



## ADVANCED MATERIALS

### Thermal Management

Heat Dissipation for  
Polymeric Materials





# We keep it cool

## Bringing High Performance and Effective Heat Dissipation Solutions to Everyday Life

Electronic components continue to evolve; getting smaller in size and delivering more power than ever before. Accordingly, components' heat dissipation requirements are increasing. Heat management and proper integrative and miniature design are critical in order to sustain high performance, fast production throughput rates, reliability and safety, as high temperatures can render electronic parts inoperable or reduce their life cycle.

Thermally conductive plastic materials have gained enormous momentum in recent years. There is a trend towards plastic components as they are lighter and less costly to produce than comparable metal parts. Unmodified polymeric systems are not ideal as they are thermal insulators and cannot conduct heat. Polymeric systems, therefore, require effective thermally conductive additives to dissipate the heat while maintaining its electrically insulating properties. Thermal management is all around us and enables modern everyday life such as in automotive, e-mobility, electrical vehicles, batteries, electric motors, aerospace, electronics, mechatronics

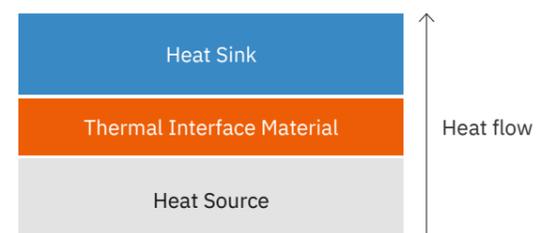
and power modules, which require reliable, light weight solutions. Thermal interface materials are used for functional sheets, IC packaging, heat sinks, electrical power appliances, tapes, pads, thermal gap fillers, encapsulation compounds, adhesives, grease, sealing materials, coatings SF<sub>6</sub> gas circuit breakers and solar panels among other applications. Filled polymers are ideal materials for the design of more efficient, integrative and complex components.

**Huber Advanced Materials has developed a comprehensive range of Thermal Management solutions featuring:**

- A broad product portfolio of engineered solutions for a wide variety of polymeric systems
- Cost-effective and easy-to-use products, optimized for the specific polymer matrix
- Products designed to maintain thermal conductivity in the most demanding applications
- Loading levels up to 90% in polymer
- Superior mechanical performance, processability and low in abrasion

### Principle of Thermal Interface Materials

Huber Thermal Management solutions enable a proper heat flow from the heat source to the heat sink



**Touching Lives - Enhancing Safety**  
Huber's innovative Thermal Management solutions enable the everyday life of tomorrow.



## Huber Advanced Materials TM Portfolio

**Martoxid® TM**  
High quality alumina-based specialty ingredients to achieve high thermal conductivity in polymeric compounds.

**Magnifin® TM**  
Premium fillers based on magnesium hydroxide allowing for high thermal conductivity at elevated processing temperatures up to 340 °C.

**Martinal® TM**  
Aluminum hydroxide (ATH) based materials to achieve high filling levels in polymeric resins meeting high standards and low viscosities, which allow for easy processing.

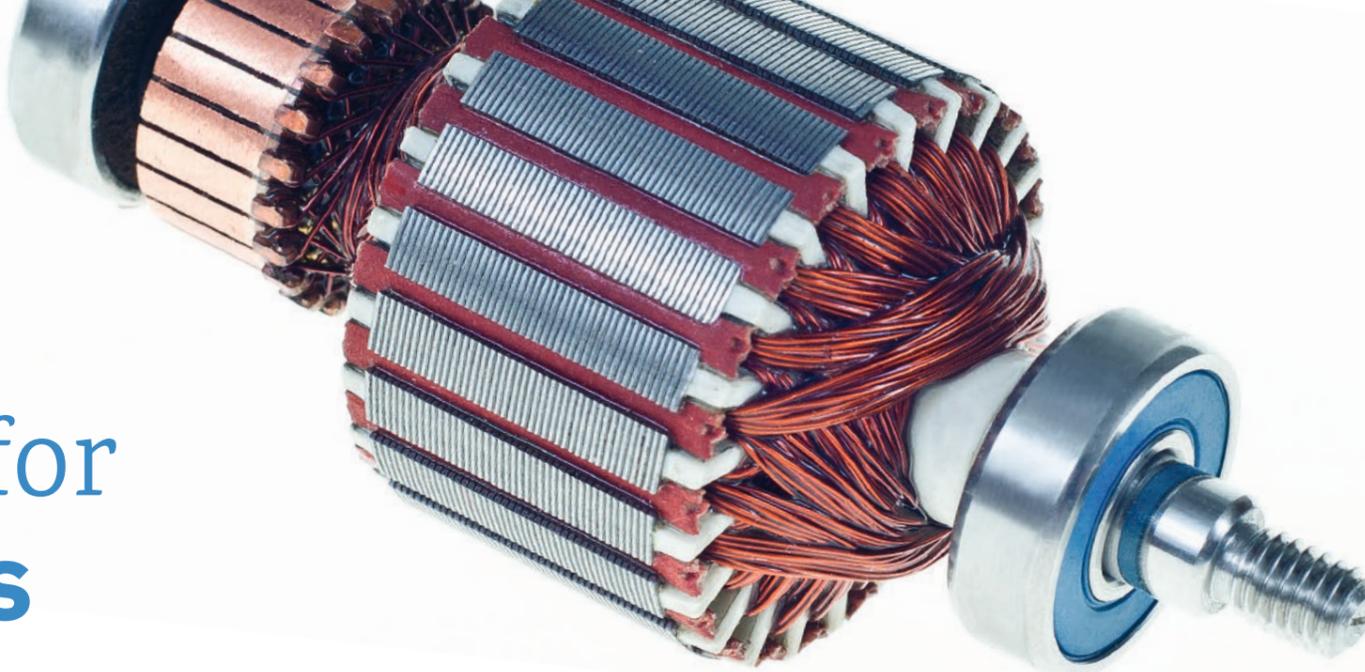
# Perfect fit for your needs

Our Thermal Management solutions provide you with cost-efficient and effective engineered solutions that fit your needs

The thermal conductive performance of polymeric composite materials depends on numerous parameters. The polymer's mechanical properties should be maintained while the particles incorporated in the polymer create the thermal conductivity. Important for the selection of the conductive filler is the polymer, the processing temperature of the composite material as well as the targeted thermal conductivity. Requirements can widely differ dependent on the application. We are confident that we can support you with the right engineered solution.

Our broad product portfolio consists of a series of thermally conductive powders for modified polymeric systems. Our products are easy-to-use, designed to improve the co-existence of the powder and polymer matrix in thermally sensitive applications. They allow high loading levels necessary to transfer heat away from the electronic part. The resulting part has exceptional properties appropriate for thermal management of polymeric and resin compounds.

Depending on the necessary loading levels to achieve the desired heat dissipation, the powders can be a significant contributor to the cost of the formulation.



Our solutions are designed to allow for an excellent cost/performance balance. In addition, all our products are categorized under REACH as non-hazardous substances.

**Huber Advanced Materials products from TM-1000 grades** serve standard applications at low/medium filler degrees performing at a fit and proper thermal conductivity.

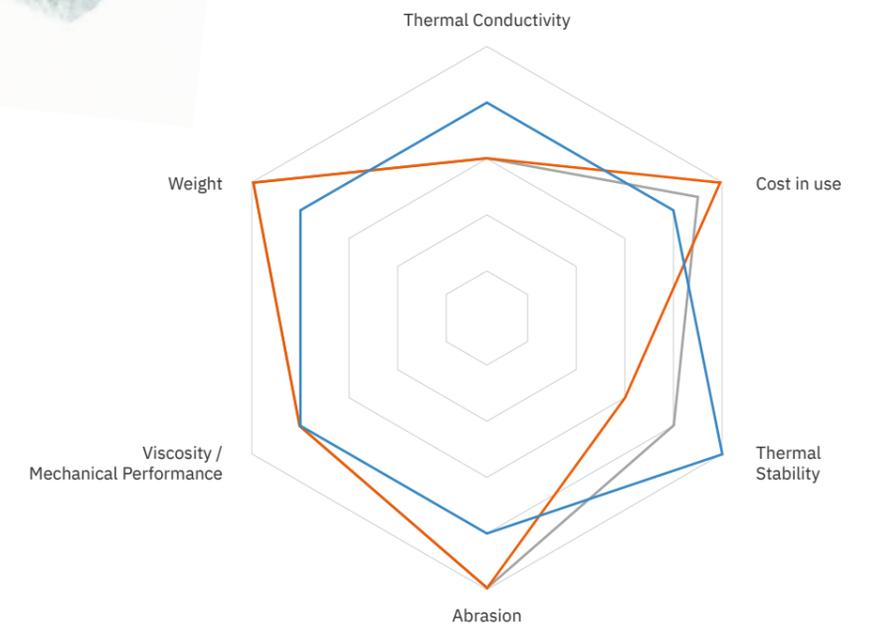
**TM-2000 grades** are dedicated to sophisticated applications needing high filler degrees in providing a high thermal conductivity and balanced mechanical and rheological behavior.

**TM-3000 grades** are designed for high performance applications to guarantee extreme filling degrees coupled with reduced viscosity and a significantly improved workability in the processing of polymers. Products can be loaded up to 90%. Packing of the filler particles ensures an outstanding thermal conductivity.

**TM-4000 grades** are thermally conductive, electrically insulative additives, especially designed for polyamides.

## Balanced Properties

When creating a polymer compound with heat dissipating properties, a set of parameters have to be considered: Martoxid® TM, Magnifin® TM and Martinal® TM products offer a uniquely balanced set of properties that enable your success. The closer the line is to each respective corner, the more favorable the performance.



## Overview of Customer Benefits and Value

### Martoxid® TM

Technical Properties	Customer Benefits	Customer Values
High thermal conductivity	Quickly cooling if compounds	Superior thermal management solution
Flat & smooth surface	Improved wear Low abrasion	Easy processing
High thermal stability	Suitable for most polymers	Versatility in design

### Martinal® TM and Magnifin® TM

Technical Properties	Customer Benefits	Customer Values
Low density	Higher volume Lightweight	Higher filling levels
Soft Material	Improved wear Low abrasion	Easier processing
No calcination	Lower carbon footprint	Increased sustainability



# Moving ahead with Huber Advanced Materials TM products

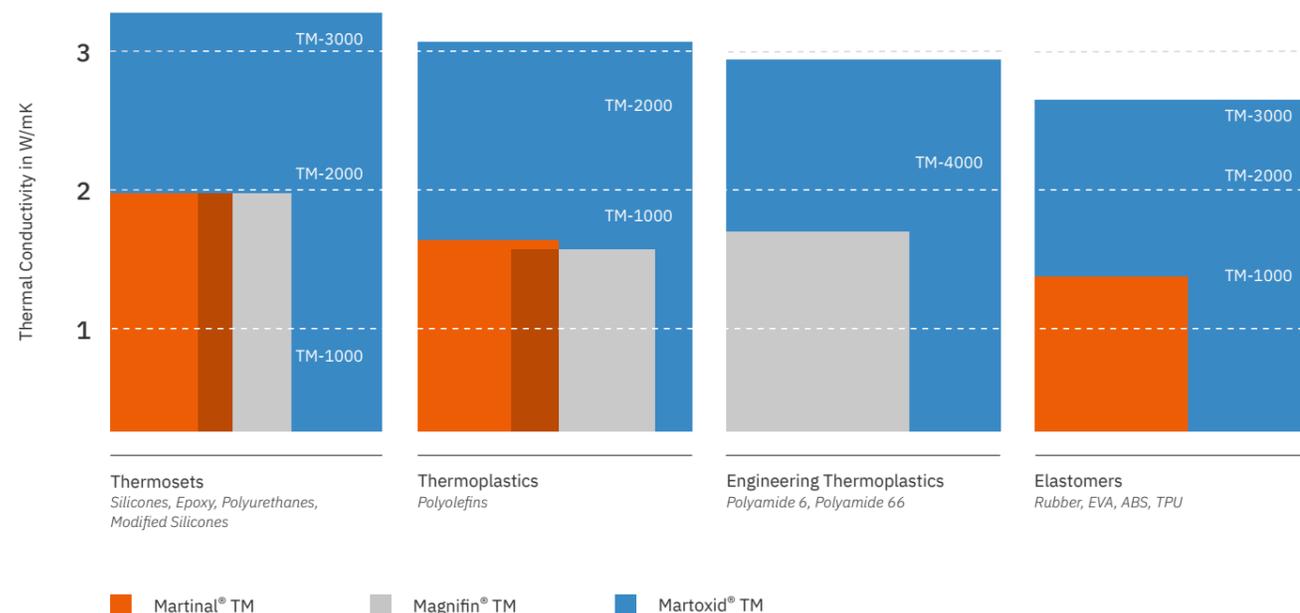
A broad product portfolio to meet today's and tomorrow's challenges

To meet the demanding requirements of polymeric-related applications, different series of high-performing additives with useful properties have been developed. Our products are developed and tailored to provide improved processability and better product characteristics. In order to achieve high loading levels, additives must be compatible

with the polymer matrix, and the final product should possess high mechanical strength. Our additives feature optimized particle morphology, particle size distributions and optimized functional surface characteristics. The improved dispersibility results in low viscosities at high filler contents, combined with low abrasion levels.

## Huber's TM solutions by application

The optimal Huber Advanced Materials TM product depends on the polymer system and desired level of thermal conductivity



## Product Portfolio

Our innovative portfolio of products suits a wide range of thermal management applications. Our product lines Martoxid<sup>®</sup> TM, Magnifin<sup>®</sup> TM and Martinal<sup>®</sup> TM offer technical advantages whilst being reliable and cost-efficient. Our experts will help you selecting the appropriate grades to meet your specific requirements.

Series	Alumina	Magnesium Hydroxide	Aluminum Hydroxide
Economic	Martoxid <sup>®</sup> TM-1250		
	Martoxid <sup>®</sup> TM-1320		
	Martoxid <sup>®</sup> TM-1410		
Preferred	Martoxid <sup>®</sup> TM-2250	Magnifin <sup>®</sup> TM-2760	Martinal <sup>®</sup> TM-2550
	Martoxid <sup>®</sup> TM-2320	Magnifin <sup>®</sup> TM-2770	Martinal <sup>®</sup> TM-2590
	Martoxid <sup>®</sup> TM-2410		
Superior	Martoxid <sup>®</sup> TM-3310		Martinal <sup>®</sup> TM-3620
	Martoxid <sup>®</sup> TM-3220		Martinal <sup>®</sup> TM-3810
	Martoxid <sup>®</sup> TM-3510		
Polyamides	Martoxid <sup>®</sup> TM-4220	Magnifin <sup>®</sup> TM-4760	
	Martoxid <sup>®</sup> TM-4250	Magnifin <sup>®</sup> TM-4770	
	Martoxid <sup>®</sup> TM-4410		

## Typical properties

Physical properties of Martoxid<sup>®</sup> TM, Magnifin<sup>®</sup> TM and Martinal<sup>®</sup> TM are different. Depending on the desired performance, our experts can identify the right technical solution for your needs. Values below refer to bulk values of the active ingredient.

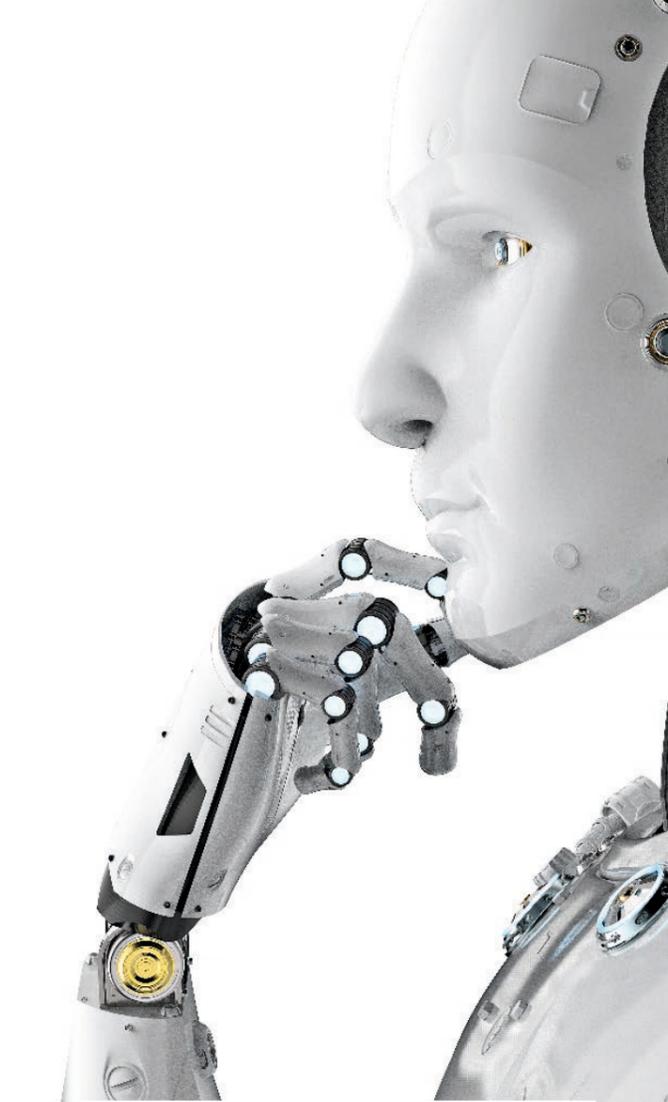
Property	Unit	Martoxid <sup>®</sup> TM	Magnifin <sup>®</sup> TM	Martinal <sup>®</sup> TM
Thermal Conductivity	[W/m·K]	30	~15	~15
Density	[g/cm <sup>3</sup> ]	3.98	2.37	2.41
Color	-	White	White	White
Hardness	Mohs	9	2.5	3
Thermal Expansion Coefficient	[10 <sup>-6</sup> /K]	8	70	15
Specific Heat	[J/kg·K]	1000	1260	1700

### Other Solutions

In addition to Huber Advanced Material's Thermal Management portfolio, Huber is a leading supplier of environmentally friendly, halogen-free fire retardants, smoke suppressants and aluminas, which deliver value to our customers and meet the highest regulatory standards. Huber makes everyday life better and safer. This includes innovative solutions enhancing life for millions of people around the world, whether you are at home, in a skyscraper or traveling by car, plane or public transportation.

Our reputation for quality and reliability is illustrated through a comprehensive portfolio of high-end solutions.

Understanding your business needs helps us develop innovative solutions with unrivaled product performance that creates value for your business. Huber's motto, "Touching Lives – Enhancing Safety", reflects our commitment to safety and high quality solutions. Talk to our experts to discuss your specific requirements.



# Our global footprint

The Huber Advanced Materials (HAM) SBU is a specialty chemicals business with a global, leading position in the development and production of halogen-free fire retardant solutions, smoke suppressants and specialty aluminas touching lives and enhancing safety for millions of people around the world.

## Americas

Fairmount, GA  
Atlanta, GA  
Kennesaw, GA  
Marblehead, IL  
Bauxite, AR

## Europe

Bergheim, Germany  
Breitenau, Austria

## Asia Pacific

Qingdao, China



2

R&D Centers

6

Manufacturing plants

3

Customer Care  
Centers



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