CWIEME BERLIN | 14-16 MAY 2024 MESSE BERLIN

Toward Greener Mobility:

Biomass-based Adhesives for EV Motor Cores with Excellent Adhesion and High Oil Resistance

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Samyang Corporation

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Samyang Group Overview

Taking Off as a **Global R&D Specialist**

Established: 1924

Revenue: 4.2 billion euros (as of 2023)

Employees: Approx. 3,000

Businesses: **Chemical**, Food, Biopharmaceutical, Packaging

Location: Seoul (HQ, Korea), Chicago/San Diego (US), Halifax (UK), Jászberény (Hungary), Tokyo (JP), Shanghai (China)

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Samyang's **Chemical Division**

Samyang Corporation	Samnam Petrochemical	Samyang Kasei	Samyang Innochem
Headquarter	TPA (Terephthalic acid)	Polycarbonate	BPA (Bisphenol-A) **ISB (Isosorbide)**

KCI	NC Chem	Verdant (US)	Samyang Fine Technology
Ingredients for Personal Care	Materials for Semiconductor Tech	Ingredients for Personal Care	Ion Exchange Resin

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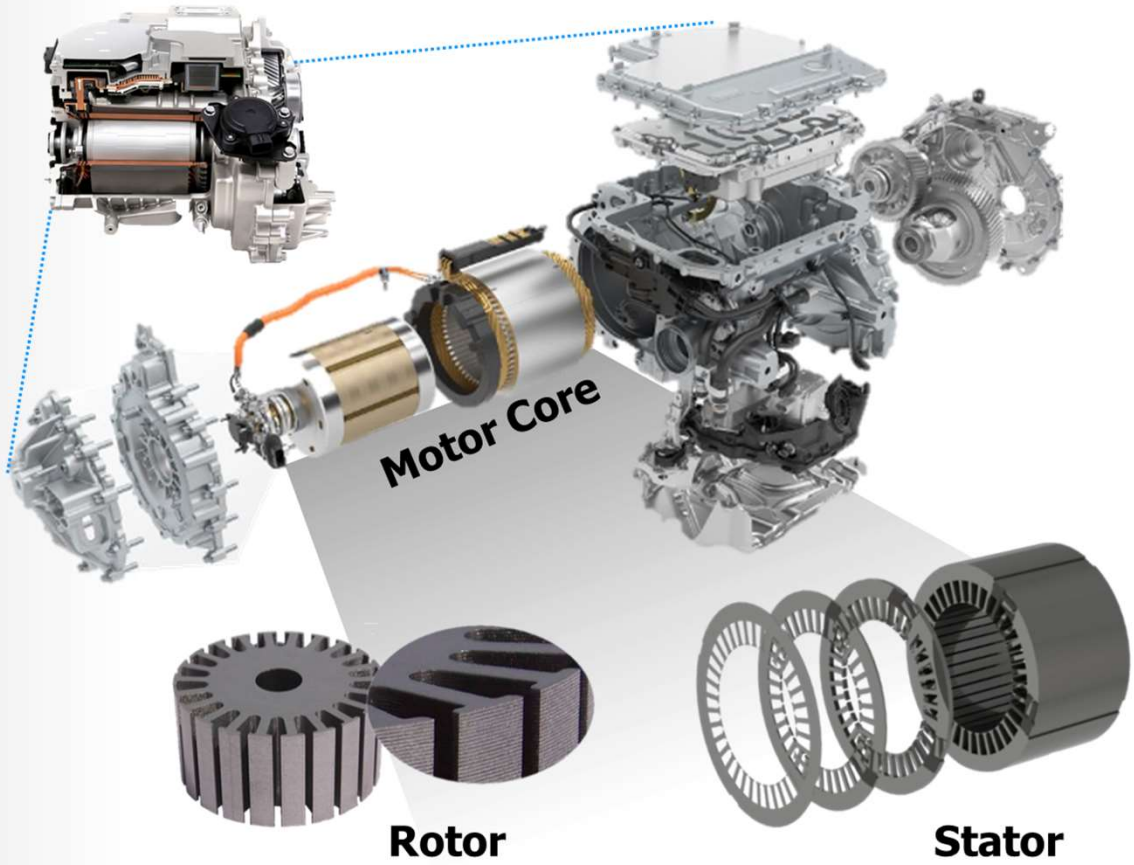
The Heart of the Electric Vehicles: **Motor Core**



Source: https://www.caranddriver.com/features/a39493798/ev-motors-explained

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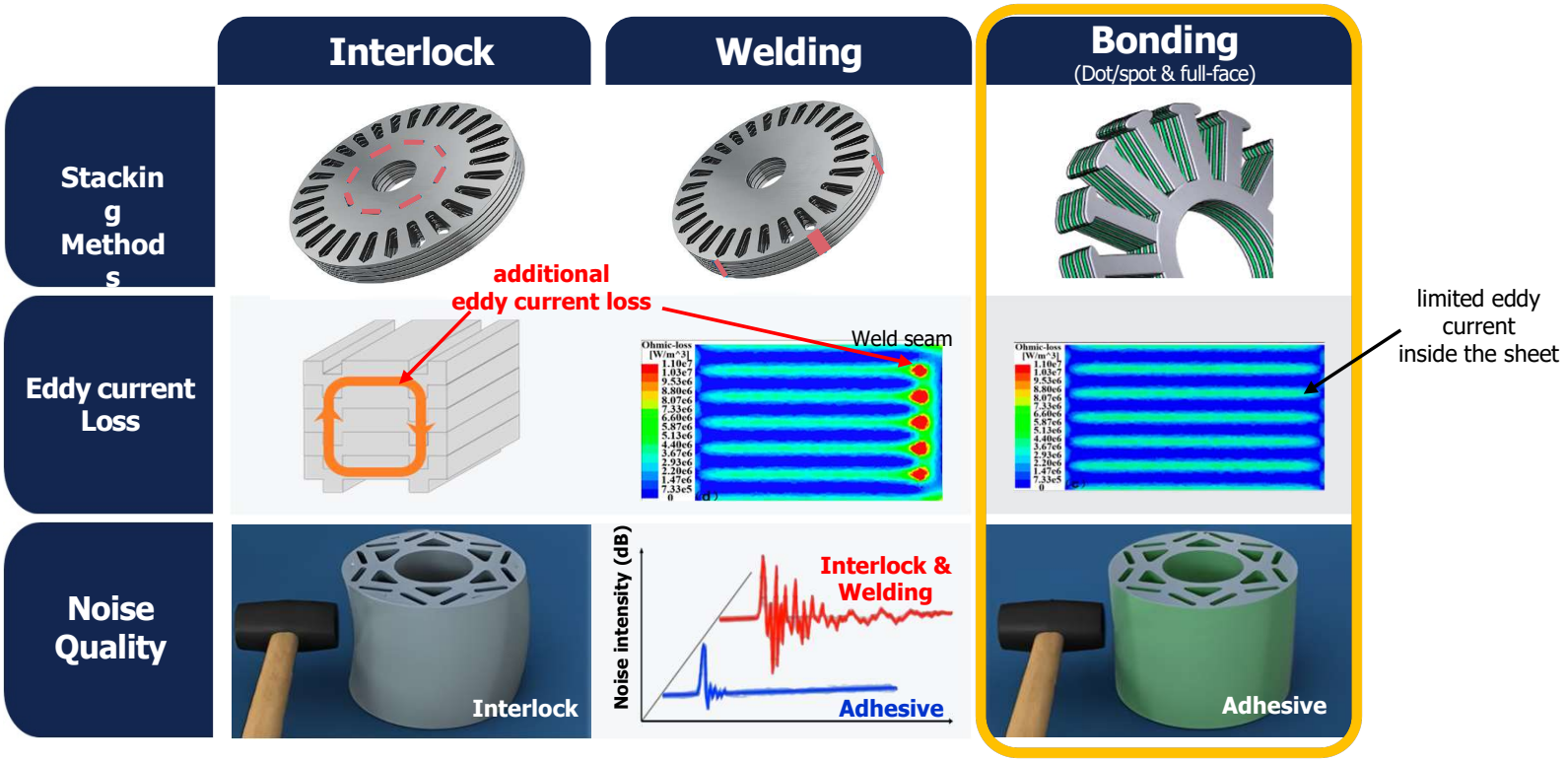
Stacking Methods for Laminated Electrical Steels



Ref, Source: Voestalpine backlack system, KURODA FASTEC system, Wikipedia
Wang et al. *IEEE Trans. Ind. Electron.* **2017**, *64*, 2992–3000

Bonding is preferred for applications where minimizing iron losses and maximizing motor efficiency is critical.

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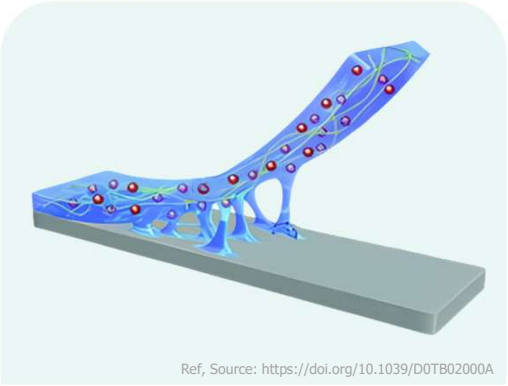
Demanding **Requirements** for High-Efficiency Motors



Ref, Source: https://doi.org/10.1039/D0TB02000A

Adhesion Strength

To prevent core separation or layer changes caused by shocks during processing or operation.

Thermal Reliability

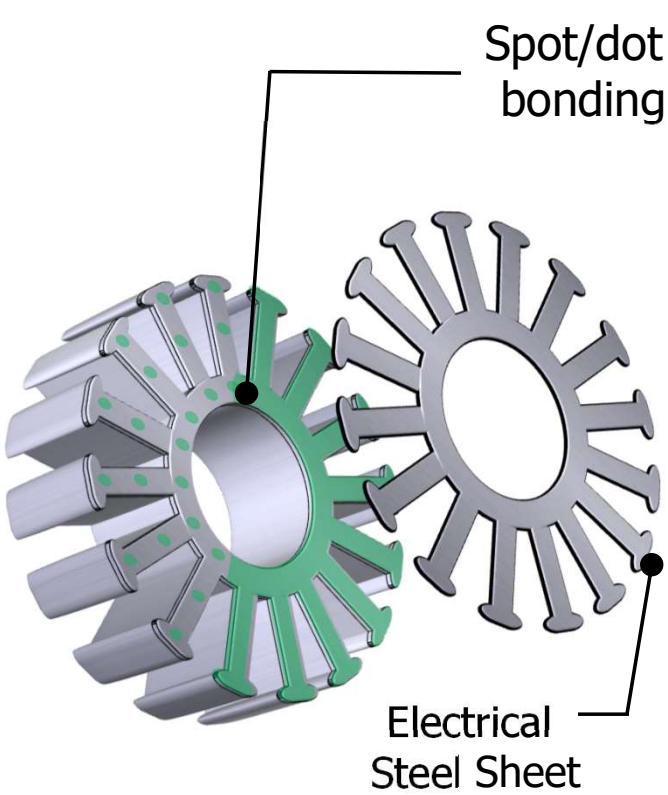
To maintain bond strength under the heat generated by high-speed rotation and eddy current.

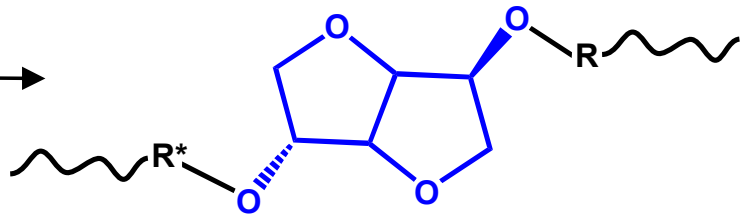
Oil Resistance

To withstand exposure to lubricating oil enters between the cores ensuring long-term performance.

How our adhesives can be the solutions for these demanding requirements?

Unlocking High-Performance Bonding





Formulation with **isosorbide**
(100% plant-derived molecule)

Adhesives with isosorbide (ISB) can give;

1. Enhanced bonding strength
2. Improved high-temperature performance
3. Superior oil resistance

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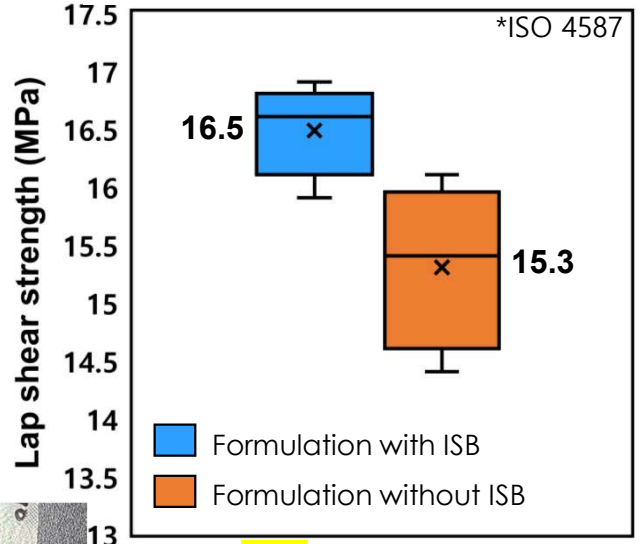
Spot/dot bonding (1K)

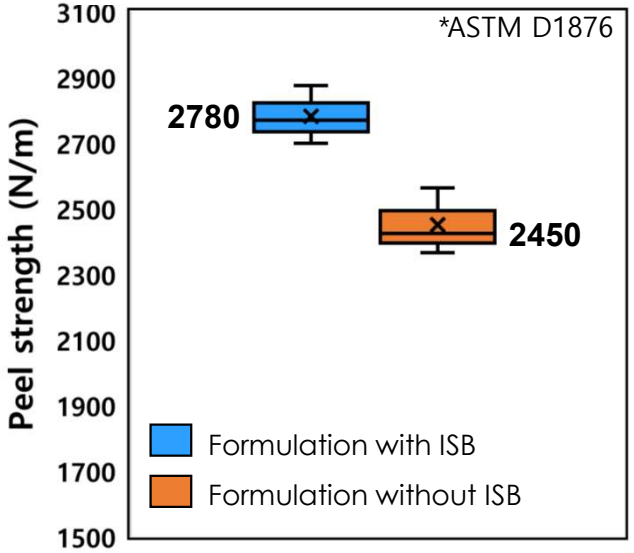
1. Enhanced **Bonding Strength**

Lap Shear Strength (w/ 0.5T* steels)

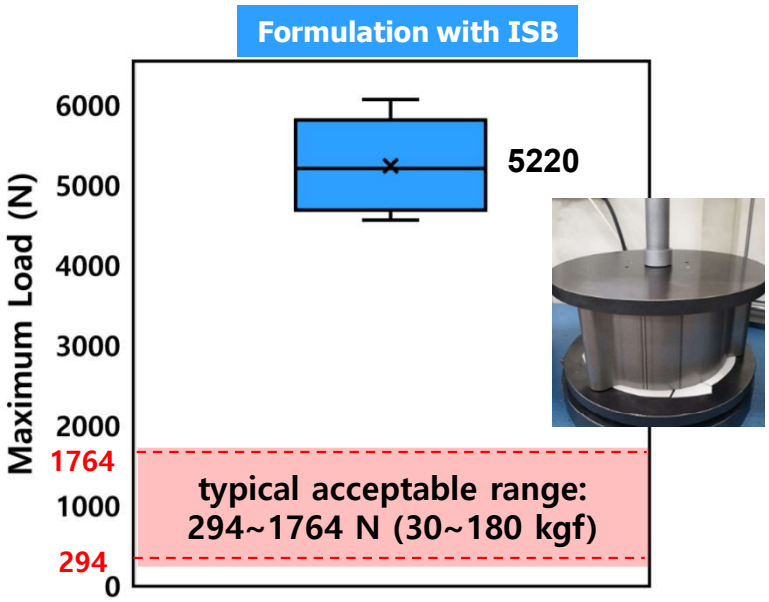


*As for 0.25T steels, our adhesive achieves bond over 11 MPa which is beyond the 'Yield Strength' of the 0.25T steel sheet.

T-peel Strength (w/ 0.25T steels)



Pull-Off Test (Stator)



Our adhesive appears to have enhanced bonding strength and exceed the typical acceptable range for pull-off strength!

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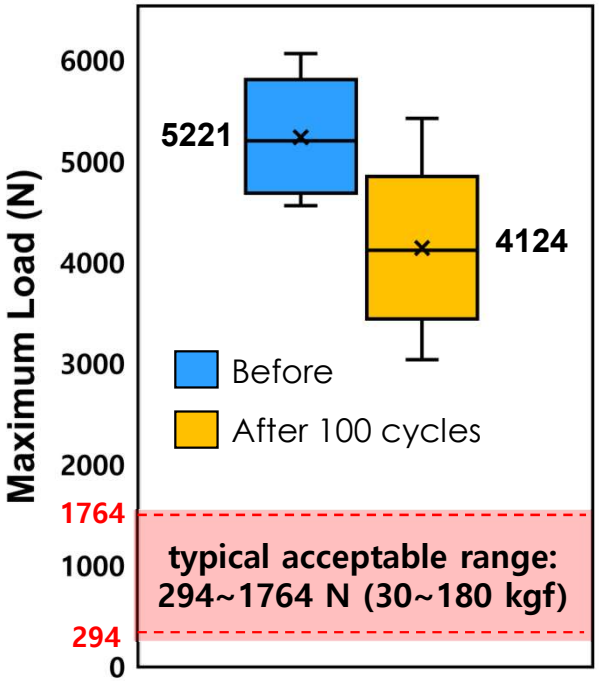
Spot/dot bonding (1K)

2. Improved **Thermal Reliability**

Pull-off test

(with 100 cycles of thermal shock)
*1 cycle: 160°C (1h) ↔ RT (0.5h)↔ -40°C(1h)

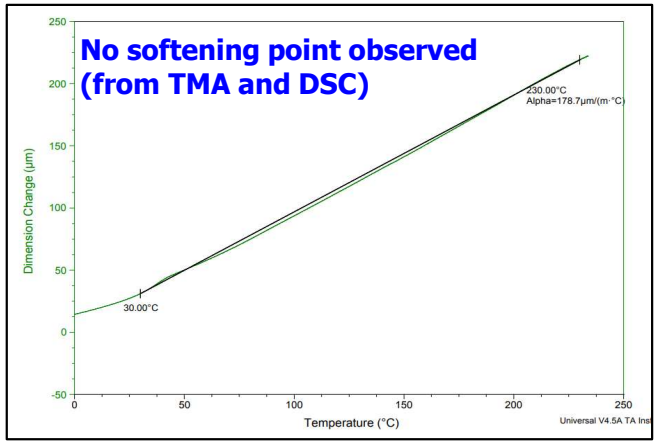
Formulation with ISB



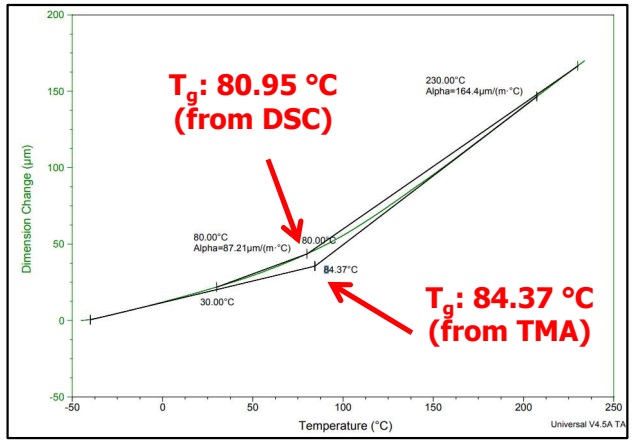
Thermal Analysis

(with TMA and DSC)

Formulation with ISB



Formulation without ISB



Without softening, the adhesive with ISB retains its shape better under elevated temperatures leading to enhanced structural stability of motor cores.

Even after these severe temperature fluctuations, the stator's bonding strength remains well above the typical acceptable range.

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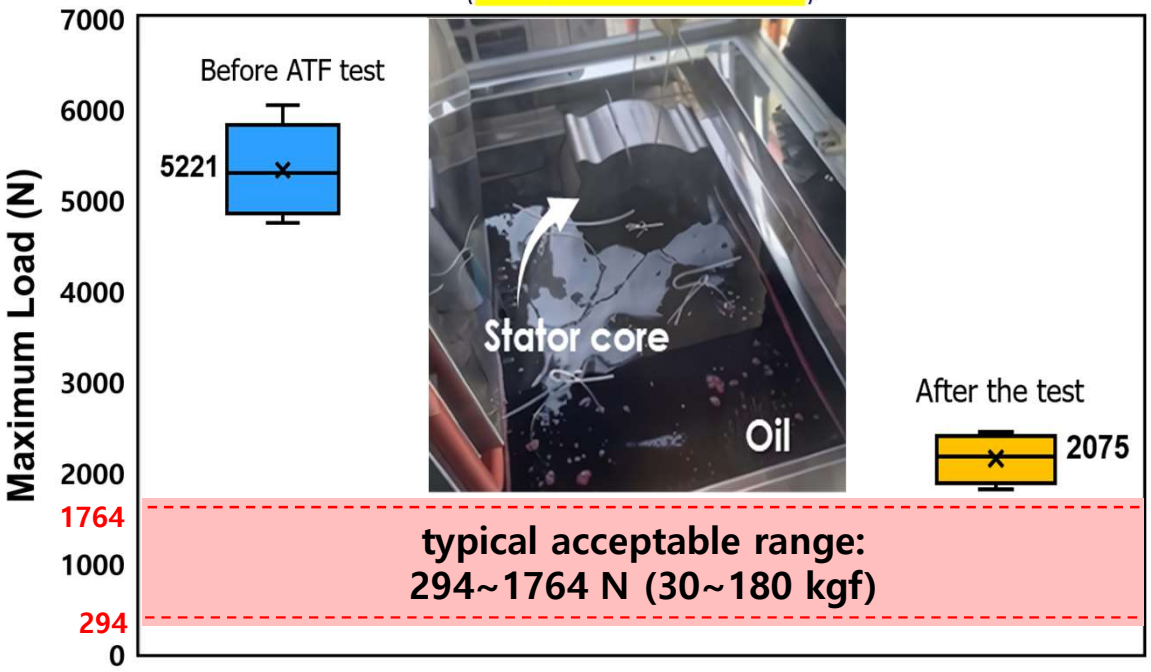
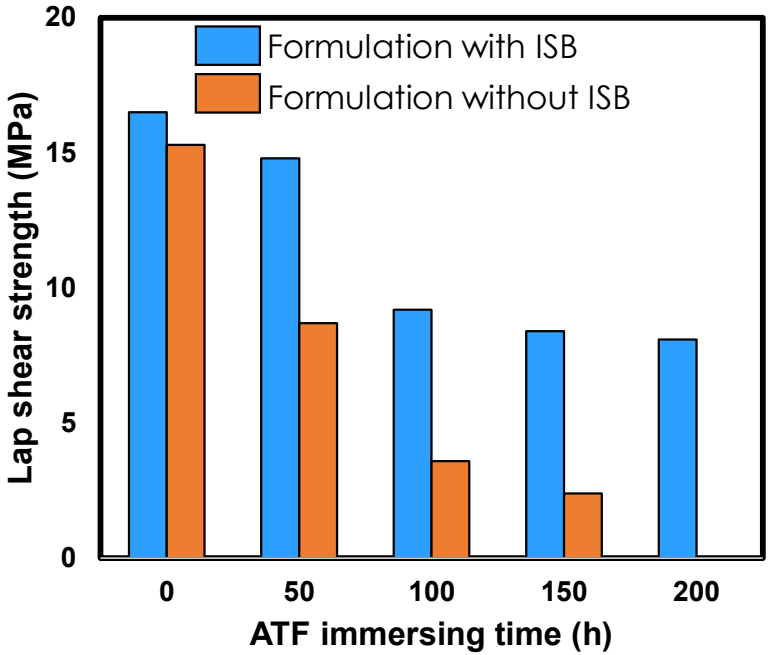
3. Superior **Oil Resistance** at elevated temperature

Pull-off test with ATF (Auto Transmission Fluid)
(150°C for 1000 h)



Lap shear strength with accelerated ATF
(180°C for 200 h @lab, w/ 0.25T steels)



Even after the ATF test, the bond strength remains above the acceptable range for a typical stator.

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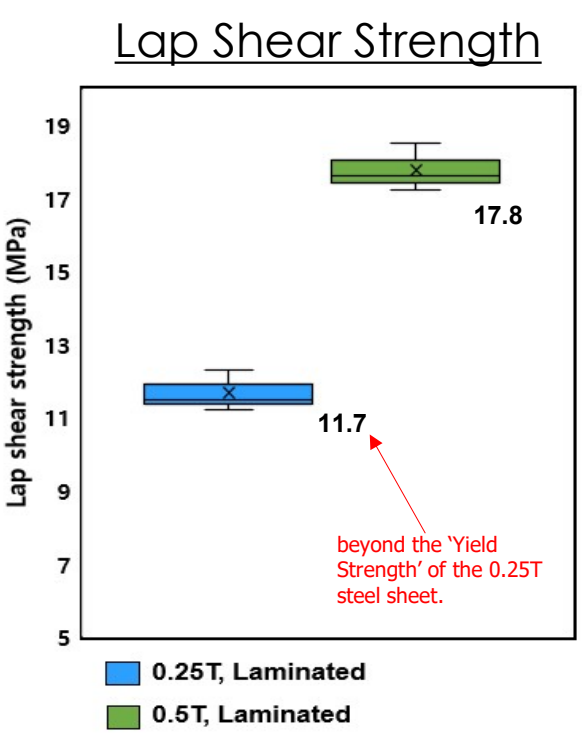
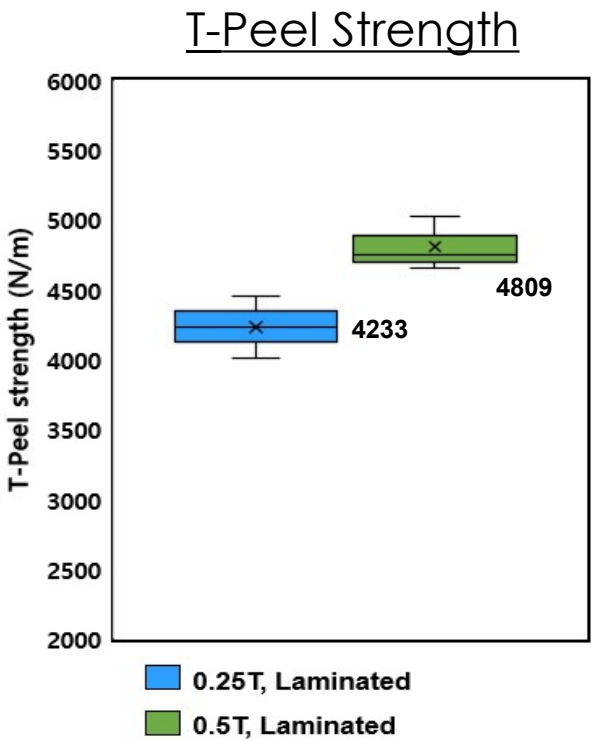
Face-/Self-bonding (1K)

Finally, **Face-/Self-**bonding!





SYC-300 Series (Face-/Self-bonding Adhesive)	
Type	1K (1-component) Aqueous dispersion
Viscosity (@25°C)	50-500 cPs (customizable)
Curing temperature	80-200°C (customizable)
Lamination thickness	<3 um
Lap shear strength (MPa)	>11 (0.25T) >17 (0.5T)
T peel strength (N/m)	>4000 (0.25T) >4500 (0.5T)
ATF at 180C for 200h	Reduced by 35% in shear strength
Storage temperature	5-20°C

We're looking for partners to work on together with our self-bonding adhesives.

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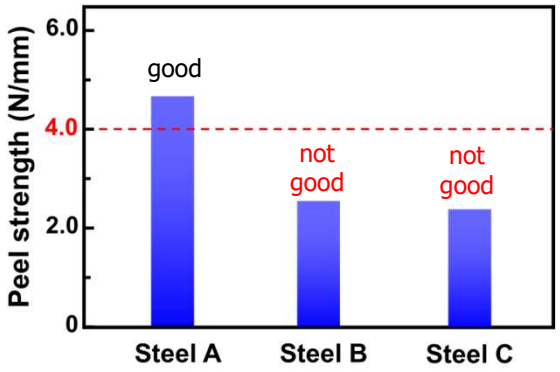
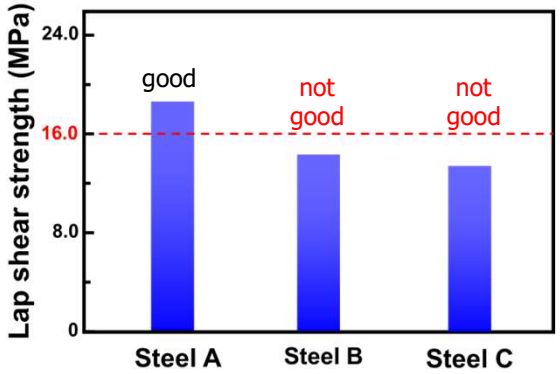
Custom Adhesives: *Beyond Your Catalog*

With one good adhesive, steels from 3 different sources

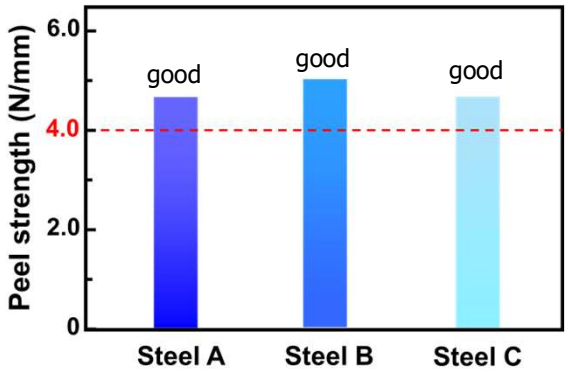


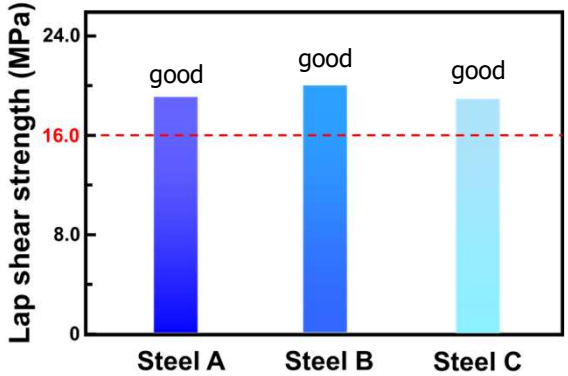


Not all steels are the **same**!

Customized Solutions:
Coating Analysis
Thermal Analysis
New materials

With customized adhesives





By collaborating with you, we can tailor our adhesives to your specific steel requirements, offering a superior solution than a simple adhesive selection from catalog.

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Summary

Our solutions	Your benefits
Exceptional Adhesion	Contrary to perception, our bonding adhesives maintain strong adhesion even beyond the yield strength of the steel specimen
Improved thermal reliability	Maintains bond strength despite the heat generated by high-speed rotation or eddy currents
Superior oil resistance	Withstands exposure to lubricating oils, ensuring long-term performance
Cured at room temperature (2K type)	Increases productivity and reduces cost
Provides customizing solution (curing temperature, viscosity, and steel sheet compatibility)	Creates much more flexible process conditions
Eco-friendly ingredient	Impacts positively on environment

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Thanks for your attention!

Samyang

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Tech Data Sheet (**TDS**)

		SYC-100	SYC-200	SYC-300
		1K	2K	Aqueous Dispersion (1K)
Viscosity		500~2500 cPs (@25℃)	500~2500 cPs (@25℃)	50~500 cPs (@25℃)
Curing temperature		70~160 ℃ (customizable)	20~70 ℃ (customizable)	80~200 ℃ (customizable)
TMA (Tg)		No softening point observed (betwee n 30-200 ℃)	No softening point observed (between 30-200 ℃)	No softening point observed (between 30-200 ℃)
TGA		5wt% loss at 293 ℃	5wt% loss at 289 ℃	5wt% loss at 254 ℃
Pot Life		>56 hours	-	-
Fixation Time		-	<< 5 min	-
Shelf-life		6 months at -10~20 ℃	3 months at room temperature 3 weeks at 40 ℃	1 month at room temperature 1 week at 40 ℃
Recommended Storage Condition		-10~20 ℃	<30 ℃	5~20 ℃
Lap shear test (MPa)	Steel to Steel (1.0T, Unlaminated)	>22	>22	>22
	Steel to Steel (0.5T, Laminated)	>17	>17	>17
	Steel to Steel (0.25T, Laminated)	>11	>11	>11
T-peel strength (N/m)	Steel to Steel (1.0T, Unlaminated)	>6000	>6000	>15,000
	Steel to Steel (0.5T, Laminated)	>3500	>3500	>4,500
	Steel to Steel (0.25T, Laminated)	>3000	>3000	>4,000
Oil resistance (180°C, 200h)		Good (Reduces bond strength by around 30% after 200h at 180℃ in oil)		