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A New Option for Automotive Interior Trim Assembly

Assembling automotive interior trim is a complex process. The components are made of a variety of different materials, some of which are notoriously resistant to adhesives. The adhesives themselves need to be applied cleanly, efficiently and cost effectively, and worker safety is a significant concern. And, the finished assemblies have to withstand rough handling and temperature extremes for the life of the automobile.

Until now, meeting all of these demands with a single adhesive has been impossible, requiring compromise in selecting individual adhesives and, in most cases, requiring multiple production lines to handle different adhesives depending on the substrate. Swift®lock 2900, a new polyurethane reactive hot melt (PUR-HM), meets all of the performance requirements regardless of substrate. It adheres to both Acrylonitrile-Butadiene-Styrene (ABS) and Polypropylene (PP) substrates without any kind of pretreatment, eliminating the need for multiple production lines. It is suitable for spraying, as well as for slot die and roll coating applications. It has very low VOC content. It sets quickly, speeding up throughput on the production line, and it matches or exceeds the performance of currently used polyolefin reactive hot melts (PORs).

Because Swift®lock 2900 works with both ABS and PP substrates, Tier 1 parts providers benefit by being able to replace multiple production lines for different adhesives with a single universal line. Regardless of where it is used, Swift®lock 2900 can significantly reduce capital expenditures by replacing multiple production lines for different adhesives with a single line handling both ABS and PP substrates. Yet, the real difference is that Swift®lock 2900 eliminates the need to give up or compromise on any of the attributes of an ideal automotive trim adhesive.

An Alternative to Pure POR for Non-Polar Substrates

Until now the adhesive for automotive interior trim on non-polar substrates has been products based on thermoplastic amorphous poly-alpha-olefin (APAO) technology. Although it has not been tested directly against APAOs, Swift®lock 2900 compares favorably with polyolefin reactive adhesives (POR) in virtually every way, and it can be applied at moderate temperatures using equipment that most manufacturers already use.

- Even at a safer, energy-saving 130°C (versus POR's typical 160°C), Swift®lock 2900 can be applied using a variety of application methods.
- In tests, the adhesive shows excellent pot stability.
- Its short open time of 15 to 20 seconds fits multiple production processes and supports both inline and off-line application methods.
- Swift®lock 2900 lower tack-free time—two minutes compared to POR's three minutes—allows foil rolls to be formed faster, increasing the productivity of that process.
- In use, Swift®lock 2900 exhibits good wet-out of both ABS and non-polar substrates at moderate temperatures (60-70°C) for maximum adhesion.

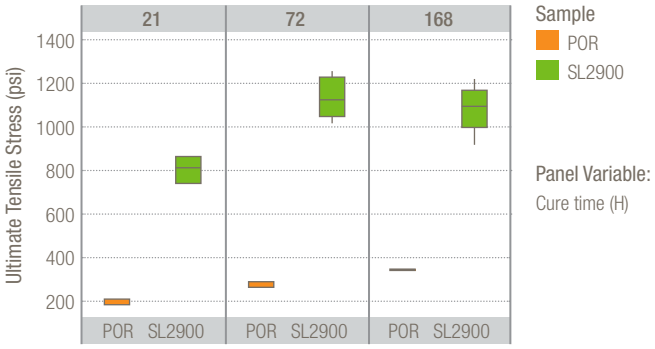
Excellent green strength allows faster assembly on complex geometries and the ability to stay in place when manually folded over edges.

Adhesive Cure Profile

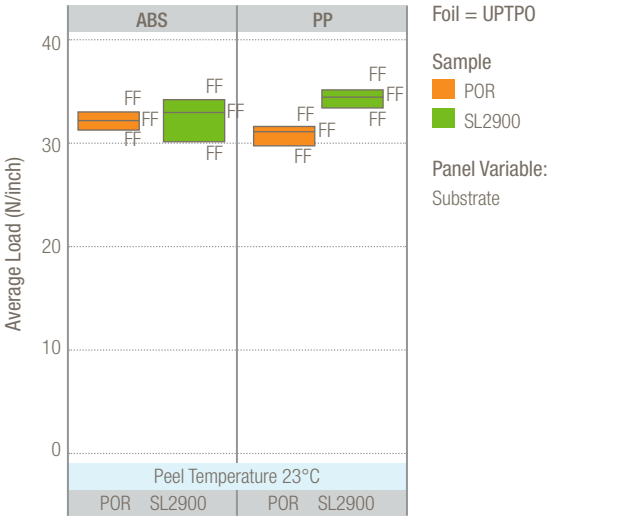
From 24 hours to seven days after application, the tensile stress and elongation of Swift®lock 2900 are superior to that of POR.

In peel strength testing of unprimed thermoplastic olefin (TPO) foil at room temperature, Swift®lock 2900 shows comparable performance to POR on ABS substrate and better performance on PP substrate. In all cure profile testing, failure is due to foil failure rather than adhesive failure. The adhesive is stronger that the foil itself, and differences in the graph are due to the foil itself rather than the adhesive.

Boxplot of Ultimate Tensile Stress (psi)



Initial Peel Strength on Unprimed TPO at Room Temperature

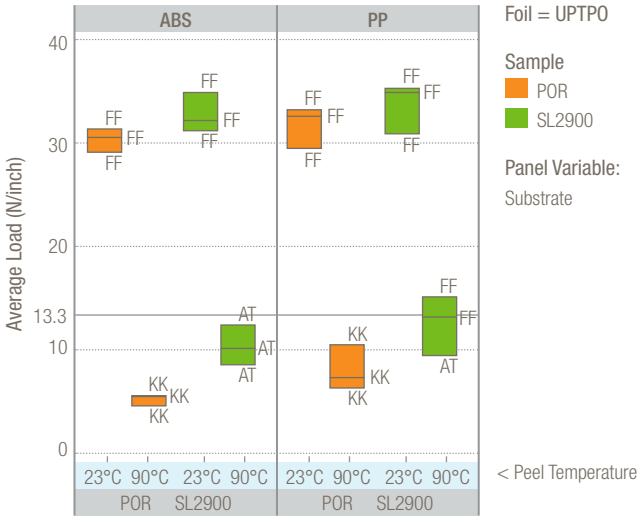


Performance After Curing

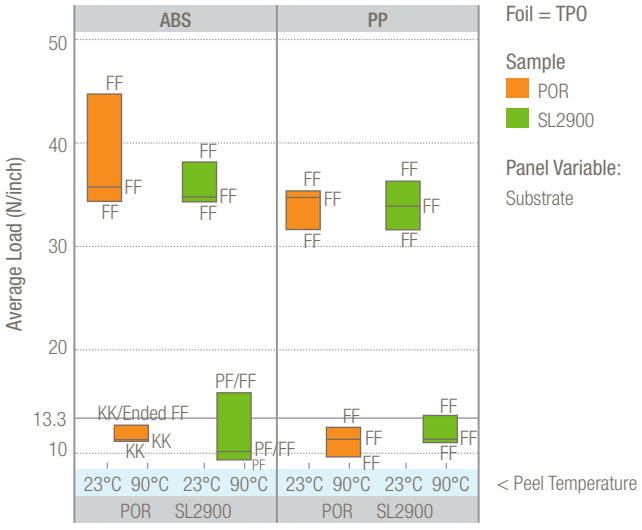
After seven days' cure, in peel strength testing of unprimed TPO, Swift®lock 2900 shows somewhat superior performance to POR on both ABS and PP substrates. These differences at room temperature are negligible since they are due to the foil failing. At 90°C, however, Swift®lock 2900 shows significantly greater peel strength on both substrates compared to POR. Note that the preferred peel strength at temperatures over 60°C is 13.3 N/in. Testing was not done at 60°C, but at 90°C Swift®lock 2900 reached that goal on the PP substrate and approached the ideal on ABS.

After seven days' cure, in peel strength testing of primed TPO, Swift®lock's 2900 AP performance is generally comparable to that of POR at both room temperature and at 90°C.

Peel Strength on Unprimed TPO After 7 Days of Curing



Peel Strength on Primed TPO After 7 Days of Curing



Comparing the relative peel strength of POR and Swift®lock 2900, as shown in the following chart:

- At room temperature Swift®lock 2900 and POR are generally comparable on both substrates, both primed and unprimed.
- At 90°C, the two adhesives are more-or-less comparable on primed substrates.
- At 90°C, Swift®lock 2900 has a substantial strength advantage over POR on unprimed ABS and PP substrates.

Cure Time	Substrates	Adhesive	RT (N/inch)	Failure	90°C (N/inch)	Failure
7 days	Unprimed TPO-PP	SL2900	33.9	FF	12.6	FF
		POR	31.9		7.8	K
	Unprimed TPO-ABS	SL2900	33.0		10.1	AT
		POR	30.5		4.9	K
	Primed TPO-PP	SL2900	34.0		12.00	FF
		POR	33.0		11.1	FF
	Primed TPO-ABS	SL2900	35.8		11.6	PF/FF
		POR	38.4			K

Note: All PP used is untreated

Acronym	Type of Failure
FF	Foil failure
K	Cohesive failure
AT	Adhesive failure to the hard substrate
AF	Adhesive failure to the foil
PF	Primer failure

This chart highlights one of the major advantages of Swift®lock 2900 over POR in maintaining peel strength without requiring priming of either ABS or PP substrates.

Environmental Cycling

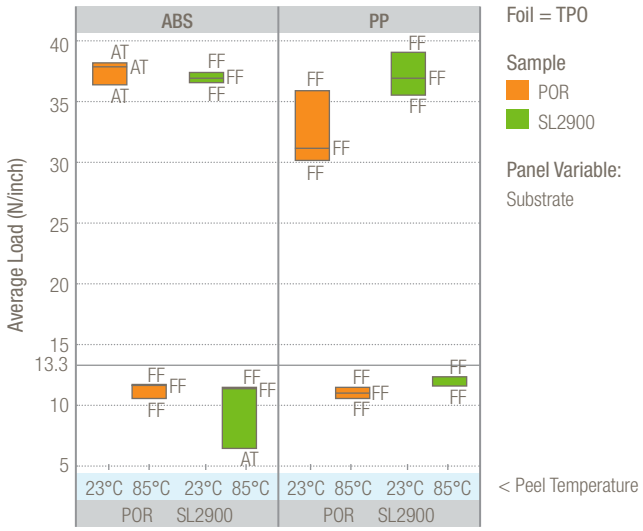
To be effective over the life of an automobile, an interior trim adhesive must withstand repeated cycles of heat, cold and humidity, so Swift®lock 2900 and POR were peel tested using both unprimed and primed TPO after environmental cycling. The environmental cycling test consisted of several days during which the sample were exposed to temperatures ranging from -30°C to 85°C and relative humidities ranging from 0 percent to 95 percent. The cycled samples were then tested at room temperature and at 85°C. As shown in the two accompanying charts, Swift®lock 2900 is comparable to, or slightly superior to, POR at both room temperature and at 85°C after environmental cycling. Throughout this study, we noticed that the peels on ABS substrate were more sensitive to variables such as coat weight and activation temperature, and this is evident in the broader data spread observed on ABS. This performance suggests that optimal substrate wetting conditions for ABS vary more than those of PP. Optimal substrate wetting is achieved by fine tuning the application conditions to the particular substrates.

In Summary

Strength is a critical factor in choosing an adhesive for auto trim, and Swift®lock 2900 equals or exceeds the performance of POR, initially and after cure, on both ABS and PP substrates, and with and without priming. The fact that Swift®lock 2900 outperforms POR on unprimed substrates suggests that the costly and time-consuming priming step can be completely eliminated from the assembly process.

Swift®lock 2900's performance on both ABS and PP substrates allows both types of material to be run on a single production line. And, the reduced application temperature reduces risk to workers as well as costs for protection and energy. Shorter open time and reduced tack-free time

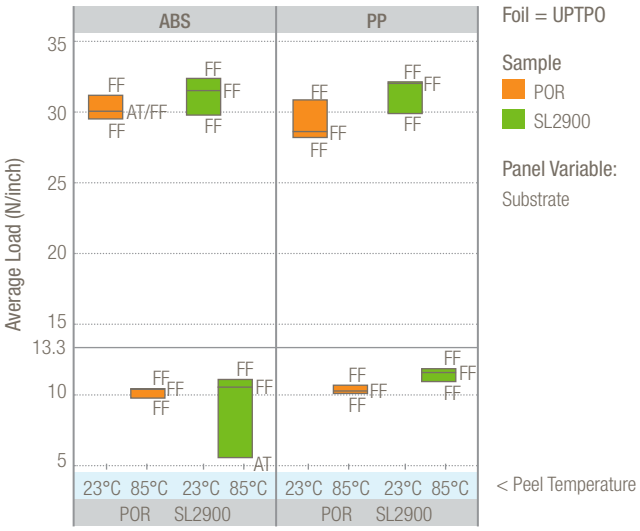
Primed TPO Peel Strength After Environmental Cycling



contribute to higher throughput on the production line, and the low concentration of isocyanate—less than one percent free monomer—protects workers and reduces cost for employers.

In short, Swift®lock 2900 does everything that traditional POR does but works faster, more safely and at lower operating cost.

Unprimed TPO Peel Strength After Environmental Cycling



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