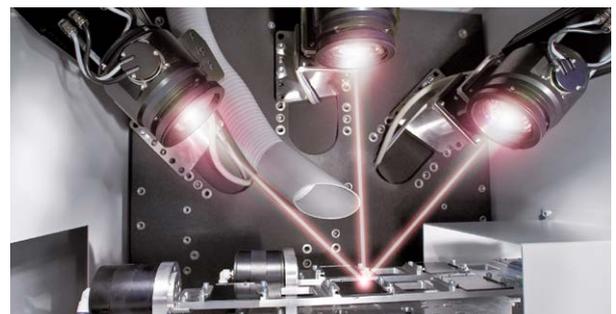
### **Benefits of TECACOMP® TC:**

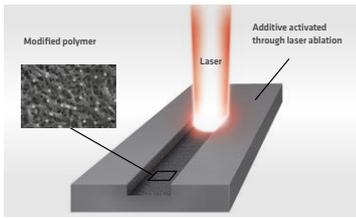
- Wide selection of base polymers
- Wide range of fillers with thermally conductive properties
- Excellent thermal conduction capacity:
  - up to 10 W/(m·K) with electrically isolating materials and
  - up to 25 W/(m·K) with electrically conductive materials
  - up to 85 W/(m·K) in special cases (see TECACOMP® HTE)
- Extremely good processing properties
- Segment specific solutions (LED, E&E, Automotive)
- Savings potential due to injection moulding capability



*TECACOMP® LDS  
Compounds for laser direct structuring*

**LASER-DIRECT**  
TERM. CONDUCT





Laser structuring



Smart phone antennae



Hearing aid  
(Picture courtesy of:  
LPKF Laser & Electronics AG -  
Siemens Audiologische Technik)



3D HIPMAS

*Moulded Interconnect Devices (MID) integrate conductors and electrical circuits directly into three-dimensional plastic components which can be moulded practically at will. This makes the components both a housing and an electronic circuit in one. These injection moulded circuit carriers enable companies to develop components which are smaller, lighter and less expensive than is possible using classical circuit boards. Three dimensional MID systems are also simpler to mount and enable the integration of additional functions.*

**Extremely high requirement profile:  
High temperature thermoplastics**

There can be hardly any other application which poses such widely differing demands on a compound than MID technology. LDS requires the compound to have high thermal resistance, isotropic component behaviour and, most importantly, good capacity for metallization.

Material developments are focused on the implementation of reduced conductor widths and improvement of thermal expansion and conduction. The choice of polymers is consequently restricted to highly thermally stable plastics. The matrix polymers used by Ensinger are polyphthalamides (PPA), polyetheretherketones (PEEK) and liquid crystal polymers (LCP). High-tech plastics are characterized by their excellent dimensional stability and rigidity, even at extremely high temperatures. LCP also comes with good chemical and flame-retardant properties, and is the thermosetting plastic with the lowest thermal expansion. The use of fillers further reduces expansion. Ensinger's newly developed compound TECACOMP® LCP LDS 4107 expands approximately equally both in the direction of flow and also vertically to it.

During the LDS process, polymers are bonded to metals. The difficulty here is that plastics fundamentally demonstrate much higher thermal expansion than metals. If components are exposed to alternating thermal stress, there is a considerable risk of the conductor becoming detached over time. As part of a research project, Ensinger performed extensive test series in order to reconcile the material properties (thermal expansion) of polymers with those of the metal used. This has culminated in the development of special mineral and ceramic fillers which are new both in terms of their size and shape. The compound formulations optimized in this way ensure durable, firmly fixed and functionally reliable metal pathways.

**Benefits of TECACOMP® LDS:**

- Suitable for all popularly used soldering techniques up to 260°C
- Optimized filler systems for fine pitch structures up to 70 µm
- Reduced thermal expansion in the event of temperature changes
- Enhanced thermal conductivity for improved cooling



*TECACOMP® ELC*  
*Electrically conductive compounds*



Compound in bipolar plates  
in a fuel cell



Raw material



Fuel cell

*If non-conductive plastics are modified in a targeted way, then they become ideally suited to applications in which electrical conductivity is crucial. With TECACOMP® ELC it is even possible to achieve electrical conductivity values of up to  $10^4$  S/m.*

*Ensinger Compounds offers you a huge choice of high-performance plastics which not only have high electrical conductivity but also correspondingly high thermal conductivity.*

### **Highly filled graphite compounds for energy technology TECACOMP® HTE**

The new TECACOMP® HTE material from Ensinger Compounds is a compound which has been specifically developed and optimized for applications of this or a similar type. Their suitability is based on a significantly higher than normal ratio of fillers. This high filling ratio enables a degree of electrical and thermal conductivity which was previously unachievable with plastics. At the same time, chemical resistance is also maintained.

The polymers propylene (PP) or polyphenylene sulphide (PPS) is used as the basis for TECACOMP® HTE. It is able to cover application temperatures ranging from 60° to 200°C. PPS has already proven its superiority over thermosetting plastic binders in HT PEM (high-temperature polymer electrolyte membrane) fuel cells. PP compounds are suitable for use in NT-PEM (low-temperature polymer electrolyte membrane) fuel cells as well as in

direct methanol fuel cells (DMFC) or redox flow batteries.

To achieve the high electrical and thermal values required by these applications, carbon-based fillers such as graphite, carbon black or polymer fibres are mixed with the base polymers for TECACOMP® HTE in a ratio of up to 90% by weight.

Depending on the polymer used, the degree of filling and the targeted component size, the formulas are suitable either for processing by injection moulding or compression moulding. This is why the compounds are available in different versions either in powder or in granulate form.

### **Benefits of TECACOMP® HTE:**

- Optimized for bipolar plates in fuel cells, heat exchangers and redox flow batteries
- up to 85 W/(m·K) thermal conduction capacity



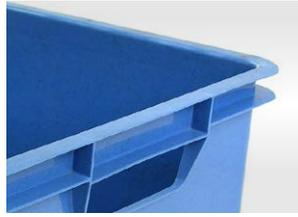
*TECACOMP® ID*  
*Safety through detectable plastics*



Compound for detectable cable ties



Knife handle in detectable plastic



Transport box



Production in the food industry

### **Elimination of risks**

*There are many sectors in which minor errors in production are not a life-or-death issue. They can often result in nothing more than a blemish. When producing food or medicines, for instance, what may appear to be no more than a „detail“ can have wide-ranging repercussions.*

### **Plastics with a safety package**

With TECACOMP® ID, Ensinger offers its customers a safety package: Safety against residues, damaging loss of image, and incalculable follow-on costs.

These benefits add up to a major sales argument which can substantially strengthen your market position.

### **Instantly recognizable in metal detectors**

TECACOMP® ID is picked up by metal and X-ray detectors. Using standardized procedures, any material residues are reliably detected using standard commercially available systems. With the support of our partner RONDOTEST, which has specialized in the manufacturer-impartial testing of foreign body detection in the food and pharmaceutical industry, TECACOMP® ID has been ideally adjusted in line with the functional characteristics of the most widely used metal detectors. TECACOMP® ID is produced by adding detectable fillers to the base polymer. These components ensure optimum presence recognition by detectors.

All popularly used plastics such as PE, PP, PA66, POM or PEEK can be equipped with detectable fillers. Due to the low degree of filling, these TECACOMP® ID materials largely correspond to the profile of the base polymers used. Depending on the requirements imposed on the end product, specific compound compositions are also possible. TECACOMP® ID naturally fulfils all the requirements for food contact (in conformity with the FDA requirements, Directive 2000/72/EC and Regulation (EU) no. 10/2011).

### **Benefits of TECACOMP® ID:**

- Additional security for you and your customers
- Wide range of base polymers (PE, PP, PA66, POM or PEEK)
- Reliable detectability
- Individual colour settings possible
- Toughness modification for lower susceptibility to breakage



***Your advantages from Ensinger Compounds at a glance***

- Decades of experience in the production and development of speciality compounds
- High-performance compounds and individual formulations
- Proven standard products and development of customer-specific formulations
- Tried-and-tested, state of the art production facilities for demanding compounding tasks



*Advantages of Ensinger Compounds*

## **Ensinger Compounds**

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*Thermoplastic engineering and high-performance plastics from Ensinger are used in every important sector of industry today. Their economy and performance benefits have seen them frequently supplant classically used materials.*

