Detailed Account of
Rat Attack Resistance Test
Performed from 10th to 24th May 2017
by the Independent and Accredited Test Institution
Danish Technological Institute
(DTI project number 757848)

Contents

Appendices

1 The Object of the Test

The object of the test was to establish, that the rodent proofing technology of the test door sweep is capable of repelling sustained rat attacks.

2 The Door Sweep

The test door sweep was characterized by the following:

- It was opaque black.
- It was 3 mm thick and 75 mm broad.
- It was made of Santoprene™ 201-73 and 1 mm thick solid steel wires.
- The door sweep had been produced by simultaneous extrusion of the Santoprene™ and the steel wires. The steel wires were, therefore, completely encapsulated by the Santoprene™ – except in the end pieces, where the cross section of the wires could be seen.
- There were 10 parallel steel wires embedded in the door sweep.
- The distance between the steel wires and their parallel neighboring wires was 5 mm (0.2 in).

3 The Test Equipment

3.1 The Test Doors

The door sweep was tested on an old used double swing door of steel with each door panel mounted on 2 hinges. The double door was mounted without any door saddle. At ground level under the double door there was mounted a 50 mm broad steel strip. The purpose of the steel strip was to make the test setup reflect the way double doors in real life are mounted in Denmark in order to comply with Danish fire regulations. There was nothing between A) the bottom of the 2 door panels when closed and B) the underlying steel strip. The threshold gap i.e. the distance between the bottom of the 2 door panels when closed and the underlying steel strip was 45 mm (1.8 in). The astragal gap i.e. the distance between the 2 doors panels when closed was 8 mm (0.3 in).

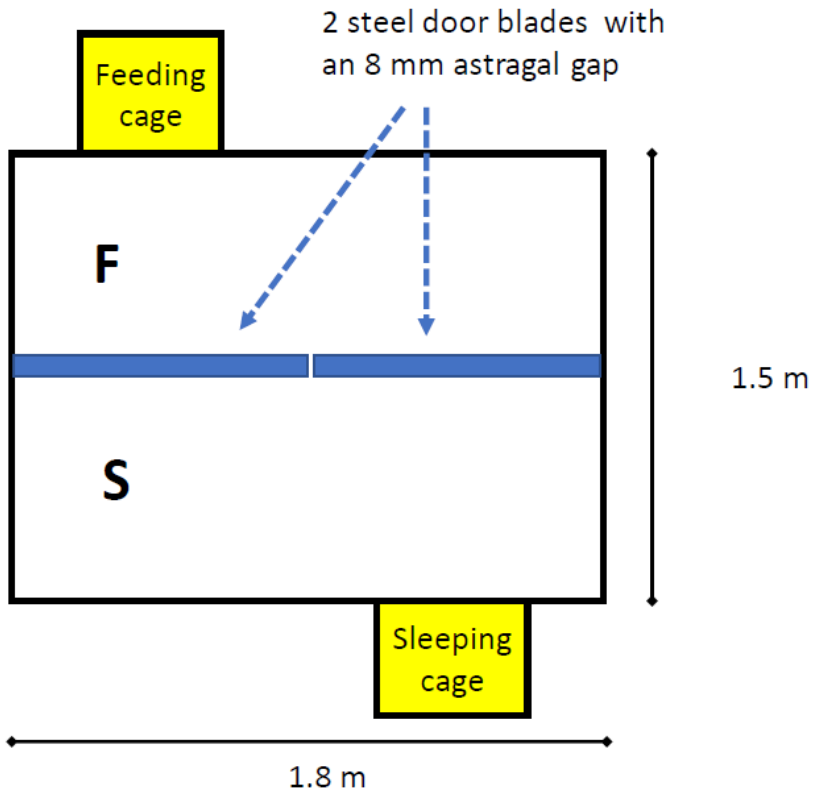
3.2 The Test Rats and the Test Box

The 2 rats used in the test were male rats of average size and in good health.

The bottom of the quadrangular test box, where the double door was mounted and the test was performed, was 1.8 m (71 in) by 1.5 m (59 in). The test box was 0.6 m (24 in) high. The height of the door panels had been reduced to the height of the test box.

The bottom and the walls of the test box were made of 18 mm (0.7 in) brown Huskyform F/F plate. On top of the test box there was a plywood plate with 2 transparent Plexiglas windows, which made it possible to observe the rats without taking the top plate of.

Attached to one end of the test box there was a small steel cage, where the 2 rats could sleep. Attached to the opposite end of the box there was another small steel cage, where their food was served during the first week of the 2-week test period. The following drawing depicts the construction of the test box with the double door and the cages seen from above (with the top plate removed):



The half of the test box marked with an S is hereafter called the Sleeping Half while the other half marked with an F is called the Feeding Half.

3.3 The Assembly of the door sweep and the Double Door

Three pieces of the test door sweep were mounted on the 2 door panels. The threshold gap under the 2 door panels was blocked by 2 pieces of door sweep mounted horizontally on the bottom of the door panels – meeting in the middle of the threshold gap. The astragal gap was blocked by the 3rd door sweep placed vertically on the active door panel.

4 The Test Standard

There is no official standard test for testing door sweeps against rat attacks. Danish Technological Institute therefore used the test standard for testing sewer system products with some adjustments.

5 The Test

The test was performed over a 14 days period from 11:30 am 9th May to 11:30 am 23rd May 2017.

In the beginning of the test period none of the door sweeps were mounted. The rats could, therefore, freely pass under the double door with the 45 mm (1.8 in) high threshold gap and enter the Feeding Half.

During the first 7 days, the rats were fed generously in the feeding box attached to the Feeding Half of the test box.

On day 8 the 3 pieces of door sweep were mounted. They blocked the rats' access to the Feeding Half.

The next 7 days, the 2 rats were on a restricted diet and were fed in the Sleeping Half. Even though the diet was restricted, it was sufficient to keep them in good health and alert. Their favorite food was placed in the Feeding Half and a fan was placed behind the food in order to blow the smell of the food through chinks in the double door to the

Sleeping Half. During all 14 days, the rats were given access to all the fresh water they could drink.

The purpose of restricting the diet and placing favorite food in the Feeding Half was to make the 2 rats interested in overcoming the introduced obstacle between the 2 halves of the test box – i.e. to make them interested in attacking the 3 pieces of door sweep.

The 2 rats did – as they were supposed to – try to gnaw their way through the door sweeps but did not manage to impair the steel wire barrier. They also tried to push the horizontally mounted door sweeps up so they could pass under them but didn't succeed in that either.

6 Conclusion

The rodent proofing technology passed the test for proofing threshold gaps of up to 45 mm (1.8 in) and astragal gaps of up to 8 mm (0.3 in) against sustained rat attacks as the door sweep successfully repelled the one week long rat attacks.

San Francisco, California 7th October 2019

Bjørn von Ryberg
president, Ph.D., co-inventor and attorney-at-law

Appendix 1

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Santoprene™ 201-73

Thermoplastic Vulcanizate

Product Description

A soft, colorable, versatile thermoplastic vulcanizate (TPV) in the thermoplastic elastomer (TPE) family. This material combines good physical properties and chemical resistance for use in a wide range of applications. This grade of Santoprene TPV is shear-dependent and can be processed on conventional thermoplastics equipment for injection molding, extrusion, blow molding, thermoforming or vacuum forming. It is polyolefin based and recyclable within the manufacturing stream.

Key Features

- UL listed: file #QMFZ2.E80017, Plastics - Component; file #QMFZ8.E80017, Plastics Certified For Canada - Component.
- Although not NSF certified, this product has a Material Supplier Form on file with NSF to facilitate its evaluation for use in applications requiring NSF certification.
- Recommended for applications requiring excellent flex fatigue resistance.
- Excellent ozone resistance.

General

Availability [1]	▪ Africa & Middle East ▪ Asia Pacific	▪ Europe ▪ Latin America	▪ North America
Applications	▪ Automotive - Plugs, Bumpers, Grommets, Clips ▪ Automotive - Seals and Gaskets	▪ Industrial - Seals and Gaskets ▪ Soft Touch Grips	▪ Tubing
Uses	▪ Appliance Components ▪ Automotive Applications ▪ Automotive Under the Hood	▪ Consumer Applications ▪ Diaphragms ▪ Electrical Parts	▪ Gaskets ▪ Seals ▪ Tubing
Agency Ratings	▪ UL QMFZ2	▪ UL QMFZ8	
RoHS Compliance	▪ RoHS Compliant		
Automotive Specifications	▪ CHRYSLER MS-AR-100 CGN	▪ FORD WSD-M2D380-A1	
UL File Number	▪ E80017		
Color	▪ Natural Color		
Form(s)	▪ Pellets		
Processing Method	▪ Blow Molding ▪ Coextrusion ▪ Extrusion ▪ Extrusion Blow Molding	▪ Injection Blow Molding ▪ Injection Molding ▪ Multi Injection Molding ▪ Profile Extrusion	▪ Sheet Extrusion ▪ Thermoforming ▪ Vacuum Forming
Revision Date	▪ 10/08/2014		

Physical	Typical Value (English)	Typical Value (SI)	Test Based On
Density / Specific Gravity	0.970	0.970	ASTM D792
Density	0.970 g/cm³	0.970 g/cm³	ISO 1183
Detergent Resistance	f3	f3	UL 749
Detergent Resistance	f4	f4	UL 2157

Hardness	Typical Value (English)	Typical Value (SI)	Test Based On
Shore Hardness			ISO 868
Shore A, 15 sec, 73°F (23°C)	78	78	

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Elastomers	Typical Value (English)		Typical Value (SI)		Test Based On
Tensile Stress at 100% - Across Flow (73°F (23°C))	522	psi	3.60	MPa	ASTM D412
Tensile Stress at 100% - Across Flow (73°F (23°C))	522	psi	3.60	MPa	ISO 37
Tensile Strength at Break - Across Flow (73°F (23°C))	1280	psi	8.80	MPa	ASTM D412
Tensile Stress at Break - Across Flow (73°F (23°C))	1280	psi	8.80	MPa	ISO 37
Elongation at Break - Across Flow (73°F (23°C))	490	%	490	%	ASTM D412
Tensile Strain at Break - Across Flow (73°F (23°C))	490	%	490	%	ISO 37
Tear Strength - Across Flow					ISO 34-1
73°F (23°C), Method Ba, Angle (Unnicked)	170	lbf/in	29	kN/m	
Compression Set					ASTM D395B
158°F (70°C), 22 hr, Type 1	28	%	28	%	
257°F (125°C), 70 hr, Type 1	37	%	37	%	
Compression Set					ISO 815
158°F (70°C), 22 hr, Type A	28	%	28	%	
257°F (125°C), 70 hr, Type A	37	%	37	%	

Thermal	Typical Value (English)		Typical Value (SI)		Test Based On
Brittleness Temperature	-76	°F	-60	°C	ASTM D746
Brittleness Temperature	-76	°F	-60	°C	ISO 812
RTI Elec	212	°F	100	°C	UL 746
RTI Str					UL 746
0.04 in (1.0 mm)	194	°F	90.0	°C	
0.06 in (1.5 mm)	194	°F	90.0	°C	
0.12 in (3.0 mm)	203	°F	95.0	°C	

Electrical	Typical Value (English)		Typical Value (SI)		Test Based On
Dielectric Strength					ASTM D149
73°F (23°C), 0.0787 in (2.00 mm)	770	V/mil	30	kV/mm	
Dielectric Constant					ASTM D150
73°F (23°C), 0.0772 in (1.96 mm)	2.40		2.40		
Dielectric Constant					IEC 60250
73°F (23°C), 0.0772 in (1.96 mm)	2.40		2.40		
Comparative Tracking Index (CTI)	PLC 0		PLC 0		UL 746
High Amp Arc Ignition (HAI)	PLC 0		PLC 0		UL 746
High Voltage Arc Resistance to Ignition (HVAR)	PLC 6		PLC 6		UL 746
High Voltage Arc Tracking Rate (HVTR)	PLC 1		PLC 1		UL 746
Hot-wire Ignition (HWI)					UL 746
0.04 in (1.0 mm)	PLC 4		PLC 4		
0.06 in (1.5 mm)	PLC 3		PLC 3		
0.12 in (3.0 mm)	PLC 3		PLC 3		

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Injection	Typical Value (English)		Typical Value (SI)	
Drying Temperature	180	°F	82	°C
Drying Time	3.0	hr	3.0	hr
Suggested Max Moisture	0.080	%	0.080	%
Suggested Max Regrind	20	%	20	%
Rear Temperature	350	°F	177	°C
Middle Temperature	360	°F	182	°C
Front Temperature	370	°F	188	°C
Nozzle Temperature	380 to 440	°F	193 to 227	°C
Processing (Melt) Temp	390 to 450	°F	199 to 232	°C
Mold Temperature	50 to 125	°F	10 to 52	°C
Injection Rate	Fast		Fast	
Back Pressure	50.0 to 100	psi	0.345 to 0.689	MPa
Screw Speed	100 to 200	rpm	100 to 200	rpm
Clamp Tonnage	3.0 to 5.0	tons/in^2	41 to 69	MPa
Cushion	0.125 to 0.250	in	3.18 to 6.35	mm
Screw L/D Ratio	16.0:1.0 to 20.0:1.0		16.0:1.0 to 20.0:1.0	
Screw Compression Ratio	2.0:1.0 to 2.5:1.0		2.0:1.0 to 2.5:1.0	
Vent Depth	1.0E-3	in	0.025	mm

Injection Notes

Santoprene™ TPV is incompatible with acetal and PVC. For more information regarding processing and mold design, please consult our Injection Molding Guide.

Extrusion	Typical Value (English)		Typical Value (SI)	
Drying Temperature	180	°F	82	°C
Drying Time	3.0	hr	3.0	hr
Melt Temperature	395	°F	202	°C
Die Temperature	400	°F	204	°C
Back Pressure	725 to 2900	psi	5.00 to 20.0	MPa

Extrusion Notes

Santoprene™ TPV is incompatible with acetal and PVC. For more information regarding processing and die design, please consult our Extrusion Molding Guide.

Aging	Typical Value (English)		Typical Value (SI)		Test Based On
Change in Tensile Strength in Air					ASTM D573
302°F (150°C), 168 hr	-1.0	%	-1.0	%	
Change in Tensile Strength in Air					ISO 188
302°F (150°C), 168 hr	-1.0	%	-1.0	%	
Change in Ultimate Elongation in Air					ASTM D573
302°F (150°C), 168 hr	-3.0	%	-3.0	%	
Change in Tensile Strain at Break in Air					ISO 188
302°F (150°C), 168 hr	-3.0	%	-3.0	%	
Change in Durometer Hardness in Air					ASTM D573
Shore A, 302°F (150°C), 168 hr	7.0		7.0		
Change in Shore Hardness in Air					ISO 188
Shore A, 302°F (150°C), 168 hr	7.0		7.0		
Continuous Upper Temperature Resistance					SAE J2236
1008 hr	275	°F	135	°C	

Flammability	Typical Value (English)	Typical Value (SI)	Test Based On
Flame Rating			UL 94
0.04 in (1.0 mm)	HB	HB	
0.06 in (1.5 mm)	HB	HB	
0.12 in (3.0 mm)	HB	HB	

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Additional Information

Where applicable, test results based on fan gated, injection molded plaques.

Tensile strength, elongation and tensile stress are measured across the flow direction - ISO type 1, ASTM die C.

Compression set at 25% deflection.

All products purchased directly from an ExxonMobil affiliate in Europe are REACH compliant. For products not imported into Europe by ExxonMobil, customers should assess their legal responsibilities under REACH.

Legal Statement

This product, including the product name, shall not be used or tested in any medical application without the prior written acknowledgement of ExxonMobil Chemical as to the intended use. For detailed Product Stewardship information, please contact Customer Service.

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Processing Statement

Desiccant drying for 3 hours at 80°C (180°F) is recommended. Santoprene™ TPV has a wide temperature processing window from 175 to 230°C (350 to 450°F) and is incompatible with acetal and PVC. For more information, please consult our Safety Data Sheet, Injection Molding Guide and Extrusion Guide.

Notes

Typical properties: these are not to be construed as specifications.

[1] Product may not be available in one or more countries in the identified Availability regions. Please contact your Sales Representative for complete Country Availability.

For additional technical, sales and order assistance: www.exxonmobilchemical.com/ContactUs

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OK Autrod 316LSi

Appendix 2

A continuous, solid, corrosion-resistant, chromium-nickel-molybdenum wire for welding austenitic stainless alloys of the 18% Cr -8% Ni and 18% Cr -10% Ni -3% Mo types.OK Autrod 316LSi has good general corrosion resistance; in particular, the alloy has very good resistance to corrosion in acid and chlorinated environments. The alloy has a low carbon content which makes it particularly recommended when there is a risk of intergranular corrosion. The higher silicon content improves the welding properties such as wetting. The alloy is widely used in the chemical and food processing industries, as well as in shipbuilding and various types of architectural structure.

Classifications Wire Electrode:	EN ISO 14343-A:G 19 12 3 L Si, SFA/AWS A5.9:ER316LSi, Werkstoffnummer :~1.4430
Approvals:	CE EN 13479, CWB ER316LSi, DB 43.039.05, DNV NV 316L (M13), VdTÜV 04268, NAKS/HAKC 1.0MM-1.2MM

Approvals are based on factory location. Please contact ESAB for more information.

Alloy Type:	Austenitic (with approx. 8 % ferrite) 19% Cr - 12% Ni - 3% Mo - Low C - High Si

Typical Tensile Properties

Condition	Yield Strength	Tensile Strength	Elongation
As welded	400 MPa	560 MPa	37 %
Tested at 350\00B0C.			
As welded	340 MPa	440 MPa	26 %

Typical Charpy V-Notch Properties

Condition	Testing Temperature	Impact Value
As welded	20 °C	120 J
As welded	-60 °C	95 J
As welded	-110 °C	70 J
As welded	-196 °C	45 J

Typical Wire Composition %

C	Mn	Si	Ni	Cr	Mo	Cu	Ferrite FN
0.01	1.8	0.9	12.2	18.4	2.60	0.12	7

Deposition Data

Diameter	Current	Voltage	Wire Feed Speed	Deposition Rate
0.6 mm	-	-	-	-
0.8 mm	55-160 A	12-24 V	4.0-17.0 m/min	1.0-4.1 kg/h
0.9 mm	65-220 A	15-28 V	3.5-18.0 m/min	1.1-5.4 kg/h
1.0 mm	80-240 A	15-28 V	4.0-16.0 m/min	1.5-6.0 kg/h
1.14 mm	-	-	-	-
1.2 mm	100-300 A	15-29 V	3.0-14.0 m/min	1.6-7.5 kg/h
1.6 mm	230-375 A	23-31 V	5.5-9.0 m/min	5.2-8.6 kg/h

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