Silquest* A-Link* 15

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Description

Silquest A-Link 15 silane may be used for use as an endcapper or crosslinker for isocyanate functional prepolymer systems. This product provides improved thermal and UV stability over previous secondary amino silane endcappers. Silquest A-Link 15 silane can also be utilized as an adhesion promoter in silicone, hybrid, urethane, and epoxy adhesives and sealants.

Key Features and Benefits

Secondary Amino Functionality	• Provides a controlled reaction with -NCO, -COOH, and epoxy functional materials,providing a moisture cure silane crosslink mechanism • Secondary amino functionality avoids viscosity instability associated with use of primary amino silanes as prepolymer endcappers/crosslinkers. • This alkylamino offers enhanced thermal stability versus arylamino silanes.
Trimethoxy Silane Functionality	• Provides fast hydrolysis in the presence of formulated or atmospheric moisture. • Provides excellent wet adhesion to glass, metal and other inorganic substrates. • Resulting bond offers excellent thermal, chemical and UV stable performance. • Amine catalyzed crosslinker and adhesion promotion in silane functional systems (silicone, hybrid, SPUR+* prepolymer technology modified urethanes).

Features and Typical Benefits of SPUR+ Prepolymer Technology

Silylated Urethanes

After endcapping an -NCO functional prepolymer with Silquest A-Link 15 silane, the silylated resin will moisture-cure at room temperature by hydrolysis and condensation of the reactive alkoxysilane terminal groups. The resulting siloxane bond is stable to attack from heat, solvents and UV radiation. Sealants formulated with silylated prepolymers offer broad formulation freedom and a wide variety of features and benefits.

- Excellent primerless adhesion to glass, aluminium and other metals
- Unusually good adhesion to plastics such as PVC, Polystyrene,Nylon, ABS and acrylics, when an amino silane such as Silquest A-1110 silane is utilized as an adhesion promoter in conjunction with the silylated resin
- Fast, bubble free cure
- Excellent durability and joint movement
- Good tensile strength and elasticity

- Freedom to formulate low modulus/high elongation or high modulus/low elongation systems
- Durable Si-O-Si crosslinks
- Excellent solvent resistance
- Immediate paintability
- Isocyanate-free urethane performance

This technology may be an excellent material of choice for applications such as various windshield, transportation and industrial sealants, that require strong adhesion to a wide array of substrates.

Like silicone sealants, sealants based upon Momentive Performance Materials SPUR+ prepolymer technology benefit from the freedom to utilize amino silanes such as Silquest A-1110, and Silquest A-1170 silanes as adhesion promoters, dramatically enhancing the final systems wet adhesion to plastics.

Preparation of SPUR+ Prepolymer-Based Sealants

There are three steps to the preparation of a silane-crosslinked adhesive or sealant:

- Preparation of an isocyanate functional prepolymer
- Silane capping of the prepolymer; and
- Formulation of the adhesive or sealant

Preparation of an Isocyanate Functional Prepolymer

The urethane prepolymer is made in the usual fashion by reacting diisocyanate with a diol in the presence of a catalyst. The model formulations discussed here utilized MDI, 4000 MW polypropylene glycol (NCO/OH ratio 1.4) and dibutyltin dilaurate catalyst, however prepolymers can be formulated from a wide array of polyols and isocyanates. The reaction is run at 65-70°C (149-158°F), until all -OH groups have been consumed. This takes approximately three hours.

Silylation of an Isocyanate Functional Prepolymer

At this point (capping point), Silquest A-Link 15 silane is added, and the reaction is allowed to continue until all free-isocyanate groups have been consumed. A 65-70°C (149-158°F) reaction temperature is recommended. No exotherm is observed, and no additional catalyst is required. Typically, a 5% stoichiometric excess of Silquest A-Link 15 silane is recommended to insure full capping. At this point, one has an isocyanate-free prepolymer, which will cure upon exposure to moisture.

Formulation of One-Part Silylated Urethane Sealants

Silylated urethane polymers can be formulated with plasticizers, fillers and other additives into one-part, room-temperature, moisture- curable sealants. The final formulation is mixed for 60 minutes at 80°C (176°F). The kettle is then recommended to be cooled to 50°C (122°F) before adding the desired silane adhesion promoter (Silquest A-1110 silane), dehydrating agent (Silquest A-171* silane) and cure catalyst (Fomrez(1) SUL-11A tin catalyst, or Fomrez UL-4 tin catalyst). The mixture is then mixed for 30 minutes, preferably under nitrogen. Formulations and procedures are similar to those used in making silicone

sealants.

Table 1: Sealant Starting Point Formulation

Components	Weight (g)
SPUR+ Prepolymer	250
DIDP	100
Silquest A-171 Silane	5
Calcium Carbonate (fine)	150
Calcium Carbonate (coarse)	100
UV Inhibitor	2.5
TiO_2	7.5
SiO_2	15
Silquest Silane Adhesion Promoter	3.75
Fomrez[1] SUL-11A	0.5

(1) Fomrez is a trademark of Chemtura Corporation

One-Part Silylated Urethane Sealants

Preparation of Cured Prepolymer Samples:

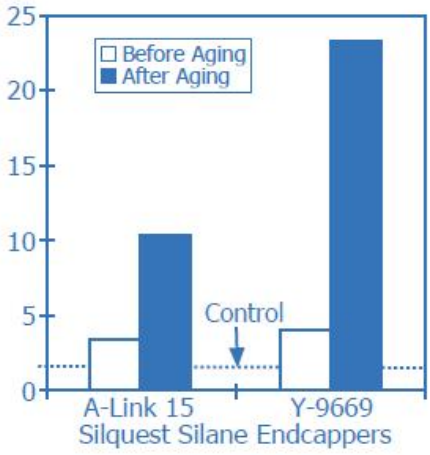
The prepolymers made were blended with 1 wt % of Fomrez[1] SUL 4 (dibutyltin dilaurate) and cured in an environmental chamber at 23°C (73°F) and 50% relative humidity for three days, then in a regular oven at 50°C (122°F) for four days.

Yellowing Test:

The above cured silylated prepolymers were placed in an oven at 80°C (176°F) for a week. The change of color before and after the accelerated aging was determined with a Minolta Chroma Meter C210.
(1) Fomrez is a trademark of Chemtura Corporation

Table 2: Yellowing Index of Cured Prepolymers: (Control Index 1.97)

	Yellow index	
Prepolymer Silane Endcapper	**Before Aging**	**After Aging**
Silquest A-Link 15 silane	3.3	10.2
Silquest Y-9669 silane	4	23.3



Adhesion-in-Peel Test:

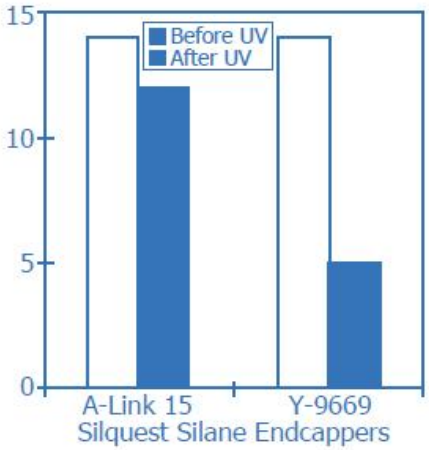
SPUR+* prepolymer technology offers a route to excellent UV stability in general. A Silquest Y-9669 silane and MDI, based prepolymer (MDI/PPG4000 NCO:OH ratio 1.4 endcapped with Silquest Y-9669 silane) employed in the starting formulation discussed earlier, survived 8,500 hours before exhibiting signs of microcracking.

Given the excellent UV stability achieveable with this technology, Momentive Performance Materials has begun evalu ating adhesion after 350 hours of UV-through glass under hot-humid conditions as a means of more rapidly differentiating between the UV performance of various systems. Under this extreme test most sealants will lose substantial adhesion prior to reaching the 350 hour goal. Our 8,500 hour QUV system will see a 65% reduction in adhesion, but still maintains 5 pli adhesion.

Silquest A-Link 15 silane exhibits an additional substantial improvement in QUV through glass performance, maintaining better than 85% of initial adhesion performance. Our conclusion, is that SPUR+ prepolymer-based sealants prepared with Silquest A-Link 15 silane will exhibit excellent UV performance. This product is particularly suitable for use in OEM and aftermarket windshield, industrial and transportation sealant applications.

Table 3: Adhesion of SPUR+ Prepolymer-Based Sealants After Aging by UV-Through Glass

	Wet Adhesion pli/N/mm)	
Sealant	**Before UV Through Glass**	**After UV Through Glass**
Silquest A-Link 15 silane	14/2.45	12/2.10
Silquest Y-9669 silane	14/2.45	5/0.87



Adhesion Test Method:

Glass substrates were thoroughly cleaned with an isopropanol, detergent (0.1%) solution and rinsed with de-ionized water. The cleaned substrates were allowed to air dry prior use.

The adhesion-in-peel testing was conducted in accordance with the ASTM C 794 procedure. The experimental sealant was spread over 2/3 of the substrate coupon to a depth of approximately 1/16''. The sealant was then covered with a 30 mesh aluminum screen which was covered with an additional 1/16'' layer of sealant. Specimens were cured for 21 days according the following schedule: 7 days at 23°C (73°F) and 50% relative humidity; 7 days at 38°C (100°F) and 95% relative humidity; 7 days at 23°C (73°F) and 50% relative humidity

The cured specimens were placed in a QUV with glass substrates faced to UV light for 350 hours. The QUV was operated in a schedule of four hours at high humidity and 60°C (140°F) with UV light on, followed by four hours heat off and UV light off.

The treated samples then were immersed into water for 7 days prior to test. The 180° peel strength, or so called wet adhesion, was measured on an instron. The peel strength measured without immersing in water is called dry adhesion

Mechanical Property Test:

Mechanical properties were evaluated using ASTM specifications. Tensile strength, elongation, modulus (ASTM D 412), Shore A hardness (ASTM C 661) and tear resistance (ASTM D 624) data were obtained on samples cured according to the following schedule: 3 days at 23°C (73°F) and 50% relative humidity followed by an additional 4 days at 50°C (122°F).

Table 4: SPUR+* Prepolymer-Based Film Mechanical Properties

	Silquest A-Link 15 Silane	Silquest Y-9669 Silane
Tensile Strength (psi/MPa)	106/0.73	104/0.72
Youngs Modulus (psi/MPa)	113/0.78	112/0.77
Elongation (%)	148	149
Shore A Hardness	33	32

Silquest A-Link 15 silane offers comparable prepolymer film properties to that of Silquest Y-9669 silane.

Table 5: SPUR+* Prepolymer-Based Sealants Mechanical Properties of the Sealants

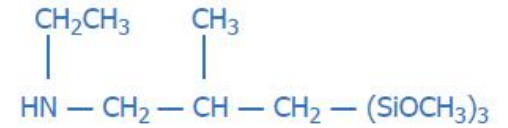
	Silquest A-Link 15 Silane	Silquest Y-9669 Silane
Tensile Strength (psi/MPa)	231/1.59	183/1.26
Youngs Modulus (psi/MPa)	271/1.87	184/1.27
Elongation (%)	150	213
Shore A Hardness	51	34

Silquest A-Link 15 silane is suitable for medium to high modulus sealants.

Typical Physical Properties

Molecular Weight	222
Physical Form	Light Yellow
Specific Gravity (25/25°C)	1.05
Flash Point, °C (°F) PMCC, Method STM D 93	91 (195)

Chemical Structure



N-ethyl-amino isobutyl trimethoxy silane

Silquest A-Link 15 Silane

Potential Applications

NCO-free Moisture Crosslinkable Urethane Prepolymers via SPUR+* Prepolymer Technology

Silquest A-Link 15 silane can be utilized to cost effectively construct a high performance moisture cureable silylated prepolymer. The resultant silylated prepolymer can be formulated with fillers, plasticizers and other additives into room-temperature, moisturecurable products such as one-part transportation, windshield,

general industrial, construction sealants or hot melt adhesives. Properties may be modified by varying the prepolymer backbone molecular weight, functionality and chemistry of the polyol, and the sealant formulation.

Crosslinking with Momentive Performance Materials Silquest A-Link 15 silane offers several advantages over other amino silane crosslinked approaches, including:

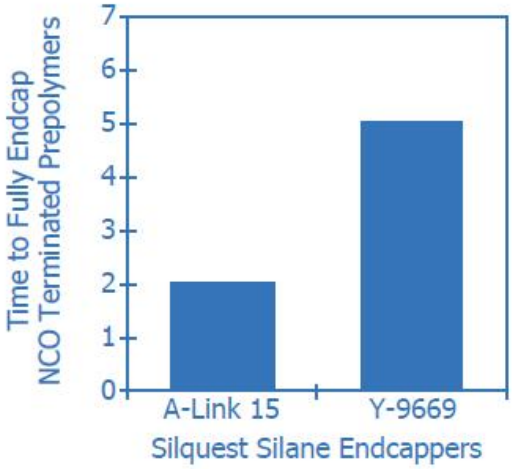
Enhanced Thermal Color Stability- Silylated prepolymers prepared with Silquest A-Link 15 silane provide superior color stability versus amino based endcapper technologies.

Enhanced UV Stability - Silquest A-Link 15 silane based SPUR+ prepolymer-based sealants offer exceptional UV performance. Silquest silane endcapped prepolymers can be formulated to provide superior UV stability versus standard urethane prepolymer technology. The isocyanate-free nature of this system allows the formulator to work with a broader range of UV stabilizers, enabling one to achieve dramatic improvements in UV stability. Silquest A-Link 15 silane extends this performance with an endcapping structure offering superior UV stability versus other secondary amino silanes.

SPUR+ prepolymer-based sealants prepared with MDI have achieved in excess of 8,500 hours under QUV A conditions. Silquest A-Link 15 silane further extends this performance (see page 4).

Improved Cost Efficiency - Silquest A-Link 15 silane provides a cost effective means of accessing the benefits of SPUR prepolymer technology. A low equivalent weight translating into reduced use levels versus previous technologies.

Reduced Process Cost - Silquest A-Link 15 silane offers superior NCO endcapping speed, versus other



secondary amino silanes.

Patent Status

Nothing contained herein shall be construed to imply the nonexistence of any relevant patents or to constitute a permission, inducement or recommendation to practice any invention covered by any patent, without authority from the owner of the patent.

Product Safety, Handling and Storage

Customers should review the latest Safety Data Sheet (SDS) and label for product safety information, safe handling instructions, personal protective equipment if necessary, emergency service contact information, and any special storage conditions required for safety. Momentive Performance Materials (MPM) maintains an around-the-clock emergency service for its products. SDS are available at www.momentive.com or, upon request, from any MPM representative. For product storage and handling procedures to maintain the product quality within our stated specifications, please review Certificates of Analysis, which are available in the Order Center. Use of other materials in conjunction with MPM products (for example, primers) may require additional precautions. Please review and follow the safety information provided by the manufacturer of such other materials.

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