FASTER ASSEMBLIES AT ROOM TEMPERATURE WITH NEW, VERY FAST CURE DOWSIL™ EA-3838 FAST ADHESIVE

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AGENDA

- Market growth and major trends
- Silicone cure and product technology
- Sealing and bonding – Room-temperature vulcanization
- **DOWSIL™ EA-3838 Fast Adhesive**
- Typical applications
- Packaging and literature
- Q&A

Global adhesive and sealant market growth

- The global adhesives and sealants market size is expected to reach **USD 82.4 billion by 2025**.
- This corresponds to a **CAGR of 5.6%** during the forecast period.
- High demand for adhesives and sealants comes from different industries:
  - Construction
  - Assembly
  - Automotive
  - Appliance
  - Aviation

Major growth trends

	Trends	Product needs
Environmental, health and safety	Safety	Non-flammable components
	Sustainability, reduced environmental impact	Products which eliminate or reduce the need for heat cure
High throughput	Consolidation, trends towards more versatile materials that are certified for a wider range of end uses to reduce the number of different products that must be handled at the job site.	One product fits it all, flexible mixing ratios
Lower processing costs	Lower energy consumption, reducing the need of heat curing	RTV products
Lightweight materials	Increase of demand of adhesive applications in transportation; the trend towards lightweight cars to facilitate wind resistance and enable high speeds	Adhesives with a strong bond to several substrates

ADDRESSING THE NEEDS

Improving profitability and reducing carbon footprint

DOWSIL™ EA-3838 Fast Adhesive has been developed for manufacturers of appliances, automotive electronics, lighting, aerospace and beyond, willing to improve their profitability while reducing their costs and carbon footprint.

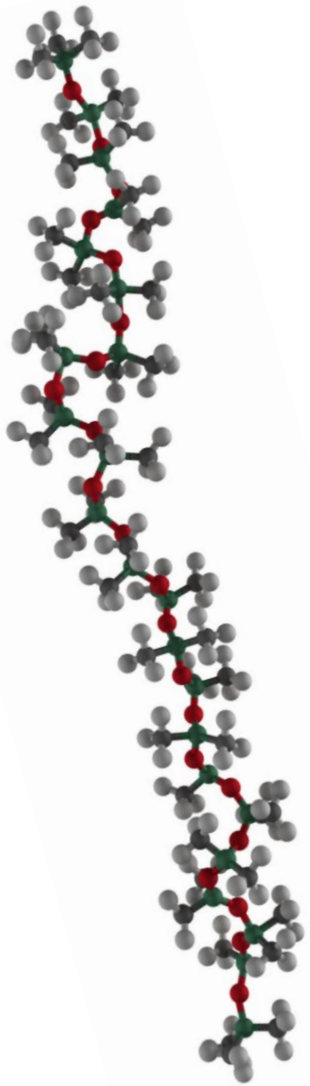
Silicone technologies

Sealing and bonding

Room temperature vulcanization (RTV)

Seek Together™

SILICONE CURE TECHNOLOGIES



Condensation-cure mechanism						
Known as	**Reactant 1**	**Reactant 2**	**Catalyst**	**Curative**	**Product**	**By-product**
Silanol	Si-OH	Si-H	Pt		Si-O-Si	H_2
2p RTV	Si-OH	$Si-O-CH_3$	Sn		Si-O-Si	$HO-CH_3$
Acetoxy	Si-OH	$Si-O-C(=O)CH_3$	Sn	H_2O	Si-O-Si	$HO-C(=O)CH_3$
Oxime *	Si-OH	$Si-O-N=CR^1R^2$	Sn	H_2O	Si-O-Si	$HO-N=CR^1R^2$
Alkoxy	Si-OH	$Si-O-CH_3$	Ti	H_2O	Si-O-Si	$HO-CH_3$

Addition-cure mechanism / peroxide-cure mechanism						
Known as	**Reactant 1**	**Reactant 2**	**Catalyst**	**Curative**	**Product**	**By-product**
Hydrosilation LSR	$Si-CH=CH_2$	Si-H	Pt		$Si-CH_2-CH_2-Si$	
HCR	$Si-CH=CH_2$	PDMS	$R^1-O-O-R^2$	Heat	Branched PDMS	$OH-R^{1,2}$

Thermal radical-cure mechanism	UV + moisture dual-cure mechanism

** Dow stopped manufacturing and selling silicone-based oxime materials*

SILICONE PRODUCT TECHNOLOGIES

Sealing

Silicone reactive hotmelt

Sealing & bonding

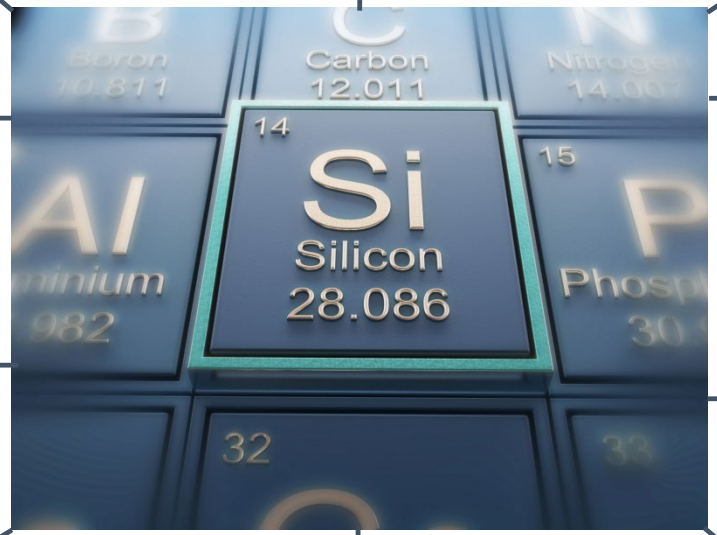
1- / 2-part RTV sealants, room-temperature vulcanization

Sealing & bonding

1- / 2-part HTV adhesives, high-temperature vulcanization

Adhesion promotion

Silane primer



Gasketing

Cure-in-place gasket (CIPG), Dispensed foam gasket (DFG)

Bonding

Pressure sensitive adhesive (PSA)

Rubber

Mold-making rubber, High-consistency rubber (HCR), Liquid silicone rubber (LSR), 3D printing, EMI shielding

Coating application

Silicone coating

Encapsulation & protection

Silicone gels and potting materials

Thermal management

Thermally conductive (TC) and Thermal interface materials (TIM)

SEALING AND BONDING – ROOM-TEMPERATURE VULCANIZATION

Package / Delivery / Storage

Typical storage conditions of 1-part RTV sealants:

When stored at or below 30°C (86°F) in the original unopened containers, this product has a usable life of 12 months from the date of production.

Hazard pictograms

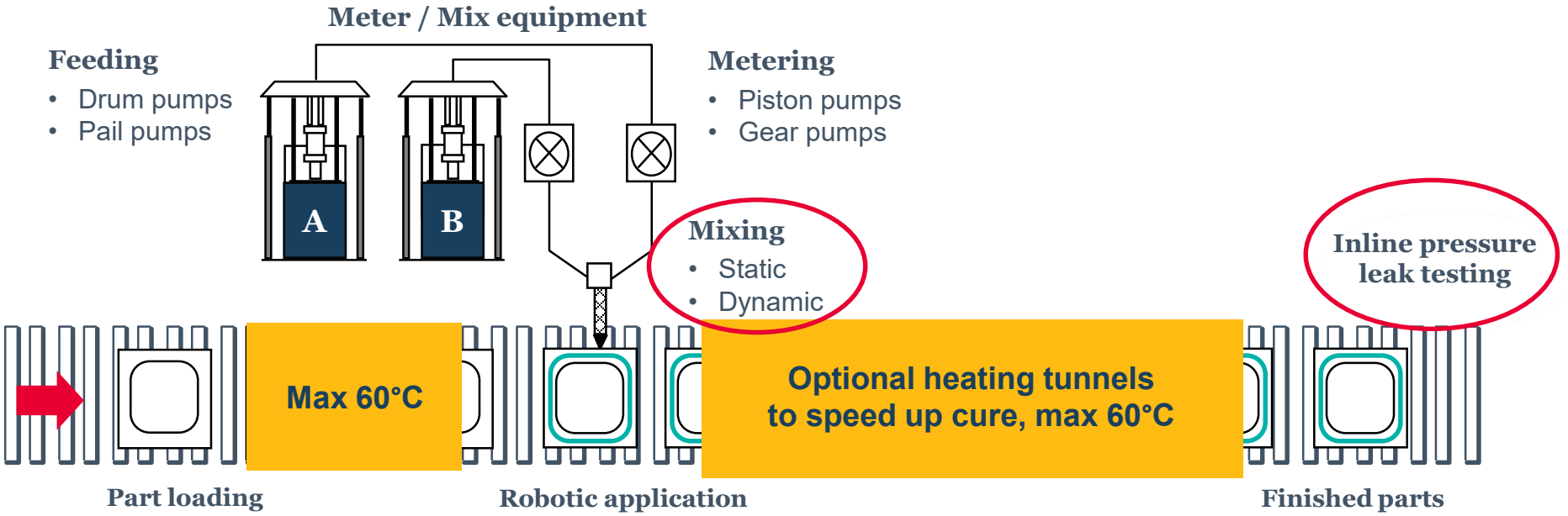
Signal word: WARNING

Storage conditions of SILASTIC™ Q3-3636 Adhesive Catalysts, 2-part RTV:

When stored at or below 25°C in the original unopened containers, SILASTIC™ Q3-3636 Adhesive Catalysts have a usable life of 5 months from date of production.

SEALING AND BONDING – ROOM-TEMPERATURE VULCANIZATION

Dispensing / Application



1-Part RTV equipment is less complex as no mixing or heating tunnels are required. This is because short-term heat has no significant effect on cure speed.

BUT a storage area is needed for curing finished parts. Time in storage area depends on

- **Temperature and humidity**
- **Part design**
- **Follow-up processes**

Mix ratio of current 2-part RTV sealants is 100:14 by weight (100:17 by volume)

Uneven mix ratio

- **Requires different pumps to meter correctly**
- **Requires precise mix ratio control**
- **Means that no commercial cartridge system is available**

SEALING AND BONDING – ROOM-TEMPERATURE VULCANIZATION

Open-time / tack-free time

1-Part RTV

Cure rate – skin-over / tack-free time by fingertip contact

Abstract: The skin-over time, a measure of cure rate, is defined as the time in minutes required for a curing material to form a non-tacky surface film.

2-Part RTV

Working time – snap technique

Abstract: This technique measures the length of time it takes for a room-temperature vulcanizing material to show the first sign of rubberiness after the material is completely formulated and exposed to normal curing conditions.

Cure rate – skin-over / tack-free time by polyethylene contact

Abstract: The skin-over time (measure of cure rate) is defined as the time in minutes required for a curing material to form a non-tacky surface film. This method uses polyethylene film contact to determine the non-tacky characteristic and can report pass/fail if the skin-over time is specified as a minimum.

Product	Skin over	Tack free
DOWSIL™ 7091 Adhesive Sealant	15	28
DOWSIL™ 7092 High Green Strength Adhesive		15 - 25
DOWSIL™ 7093 Low Modulus Adhesive Sealant	15	28
DOWSIL™ 7094 Flowable Sealant	25	50
DOWSIL™ 732 Multi-Purpose Sealant	7	20
DOWSIL™ Q3-1566 Heat Resistant Adhesive	5	

Product	Snap time	Tack free
DOWSIL™ EA-2626 Adhesive - Base SILASTIC™ Q3-3636 Adhesive - Catalyst	6 – 9	11 - 18

SEALING AND BONDING – ROOM-TEMPERATURE VULCANIZATION

Inline pressure leak test

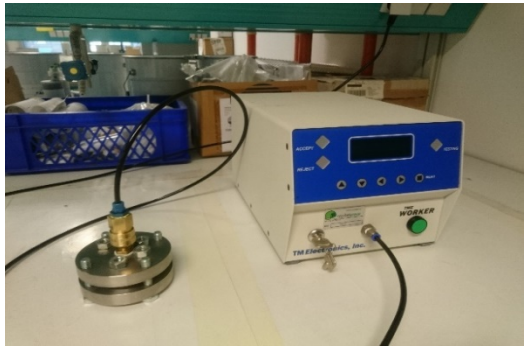
The inline pressure leak test can be done with Time Worker from TM Electronics, Inc., in combination with a metal jig according to ASTM F2523-13. The jig has a gap of 1 mm height and 8 mm width. A small bead of material was applied all around the flange of the metal jig. Right after application of the material, the jig was assembled and the test was started.

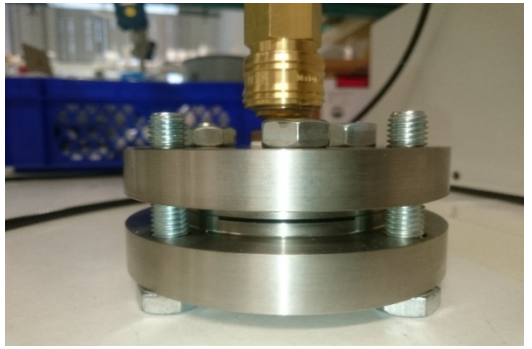
Dow lab leak test parameter: **Charge 6.5 kPa for 80s -► hold 6.5 kPa for 5s -► test**

Test time: **Hold 6.5 kPa for 120s**

Pass criteria: **Pressure decay max. 0.1 kPa**

Test parameters are application and customer specific.





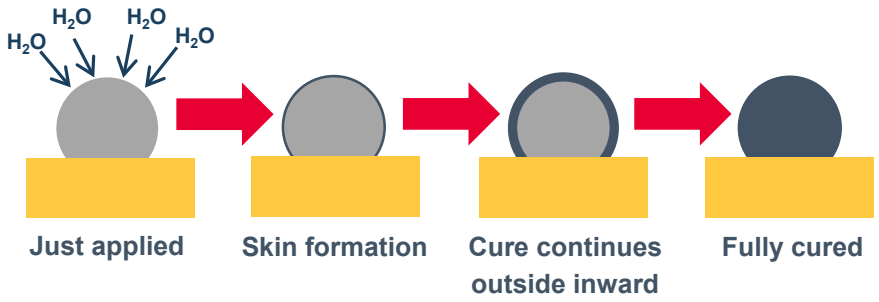
Pressure [mbar]	DOWSIL™ 7091 Adhesive	DOWSIL™ 7092 Adhesive
65	Pass	Pass
100	Pass	Pass
150	Fail	Pass
200		Fail

Product	Typical time to conduct pressure leak test
1-Part RTV	Next day
2-Part RTV	Minimum 18 minutes

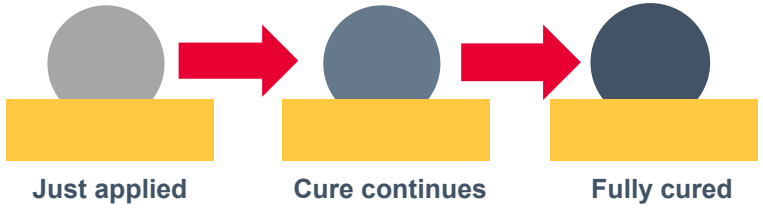
SEALING AND BONDING – ROOM-TEMPERATURE VULCANIZATION

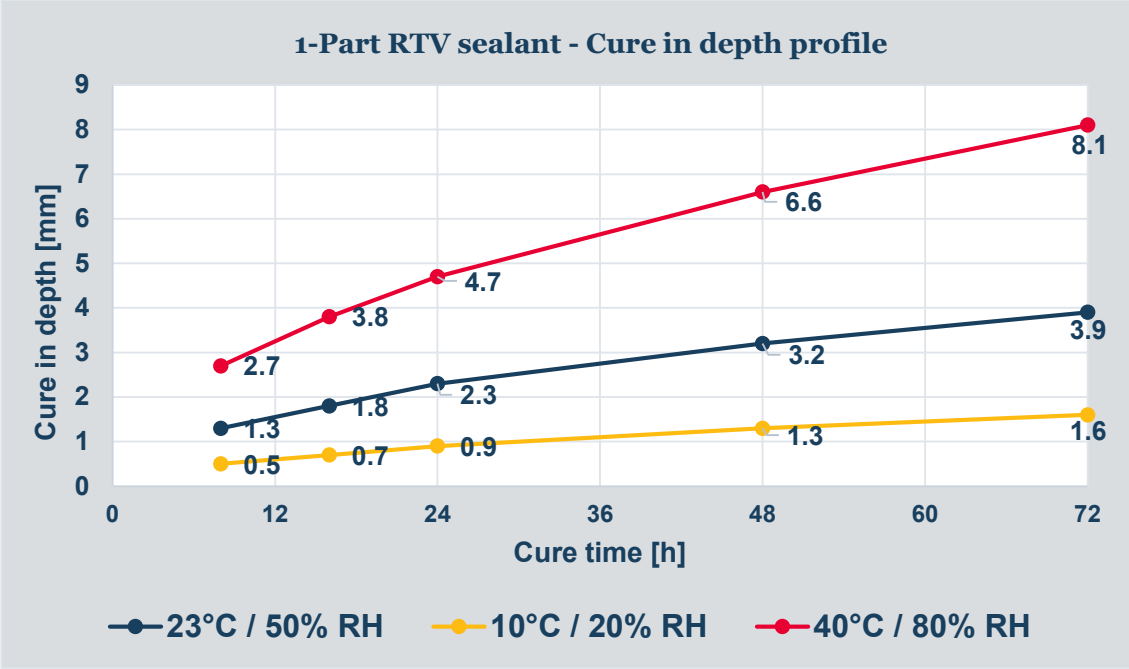
Cure profile

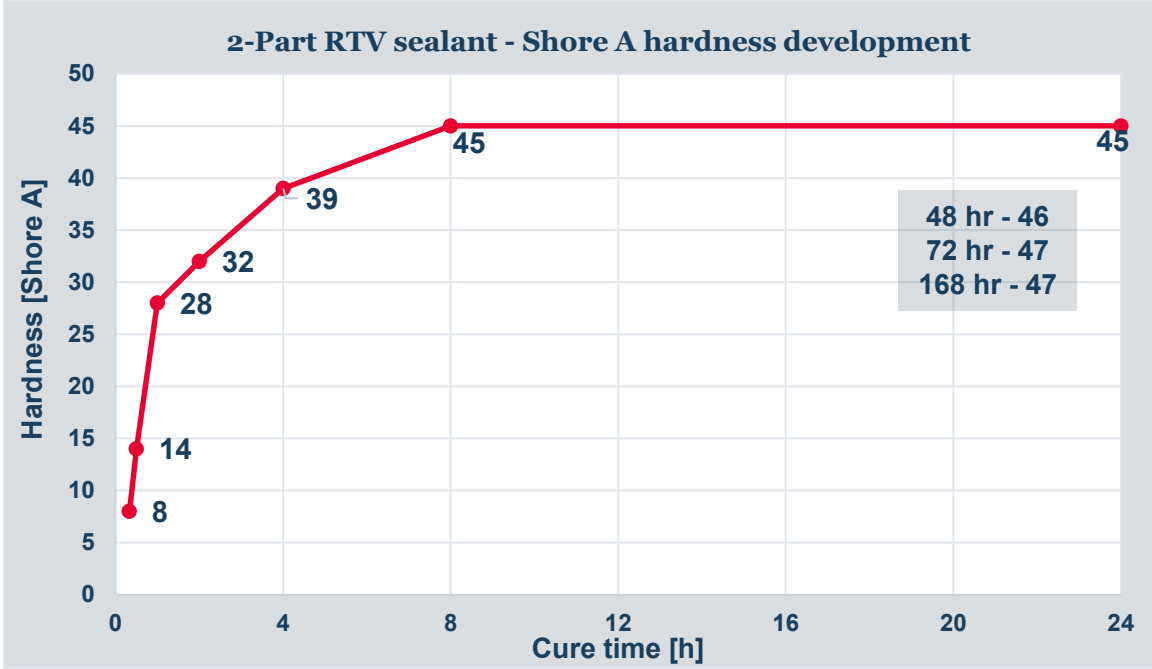
1-Part RTV



2-Part RTV

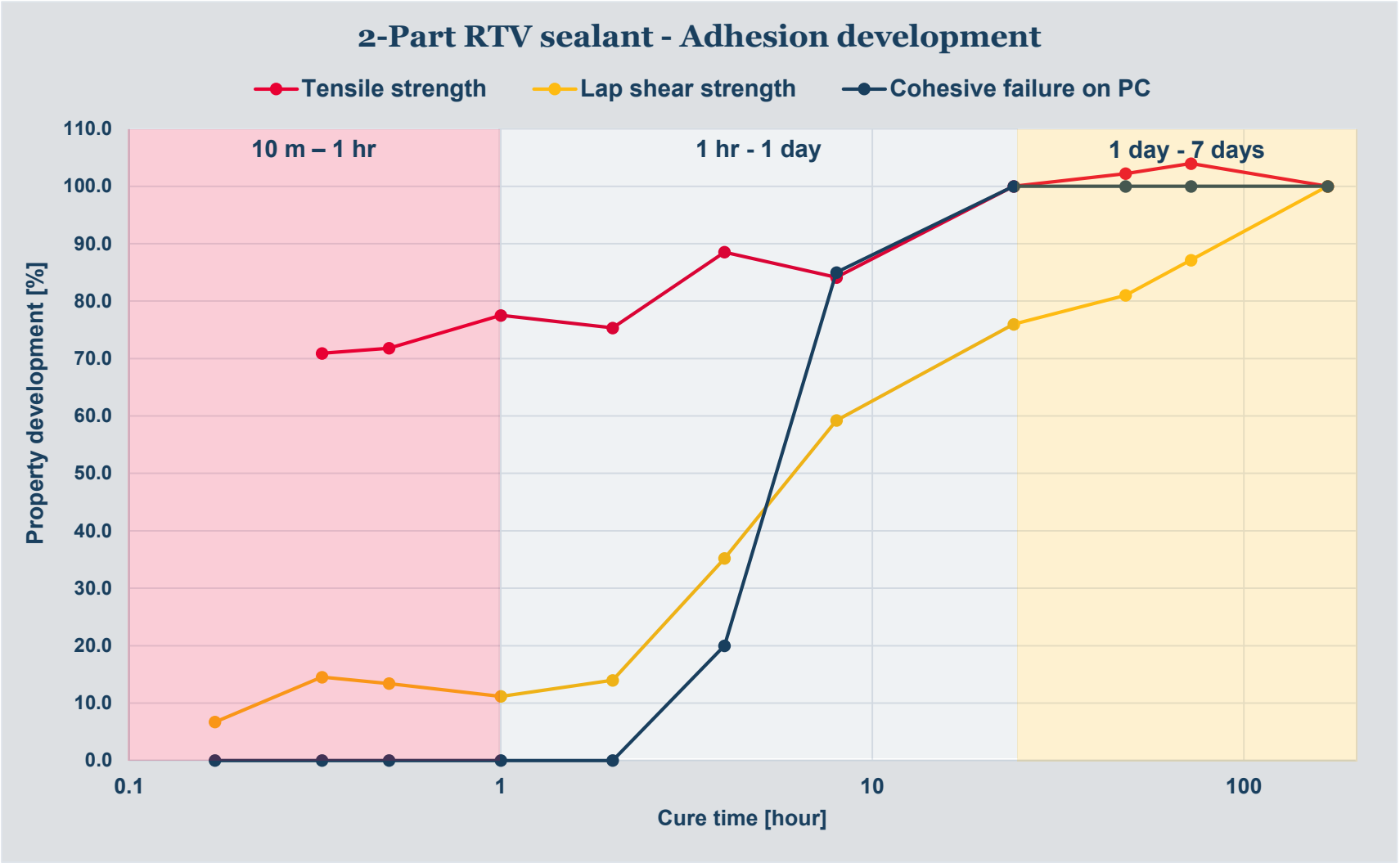






SEALING AND BONDING – ROOM-TEMPERATURE VULCANIZATION

Adhesion development



SEALING AND BONDING – ROOM-TEMPERATURE VULCANIZATION

Typical properties

Property	Unit	1-Part RTV	2-Part RTV	CTM	ASTM
Color		White, grey, black	Grey, black		
Appearance		Non-slump paste, viscous liquid	Non-slump paste	0176	
Extrusion rate / viscosity	g/min / mPas	185 – 350	18,000 – 350,000	0364	D2452
Skin-over time	min	5 – 25	6 – 9	0098	
Tack-free time	min	15 – 50	11 – 18	0095	MIL-S-8802E
Cure in depth 24 hr, 23°C, 50% RH	mm	2	Not applicable	0663	
Specific gravity		1.04 – 1.55	1.27 – 1.33	0022	D0792
Durometer hardness, Shore A		19 – 55	35 – 45	0099	D2240
Tensile strength	N/mm^2	1.2 – 3.6	> 1.8	0137A	D412
Elongation at break	%	340 – 680	> 200	0137A	D412
Lap shear strength (different surfaces)	N/mm^2	1.1 – 1.4	> 1.0	0243	D1002

CTM: Corporate test method
ASTM: American Society for Testing and Materials
Extrusion rate measured using 3.18 mm diameter nozzle at 0.62 MPa

SEALING AND BONDING – ROOM-TEMPERATURE VULCANIZATION

Special properties

Heat resistance at 200°C

DOWSIL™ EA-2626 Adhesive - Base SILASTIC™ Q3-3636 Adhesive - Catalyst			
Storage at 200°C	Lap shear [N/mm²]	Elongation [%]	Cohesive failure glass / steel [%]
0 days	1.8	356	100 / 100
7 days	1.5	304	100 / 100
21 days	2.1	231	100 / 100
42 days	1.5	191	100 / 100

Mix ratio: 100:14 by weight
Lap shear assembly: glass / stainless steel with 2 mm gap
Cure time before test: 7 days at 23°C

Fire resistance

SEALING AND BONDING – ROOM-TEMPERATURE VULCANIZATION

Special properties

Heat Resistance

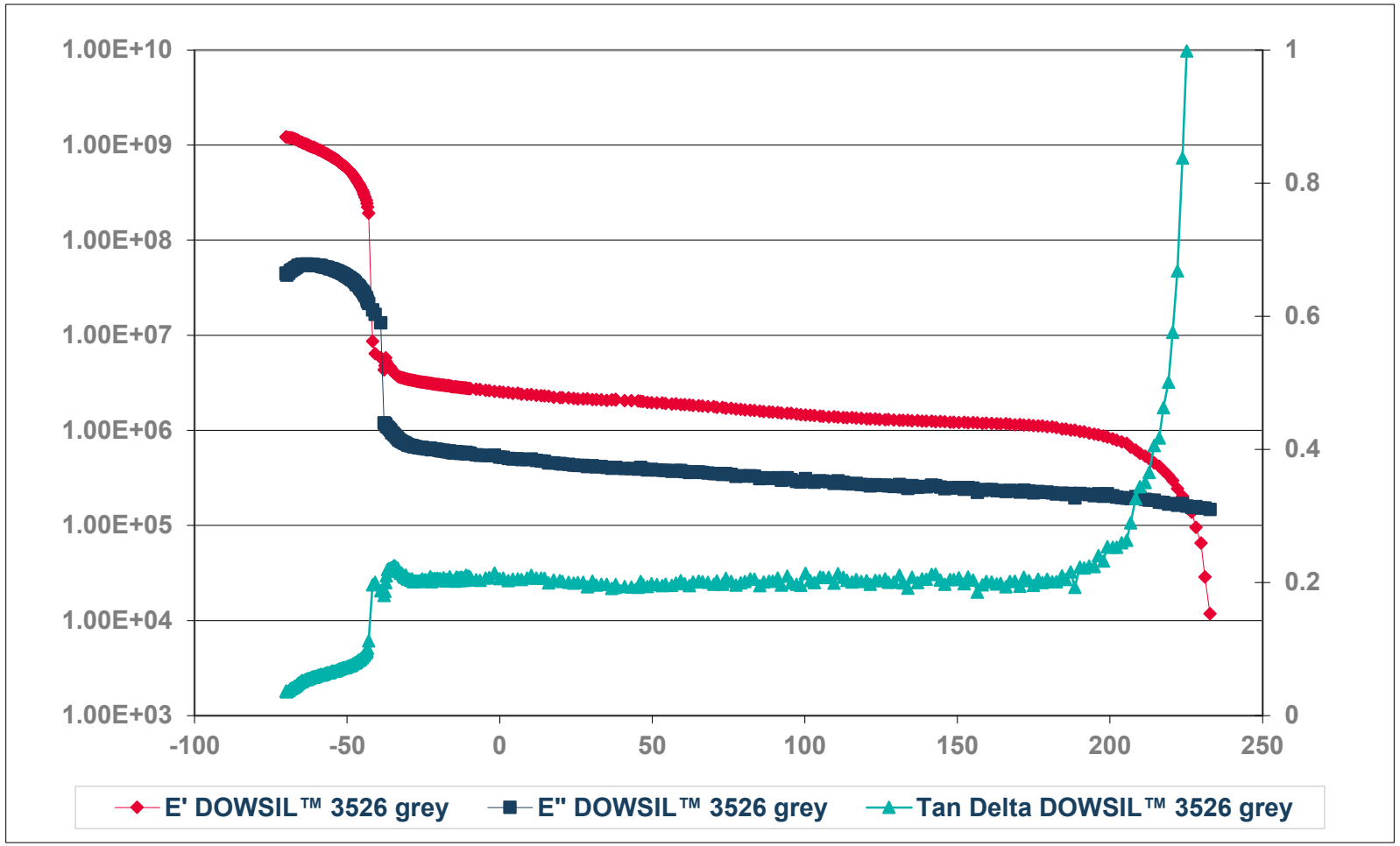
Product			Durometer [Shore A]				Tensile strength [N/mm²]					Elongation [%]				
	[°C] / Days	0	1	7	21	42	0	1	7	21	42	0	1	7	21	42
DOWSIL™ 7091 Adhesive	150	33	32	26	29	28	2.5	1.7	2.2	2.3	2.2	451	298	493	469	506
	180		27	26	32	57		2.0	1.8	1.4	1.7		388	458	387	151
	200		23	40				1.6	1.2				411	283		
	220		33					0.9					254			
	250		74					1.1					44			
DOWSIL™ 732 RTV Adhesive	150	24	25	25	25	26	2.4	2.2	2.5	2.2	2.1	501	502	487	487	440
	180		25	23	23	21		2.2	2.3	2.2	2.1		576	503	566	563
	200		24	21	19	25		2.1	2.1	1.7	1.3		559	611	578	258
	220		19	42	70			1.5	1.0	1.0			440	57	14	
	250		67					0.7					12			
DOWSIL™ Q3-1566 Adhesive	150	46	49	48	50	50	3.7	3.1	3.2	3.4	3.2	293	257	238	252	224
	180		48	48	47	46		4.4	3.9	3.7	3.7		416	347	307	294
	200		49	44	42	43		3.7	4.0	3.7	4.1		357	340	404	374
	220		44	39	38	40		3.9	3.6	3.2	4.1		334	344	325	513
	250		40	37	40	42		3.5	3.2	3.0	2.1		453	399	315	107

Fail criteria: Change from initial value is greater 50%

SEALING AND BONDING – ROOM-TEMPERATURE VULCANIZATION

Special properties

Dynamic mechanical thermal analysis (DMTA)



Recap

	Product features	DOWSIL™ EA-2626 Adhesive & SILASTIC™ Q3- 3636 Adhesive	Customer benefits
Product performance	Cure speed	Moderate	• Reduction of assembly / fixture time and improved sustainability • Improved quality of final product
	Adhesion development speed		
	Final mechanical performance		
Cost-in-use	Mixing ratio by volume	5.5:1	• Simplified process and better reliability • Less waste • Smaller runs allows rework • Improved safety and less capex
	Shelf life	5 months	
	Cartridge	No	
	Non-flammability	No	

Technical introduction

DOWSIL™ EA-3838 Fast Adhesive

Seek Together™

DOWSIL™ EA-3838 Fast Adhesive

General product information

Condensation-cure mechanism					
Reactant 1	Reactant 2	Catalyst	Curative	Product	By-product
Si-OH	Si-O-CH3	Sn	-	Si-O-Si	CH3OH

- A 2-part, alkoxy, RTV material that develops early primerless adhesion on various substrates, with a very fast cure speed
- This adhesive consists of a black base and a white catalyst
- It has a variable 2:1 to 4:1 volumetric mixing ratio, non-flammable components, and an up to 12-month shelf life for both components
- It will be commercially available in pail, drum and dual-cartridge kit packaging

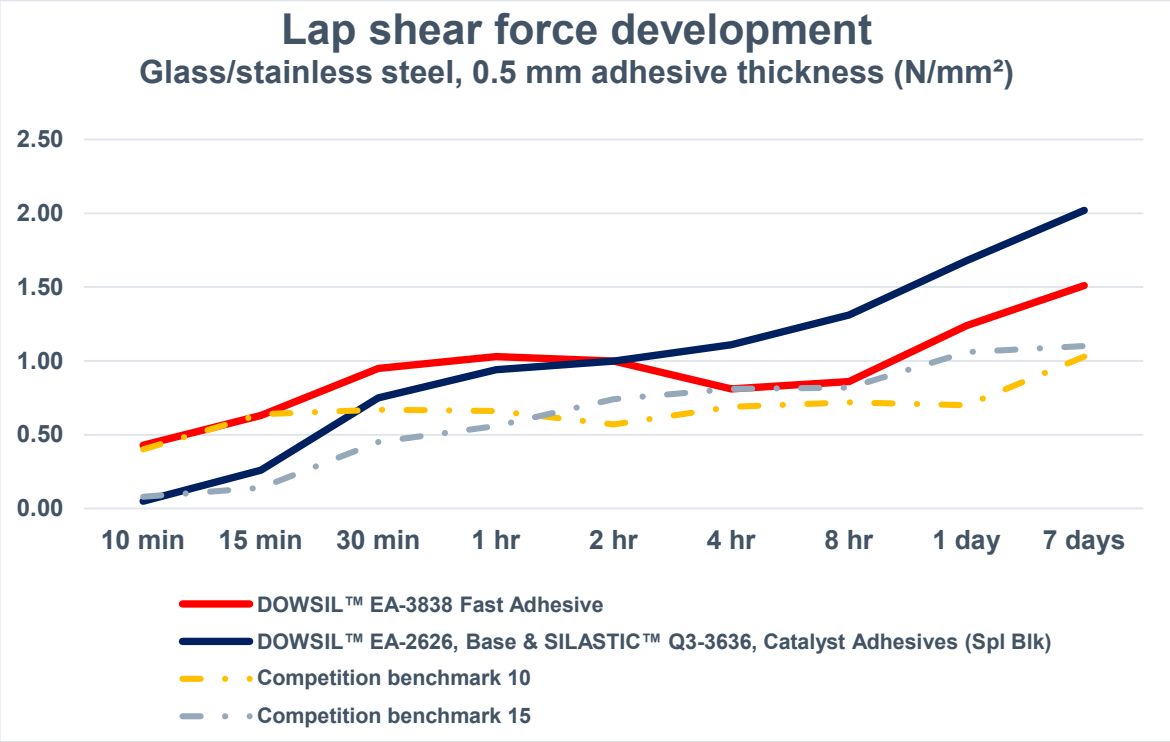
DOWSIL™ EA-3838 FAST ADHESIVE

Mechanical properties versus competition

		DOWSIL™ EA-3838 Adhesive	DOWSIL™ EA-2626 Base & SILASTIC™ Q3-3636 Catalyst (Spl Blk)	Competition benchmark - 10	Competition benchmark - 15
		2:1 by volume; Black paste	100:14 by weight; Black paste	2:1 by volume; Black paste	2:1 by volume; Black paste
Specific gravity	Base	1.34	1.36	1.35	1.35
	Catalyst	1.6	1.04	1.75	1.75
Initial properties	Flow jig: vertical flow (mm /60 sec)	1-2	1-2	1-2	1-2
	Snap time; spatula (min:sec)	2:50	5:45	2:35	5:20
	Tack-free PE foil (min:sec)	5:20	11:15	4:50	9:00
Mechanical properties after curing 7 days	Specific gravity (Weighing method on cured sheet)	1.4	1.36	1.4	1.39
	Durometer Shore A	40	46	44	37
	100% Modulus (N/mm^2)	1.01	1.32	1.41	0.91
	Tensile strength (N/mm^2)	2.1	2.48	1.98	1.69
	Elongation %	316	267	219	288

DOWSIL™ EA-3838 Fast Adhesive

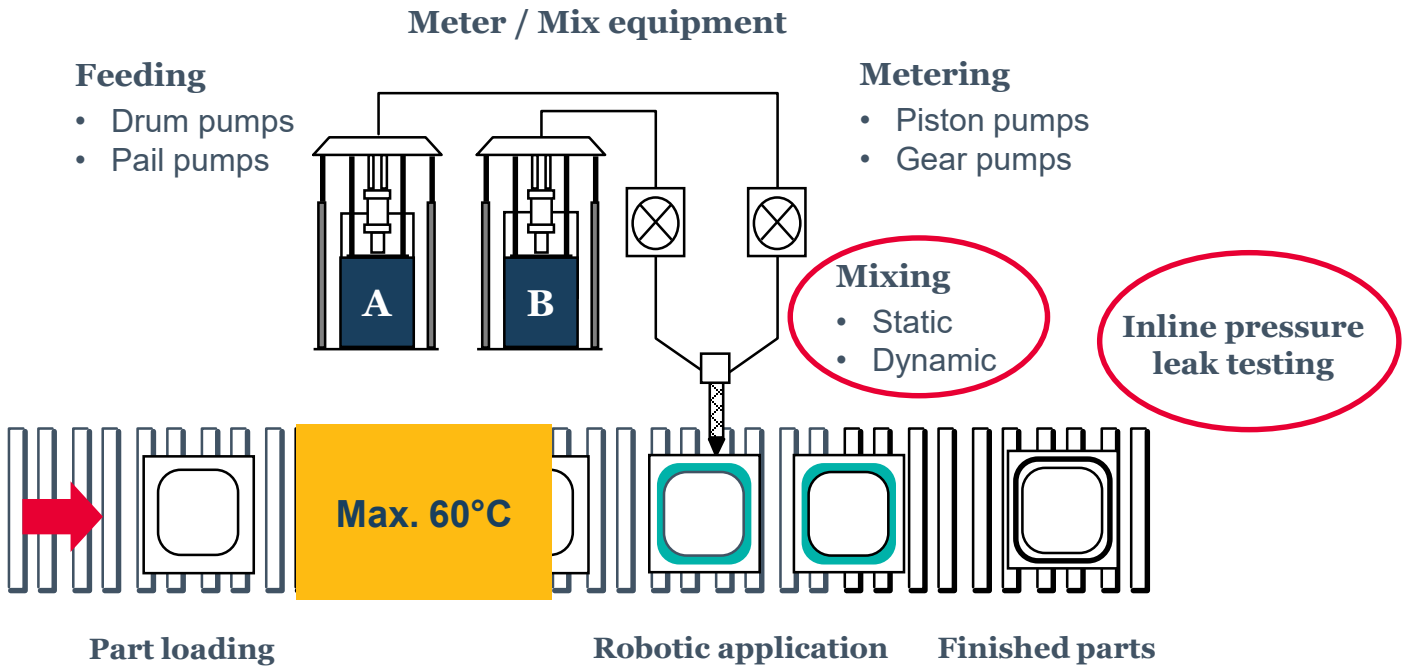
Cure speed and early adhesion development



	DOWSIL™ EA-3838 Fast Adhesive	DOWSIL™ EA-2626 & SILASTIC™ Q3-3636 Adhesives (Spl Blk)	Competition benchmark 10	Competition benchmark 15
10 min	0.43	0.05	0.40	0.08
15 min	0.63	0.26	0.64	0.14
30 min	0.95	0.75	0.67	0.45
1 hr	1.03	0.94	0.66	0.56
2 hr	1.00	1.00	0.57	0.74
4 hr	0.81	1.11	0.69	0.81
8 hr	0.86	1.31	0.72	0.82
1 day	1.24	1.68	0.70	1.06
7 days	1.51	2.02	1.03	1.10

SEALING AND BONDING – ROOM-TEMPERATURE VULCANIZATION

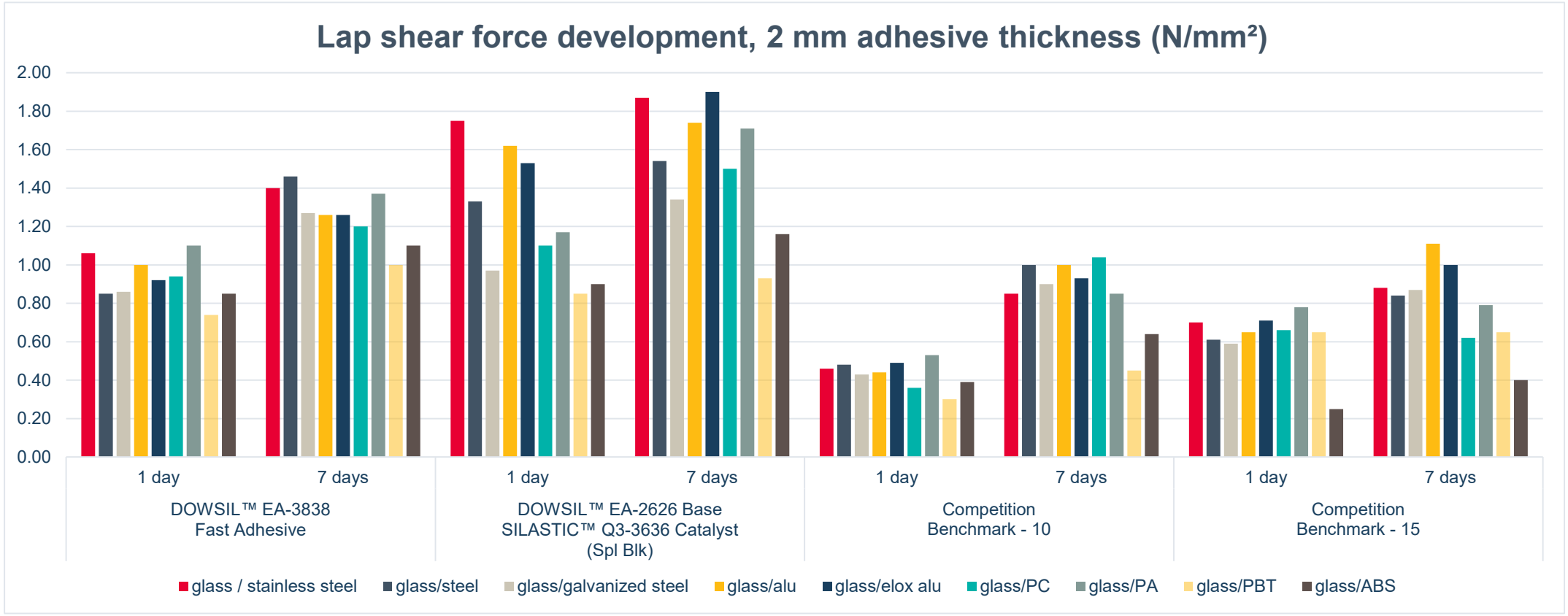
Dispensing / Application; 1- and 2-part RTV



- Eliminates the need for oven acceleration, but can be accelerated through heating tunnels - max 60°C
- Elimination of heat decreases energy consumption and improves sustainability
- Faster cure makes earlier inline pressure leak testing possible, reducing cycle time drastically
- Variable mixing ratio provides flexibility to meet a wide range of open times– cure speeds

DOWSIL™ EA-3838 FAST ADHESIVE

Adhesion development after full cure



Actual test data from Dow laboratories by parallel testing

Typical break pattern on clean surfaces without any surface pretreatment is cohesive failure, but adhesion depends on the specific properties of the surface.

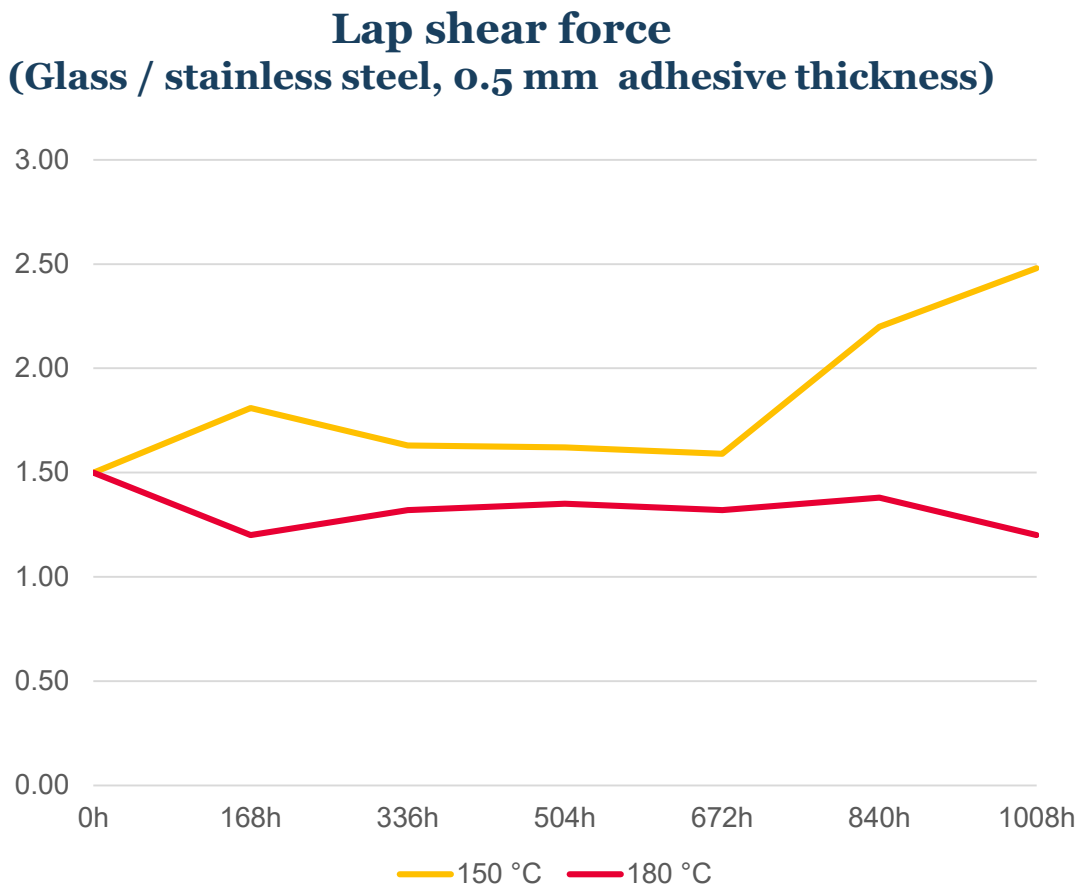
DOWSIL™ EA-3838 ADHESIVE - POTENTIAL MIXING RATIOS / VERSION

		DOWSIL™ EA-2626 Adhesive-Base SILASTIC™ Q3-3636 Adhesive-Catalyst (Sp. Black)	DOWSIL™ EA-3838 Fast Adhesive		
		100:14 weight Hand mixing	2:1 Vol Cartridges	3:1 Vol Hand mixing	4:1 Vol Hand mixing
Initial properties	Appearance – color	Black	Black	Black	Black
	Flow - jig, Vertical flow (mm/60 sec)	1-2	1-2	1-2	1-2
	Snap time - spatula (min:sec)	5:45	2:50	3:15	4:45
	Tack free time - PE foil (min:sec)	11:15	5:20	8:40	15:00
Glass / stainless steel, 2 mm adhesive thickness (N/mm²)					
Lap shear force development	10 min	0.10	0.56	0.17	0.03
	15 min	0.20	0.76	0.56	0.10
	30 min	0.50	0.87	0.90	0.94
	1 hr	0.70	0.72	1.07	1.20
	2 hr	0.80	0.76	0.98	0.92
	4 hr	1.10	0.92	0.98	1.13
	8 hr	0.90	1.10	1.24	1.32
	1 day	1.20	1.06	1.19	1.49
	7 days	1.87	1.40	1.48	1.50

Heat resistance

Heat resistance at 180°C DOWSIL™ EA-3838 Fast Adhesive			
Storage at 180°C	Lap shear [N/mm²]	Elongation [%]	Cohesive failure [%] glass / steel
0 days	1.50	310	100 / 100
7 days	1.20	324	100 / 100
21 days	1.35	354	100 / 100
42 days	1.20	315	100 / 100

- **DOWSIL™ EA-3838 Fast Adhesive** can withstand temperatures up to 180°C and even shorter peaks at above temperatures.
- When larger adhesive surfaces are subject to atmospheric contact (O_2), resistance at higher temperatures might be negatively affected.



SEALING AND BONDING – ROOM-TEMPERATURE VULCANIZATION

Package / Delivery / Storage

When stored at or below 30°C in the original unopened containers **DOWSIL™ EA-3838 Fast Adhesive Catalyst** has a usable life of 12 months from date of production.

Hazard pictograms

Signal word: WARNING

Storage conditions of DOWSIL™ EA-3838 Fast Adhesive Catalyst

GMID	Product name
99163080	DOWSIL™ EA-3838 Fast Adhesive Base Black, 250 KG-Drum
99163081	DOWSIL™ EA-3838 Fast Adhesive Base Black, 25 KG-Pail
99156914	DOWSIL™ EA-3838 Fast Adhesive Catalyst, 250 KG-Drum
99156918	DOWSIL™ EA-3838 Fast Adhesive Catalyst, 25 KG-Pail
Soon	DOWSIL™ EA-3838 Fast Adhesive Dual Cartridge Kit, 400 mL

Final recap

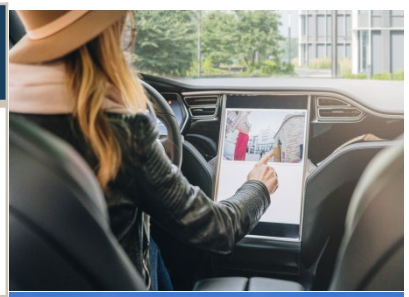
	Product features	DOWSIL™ EA-2626 Adhesive & SILASTIC™ Q3- 3636 Adhesive	DOWSIL™ EA-3838 Fast Adhesive	Customer benefits
Product performance	Cure speed	Moderate →	Fast	• Reduction of assembly/ fixture time and improved sustainability • Improved quality of final product
	Adhesion development speed	→		
	Final mechanical performance			
Cost-in-use	Mixing ratio by volume	5.5:1	2:1 to 4:1	• Simplified process and better reliability • Less waste • Smaller runs allows rework • Improved safety and less capex
	Shelf life	5 months →	12 months	
	Cartridge	No →	Yes	
	Non-flammability	No →	Yes	

Applications – Household appliances

Appliance	Application
Oven / stovetop	• Bonding glass doors • Sealing and bonding of cooktops
Microwave	• Bonding inner and outer window to frame
Refrigerator	• Interior door gasket bonding • Door / glass door bonding • Interior drawer and shelf bonding
Dishwasher	• Sealing of tub • Bonding the base (metal on plastics)
Washing machine	• Control panel bonding • Door gasket bonding • Door and pump assembly bonding
Tumble dryer	• Control panel bonding • Door gasket bonding • Door and pump assembly bonding • Top lid bonding
Vacuum cleaner	• Hose sealing • Plastic and brush bonding

Applications – Other markets

Markets	Possible applications
Automotive electronics	Display bonding, general maintenance sealant, bond and seal of housings
Industrial	Wind turbine sealant, general industrial sealing, gasketing and bonding applications
Aerospace	Cargo door seal, general maintenance sealant, edge sealant



Packaging

Product code	Product name	Pack size
99163080	**DOWSIL™ EA-3838 FAST ADHESIVE** BASE BLACK, KG, 250KG-DR	**250 kg Drum**
99156914	**DOWSIL™ EA-3838 FAST ADH** CTLYST, KG, 250KG-DR	**250 kg Drum**
99163081	**DOWSIL™ EA-3838 FAST** BASE BLACK, KG, 25K-PAIL	**25 kg Pail**
99156918	**DOWSIL™ EA-3838 FAST ADH** CTLYST, KG, 25K-PAIL	**25 kg Pail**
Coming soon	**DOWSIL™ EA-3838 Fast Adhesive Kit** Black, 400ml-12CTN	**400 ml Dual cartridges**

Conclusions

DOWSIL™ EA-3838 Fast Adhesive is a 2-part, alkoxy RTV silicone adhesive aimed at applications where a strong bond is needed along with a **fast cure speed** and **early primerless adhesion development.**

Features and benefits

- Fast curing time
- Early primerless adhesion development
- Improved adhesion to several substrates
- Improved shelf life to 12 months
- Easy & flexible mixing ratio (2:1, 3:1, 4:1)
- Also available in cartridges

Main market: Appliance

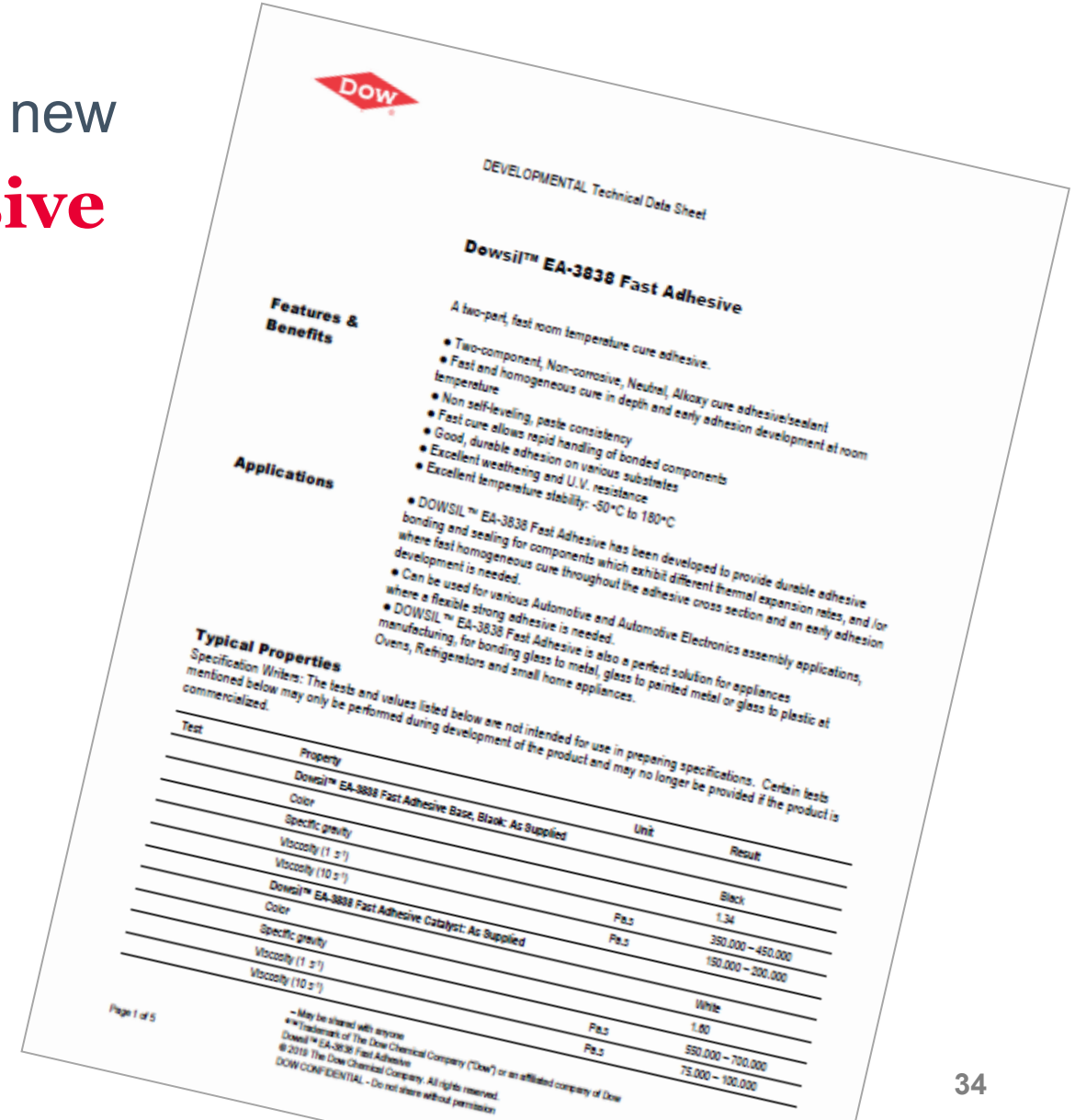
Secondary markets: Aviation, automotive, lighting and industrial

Technical data sheet and product information available

Please visit **dow.com** to learn more about new

DOWSIL™ EA-3838 Fast Adhesive

See this
fast-cure adhesive
in action.



DEVELOPMENTAL Technical Data Sheet

Dowsil™ EA-3838 Fast Adhesive

Features & Benefits

A two-part, fast room temperature cure adhesive.

- Two-component, Non-corrosive, Neutral, Alkoxy cure adhesive/sealant
- Fast and homogeneous cure in depth and early adhesion development at room temperature
- Non self-leveling, paste consistency
- Fast cure allows rapid handling of bonded components
- Good, durable adhesion on various substrates
- Excellent weathering and U.V. resistance
- Excellent temperature stability: -50°C to 180°C

Applications

- DOWSIL™ EA-3838 Fast Adhesive has been developed to provide durable adhesive bonding and sealing for components which exhibit different thermal expansion rates, and /or where fast homogeneous cure throughout the adhesive cross section and an early adhesion development is needed.
- Can be used for various Automotive and Automotive Electronics assembly applications, where a flexible strong adhesive is needed.
- DOWSIL™ EA-3838 Fast Adhesive is also a perfect solution for appliances manufacturing, for bonding glass to metal, glass to painted metal or glass to plastic at Ovens, Refrigerators and small home appliances.

Typical Properties

Specification Writers: The tests and values listed below are not intended for use in preparing specifications. Certain tests mentioned below may only be performed during development of the product and may no longer be provided if the product is commercialized.

Test	Property	Unit	Result
	Dowsil™ EA-3838 Fast Adhesive Base, Black: As Supplied		
	Color		Black
	Specific gravity	Pa.s	1.34
	Viscosity (1 s⁻¹)	Pa.s	350,000 – 450,000
	Viscosity (10 s⁻¹)		150,000 – 200,000
	Dowsil™ EA-3838 Fast Adhesive Catalyst: As Supplied		
	Color		White
	Specific gravity	Pa.s	1.60
	Viscosity (1 s⁻¹)	Pa.s	550,000 – 700,000
	Viscosity (10 s⁻¹)		75,000 – 100,000

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Seek

Together™

Thank You

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