3M Science. Applied to Life.™

Electrical Markets Division

Epoxy-Copolymer. Applied to electrical motor magnets for easy, clean, durable bonding.

3M™ Magnet Bonding Adhesive AU-205

An innovative adhesive from 3M Company can make it easier and cleaner to build permanent magnet (PM) motors with less rework and waste. For motor design engineers, this adhesive based on epoxy-copolymer ether offers a new tool for building higher-efficiency electric motors.

The 3M tape-like adhesive technology includes a thickness control system to provide consistent bond line thickness. As commonly used, unsupported liquid one- and two-part adhesives can move in an uncontrolled manner as inconsistent pressure is applied to the magnet's surface. This can lead to inconsistent bond line thickness and excessive squeeze out from under magnets. Even worse, it can allow magnets to become misaligned during the application and adhesive curing process.

3M Magnet Bonding Adhesive AU-205 is a light-tack, b-stage, double-sided adhesive film tape designed to simplify permanent magnet positioning and bonding without the mess and complexities of adhesive mixing and metering equipment.

AU-205 adhesive is RoHS & REACH compliant and contains zero Volatile Organic Components (VOCs).

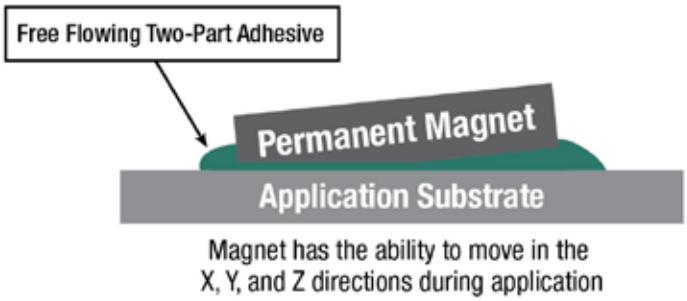
Applications

- Bonding permanent magnet to rotors and stators
- Bonding metal components together

Features	Advantages	Benefits	Common Competitive Shortfalls
B-staged Double Sided Tape	Solid Base to Align Magnets	Reduce Rework	Liquid adhesives are free flowing so adhesive will squeeze out when pressure is applied and magnets are free to move in x, y & z directions.
B-staged Double Sided Tape	Minimizes Adhesive Squeeze Out	Reduce Rework	Liquid adhesives are free flowing so adhesive will squeeze out when pressure is applied and magnets are free to move in x, y & z directions.
B-staged Double Sided Tape	No Adhesive Mixing, Meter or Special Clean Up Requirements	Minimizes the Requirement for Cold Storage	Most liquid adhesives require special activators, precision mixing, high performance metering, increased maintenance on dispensing equipment, complex clean up and special material disposal.
Consistent Bond Line	Minimize Rotor & Stator Air Gap	Higher Efficiency Motor	Variable bond line thickness requires the design engineer to build in an air gap safety factor that has a direct negative relationship to motor efficiency.
High Room Temperature Shear & Tensile Strength	Increased Motor Magnet Bond Strength	Robust Magnet Bond	Many liquid adhesives have lower initial and at temperature bond strengths.
Chemical Resistant Formulation	Minimal Impact to Bond Strength	Supports Robust Performance	Lack chemical resistance to some common industrial chemicals.
Room Temperature Stable for Six Months	Can be Stored in the Production Area for up to Six Months	Minimizes the Requirement for Cold Storage	Many liquid adhesives have cold temperature storage requirements.
Minor EHS Recommendations/ Requirements	Minimizes Operator Exposure, Special Production Equipment and Environmental Protection Equipment	Increased Operator Safety and Lower Production Costs	Many liquid adhesives contain volatile organic chemicals (VOC) that can be hazardous to operators and the environment.

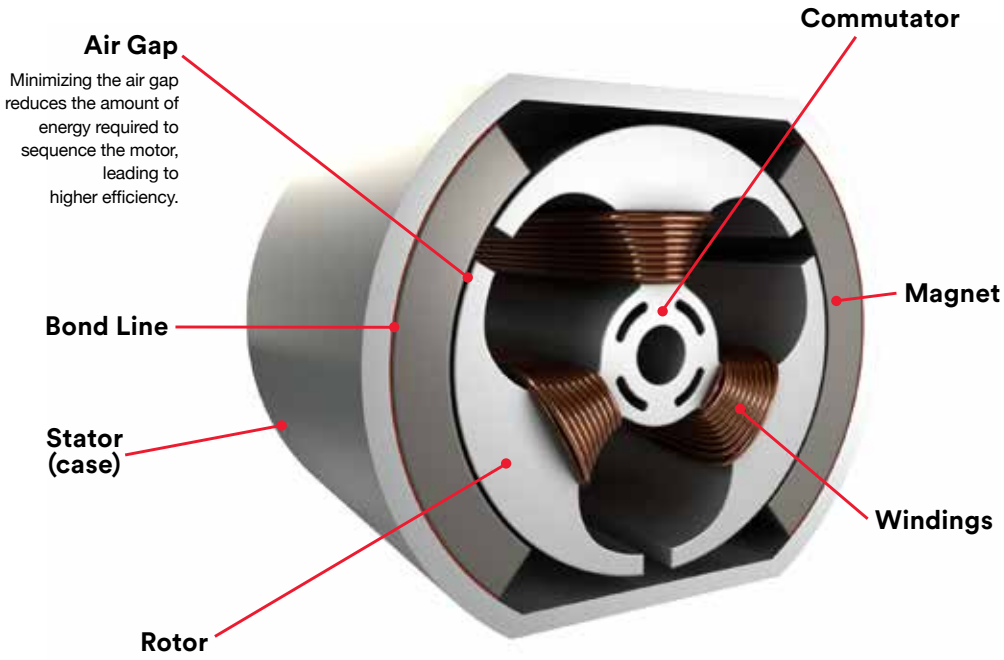
Importance of Bond Line Control

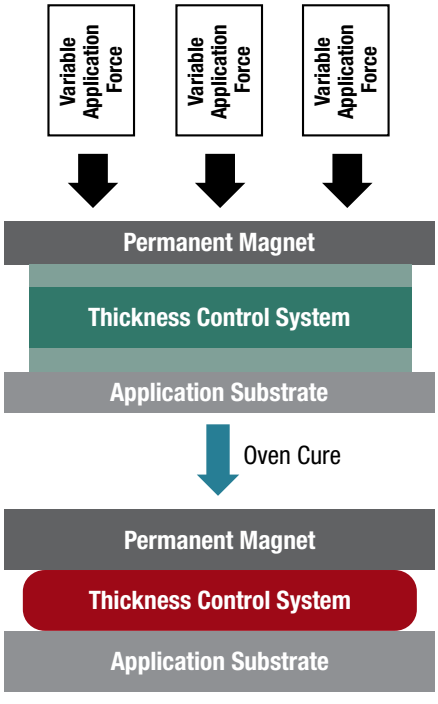
New global energy efficiency standards are being legislated to reduce energy losses in electric motors. PM motor designs are seen as a technology platform that will support meeting these challenging new performance requirements.



AU-205 adhesive does not require mixing or liquid metering, or complex production equipment.

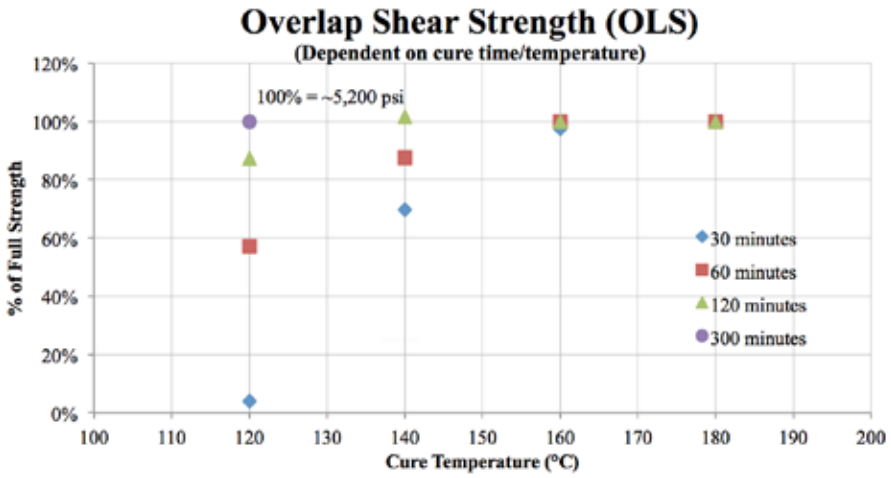
Precise control of the permanent magnet bond line thickness–the distance between the magnet and substrate–is critical for minimizing the rotor-stator air gap. Minimizing the air gap distance has a direct relationship to the motor's energy efficiency. 3M™ Magnet Bonding Adhesive AU-205 contains a built-in thickness system providing electric motor designers and manufacturing engineers with a new tool to control that gap, helping achieve higher efficiencies.



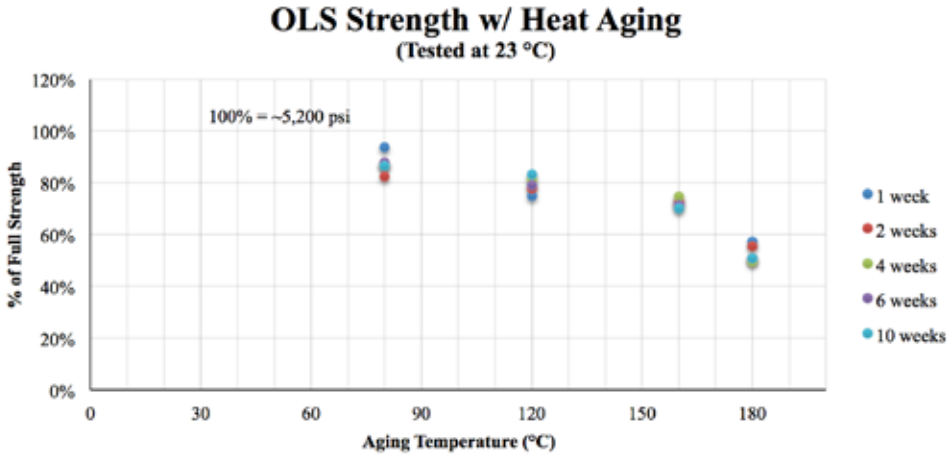


Shear Strength Measurements for 3M™ Magnet Bonding Adhesive AU-205

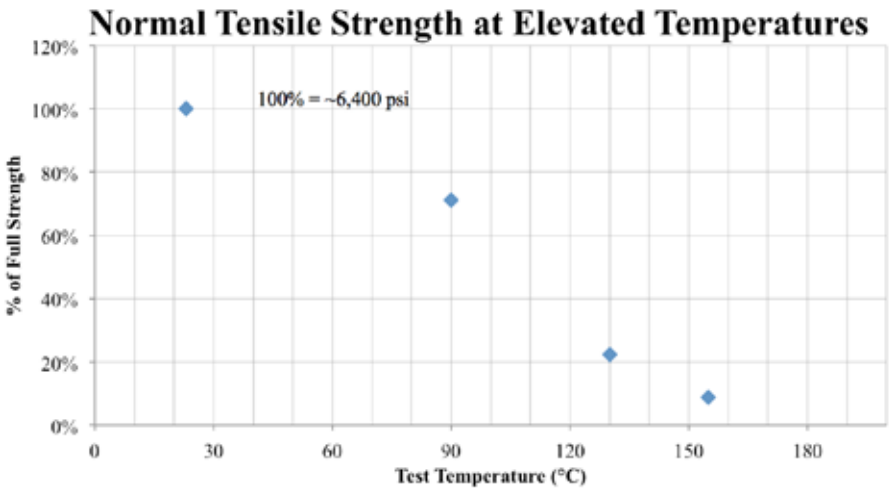
When a cured adhesive is subjected to heat, its overlap shear strength typically decreases. The chart (right) shows shear strength of AU-205 adhesive samples cured at specific temperatures at four different time intervals, cooled to room temperature, then overlap shear tested at room temperature. Overlap shear strength performance is dictated by the state of cure of the adhesive system. The state of cure is dependent upon cure time, temperature and the heat capacity of the parts and fixtures used for positioning during the cure cycle.



In the graph to the right, test samples were cured at 160°C for 60 minutes, then aged at temperature. After aging, samples were equilibrated at the test temperature and overlap shear (ASTM D-1002) testing was completed.



In the graph to the right, test samples were cured at 160°C for 60 minutes. Samples were equilibrated at the test temperature for the completion of normal tensile testing. This normal test is conducted on Instron™ testing equipment using an internal 3M EMD test method designed to measure the normal tensile strength at elevated temperatures.



Chemical Resistance Testing

3M™ Magnet Bonding Adhesive AU-205 was evaluated in the following common chemicals to determine if exposure to these chemicals would impact overlap shear strength.

	Aging Temp (°C)	Aging Time (Hours)	Overlap Shear Strength (psi)
Gasoline	23°C	1000	4692
Mobil 1 Motor Oil	80°C	1000	5477
Automatic Transmission Fluid	80°C	1000	5344
Motor Oil	80°C	1000	4828
Antifreeze	80°C	1000	4085

AU-205 adhesive fluid resistance lap shear

AU-205 adhesive was cured at 165°C for 60 minutes in overlap shear on steel test panels

Overlap area = 1/2 sq. in.

Samples were submerged in various fluids for 1,000 hours (~6 weeks)

Samples tested 30 minutes after fluid aging

Unaged AU-205 adhesive has an average lap shear value = ~5,200 psi

Shelf Life, Storage and Converting

AU-205 adhesive is room temperature stable for six months if stored at 23°C. Storing at temperatures lower than 23°C will extend shelf life. For minimum two years extended shelf life, storage at 4°C is recommended. Based on tests conducted at 3M and at a converter outside 3M, AU-205 adhesive is convertible to standard lathe slitting techniques and lubricants, such as silicone and citrus-based lubricants. It also is die cuttable with standard die-cutting techniques.

Meet the demand for higher-efficiency, higher-density motors with 3M Magnet Bonding Adhesive AU-205 for magnet bonding that offers the ease and durability of tape.

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