Hi-Sil™ 134G

Rubber Reinforcing Silica

Hi-Sil™ 134G is a white, synthetic, amorphous silicon dioxide in micro-granular form. It is used as a highly reinforcing filler in black, colored, and industrial rubber and highly filled tire tread formulations.

Typical Properties and Characteristics of Hi-Sil™ 134G

N_2 Surface Area, BET-5	CTAB Surface Area	pH	Na_2SO_4, wt. %	Apparent Tamped Density	Physical Form
180 m^2/g	160 m^2/g	6.3	2.0 Max	330 g/L	micro-granule

Registration Numbers

231-545-4	European EINECS
CAS No. 7631-86-9	TSCA Chemical Substance Inventory (SiO_2)
CAS No. 112926-00-8	Synthetic Precipitated Amorphous Silica

Industrial Rubber Applications

Hi-Sil™ 134G was compared to a competitive silica product (Silica A) with similar physical properties in EPDM, NR, and NBR compounds.
Hi-Sil™ 134G micro-granules are consistently sized. These micro-granules are easy to convey and process well in mixers as compared to standard granules. In addition they generate little dust during handling and mixing.

Rubber Processing Recommendations

For all Hi-Sil™ product 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 powders, 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 micro-granules, a single addition can be made with the polymer/s and 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.

Hi-Sil™ 134G

Natural Rubber: General Purpose 70 Shore A Hardness

Formula (phr): CV-60 – 100, Red iron oxide – 5, Silica – 50, Plasticizer resin – 5, ODPA – 1, PEG – 1, ZnO – 5, Sulfur – 3, TBBS – 3 (2 pass mix - 5 and 4 minutes respectively, 4 wing rotor design)

Summary: Hi-Sil™ 134G was compared to Silica A for processing behavior and reinforcement capability.
Hi-Sil™ 134G exhibited better flow or less viscosity build than the competitive granule.
Dusting, or "blow back" during mixing was negligible for Hi-Sil™ 134G's micro-granulated form.
Reinforcement as defined by abrasion resistance, and tensile and tear strength were essentially equal.
Static and dynamic properties were better for the compound using Hi-Sil™ 134G as shown in Table 1.

Table 1: Natural Rubber – General Purpose 70 Shore A Hardness

Tests	Hi-Sil™ 134G	Silica A
ML 1+4 (100°C), Mooney Units	73.6	80.1
MS @ 121°C, T5, minutes	30+	30+
Specific Gravity (in water)	1.188	1.188
Dispersion, White Area	0.7%	0.9%
Cured 22 minutes @ 150°C		
Tensile Properties - Original		
Tensile, MPa	27.7	28.8
Elongation, %	674	761
100% Modulus, MPa	2.4	2.4
300% Modulus, MPa	6.7	7.6
Hardness, Shore A	70	70
Tear Resistance, Die B, N/mm	169	164
Cured 27 minutes @ 150°C		
DIN Abrasion Loss, mm^3	166	167
Compression Set, 72 hours @ 100°C,	70%	76%
Goodrich Flexometer, Heat Build-Up	31°C	42°C

NBR: General Purpose – 70 Shore A Hardness

Formula (phr): NBR (N-300) – 100, Silica – 55, DOP – 15, Stearic Acid – 2, PEG – 1.5, ZnO – 5, Magnesium Oxide – 1.5, ODPA – 2, Red iron oxide – 5, Sulfur – 0.5, TBBS – 1.5, TMTD – 1, Morpholinodisulfide – 2 (2 pass mix - 4 and 2 minutes respectively, 4 wing rotor design)

Summary: Hi-Sil™ 134G was compared to Silica A for processing behavior and reinforcement capability.
Hi-Sil™ 134G exhibited slightly less viscosity build than the competitive granule.
Dusting, or "blow back" during mixing was negligible for Hi-Sil™ 134G's micro granulated form.
Reinforcement as defined by tensile strength (original and aged), abrasion resistance, and tear strength are essentially equal for both silica products (Table 2).

Table 2: Nitrile: General Purpose – 70 Shore A Hardness

Tests	Hi-Sil™ 134G	Silica A
ML 1+4 (100°C), Mooney Units	71.1	72.2
MS @ 130°C, T5, minutes	30+	30+
Specific Gravity (in water)	1.246	1.246
Dispersion, White Area	0.80	1.17
Cured 18 minutes @ 160°C		
Tensile Properties - Original		
Tensile, MPa	21.3	21.7
Elongation, %	641	685
100% Modulus, MPa	1.6	1.8
300% Modulus, MPa	3.3	3.8
Hardness, Shore A	72	73
Tensile Properties – Oven Aged 72 hours @ 125°C		
Tensile, MPa	11.7	12.9
Elongation, %	111	114
100% Modulus, MPa	10.3	9.8
Hardness, Shore A	94	94
Tear Resistance, Die C, N/mm	38.2	37.9
Cured 23 minutes @ 160°C		
DIN Abrasion Loss, mm^3	213	205
Compression Set, 72 hours @ 100°C,	79	78

EPDM: General Purpose – 70 Shore A Hardness

Formula (phr): EPDM (LCB) – 100, Silica – 50, NAPH Oil – 20, Tackifier – 2, PEG 3350 – 2, ZnO – 5, RM Sulfur – 0.5, TETD – 3, Methasan powder – 3, DTDM – 1
(2 pass mix - 5 minutes and 3 minutes respectively, 4 wing rotor design)

Summary: Hi-Sil™ 134G was compared to Silica A (competitive silica with similar surface area) for processing behavior and reinforcement capability. Similar to NR, NBR, and SBR/BR, Hi-Sil® 134G exhibited better flow or less viscosity build than the competitive granule.
Again dusting or "blow back" during mixing was negligible for Hi-Sil™ 134G's micro granulated form. Reinforcement as defined by abrasion resistance, and tensile and tear strength and was similar. Silica dispersion was very good in both compounds.

Table 4: EPDM: General Purpose – 70 Shore A Hardness

Tests	Hi-Sil™ 134G	Silica A
ML 1+4 (100°C), Mooney Units	106	113
MS @ 121°C, T5, minutes	17.5	17.3
Specific Gravity (in water)	1.064	1.064
Dispersion, White Area	0.03%	0.03%
Cured 16 minutes @ 165°C		
Tensile Properties – Original		
Tensile, MPa	22.2	22.8
Elongation, %	727	706
100% Modulus, MPa	1.9	2.0
300% Modulus, MPa	3.4	3.8
Hardness, Shore A	67	68
Tensile Properties – Oven Aged 72 hours @ 125°C		
Tensile, MPa	21.0	20.2
Elongation, %	503	527
100% Modulus, MPa	3.7	3.7
300% Modulus, MPa	10.6	9.8
Hardness, Shore A	80	79
Tear Resistance, Die C, N/mm	34.7	34.9
Cured 21 minutes @ 165°C		
DIN Abrasion Loss, mm^3	151	153
Compression Set, 72 hours @ 100°C,	86.1	81.6

Packaging

Hi-Sil™ 134G is packaged as follows:

Hi-Sil™ Product	Net weight	Bag Construction
Hi-Sil® 134G	25 Kg (55 pounds)	multi-wall paper bags
	360 Kg (800 pounds)	Flexible Intermediate Bulk Container (FIBC)

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

Responsible Care® Good Chemistry at Work

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™ 134G.
Gallon containers and bag-size samples are available upon request from Technical Service.

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CERTIFIED QUALITY MANAGEMENT SYSTEM ISO 9001:2000 DNV

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