

Hi-Sil™ HDP-320G

Rubber Reinforcing Silica

Typical Properties and Characteristics

Hi-Sil™	Surface Area, BET-5	pH	Na ₂ SO ₄ wt. %	Bulk Density	Specific Gravity	Manufacturing Location
HDP-320G	160 m ² /g	6.5	1.8 Max	18 lbs/ft ³	2.1	Lake Charles, LA USA

Registration Numbers

CAS No. 112926-00-8	Synthetic Precipitated Amorphous Silica
231-545-4	European EINECS
CAS No. 7631-86-9	TSCA Chemical Substance Inventory (SiO ₂)



Hi-Sil™ HDP-320G silica is a synthetic, white, amorphous silicon dioxide granule that is highly reinforcing and dispersible in most polymers and polymer blends. This silica product is finding uses in many types of rubber goods such as conveyor belt covers, flooring and molding, off road equipment (tire treads), passenger tire treads, and belting. The following pages provide some general rubber formulations to provide an idea of the reinforcing capability of Hi-Sil™ HDP-320G. While our mixing and testing are performed using Good Laboratory Practices and follow ATSM procedures, results may vary from lab to lab.

Rubber Processing Recommendations

For all Hi-Sil™ silica forms, it is recommended that the silica be added as early as possible in the mixing schedule. Ideally, the silica should be added at the same time as the polymer(s) and before the addition of process oil to allow time for silica incorporation into the polymer(s). For high loadings of silica, split additions are recommended...first addition with the polymer(s) and the second with the process oil. For loadings of high density - low dust silica granules, a single addition can be made with the polymer/s and just before process oil addition.

Split oil additions are recommended to maintain a high viscosity as increased shear aids in silica dispersion. Granules and pellets tend to need slightly more mixing time to disperse than milled powders.

Note: Silica incorporation time and dispersion in rubber will vary based on internal mixer type and rotor design.

Black Conveyor Belt Cover (NR/BR) *This compound was mixed in a 2-wing lab internal mixer*

Formula: SMR CV60 – 80, BR 1208 – 20, Vanox® ZMTI – 1.1, N-330 Carbon Black – 10, Hi-Sil™ – 40, Vanplast® R – 2, Sundex® 790 – 15, Santoflex® 6PPD – 2.5, ZnO – 3, RM Sulfur – 2.5, Santocure® MBS – 1.4, Perkacit® TMTD – 0.2

NR/BR Summary: Hi-Sil™ HDP-320G provides excellent crack growth, abrasion, and high tear resistance. Tensile strength and elongation provide adequate reinforcement for this type of formulation. Processing viscosity and scorch safety are good.

MS at 121C, T5, m.m.	66.7	<u>MDR 2000 @ 157C, 1° arc</u>	
ML(1+4) 100C MU	15.8	Ts2	1.2
Specific Graviy	1.118	T90	4.0
<u>Original</u>		<u>Oven Aged 70 hours @ 110C</u>	
Tensile Strength, MPa	23.3	Tensile Strength, MPa	10.7
Elongation, %	766	Elongation, %	238
200% Modulus, MPA	2.5	200% Modulus, MPA	9.2
300% Modulus	4.3	Hardness, Shore A	73
Hardness, Shore A	59		
Tear Resistance, Die C (N/mm)	85.3	D-Flex Crack Growth, 100K cycles, mm	5.0
Abrasion Resistance DIN - loss mm ³	137		

Black Conveyor Belt Cover (SBR) *This compound was mixed in a 2-wing lab internal mixer*

Formula: Copo® 1500 SBR - 100, Flectol® TMQ – 2, N-550 Carbon Black – 15, Hi-Sil™ – 50, Stearic Acid – 2, Cumar MH – 10, Calsol® 510 (NAPH Oil) – 10, Sunproof Reg. wax – 2, Santoflex® 6PPD – 2.5, ZnO – 4, RM Sulfur – 0.5, Santogard® PVI – 0.2, Santocure® TBBS – 3, Perkacit® TMTD – 1

SBR Summary: Hi-Sil™ HDP-320G provides excellent crack growth, abrasion, and high tear resistance. Original and heat aged tensile strength and elongation provide adequate reinforcement for this type of formulation. Processing viscosity and scorch safety are good.

MS @ 130°C, T5 (m.m)	60.6	<u>Original</u>	
ML(1+4) @ 100°C	30+	Tensile Strength, MPa	17.0
Specific Gravity	1.176	Elongation, %	904
		Durometer, Shore A	55
<u>MDR 2000 @ 157°C, 1° arc</u>		<u>Oven Aged 70 hours @ 110°C</u>	
TS2	5.2	Tensile Strength, MPa	18.8
TC90	9.4	Elongation, %	739
DeMattia Flex, 100,00 Cycles, mm	8.0	Durometer, Shore A	65
Tear Resistance, Die C, N/mm	43.9	Abrasion Resistance DIN - loss mm ³	147

General Colored EPDM *This compound was mixed in a 2-wing lab internal mixer*

Formula: Keltan® 2630A - 100, Yellow Iron Oxide – 6, PEG 3350 – 2, Silica – 50, AC-617 Polyethylene – 3, Calsol® 510 (NAPH Oil) – 20, Wingtack® 95 – 2, Stearic Acid – 2, ZnO – 5, Spider Sulfur – 0.5, Perkacit® TETD – 3, Perkacit® ZDMC – 3, Sulfasan DTDM – 1

General EPDM Summary: Hi-Sil™ HDP-320G provides good tensile and tear strength, and elongation (original and heat aged). Processing viscosity and scorch safety are good.

MS at 130C, T5, m.m.	9.7	<u>Oven Aged 70 hours @ 110C</u>	
ML(1+4) 100C MU	57.6	Tensile Strength, MPa	18.6
Specific Gravity	1.097	Elongation, %	645
		300% Modulus, MPA	5.6
<u>MDR 2000 @ 165C, 1° arc</u>		Hardness, Shore A	84
Ts2	1.3		
T90	5.8	<u>Oven Aged 168 hours @ 110C</u>	
		Tensile Strength, MPa	16.7
<u>Original</u>		Elongation, %	598
Tensile Strength, MPa	18.8	300% Modulus, MPA	6.8
Elongation, %	748	Hardness, Shore A	85
300% Modulus	2.7		
Hardness, Shore A	75	Tear Resistance, Die C (N/mm)	32.9

Highly Loaded Oil Extended EPDM (peroxide cure)

This compound was mixed in a 2-wing lab internal mixer

Formula: Keltan® 5531A - 200, Permanax® ODPa – 2, UM Blue powder – 3, Hi-Sil™ – 75, Vanox® ZMTI – 2, ZnO – 1, Saret® 500 – 2.8, Vul-Cup® 40KE - 5

High loaded EPDM Summary: Hi-Sil™ HDP-320G provides good crack growth resistance. Tensile and tear strength, and elongation (original and heat aged) provide adequate reinforcement for this type of formulation. Processing viscosity is manageable and scorch safety is good.

MS at 130°C, T5, m.m.	30+	<u>Tensile Properties - Original</u>	
ML(1+4), 100°C, MU	83.7	Tensile Strength, MPa	14.9
Specific Gravity, water	1.044	Elongation, %	831
		300% Modulus, MPa	2.8
<u>Rheometer (MDR 2000) at 160°C, 1° arc (Reversion)</u>		Durometer, Shore A	62
TS2	1.1		
TC90	11.9	<u>Tensile Properties Oven Aged 72 hrs. @ 110C</u>	
		Tensile Strength, MPa	14.5
<u>Tear Resistance, Die C, N/mm</u>	30.7	Elongation, %	703
		300% Modulus, MPa	3.7
DeMattia Flex, 100,000 cycles (mm)	7.5	Durometer, Shore A	63
DIN Abrasion Loss, mm3	159	<u>Tensile Properties Oven Aged 168 hrs. @ 110C</u>	
		Tensile Strength, MPa	14.2
		Elongation, %	700
		300% Modulus, MPa	3.8
		Durometer, Shore A	63

Off The Road Tread *This compound was mixed in a 2-wing lab internal mixer*

Formula: SMR CV60 - 100, Flectol® Pastilles – 1, N231 Carbon Black – 50 & 25, Silica – 25, PEG 3350 – 1, Stearic Acid – 2, Picco 6100 – 8, Santoflex® 6PPD – 2, ZnO – 3, RM Sulfur – 1, Santocure MBS – 1, Santocure® TBBS – 2, Perkacit® TB₂TD – 0.2

OTR Summary: The addition of Hi-Sil™ HDP-320G to this all black tread compound improves tear resistance, heat aged tensile properties, rebound, and abrasion resistance. Dynamic properties are not drastically altered.

	<u>HDP-320G</u>	<u>N-231</u>		<u>HDP-320G</u>	<u>N-231</u>
<u>Processing</u>			<u>Tensile Properties - Original</u>		
ML(1+4)	61.6	57.7	Tensile Strength, MPa	28.7	27.7
MS @ 130 °C, T5	30+	21.7	Elongation, %	578	529
Density	1.119	1.104	100% Modulus, MPa	2.5	2.9
			300% Modulus, MPa	10.5	13.6
<u>MDR 2000 @ 138 °C, 1 °arc</u>			Hardness, Shore A	69	71
TS2	21.2	11.9			
TC90	33.4	22.8	<u>Tensile Properties - Oven Aged 168 hours @ 90 °C</u>		
			Tensile Strength, MPa	21.1	20.9
<u>Tear Resistance, Die C (N/mm)</u>	134.5	119.5	Elongation, %	479	380
<u>Molded Groove Tear Resistance</u>			100% Modulus, MPa	3.3	4.2
Energy @ average load (J)	2.3	1.6	300% Modulus, MPa	13.4	18.0
			Hardness, Shore A	72	75
<u>Rebound (Zwick)</u>			Compression Set (Method B) (%)	60.4	60.5
Ambient Temp. (%)	53.1	48.2			
Hardness, Ambient Temp.	67	69	DIN Abrasion Resistance, Loss mm ³	149	155
Rebound, 100 °C (%)	68.1	64.8			
Hardness, 100 °C	61	62	D-Flex, 100,00 Cycles, mm	15.0	14.2
<u>Goodrich Flexometer, Stroke: 22.5%, Load: 1.0 MPa, Temp: 100C</u>					
Static Compression %	21.4	19.9			
Dyn Comp Final %	15.0	11.4			
Permanent Set %	5.9	6.2			
Heat Build Up, °C	21	23			

Packaging

Hi-Sil™ HDP-320G is packaged in low melt polyethylene bags as follows:

<u>Hi-Sil™</u>	<u>Net weight</u>	<u>Bag Construction</u>
HDP-320G	25 – 55 lbs (11.3 – 24.9)	polyethylene
HDP-320G	800 lbs. (362.9)	FIBC
HDP-320G	84,000 lbs. (38,101.8 Kg)	Rail, bulk hopper

Pallets can be hardboard or wood on 44X44 or 52X36 for PE bags. FIBC's are double stacked on 44X44 wood or cardboard pallets. We are flexible in packaging to meet customer demand.

Storage

To ensure product integrity PPG recommends that our silica products be stored under dry, clean conditions and protected against exposure to other substances.

Since silica may pick up moisture we also recommend that products that are stored more than one year, from date of manufacture, be re-tested for moisture content.

There is no shelf life limit when stretch-wrapped palletized units or bags are kept under the above stated conditions.

Safety and Health Effects



PPG Industries Inc. is committed to the safe handling of chemicals at every step of the process, from manufacturing and distribution through education of the end user. Our participation in the American Chemistry Council's *Responsible Care*® Program is evidence of our commitment to the health, safety and welfare of our employees and the industry. PPG Industries Inc. recommends thoroughly reading and understanding the product labels, Material Safety Data Sheets, and other safety information about the product prior to use or handling. Product health and safety information should be made available to your employees and customers.

Samples and Service

PPG's Technical Service specialists are available for consulting on the use, handling and storage of Hi-Sil™ HDP-320G.

Gallon containers and bag-size samples are available upon request from Technical Service.



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