



Insight CNT Masterbatches

Insight Polymers has developed a line of CNT (carbon nanotube) concentrates that contain 15% CNT's by weight and can be let down in the associated carrier materials. These concentrates exhibit property improvement of 20-50% in stiffness and strength with loadings of 2-7% by weight in the final compound. While CNT's have had the promise of improved properties since commercially available, these compounds exhibit the first significant measurable increase in mechanical properties of a thermoplastic compound.

These concentrates are currently available in PP, PETG, PA 6, PA 66, PA 12 and PPS. Insight Polymers also will be adding additional polymers to the concentrate portfolio. Custom compounds with specific polymers and loadings can be developed with the Insight team. If you have specific requirements, reach out to the Insight team to develop a custom compound, designed to meet your specific needs.

KEY APPLICATIONS	PROCESS COMPATIBILITY & CONSIDERATIONS	BENEFITS
<ul style="list-style-type: none"> ▪ Electrostatic Discharge (ESD) protective packaging ▪ Electronics storage bins and totes ▪ Conductive components in electronics assemblies ▪ Electrostatic processing such as painting and coating ▪ High cleanliness - low particulate generation 	<ul style="list-style-type: none"> ▪ Injection molding, blow molding, profile and film extrusion ▪ Compression molding ▪ Finished part testing is required to understand final conductivity as process do affect finished part conductivity ▪ High shear screw, longer L/D and or more aggressive mixing typically produces better results in both conductivity and physical properties 	<ul style="list-style-type: none"> ▪ Excellent electrical conductivity at low loadings ▪ Improvement of key physical properties like Tensile Modulus and Strength ▪ Little to no effect on Notched Izod Impact Strength, depending on the polymer ▪ Easy processing ▪ High cleanliness ▪ Consistent electrical physical properties ▪ Light weight

BASE POLYMER	PP	PETG	PA 6	PA 66	PA 12	PPS
CNT LOADING BY % WEIGHT	15%	15%	15%	15%	15%	15%
MELTING POINT (°C)	170	167	222	258	185	272

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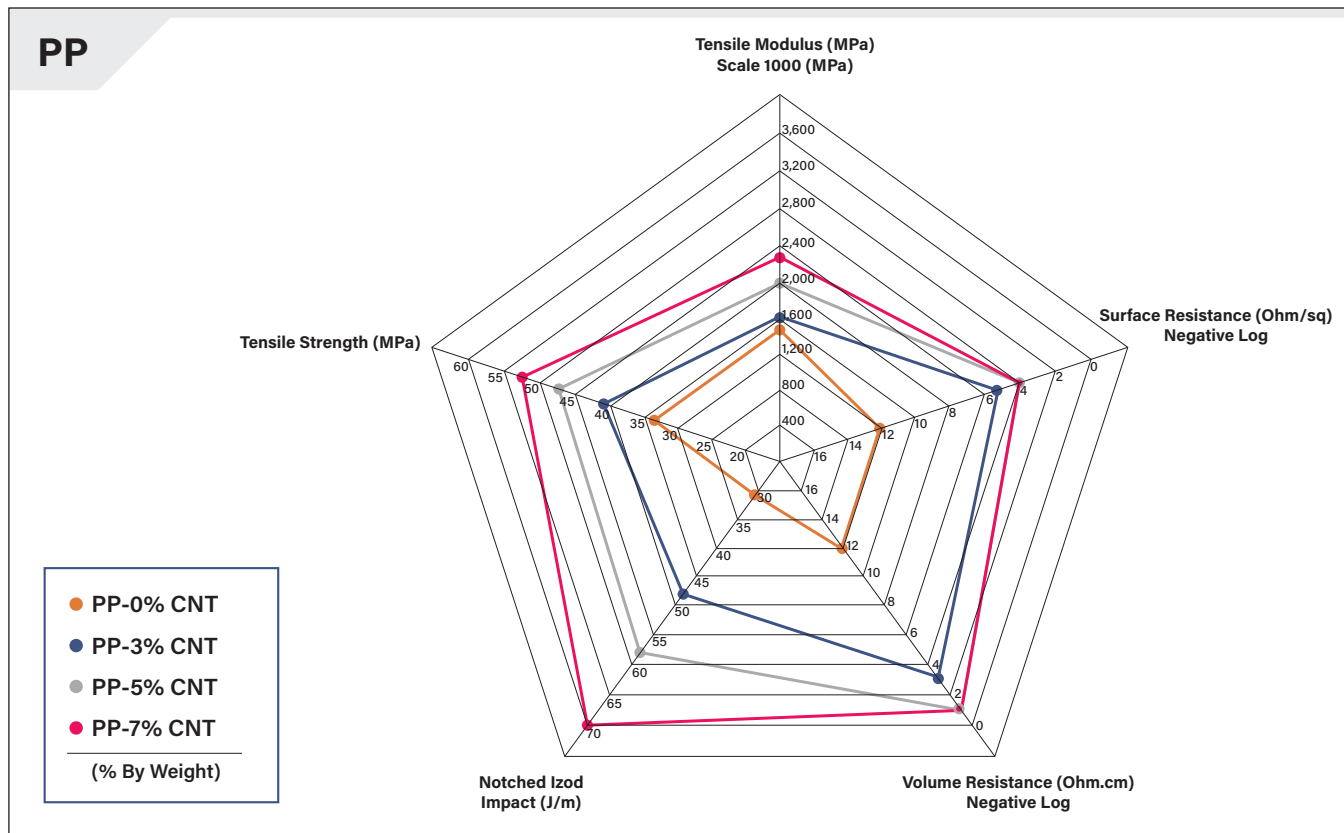


Polypropylene (PP) Carbon Nanotube (CNT) Masterbatch

The data below summarizes the mechanical and electrical properties of Insight Polymers Polypropylene 15% Carbon Nanotube (CNT) Masterbatch that has been let down to 3%, 5%, and 7% total CNT loading by weight. The addition of CNT's results in improvements to Tensile Modulus, Tensile Strength, and Electrical Resistance with minimal effect to Impact Strength.

The data summarized in the table and multi-axis spider chart below are based on injection molded ASTM test specimens.

POLYMER (% BY WEIGHT)	PP - 0% CNT	PP - 3% CNT	PP - 5% CNT	PP - 7% CNT
TENSILE MODULUS (MPa)	1500	1600	2000	2300
TENSILE STRENGTH (MPa)	34	41	47	51
BREAK %	30	8	6	5
NOTCHED IZOD IMPACT (J/m)	31	48	59	70
UN-NOTCHED IZOD IMPACT (J/m)	1200	540	500	470
SURFACE RESISTIVITY (Ohm/sq)	1E+09	<1E+05	<1E+04	<1E+04
VOLUME RESISTIVITY (Ohm.cm)	1E+12	<1E+03	<1E+01	<1E+01



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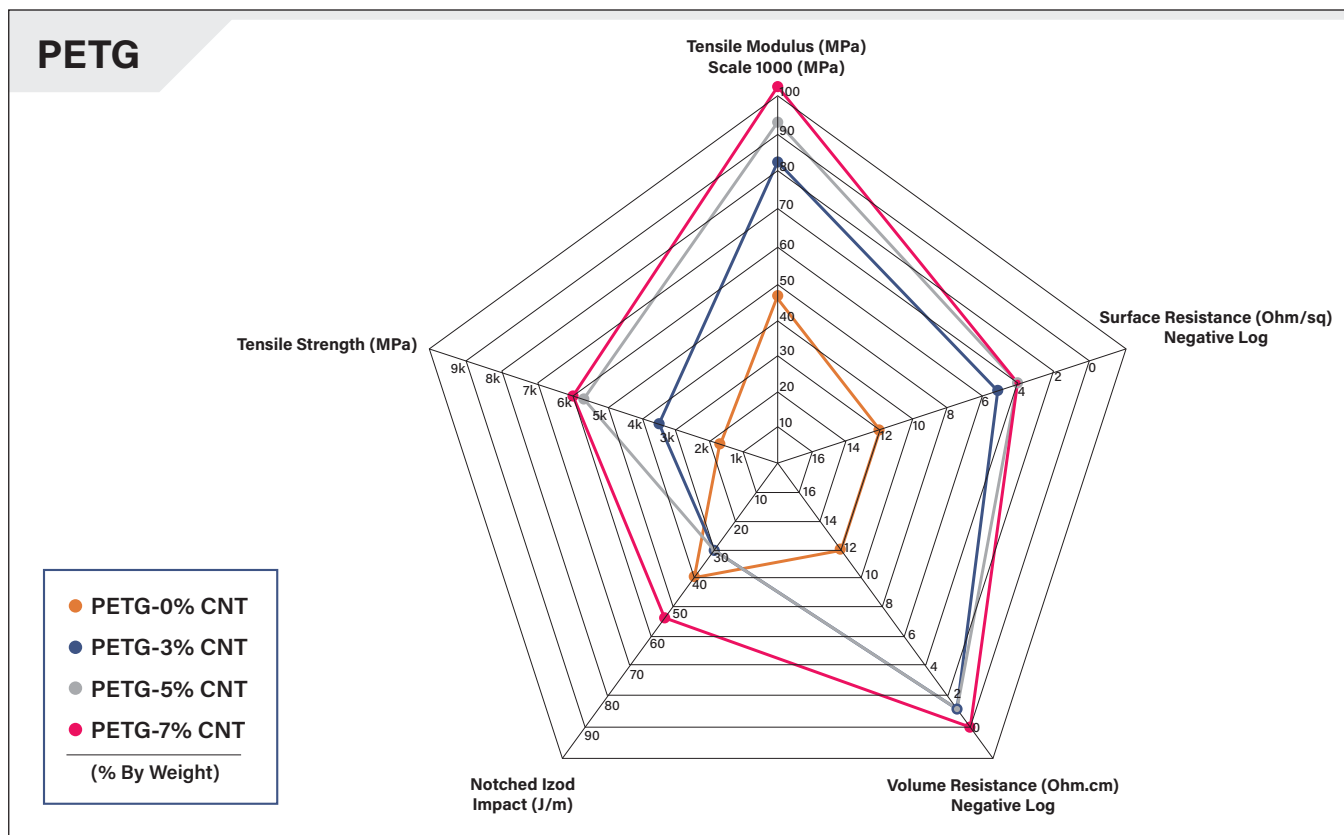


Polyethylene Terephthalate Glycol (PETG) Carbon Nanotube (CNT) Masterbatch

The data below summarizes the mechanical and electrical properties of Insight Polymers 15% Carbon Nanotube (CNT) Polyethylene Terephthalate Glycol (PETG) Masterbatch that has been let down to 3%, 5%, and 7% total CNT loading by weight. The addition of CNT's results in improvements to Tensile Modulus, Tensile Strength, and Electrical Resistance with minimal effect to Impact Strength.

The data summarized in the table and multi-axis spider chart below are based on injection molded ASTM test specimens.

POLYMER (% BY WEIGHT)	PETG - 0% CNT	PETG - 3% CNT	PETG - 5% CNT	PETG - 7% CNT
TENSILE MODULUS (MPa)	1700	3700	5800	5900
TENSILE STRENGTH (MPa)	48	82	93	110
BREAK %	39	4	2	2
NOTCHED IZOD IMPACT (J/m)	40	31	31	54
UN-NOTCHED IZOD IMPACT (J/m)	1600	1000	740	430
SURFACE RESISITIVITY (Ohm/sq)	1E+12	<1E+05	<1E+04	<1E+04
VOLUME RESISTIVITY (Ohm.cm)	1E+12	<1E+01	<1E+01	<1E+00



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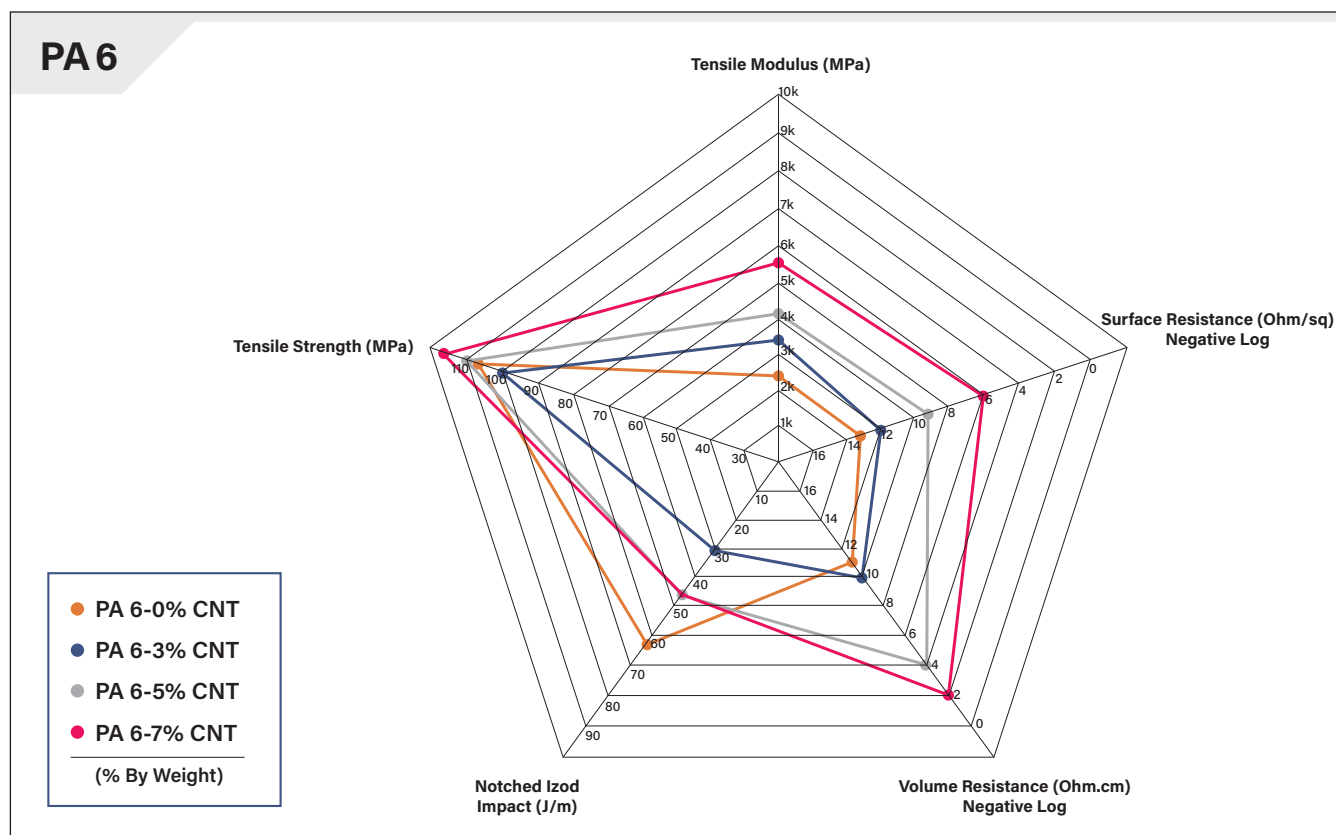


Polyamide 6 (Nylon 6) Carbon Nanotube (CNT) Masterbatch

The data below summarizes the mechanical and electrical properties of Insight Polymers Nylon 6 15% Carbon Nanotube (CNT) Masterbatch that has been let down to 3%, 5%, and 7% total CNT loading by weight. The addition of CNT results in improvements to Tensile Modulus, Tensile Strength, and Electrical Resistance with some effect to impact strength.

The data summarized in the table and multi-axis spider chart below are based on injection molded ASTM test specimens.

POLYMER (% BY WEIGHT)	PA 6 - 0% CNT	PA 6 - 3% CNT	PA 6 - 5% CNT	PA 6 - 7% CNT
TENSILE MODULUS (MPa)	2500	3500	4100	5700
TENSILE STRENGTH (MPa)	76	100	110	120
BREAK %	35	6	4	2
NOTCHED IZOD IMPACT (J/m)	62	30	48	47
UN-NOTCHED IZOD IMPACT (J/m)	1600	1300	880	890
SURFACE RESISITIVITY (Ohm/sq)	1E+13	<1E+12	<1E+09	<1E+06
VOLUME RESISTIVITY (Ohm.cm)	1E+11	<1E+10	<1E+04	<1E+02



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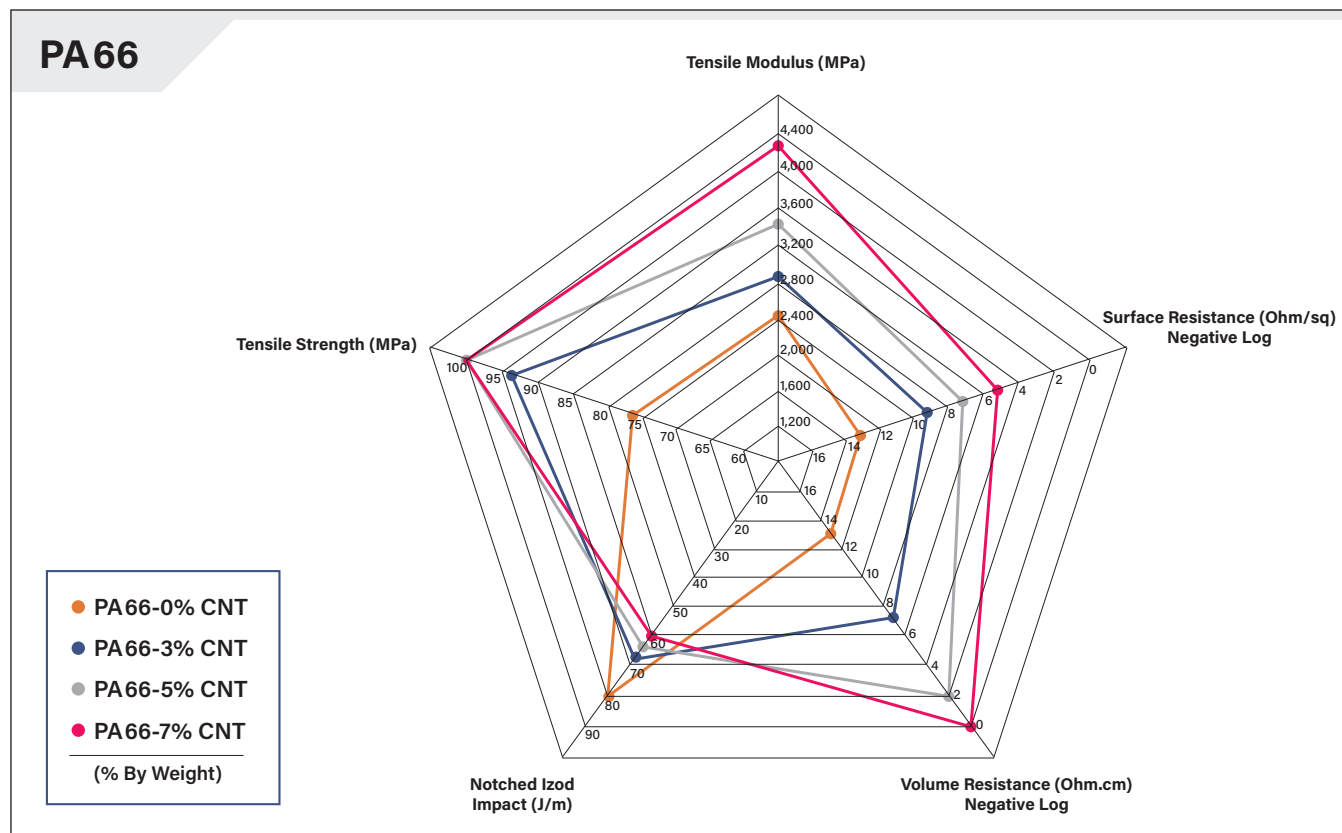


Polyamide 66 (Nylon 66) Carbon Nanotube (CNT) Masterbatch

The data below summarizes the mechanical and electrical properties of Insight Polymers Nylon 66 15% Carbon Nanotube (CNT) Masterbatch that has been let down to 3%, 5%, and 7% total CNT loading by weight. The addition of CNT's results in improvements to Tensile Modulus, Tensile Strength, and Electrical Resistance with minimal effect to Impact Strength.

The data summarized in the table and multi-axis spider chart below are based on injection molded ASTM test specimens.

POLYMER (% BY WEIGHT)	PA 66 - 0% CNT	PA 66 - 3% CNT	PA 66 - 5% CNT	PA 66 - 7% CNT
TENSILE MODULUS (MPa)	2500	2900	3500	4300
TENSILE STRENGTH (MPa)	76	90	100	100
BREAK %	9	9	5	4
NOTCHED IZOD IMPACT (J/m)	80	69	65	60
UN-NOTCHED IZOD IMPACT (J/m)	390	900	760	660
SURFACE RESISITIVITY (Ohm/sq)	1E+13	<1E+09	<1E+07	<1E+05
VOLUME RESISTIVITY (Ohm.cm)	1E+13	<1E+07	<1E+02	<1E+00



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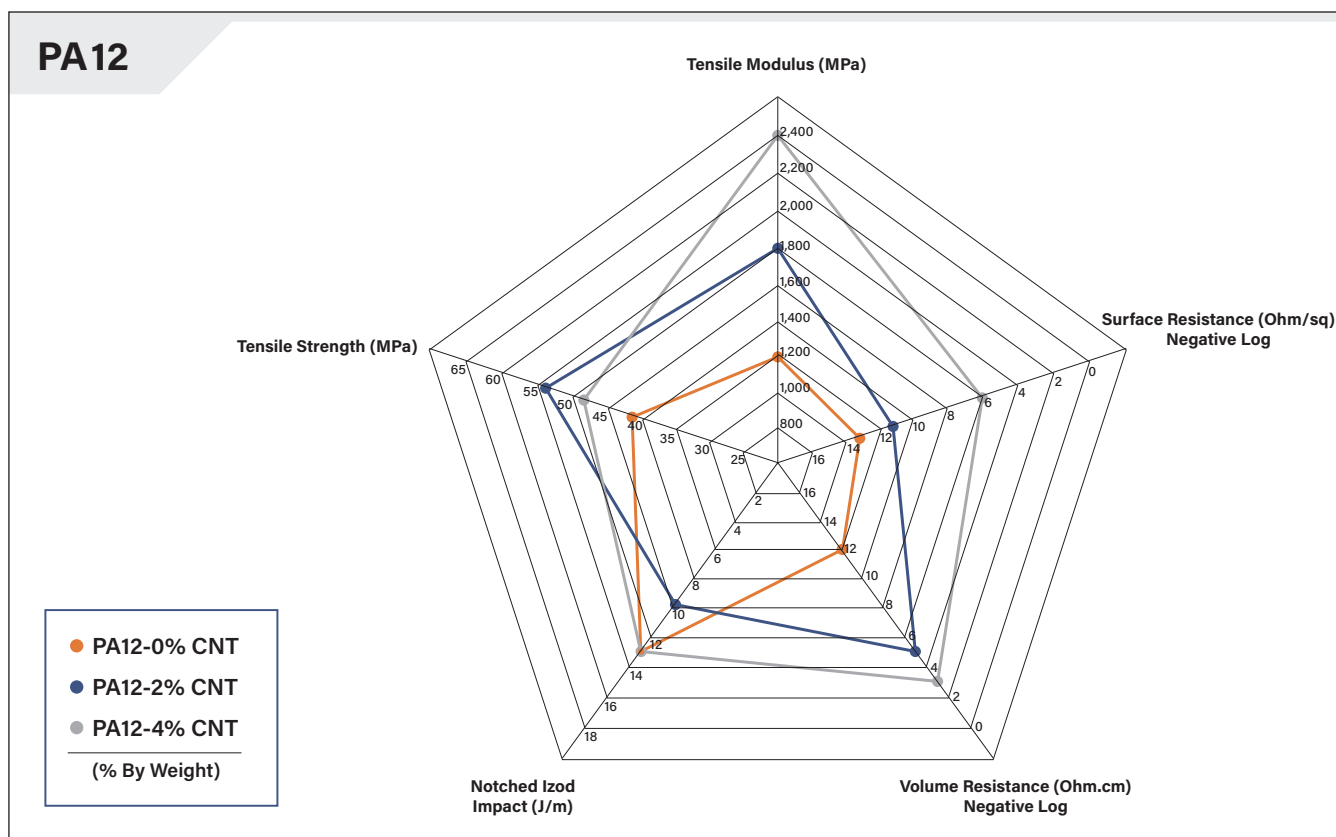


Polyamide 12 (Nylon 12) Carbon Nanotube (CNT) Masterbatch

The data below summarizes the mechanical and electrical properties of Insight Polymers Nylon 12 15% Carbon Nanotube (CNT) Masterbatch that has been let down to 2% and 4% total CNT loading. The addition of CNT's results in improvements to Tensile Modulus, Tensile Strength, and Electrical Resistance with minimal effect to Impact Strength.

The data summarized in the table and multi-axis spider chart below are based on injection molded ASTM test specimens

POLYMER (% BY WEIGHT)	PA 12 - 0% CNT	PA 12 - 2% CNT	PA 12 - 4% CNT
TENSILE MODULUS (MPa)	1200	1800	2400
TENSILE STRENGTH (MPa)	40	55	65
BREAK %	150	19	15
NOTCHED IZOD IMPACT (J/m)	39	54	55
UN-NOTCHED IZOD IMPACT (J/m)	1600	1200	1600
SURFACE RESISITIVITY (Ohm/sq)	<1E+13	<1E+11	<1E+06
VOLUME RESISTIVITY (Ohm.cm)	<1E+12	<1E+05	<1E+03



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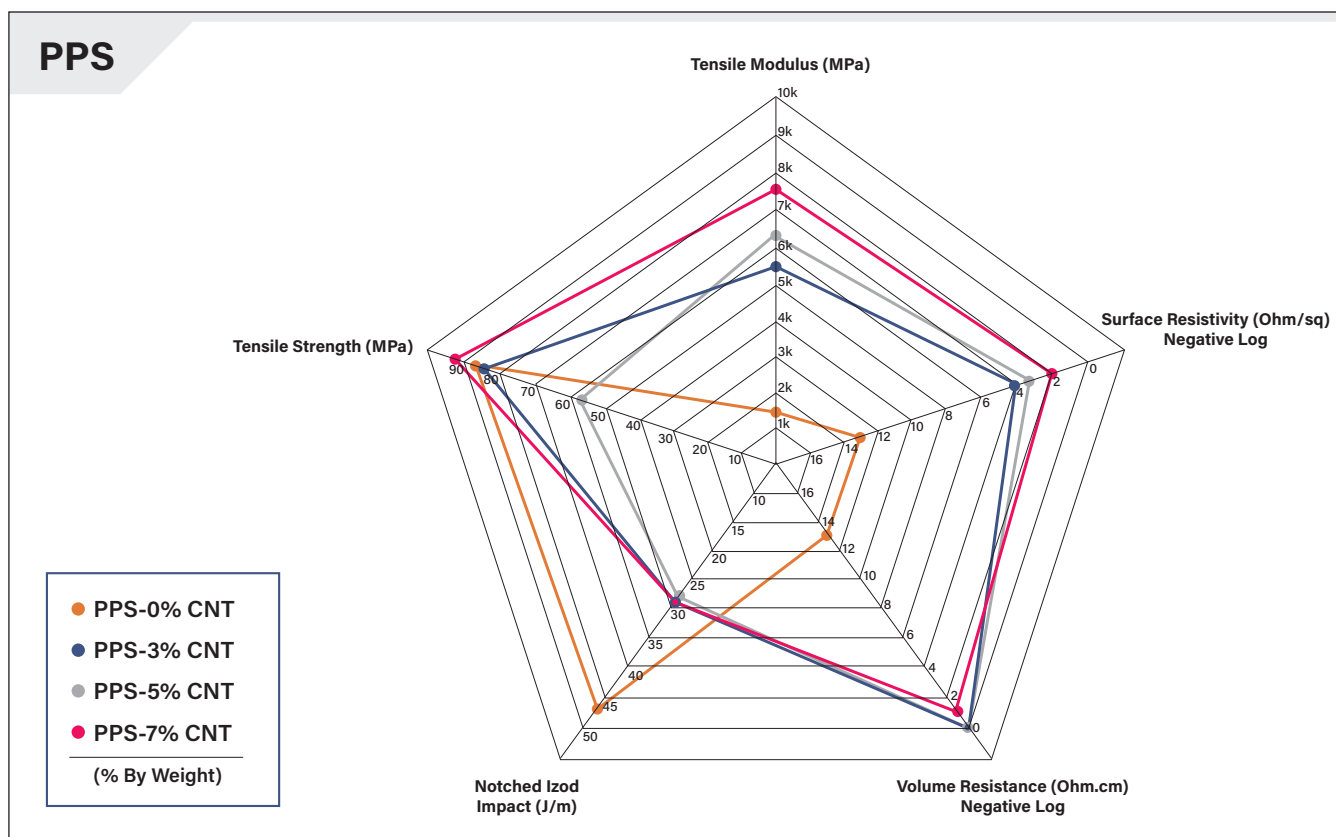


Polyphenylene Sulfide (PPS) Carbon Nanotube (CNT) Masterbatch

The data below summarizes the mechanical and electrical properties of Insight Polymers PPS 15% Carbon Nanotube (CNT) Masterbatch that has been let down to 3%, 5%, and 7% total CNT loading by weight. The addition of CNT's results in improvements to Tensile Modulus, Tensile Strength, and Electrical Resistance with minimal effect to Impact Strength.

The data summarized in the table and multi-axis spider chart below are based on injection molded ASTM test specimens.

POLYMER (% BY WEIGHT)	PPS - 0% CNT	PPS - 3% CNT	PPS - 5% CNT	PPS - 7% CNT
TENSILE MODULUS (MPa)	2800	5500	6900	7800
TENSILE STRENGTH (MPa)	70	85	90	95
BREAK %	10	2	<2	<2
NOTCHED IZOD IMPACT (J/m)	46	28	27	28
UN-NOTCHED IZOD IMPACT (J/m)	820	460	420	290
SURFACE RESISITIVITY (Ohm/sq)	1E+13	<1E+04	<1E+03	<1E+02
VOLUME RESISTIVITY (Ohm.cm)	1E+13	<1E+00	<1E+00	<1E+01



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