



Metal Matrix Composites

Lightweight technology for heavyweight industries

Imagine a component that can offer superior performance at half the weight of steel or cast iron, but with all of the strength and stiffness. 3M brings that concept to reality.

3M™ Metal Matrix Composites (MMC) are reinforced with 3M™ Nextel™ Ceramic Oxide Fiber 610, one of the world's strongest ceramic fibers. The high purity alumina fiber reinforces the MMC, producing a component or part that is half the weight of steel or cast iron, but with all of the strength and stiffness.

The Right Design

Metal matrix composites offer engineers and designers new freedom in designing high performance parts and components. The exceptional benefits cross many industries, including automotive, industrial, electrical, defense, aerospace, and sports and recreation.

Metal Matrix Composite Benefits

50% less weight than steel or cast iron

Density similar to aluminum

3X the stiffness of aluminum

High fatigue resistance

Abrasion resistance

Whether a completely new geometry is needed, or improvements to an existing design are required, MMC's can be created to benefit the system. For example, based on current performance specifications, a new solution can be designed that may have a different shape, a significant weight reduction, or better performance. Alternatively, MMC's can be designed to replace an existing component, like an interchangeable part, in order to improve on existing performance specifications, while decreasing weight and possibly improving strength or stiffness.

The Right Reinforcement

The process begins with Finite Element Analysis (FEA), which is used to determine where fiber reinforcement is needed, before the part is created. FEA can simulate real-world conditions in order to identify stress points to reinforce, adding strength where it is needed the most, without changing the overall configuration of the part. For some applications, as little as 5% of a part needs to be reinforced.



Traditional casting technology produces metal matrix composites in nearly any geometry.

Once the design is established, the process continues by determining the best use of reinforcing fiber. Nextel™ Ceramic Fiber 610, used as continuous fiber, chopped fiber or a combination, provides unsurpassed design potential. In addition, the composite part can be reinforced directionally – unidirectionally, multidirectionally, or selectively – depending on the specifications of the part and the desired performance. For example, selective reinforcement may be chosen when strength is needed only in select areas, or unidirectional reinforcement with continuous fiber may be preferable to improve overall compression strength.

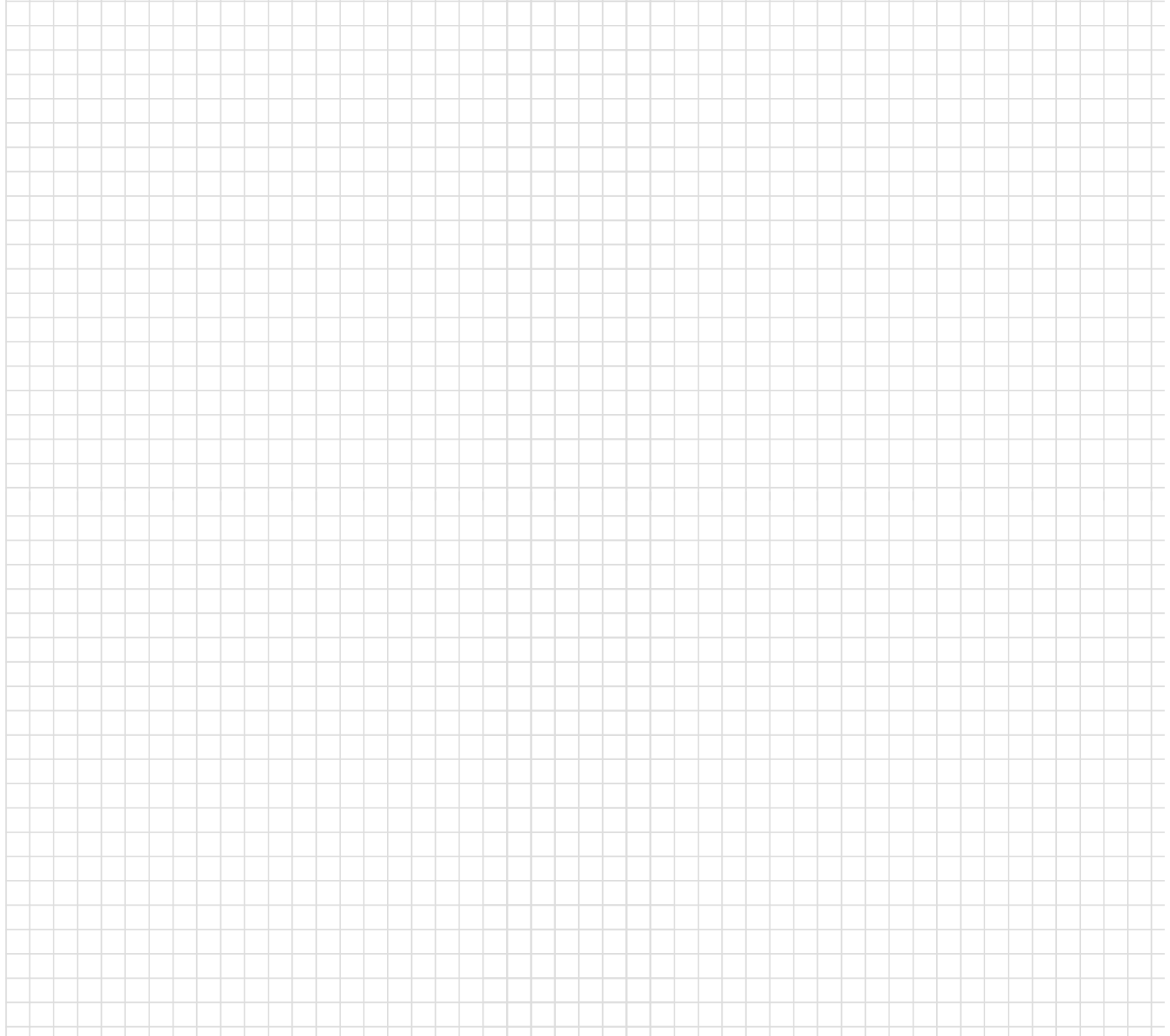
Nextel™ Ceramic Fibers are compatible with nearly all castable aluminum alloys. Products have been manufactured using traditional aluminum alloys, such as 354, 356, and 6061, and other castables such as pure aluminum and Al-2%Cu. Application and desired performance determine the alloy that is used in the composite.

The Right Manufacturing Process

Common casting technologies can be used to manufacture the final part, including pressure, squeeze, and die. After the casting process, heat treatment can be used to harden the alloy. A final machining is done to ensure precision surfaces.

Imagine the Possibilities

3M Metal Matrix Composites offer high performance material solutions to engineers and end-users worldwide. By combining advanced modeling solutions with traditional casting processes, lighter, stiffer, stronger, and cost efficient components become reality. 3M can have our engineers, with expertise in metal matrix composites, work with your designers so you can develop unique solutions.



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3M Center, Building 207-1W-11
St. Paul, MN 55144-1000
U.S.A.

Toll-free within the U.S.A.: (877) 992-7749
Outside the U.S.A.: (651) 737-5102
Email: metalmatrix@mmm.com
www.3M.com/mmc

3M Deutschland GmbH

Ceramic Textiles & Composites, Europe

Carl-Schurz-Str. 1
41453 Neuss, Germany
Telephone: +49-2131-143084
Fax: +49-2131-143898