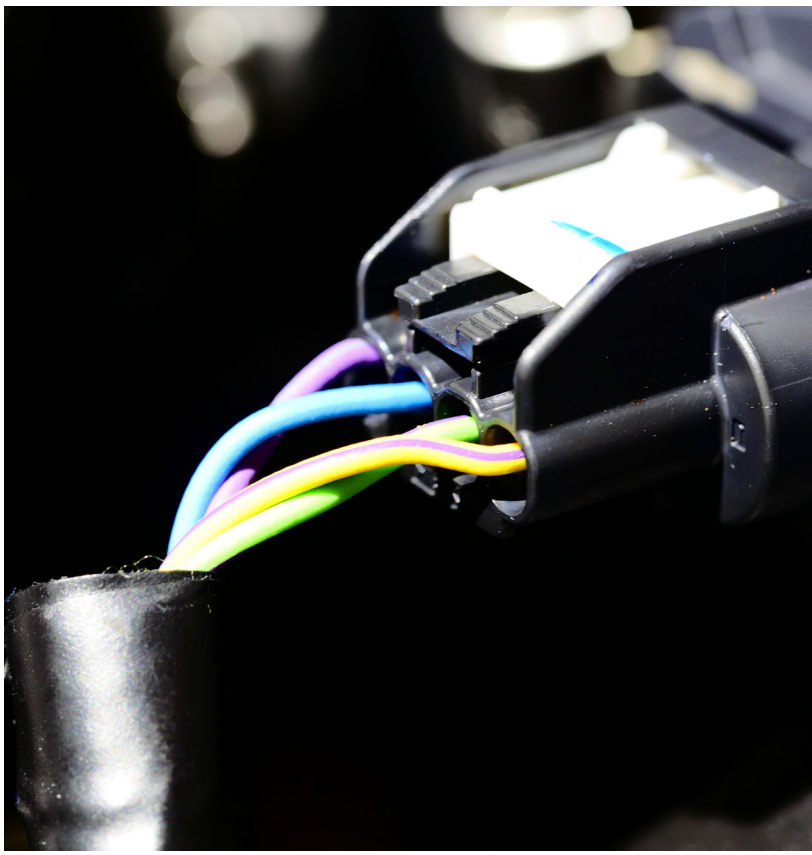
HALLSTAR

UNIPLEX™ FRP 64P

POLY(2,6-DIBROMOPHENYLENE OXIDE)

APPLICATION GUIDE FOR PET, PBT, AND POLYAMIDE



Hallstar works collaboratively with companies around the world to deliver chemistry solutions that enhance next-generation products.

As manufacturers find themselves under pressure to innovate, their ability to compete globally depends increasingly on how well they can leverage the knowledge of technology suppliers.

Hallstar's expertise in polymer modification and optimization, coupled with our application knowledge across a wide range of industrial products, is unique in the specialty chemical industry. Our ability to continually invent and formulate chemistry solutions to meet the unmet needs of our customers—is based on years of specialized esterification experience.

Taking a collaborative approach to new chemistry solutions is what Hallstar is all about. Together we can explore new approaches and possibilities, and anticipate what it takes to succeed tomorrow, next year and for years to come. Explore what our innovative plasticizers can do, then give us a call.

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UNIPLEX™ FRP 64P

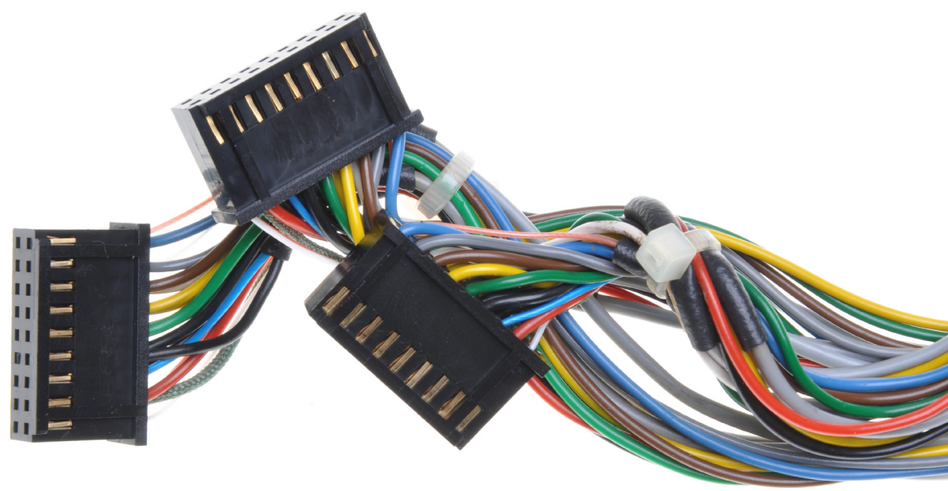
POLY(2,6-DIBROMOPHENYLENE OXIDE)

Uniplex™ FRP 64P, or poly(2,6-dibromophenylene oxide) is a brominated flame retardant additive that can be used in most engineered plastics. It has excellent heat stability and migration resistance in addition to compatibility with PET, PBT, and polyamide polymer systems.

Application

FRP 64P is mainly used in crystalline/rigid polymer systems to achieve improved flame retardant performance. It is extremely compatibility with both glass-reinforced and non-enforced nylon as well as polyester resins. Due to the FRP 64P melt temperature during mixing and processing, it improves flow of the compound, excellent dispersibility in very thin parts. FRP 64P has extremely good heat stability that can meet very high process temperature. Compounds using FRP 64P as a flame-retardant additive will retain most of its physical properties even after recycling. In addition to the mechanical benefits of FRP 64P, it is also a polymer, so it will not migrate or extract from other compounds.

Physical Properties	
Appearance	Light brown powder
Brominated Content	64
Melting Range	210-240 °C
Loss on Drying, %, max.	1
Sodium Brominate, %, max.	0.10
Tribromophenol (TBP), %, max.	0.15
Sulfonamide Plasticizer Content, %, max.	1.75



FRP 64P IN NYLON

FRP 64P is mainly used in thermoplastics, and is especially suitable for polyamide resins. When incorporated into Nylon 6 or Nylon 6,6 the most striking property is excellent mechanical properties and heat stability. Due to the polymeric nature of the FRP 64P, it will not exude from the polymer or bleed to the surface. When compounded into nylon or other moisture absorbing polymers, FRP 64P can achieve excellent electrical properties in addition to anti-corrosion improvements.

The compounding of flame-resistant nylon has historically been limited due to low heat stability of the base polyamide resin. Processing nylon at high temperatures often leads to decomposition of the polymer or corrosion of the equipment. Mixing glass-reinforced nylon can exacerbate both issues. FRP 64P can alleviate this by reducing the melt viscosity and improving the heat stability of the polyamide resin.

In Chart I we give recommended dosage of FRP 64P and Sb_2O_3 (Antimony trioxide) respectively to meet UL94 standard. If you need to achieve a certain FR target, it can be achieved by using different resin grades and other additives.

The FRP 64P flame retardant nylon has much better physical property than traditional FR additives, especially tensile strength and Izod impact. Chart II, Chart III, Chart IV show performance of FRP 64P reinforced and non-reinforced nylon.

CHART I

	FRP 64P	Sb_2O_3	UL94		
Usage	%	%	1/8″	1/16″	1/32″
Non-Reinforced Nylon	16	4	V-0	V-2	V-2
	18	4.5	V-0	V-0	V-2
	20	5	V-0	V-0	V-2
Reinforced Nylon (20% glass)	14	3.5	V-0	V-2	V-2
	16	4	V-0	V-0	V-2
	18	4.5	V-0	V-0	V-0

CHART II

Non-Reinforced Nylon 6,6

FR Additives	Control	PO-64P/ Sb_2O_3
Usage (%)	–	18/4.5
UL94		
1/8″	V-2	V-0
1/16″	V-2	V-0
Heat Deflection Temperature (HDT)[2], °F (°C) [2] 264 psi, 1/8″	151 (66)	162 (72)
Ultimate Tensile Strength, psi (MPa) [3] 2″/minute	12,200 (84.1)	12,900 (88.9)
Elongation (%)	60	10
Flex Strength, psi (MPa)	18,700 (129)	24,000 (141)
Modulus (10%), psi (GPa)	4.17 (2.87)	4.96 (3.42)
Izod Impact Strength[4] [4] 1/8″		
Notched, ft-lb/in (kj/m)	1.0 (0.05)	0.6 (0.03)
Unnotched, ft-lb/in (kj/m)	>40 (>2.1)	15 (0.8)
Dart Impact Strength, in-lb	240	40

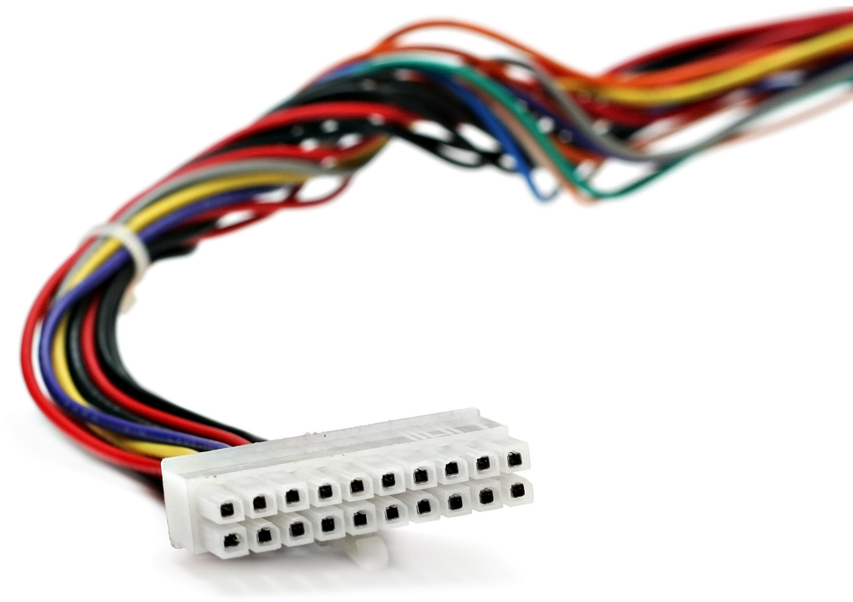


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CHART III		
Nylon 6,6 (20% Glass Reinforced)		
FR Additives	Control	PO-64P/ Sb_2O_3
Usage (%)	–	16/4
UL94		
1/8″	–	V-0
1/16″	–	V-0
Heat Deflection Temperature (HDT)[2], °F (°C) [2] 264 psi, 1/8″	452 (233)	452 (233)
Ultimate Tensile Strength, psi (MPa)[3] [3] 2″/minute	20,300 (140)	21,600 (149)
Elongation (%)	5	5
Flex Strength, psi (MPa)	31,100 (129)	29,500 (203)
Modulus (10%), psi (GPa)	8.87 (6.11)	9.98 (6.88)
Izod Impact Strength[4] [4] 1/8″		
Notched, ft-lb/in (kj/m)	1.1 (0.06)	1.2 (0.06)
Unnotched, ft-lb/in (kj/m)	20 (1.1)	12 (0.64)
Dart Impact Strength, in-lb	<10	<10

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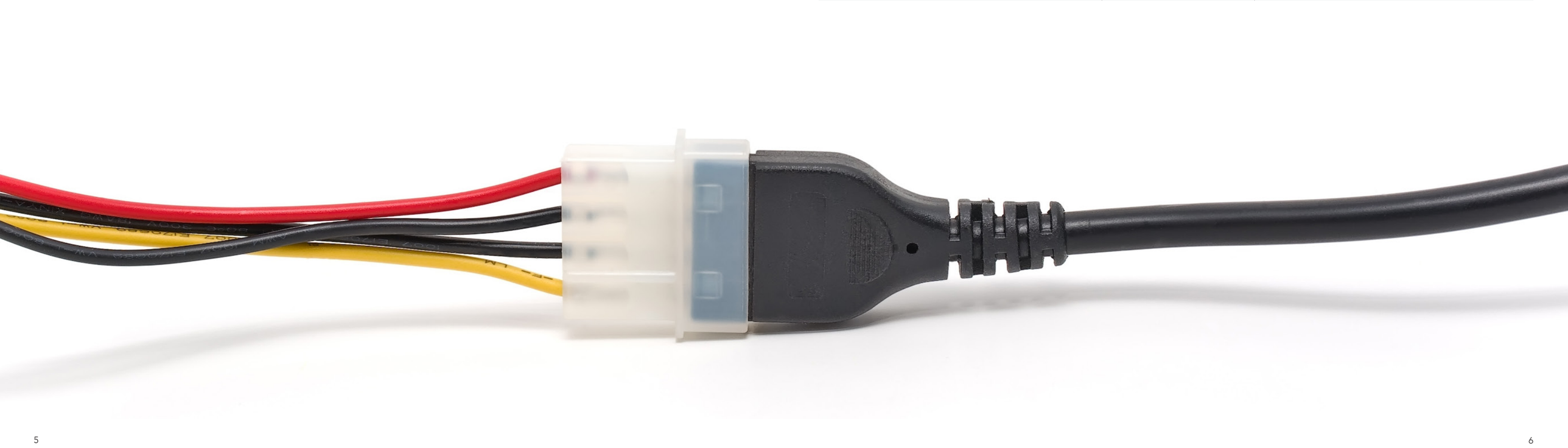
CHART IV		
Non-Reinforced Nylon 6		
FR Additives	Control	PO-64P/ Sb_2O_3
Usage (%)	–	18/4.5
UL94		
1/8″	–	V-0
1/16″	–	V-0
Heat Deflection Temperature (HDT)[2], °F (°C) [2] 264 psi, 1/8″	131 (55)	149 (65)
Ultimate Tensile Strength, psi (MPa)[3] [3] 2″/minute	11,600 (79.9)	11,700 (80.6)
Elongation (%)	22	7
Flex Strength, psi (MPa)	16,600 (114)	17,600 (121)
Modulus (10%), psi (GPa)	3.91 (2.69)	4.58 (3.16)
Izod Impact Strength[4] [4] 1/8″		
Notched, ft-lb/in (kj/m)	1.1 (0.06)	0.6 (0.03)
Unnotched, ft-lb/in (kj/m)	>40 (>2.1)	13.2 (0.7)
Dart Impact Strength, in-lb	>320	40



Product Guide

FRP 64P IN PBT

Chart V lists FRP 64P and Sb_2O_3 usage recommended for passing UL95. Chart VI, VII and VIII listed properties of reinforced and non-reinforced PBT resins with and without FRP 64P.

CHART V

	FRP 64P	Sb_2O_3	UL94		
Usage	%	%	1/8″	1/16″	1/32″
Non-Reinforced PBT	16	4	V-0	V-2	V-2
	18	4.5	V-0	V-0	V-2
	20	5	V-0	V-0	V-2
Reinforced Nylon (20% glass)	12	3	V-0	V-2	V-2
	13	3.5	V-0	V-0	V-2
	16	4	V-0	V-0	V-0
PET (30% glass fiber reinforced)	8	2	V-0	V-2	V-2
	10	2.5	V-0	V-0	V-2
	12	3	V-0	V-0	V-0

CHART VI

Non-Reinforced PBT

FR Additives	Control	PO-64P/ Sb_2O_3
Usage (%)	–	18/4.5
UL94		
1/8″	V-2	V-0
1/16″	V-2	V-0
Heat Deflection Temperature (HDT)[2], °F (°C) [2] 264 psi, 1/8″	117 (47)	151 (66)
Ultimate Tensile Strength[3], psi (MPa) [3] 2″/minute	8,500 (58.6)	8,300 (57.2)
Elongation (%)	>100	5
Flex Strength, psi (MPa)	13,300 (91.6)	13,800 (95.1)
Modulus (10%)[5], psi (GPa)	3.55 (2.45)	4.16 (2.87)
Izod Impact Strength[4] [4] 1/8″		
Notched, ft-lb/in (kj/m)	1.1 (0.06)	0.3 (0.02)
Unnotched, ft-lb/in (kj/m)	>130 (>6.9)	9.2 (0.5)
Dart Impact Strength, in-lb	>320	15

CHART VII

PBT (30% Glass Reinforced)

FR Additives	Control	PO-64P/ Sb_2O_3
Usage (%)	–	14/3.5
UL94		
1/8″	–	V-0
1/16″	–	V-0
Heat Deflection Temperature (HDT)[2], °F (°C) [2] 264 psi, 1/8″	403 (206)	398 (203)
Ultimate Tensile Strength, psi (MPa)[3] [3] 2in every minute	16,900 (116)	14,700 (101)
Elongation (%)	7	5
Flex Strength, psi (MPa)	22,900 (158)	24,800 (171)
Modulus (10%)[5], psi (GPa)	12.1 (8.34)	11.8 (8.13)
Izod Impact Strength[4] [4] 1/8″		
Notched, ft-lb/in (kj/m)	1.5 (0.08)	1.1 (0.06)
Unnotched, ft-lb/in (kj/m)	11.8 (0.63)	8.0 (0.43)
Dart Impact Strength, in-lb	<10	<10

CHART IV

Non-Reinforced PET

FR Additives	Control	PO-64P/ Sb_2O_3
Usage (%)	–	10/2.5
UL94		
1/8″	–	V-0
1/16″	–	V-0
Heat Deflection Temperature (HDT)[2], °F (°C) [2] 264 psi, 1/8″	123 (217)	393 (201)
Ultimate Tensile Strength, psi (MPa)[3] [3] 2″/minute	21,600 (149)	17,400 (120)
Elongation (%)	7	6
Flex Strength, psi (MPa)	31,800 (219)	27,000 (186)
Modulus (10%)[5], psi (GPa)	13.2 (9.09)	11.9 (8.20)
Izod Impact Strength[4] [4] 1/8″		
Notched, ft-lb/in (kj/m)	1.4 (0.07)	1.0 (0.03)
Unnotched, ft-lb/in (kj/m)	15.6 (0.83)	10.4 (0.56)
Dart Impact Strength, in-lb	<10	<10

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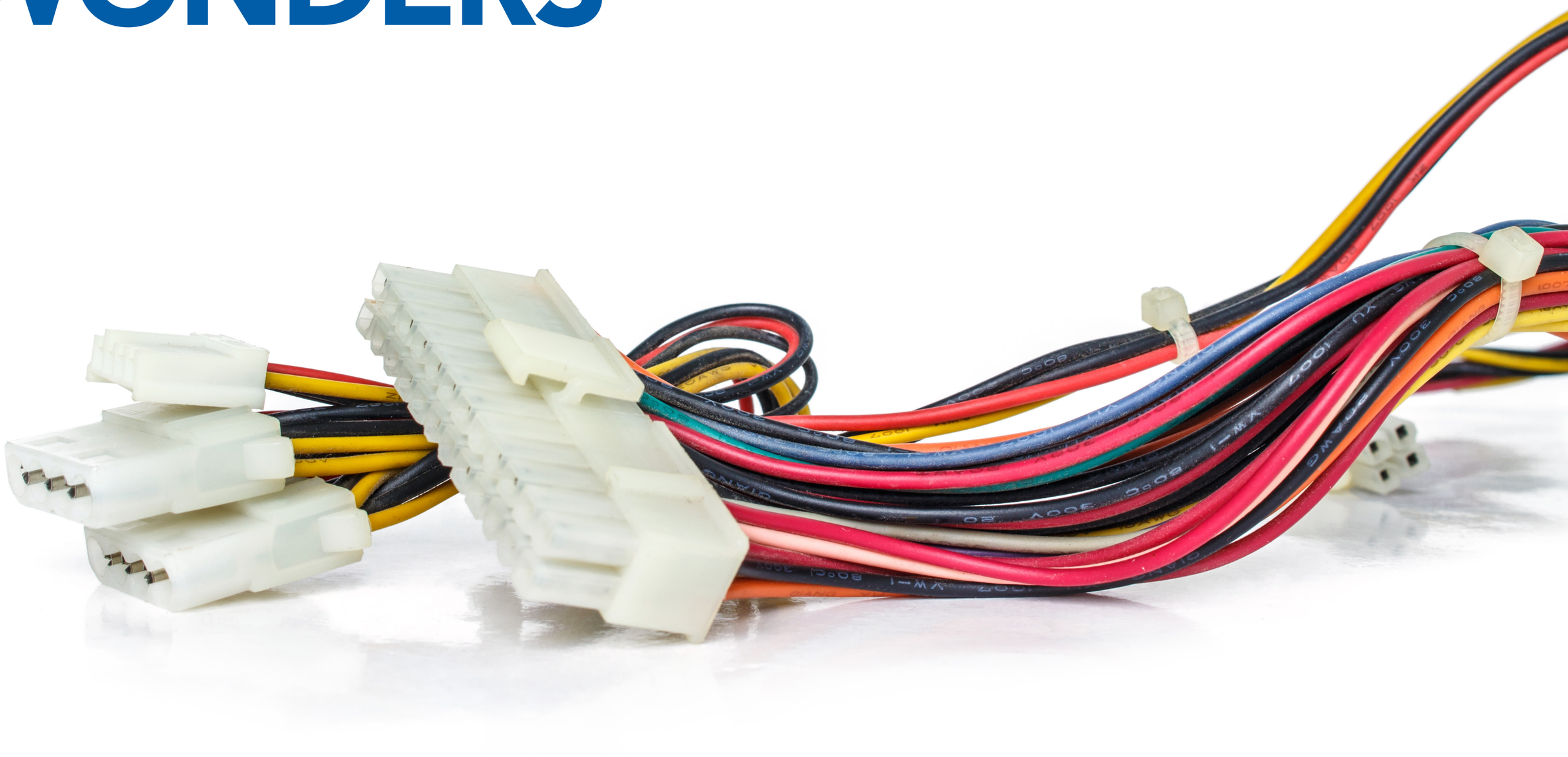

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