

SYL-OFF™ Solventless, Platinum-Catalyzed Hexenyl Silicone Release coatings

Release system information guide

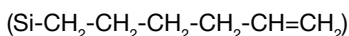


Contents

General information.....	2
Product range details.....	3
Product handling information.....	4
Application information.....	5
Formulation suggestions.....	7

General information

SYL-OFF™ Solventless, Platinum-Catalyzed Hexenyl Silicone Release Coatings are based on 100 percent solids reactive hexenyl-functional siloxane polymers:



When combined with their respective crosslinkers, these coatings cure via an addition reaction in the presence of heat.

Features

- Exceptionally fast, low-temperature cure for some hexenyl coatings
- Premium (easy) release
- A range of cure speeds, temperatures and release forces possible; choice of inhibitor systems for optimal bath life
- Cured coatings are durable, abrasion-resistant, nonblocking and nonmigratory
- Good stability against solvent-based rubber and acrylic adhesives
- 100 percent solids; solventless processing
- High-release modifiers available

Physical properties

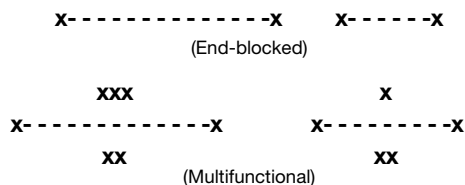
SYL-OFF™ Solventless, Platinum-Catalyzed Hexenyl Silicone Release Coatings are provided in a range of viscosities suitable for processing with equipment typically used for solventless silicone coatings. They are clear to slightly hazy and water-white to slightly amber in color.

Applications

- Potential use for coating on thermally-sensitive substrates
- Industrial release papers and films
- Casting papers
- Nonstick packaging, including packaging for rubber and asphalt
- In-line, double-sided and differential release applications

Polymer structure

Both end-blocked and multifunctional polymers are available in a variety of molecular weights:



In general, high-molecular-weight end-blocked polymers yield softer, more elastic coatings with easy release at low peel speeds and higher release at high peel speeds. Low-molecular weight and multifunctional polymers, on the other hand, yield more brittle, less flexible coatings with less differentiation between high and low-speed release force values.

The number of pendant reactive sites on the polymer chain can affect bath life, cure, adhesive compatibility and release behavior. See Table 1 for a more in-depth comparison of performance properties.

Table 1. End-blocked vs. multifunctional polymers

End-blocked	Multifunctional
Longer bath life	Faster, more complete cure
Softer cured coating	Harder cured coating
Easy release at low peel speeds	Easy release at high peel speeds

Inhibitor systems

SYL-OFF™ Solventless, Platinum-Catalyzed Silicone Release Coatings use a process of controlled catalyst inhibition to optimize bath life and cure time within defined temperature ranges. Two different inhibitor systems are available:

Inhibitor system 1

- Good cure at standard oven temperatures
- Excellent thin-film stability
- Excellent cure-rate retention over bath age

Inhibitor system 2

- Facilitates cure at lower web temperatures
- Fast cure with low Pt catalyst level
- Excellent bulk bath life (stable viscosity over bath age)

Product range details

Most of the SYL-OFF™ Solventless, Platinum-Catalyzed Hexenyl Silicone Release Coating products listed below are available worldwide and meet the majority of global industry requirements. However, they represent only a portion of Dow's silicone release technology. Contact your Dow representative for information about additional, locally available product options.

Base coatings	
SYL-OFF™ 7040 Coating	A 100 percent active solids coating containing a low-viscosity hexenyl multifunctional silicone polymer. Contains an inhibitor more suitable for lower cure temperatures. NOT pre-catalyzed. Designed for use with SYL-OFF™ 4000 Catalyst and SYL-OFF™ SL 3000 Catalyst and a silicone crosslinker. Recommended for fast cure and stable release against aggressive adhesives. Potentially suitable for thermally sensitive substrates.
SYL-OFF™ 7050 Coating	A 100 percent active solids coating containing a medium-viscosity hexenyl multifunctional silicone polymer. Contains an inhibitor more suitable for lower cure temperatures. NOT pre-catalyzed. Designed for use with SYL-OFF™ 4000 and SYL-OFF™ SL 3000 Catalyst and a silicone crosslinker. Recommended for fast cure and stable release against aggressive adhesives, can potentially be used on thermally sensitive polyolefin substrates.
SYL-OFF™ 7676 Coating	A 100 percent active solids pre-catalyzed coating containing a medium-viscosity hexenyl multifunctional silicone polymer. Contains inhibitor for improved thin film bath-life. Recommended for fast cure and stable release against aggressive adhesives, especially with low-temperature substrates.
SYL-OFF™ 7677 Coating	A 100 percent active solids pre-catalyzed coating containing a medium-viscosity hexenyl end-blocked functional silicone polymer. Contains standard inhibitor. Recommended for use against aggressive adhesives where premium release performance is required. Typically used on paper substrates.
SYL-OFF™ 7000 Coating	A 100 percent active solids pre-catalyzed coating containing a medium-viscosity hexenyl multifunctional silicone polymer. Does not contain inhibitor. Recommended for fast cure and stable release against aggressive adhesives.
Catalyst	
SYL-OFF™ 4000 Catalyst	A reactive organo-platinum complex dispersed in polysiloxane. The standard catalyst included in SYL-OFF™ Solvent-Based and Solventless Platinum-Catalyzed Release Coatings. Required for cure when formulating with SYL-OFF™ 7040 Coating. Can also be used with SYL-OFF™ 7677 Coating to obtain more complete cure at a given temperature, or to optimize machine capacity by speeding cure, or to overcome substrate inhibition.
SYL-OFF™ SL 3000 Catalyst	A reactive organo-platinum complex dispersed in polysiloxane. Suitable if very low Pt levels are required for cure. Required for cure when formulating with SYL-OFF™ 7040 or SYL-OFF™ 7050 Coating. May be used to reduce cure temperature required when coating temperature sensitive substrates. Can also be used with SYL-OFF™ 7677 Coating to obtain more complete cure at a given temperature, or to optimize machine capacity by speeding cure, or to overcome substrate inhibition.
Crosslinkers	
SYL-OFF™ 7678 Crosslinker	A 100 percent solids silicone crosslinker. Suitable for use with most SYL-OFF™ Solventless and Solvent-Based Coatings. Recommended where optimum cure performance and bath life are required. Can be blended with SYL-OFF™ 7048 Crosslinker to balance cure, bath life and anchorage.
SYL-OFF™ 7682-055 Crosslinker	A 100 percent solids silicone crosslinker. Suitable for use with most SYL-OFF™ Solventless and Solvent-Based Coatings. Recommended where optimum cure performance and bath life are required.
SYL-OFF™ 7682-000 Crosslinker	A 100 percent solids silicone crosslinker. Recommended for use where a better balance of cure and anchorage is required than can be obtained from either of the crosslinkers above.
SYL-OFF™ 7048 Crosslinker	A 100 percent solids silicone crosslinker that is suitable for use with most SYL-OFF™ Solventless and Solvent-Based Coatings. Recommended where optimum anchorage to substrate is required.
SYL-OFF™ SL 8 Crosslinker	Contains anti-mist additive. Recommended for high speed lines.
SYL-OFF™ 7006 Crosslinker	Silicone crosslinker for solventless silicone release coatings containing a platinum inhibitor.
Release modifiers	
SYL-OFF™ SL 10 Release Modifier	A 100 percent active solids release modifier. Offers particularly stable release. Recommended for use with SYL-OFF™ 7040 and SYL-OFF™ 7050 Coating and for cure on a wide range of substrates.
SYL-OFF™ SL 40 Release Modifier	Release modifier dilutes in alpha olefin. Offers possibilities of higher release modification. Recommended for use with SYL-OFF™ 7040 and SYL-OFF™ 7050 Coating and for cure on a wide range of substrates.
SYL-OFF™ 7041 Release Modifier	A 100 percent active solids release modifier compatible with hexenyl-functional polymers. Offers particularly stable release and fast cure. Recommended for use with SYL-OFF™ 7040 Coating and SYL-OFF™ 7050 Coating and for cure on a wide range of substrates.
SYL-OFF™ 7612 Release Modifier	A 100 percent active solids high-viscosity release modifier compatible with hexenylfunctional polymers. Recommended for use with SYL-OFF™ 7677 Coating and SYL-OFF™ 7676 Coating for cure at higher temperatures, especially on paper substrates.
SYL-OFF™ 7002 Release Modifier	A 100 percent active solids high-viscosity release modifier compatible with hexenyl-functional polymers. Recommended for use with SYL-OFF™ 7677 Coating and for cure at higher temperatures, especially on paper substrates.
SYL-OFF™ SL 25 Release Modifier	A 100% active solids release modifier designed for efficient low speed release and low high speed release.
High-speed process aids	
SYL-OFF™ 7137 High Speed Crosslinker	A silicone fluid used as an additive to reduce misting during high-speed silicone roll coating. Designed to have no adverse effect on coating properties. Contains reactive SiH groups that crosslink with the coating during cure. Suitable for use with silicone coatings that use SYL-OFF™ 7048 Crosslinker or SYL-OFF™ 7682-000 Crosslinker.
SYL-OFF™ 7138 High Speed Crosslinker	A silicone fluid used as an additive to reduce misting during high-speed silicone roll coating. Designed to have no adverse effect on coating properties. Contains reactive SiH groups that crosslink with the coating during cure. Suitable for use with silicone coatings that use SYL-OFF™ 7678 Crosslinker.

Product handling information

Substrates

SYL-OFF™ Solventless, Platinum-Catalyzed Hexenyl Silicone Release Coatings have been successfully applied to board; parchment; glassine; super-calendered, clay-coated and polycoated krafts; plastic films and metal foil.

Corona treatment may be needed to improve anchorage to polycoated krafts or films. The use of SYL-OFF™ 7048 Crosslinker improves anchorage to clay-coated and polycoated krafts and to films.

The suitability of a substrate for use with the chosen release coating should be evaluated before commercial application.

Application equipment

SYL-OFF™ Solventless Release Coatings are designed to be applied using precision coating equipment such as three-roll offset differential gravure and multi-roll smooth roll coaters.

Solventless coatings may also be blended with aliphatic solvents to a desired solids concentration and applied using conventional solvent coating equipment.

Coat weight

Without experimentation, it is difficult to establish precise recommendations for the correct amount of silicone coating to be deposited on the substrate. Pick-up values are entirely dependent on the coating equipment used, equipment operation and substrate.

A recommended starting point is 1 g per m² (0.62 lb per 3,000 sq ft ream); this can be adjusted to meet substrate and enduse applications. Coating trials should be conducted for each substrate and coating formulation used.

Bath life

Under normal ambient conditions, SYL-OFF™ Solventless Platinum Catalyzed Coatings containing the **inhibitor system 1** have an average static bath life of 24 hours.

Coatings containing the **inhibitor system 2** have an average static bath life of several days. The actual useable bath life in practice will be shorter due to temperature and atmospheric exposure. It is recommended that formulated coating baths be used within 4-8 hours.

Bath life varies depending on the coating formulation and the test method used. Bath life trials should be conducted for each formulation.

Formulation advice

Crosslinker: coating ratio

Good cure can be achieved with crosslinker:coating (measured and calculated as moles SiH:moles Vi) ratios ranging from 1.1:1 to 2.0:1. In some cases where anchorage and/or cure cannot be achieved within this range, it may be desirable to use higher SiH:Vi ratios. See "Optimizing cure performance" for more details.

Catalyst

2 catalysts are available in two different Pt concentrations: SYL-OFF™ 4000 Catalyst and SYL-OFF™ SL 3000 Catalyst. See the instructions under "Bath preparation" and/or consult your Dow technical service representative for additional information.

High release modifiers

Release modifiers may be added to increase the force required to separate the release liner from the adherent. Actual results will vary with the exact formula used and other factors such as adhesive and substrates. For details, see "Release performance".

Low misting at high line speed

SYL-OFF™ SL 8 Crosslinker contains anti-mist additive to control mist at high line speed.

In addition 1.0 weight percent of SYL-OFF™ 7137 or SYL-OFF™ 7138 High Speed Crosslinker can be added into the release coating bath.

SYL-OFF™ 7137 High Speed Crosslinker contains approximately 0.95 percent SiH and should be used in formulations with SYL-OFF™ 7048 or SYL-OFF™ 7682-000 Crosslinker. SYL-OFF™ 7138 High Speed Crosslinker contains approximately 0.67 percent SiH and should be used in formulations with SYL-OFF™ 7678 Crosslinker. If the adhesive is sensitive to SiH functionality, it is advisable to adjust crosslinker levels to compensate for the additional levels of SiH percent in the process aid. Contact your Dow technical service representative for additional formulation advice.

Bath preparation

Equipment should be clean and dry. Stainless steel equipment is preferred.

The components should be mixed in the following order and stirred for 20 to 30 minutes (total) to ensure homogeneity:

1. Blend the coating and high release modifier; stir.
2. Add the high-speed process aid and crosslinker; stir.
3. Add the catalyst, if required; while stirring.

NOTE: The platinum catalyst is sensitive to contamination by compounds containing nitrogen, sulfur, tin, phosphorus, arsenic, antimony, selenium, tellurium and by some residual solvents or monomers. To prevent catalyst poisoning and inhibition of cure, good coater hygiene must be maintained. A more complete list of inhibiting compounds is available from Dow.



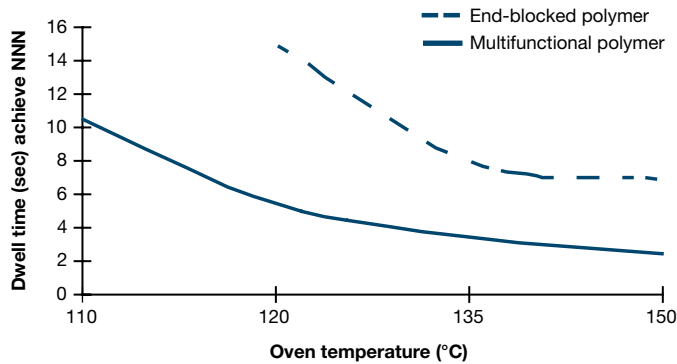
Application information

Cure performance

Polymer structure, inhibitor system, time, temperature, type and age of the substrate, coat weight and degree of surface penetration can all affect the cure performance of SYL-OFF™ Solventless, Platinum-Catalyzed Hexenyl Silicone Release Coatings.

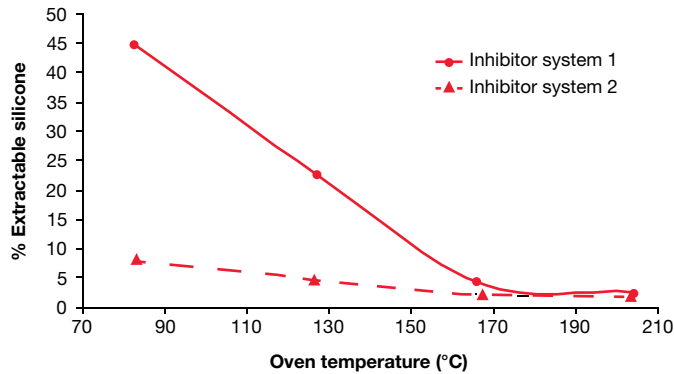
Figure 1 compares the typical cure time and temperature performance of end-blocked vs. multifunctional polymers in terms of NNN (no smear, no migration, and no rub-off). Figure 2 compares the standard vs. low-temperature inhibitor coatings in terms of percent extractables (amount of uncured silicone that can be extracted from a cured sample).

Figure 1. Cure comparison – end-blocked vs. multifunctional polymers



Test conditions: Coating applied to a super-calendered kraft base sheet and cured until NNN.

Figure 2. Inhibitor comparison – % extractable silicone



Test conditions: Coating applied to a super-calendered kraft sheet; coat weight: 1.1 g per m² (0.8 lb per 3,000 sq ft ream); 6-second cure.

Overcoming cure inhibition

Some additives used in the manufacture of films and clay and poly-coated krafts as well as the pre-coat found on most glassines and super-calendered krafts can adversely affect cure.

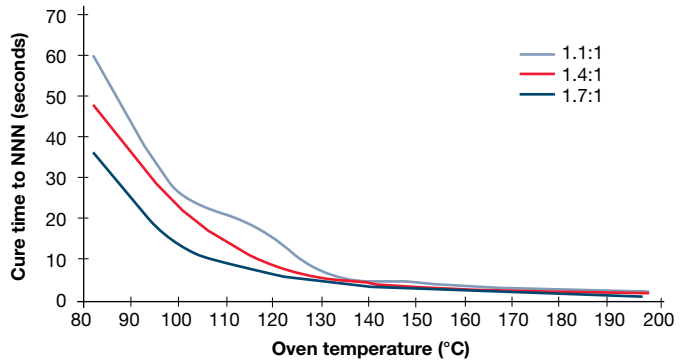
When using offset roller systems to apply platinum-catalyzed coatings, care should be taken with the choice of the rubber coated rolls. Materials used to vulcanize the rubber may inhibit the cure of the silicone coating.

Cure inhibition can be overcome with higher levels of SYL-OFF™ 4000 Catalyst. However, before attempting to remedy the problem by adding catalyst, the process and raw materials should be analyzed to determine the cause of the inhibition and whether it can be minimized or eliminated by other means. Catalyst addition should be undertaken only as a last resort due to the product's high cost.

Optimizing cure performance

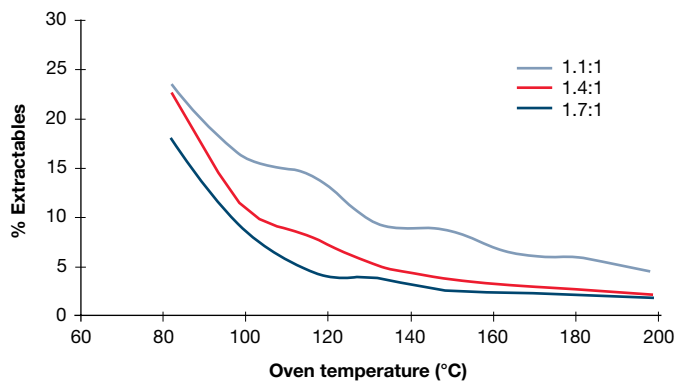
It may be possible to reduce cure time, lower cure temperature or improve the completeness of cure by adjusting the crosslinker:coating (SiH:Vi) ratio. This is accomplished by increasing or decreasing the amount of crosslinker (see Figures 3 and 4). However, the higher the crosslinker loading, the greater the potential for the silicone to interact with the adhesive and for bath life to be reduced.

Figure 3. Cure time to NNN with different SiH:Vi ratios



Test conditions: Coating applied to a super-calendered kraft sheet and cured until NNN.

Figure 4. Percent extractables with different SiH:Vi ratios

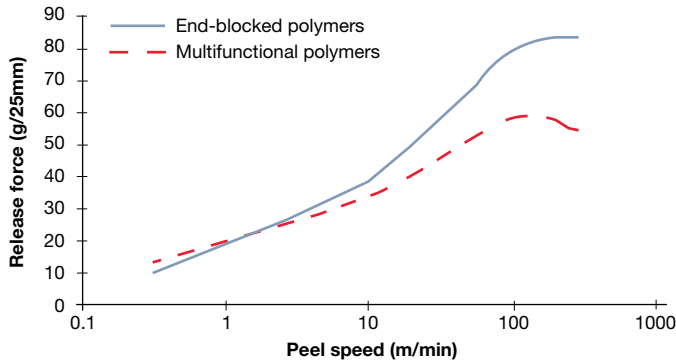


Test Conditions: Coating applied to a super-calendered kraft sheet; coat weight: 1.1 g per m² (0.8 lb per 3,000 sq ft ream); 6-second cure.

Release performance

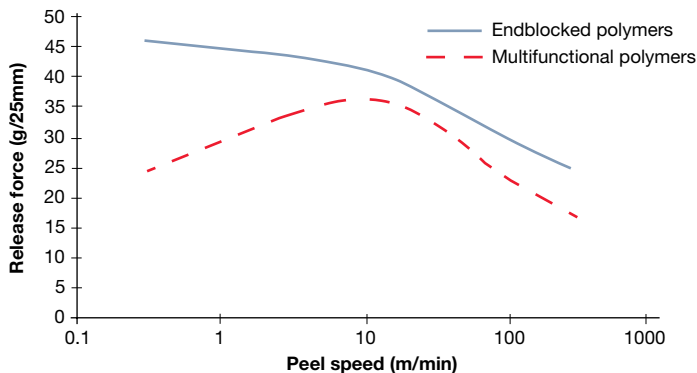
Different coatings can be selected for different applications depending on the release performance required. Figures 5 through 7 compare the release performance of SYL-OFF™ 7677 Coating (end-blocked) and SYL-OFF™ 7040 Coating (multifunctional) against three adhesive types – acrylic, solvent-based rubber and hot melt.

Figure 5. Release profile comparison of end-blocked vs. Multifunctional polymers – acrylic adhesive



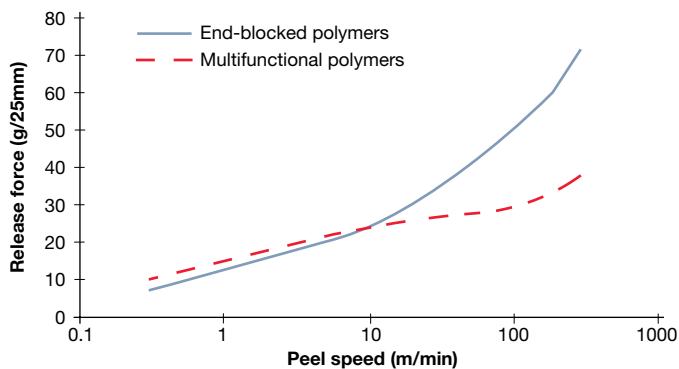
Test conditions: Release from tesa 7475 acrylic tape; coating applied to a super-calendered kraft base sheet and cured at 200°C (392°F) for 15 seconds; 1-day liner aging and 1-day laminate aging at room temperature; liner pulled from laminate at 180°.

Figure 6. Release profile comparison of end-blocked vs. Multifunctional polymers – rubber adhesive



Test conditions: Release from tesa 7476 rubber tape; coating applied to a super-calendered kraft base sheet and cured at 200°C (392°F) for 15 seconds; 1-day liner aging and 1-day laminate aging at room temperature; liner pulled from laminate at 180°.

Figure 7. Release profile comparison of end-blocked vs. Multifunctional polymers – hot melt adhesive

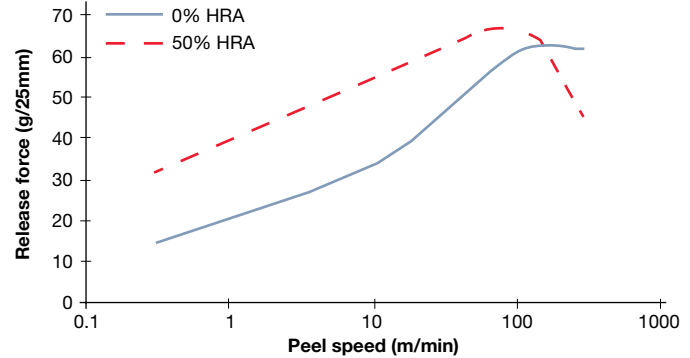


Test conditions: Release from hot melt tape; coating applied to a super-calendered kraft base sheet and cured at 200°C (392°F) for 15 seconds; 1-day liner aging and 1-day laminate aging at room temperature; liner pulled from laminate at 180°.

Effect of release modifiers

Figure 8 illustrates the effect of the addition of increasing levels of a high release modifier (SYL-OFF™ 7041 Release Modifier) on the release performance of SYL-OFF™ 7040 Coating against an acrylic adhesive.

Figure 8. Influence of SYL-OFF™ 7041 Release Modifier level on release force of SYL-OFF™ 7040 Coating – acrylic adhesive



Formulation suggestions

Formulations

SYL-OFF™ Solventless, Platinum-Catalyzed Hexenyl Silicone Release Coating components can be combined and adjusted in several ways to meet various processing and performance challenges. The typical formulations that follow are intended merely to serve as reference points for further discussion.

Dow does not warrant their merchantability, fitness for use, performance, efficacy, safety or freedom from patent infringement. It is your responsibility to thoroughly test any formulation before use.

For specific formulation advice, contact your Dow technical service representative.

Table 2. Typical formulation information

	Formulation (all with SYL-OFF™ brand)	(A) Easy release formula, good anchorage, fast cure	(B) Easy release formula fast cure, low temperature cure	(C) Easy release formula, good anchorage and cure, low Pt system	(D) Easy release fast cure, fast line speeds reduced mist	(E) Tight release formula, 50% modifier, reduced misting	(F) Moderate release formula, 25% modifier
Coatings	7040			100		50	
	7050		100				
	7676				100		
	7677	100					
	7000						75
Catalysts	4000	Not required	2.1		Not required	1.92	Not required
	SL 3000			4.2			
Crosslinkers	7678					5.98	
	7682-055		5.58	6.2			
	7048	1.17					
	7006						5.45
	SL 8				5.49		
Release modifier	7041					50	
	7002						25
High speed process aids	7138					1	

NOTE: Numerical values refer to parts (by weight) per 100 parts of coating, release modifier or additive as supplied; 1.4:1 SiH:Vi Ratio and 100 ppm Pt; Vi from Pt catalyst included.



Food contact information

Certifications available upon request. For specific details, please contact Dow as regulations vary from country to country.

Limitations

These products are neither tested nor represented as suitable for medical or pharmaceutical uses.

Health and environmental information

To support customers in their product safety needs, Dow has an extensive product stewardship organization and a team of health, environment and regulatory affairs specialists available in each area. For further information, please consult your local Dow representative.

For information and assistance

For product data sheets, selection guides and an overview of Dow's comprehensive line of products and services for the pressure sensitive industry, visit www.dow.com/psi.

Images: Cover — dow_40439373808; page 4 — dow_40265136908; page 6 — dow_40254214379; page 7 — dow_40646065828

NOTICE: No freedom from infringement of any patent owned by Dow or others is to be inferred. Because use conditions and applicable laws may differ from one location to another and may change with time, Customer is responsible for determining whether products and the information in this document are appropriate for Customer's use and for ensuring that Customer's workplace and disposal practices are in compliance with applicable laws and other government enactments. The product shown in this literature may not be available for sale and/or available in all geographies where Dow is represented. The claims made may not have been approved for use in all countries. Dow assumes no obligation or liability for the information in this document. References to "Dow" or the "Company" mean the Dow legal entity selling the products to Customer unless otherwise expressly noted. NO WARRANTIES ARE GIVEN; ALL IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE ARE EXPRESSLY EXCLUDED.

®™ Trademark of The Dow Chemical Company ("Dow") or an affiliated company of Dow

© 2021 The Dow Chemical Company. All rights reserved.

2000012864

Form No. 30-1162-01-0921 S2D