MAGNETOCALORIC MATERIAL PLATFORM

Technical datasheet

Rare-earth-free alloys for magnetic cooling, heating and heat-to-power conversion

01 Material profile

Mn-Fe-P-Si-based magnetocaloric alloy. The family notation $(Mn,Fe)_2(P,Si)$ describes the material platform, not a fixed product stoichiometry. Grade-specific composition is proprietary; element ratios and processing select the target magnetic transition temperature.

The material reversibly heats and cools during magnetic-field cycling. It is intended for active magnetic regenerators (AMRs) and heat exchangers, with grade selection matched to the application temperature.

02 Physical properties & specification

PROPERTY / UNIT	SPECIFICATION STATUS
Material density, ρ [g/cm³]	6.0
Thermal conductivity, k [W/(m·K)]	6.2 @ 20 °C
Specific heat capacity, Cp [J/(g·°C)]	Sample curves at 0 T; see page 2
Transition temperature, Tt [°C]	Selected by grade; sample curves, see page 2
Thermal hysteresis [K]	Grade-specific; ~1-2 K
Porosity, shaped parts [%]	Geometry-dependent
Particle-size distribution for powder sample [µm]	100-150

Density and thermal conductivity refer to intrinsic material properties unless stated otherwise. Bulk powder, porous and printed-part density are distinct.

03 Supply & integration

Forms: spherical powder; shaped heat-exchanger elements; assembled AMRs. Use an application-matched protective water-based heat-transfer fluid. Qualify fluid compatibility and corrosion protection for intended service; follow the supplied SDS for storage and handling.

To specify an order: target temperature, material form / geometry, quantity and application conditions.

TEMPERATURE-SELECTED MATERIAL SET

Thermal response

Two thermal properties measured directly on the same eight materials of different compositions. Magneto tailors material composition to each application, distributing transition temperatures evenly across the required operating window while keeping the magnetocaloric response as consistent as possible. The plots below illustrate this approach through specific heat capacity and adiabatic temperature change.

04 Specific heat capacity

0 T / materials M1-M8

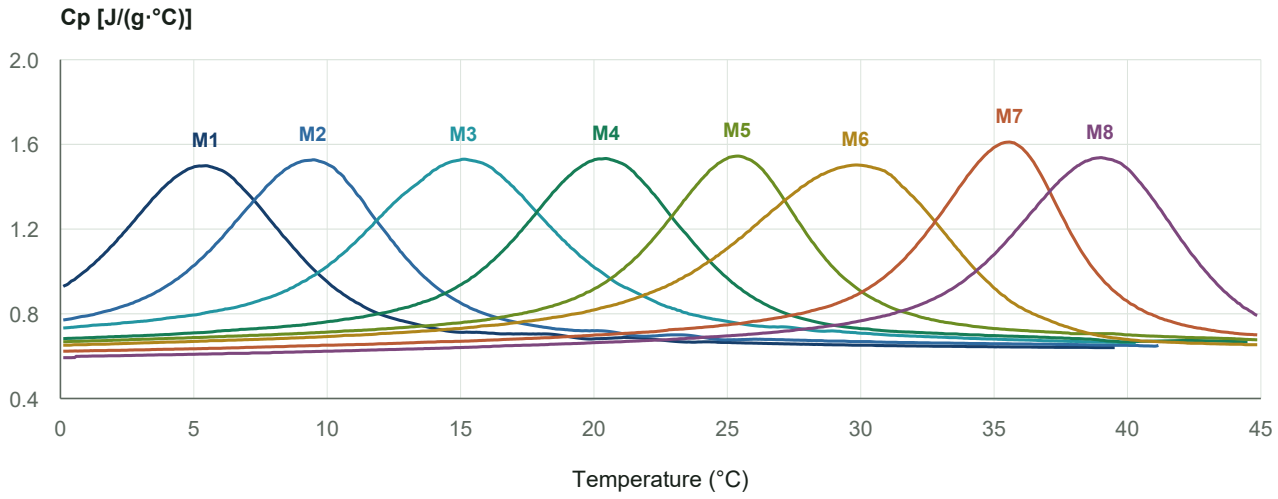


Figure 1. Cp at zero field. M1-M8 form a series of finished materials with evenly spaced transition temperatures. Matching labels and colors identify the same materials in both plots. Temperature scan rate: 2 K/min.

05 Adiabatic temperature change

Field change: 1.1 T

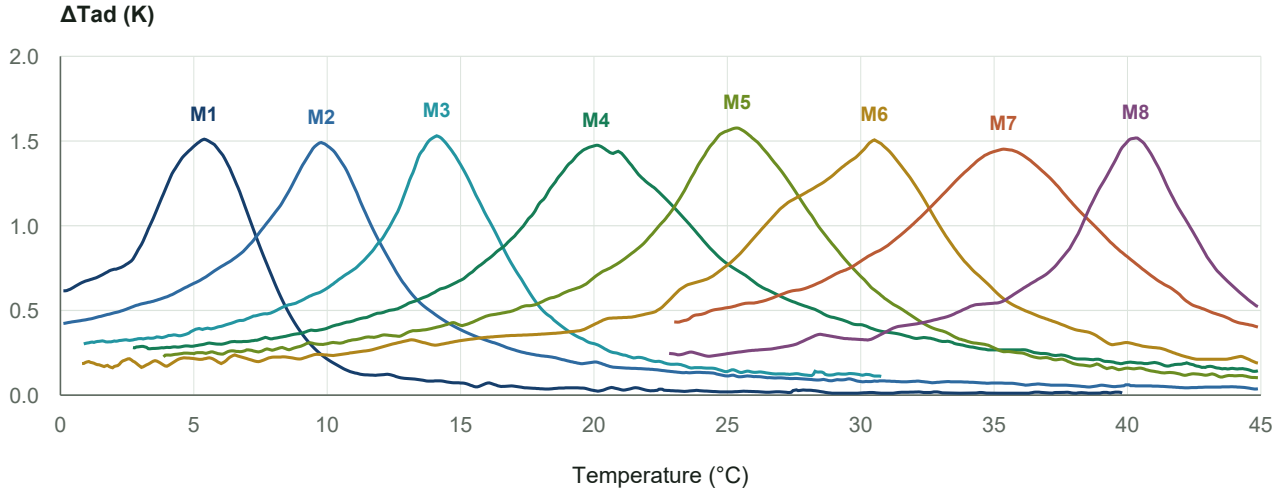


Figure 2. ΔTad for the same materials M1-M8 under a field change of 1.1 T. Temperature scan rate: 2 K/min.

GEN1 / GEN2

Generation comparison

Established product and next-generation material development

06 Adiabatic temperature change at 1.1 T

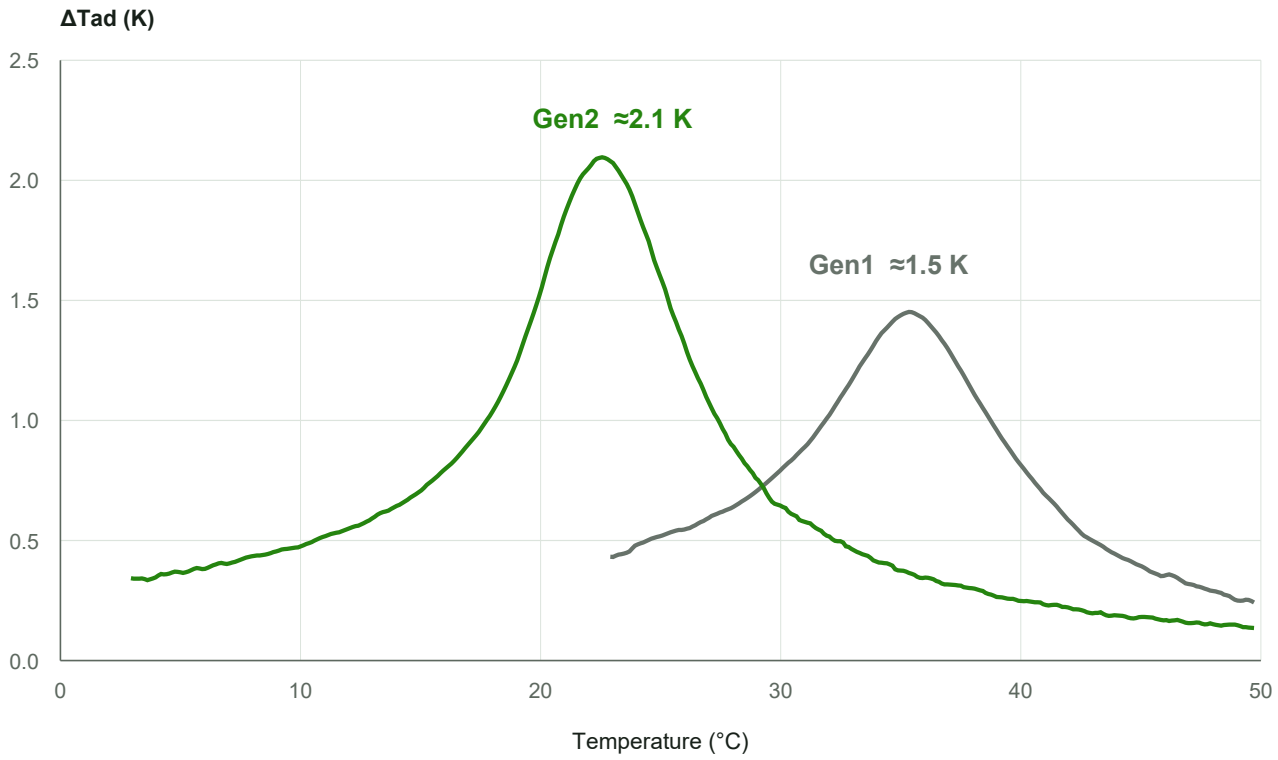


Figure 3. Gen1 and Gen2 source traces.

Gen1

Established product
Approximate peak ΔTad: **1.5 K**
Transition temperature available from **5 °C to 45 °C**.
System design target: Match the performance of gadolinium alloys.

Gen2

Next-generation material
Small-scale production
Mass production planned **Q4 2027**
Approximate peak ΔTad: **2.1 K**
Transition temperature available from **20 °C to 30 °C**.
System design target: Deliver 2× the performance of gadolinium alloys.

Advanced processing. Higher performance.
Gen2 advances Magneto's Mn-Fe-P-Si platform through improved material processing, delivering a stronger magnetocaloric response while maintaining our established standards for material stability and service life. For OEMs, this creates headroom for greater cooling/heating capacity and more compact system designs.