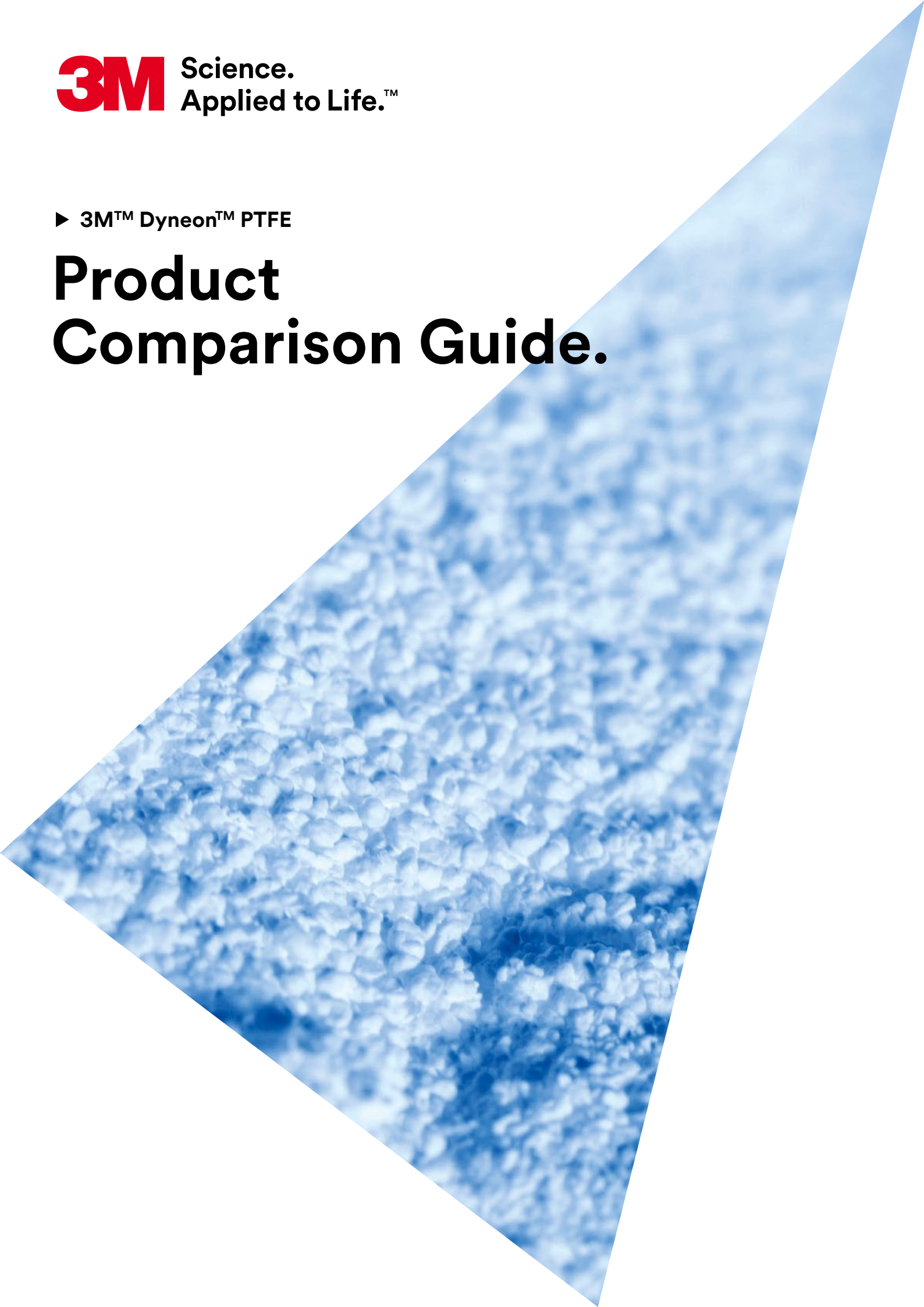


3M Science.
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▶ 3M™ Dyneon™ PTFE

Product Comparison Guide.



3M™ Dyneon™ PTFE.

Physical properties (typical values)¹⁾

				Suspension polymer (compression molding) powders										Selection of free-flowing compounds made from 3M™ Dyneon™ PTFE and 3M™ Dyneon™ TFM™ Modified PTFE ⁶⁾				
				3M™ Dyneon™ TFM™ Modified PTFE – second-generation PTFE						3M™ Dyneon™ PTFE								
Powder properties	Unit	Test method	Test specimen	TFM 1700	TFM 1705	TFM 1600	TFM 1610	TFM 1635	TFMR 1602	TF 1750	TF 1620	TF 1641	TF 1645	TF 4103	TF 4104	TF 4105	TFM 4105	
ASTM D 4894 ³⁾ , D 4895 ⁴⁾ , ASTM D 4745 ⁵⁾				type III gr. 1	type III gr. 1	type III gr. 2	type III gr. 2	type IV gr. 2	type VI	type II	type IV gr. 2	type IV gr. 2	type IV gr. 2	type II	type II	type II	type II	
Bulk density	g/l	DIN EN ISO 60		410	410	820	760	825	800	380	870	840	840	820	820	820	820	
Average particle size	µm	ISO 13320		25	25	450	430	230	800	25	220	450	450	580	580	580	575	
Powder flow properties				non-free-flowing	non-free-flowing	very good free-flowing	very good free-flowing	limited free-flowing	very good free-flowing	non-free-flowing	limited free-flowing	very good free-flowing	very good free-flowing	very good free-flowing	very good free-flowing	very good free-flowing	very good free-flowing	
Molding pressure	MPa			15	15	30	30	20	-	15	20	30	30	50	60	70	70	
Filler type				-	-	-	-	-	-	-	-	-	-	glass fiber	glass fiber	glass fiber	glass fiber	
Filler content	wt. %	internal Dyneon method		-	-	-	-	-	-	-	-	-	-	15	20	25	25	
Mechanical properties, measured at 23 °C on sintered moldings																		
Specific gravity	g/cm ³	DIN EN ISO 12086		2.16	2.16	2.16	2.16	2.16	2.16	2.16	2.15	2.15	2.15	2.21	2.22	2.24	2.24	
Tensile strength	MPa	DIN EN ISO 12086 / ASTM 4894	test specimen thickness, mm	43 0.1	47 0.1	37 0.2	35 0.2	35 0.2	35 0.5	42 0.1	38 0.2	36 0.2	37 0.2	20 1.0	18 1.0	15 1.0	12 1.0	
Elongation at break	%	DIN EN ISO 12086 / ASTM 4894	test specimen thickness, mm	625 0.1	560 0.1	600 0.2	600 0.2	600 0.2	500 0.5	430 0.1	400 0.2	430 0.2	400 0.2	400 1.0	375 1.0	350 1.0	450 1.0	
Ball indentation hardness	N/mm ²	DIN ISO 2039 part 1	plaque, 4mm	28	28	28	28	28	24	26	26	26	26	31	-	34	37	
Shore hardness D		DIN EN ISO 868		59	59	59	59	59	53	56	56	56	56	59	60	61	63	
Deformation under load (15 MPa, 100 h)	%	similar to ASTM D 621	cylinder, 10mm Ø x 10mm	9	10	9	10	10	14	17	17	17	17	17	15.5	14	6.5	
Tensile modulus	MPa	DIN EN ISO 527		650	650	650	650	650	650	600	600	600	600	-	-	-	-	
Shrinkage	%	a) internal Dyneon method b) ASTM D 4894	cylinder, 45mm Ø sheet, 80mm Ø ram extruded rod, 23mm Ø	5.6	5.4	3.4	3.5	4.1	-	4.3	2.9	2.7	2.5	-	-	-	-	
		-		-	-	-	-	-	-	-	-	-	-	-	2.2	1.9	1.7	2.3
		-		-	11.5	-	-	10.5	-	-	11	11	7	-	-	6	6	6
Thermal properties																		
Thermal conductivity	W/m-K	DIN 52 612		0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	-	-	0.35	0.35	
Coefficient of linear expansion ²⁾ (parallel to molding direction)	K-1	DIN 53 752	30–100 °C	12 · 10 ⁻⁵	12 · 10 ⁻⁵	12 · 10 ⁻⁵	12 · 10 ⁻⁵	12 · 10 ⁻⁵	12 · 10 ⁻⁵	12 · 10 ⁻⁵	12 · 10 ⁻⁵	12 · 10 ⁻⁵	12 · 10 ⁻⁵	-	-	10 · 10 ⁻⁵	9 · 10 ⁻⁵	
			30–200 °C	14 · 10 ⁻⁵	14 · 10 ⁻⁵	14 · 10 ⁻⁵	14 · 10 ⁻⁵	14 · 10 ⁻⁵	14 · 10 ⁻⁵	14 · 10 ⁻⁵	14 · 10 ⁻⁵	14 · 10 ⁻⁵	14 · 10 ⁻⁵	14 · 10 ⁻⁵	-	-	13 · 10 ⁻⁵	11 · 10 ⁻⁵
			30–260 °C	17 · 10 ⁻⁵	17 · 10 ⁻⁵	17 · 10 ⁻⁵	17 · 10 ⁻⁵	17 · 10 ⁻⁵	17 · 10 ⁻⁵	17 · 10 ⁻⁵	17 · 10 ⁻⁵	17 · 10 ⁻⁵	17 · 10 ⁻⁵	17 · 10 ⁻⁵	-	-	15 · 10 ⁻⁵	13 · 10 ⁻⁵
Electrical properties, measured at 23 °C																		
Dielectric strength	kV/mm	DIN EN ISO 12086	film, 100µm 200µm	90 -	90 -	- 78	- 82	- 78	- -	88 -	- 74	- 60	- 55	- -	- -	- -	- -	
Volume resistivity	Ω·cm	IEC 60093		10 ¹⁸	10 ¹⁸	10 ¹⁸	10 ¹⁸	10 ¹⁸	10 ¹⁸	10 ¹⁸	10 ¹⁸	10 ¹⁸	10 ¹⁸	10 ¹⁶	10 ¹⁶	10 ¹⁶	10 ¹⁶	
Surface resistance	Ω	IEC 60093		10 ¹⁷	10 ¹⁷	10 ¹⁷	10 ¹⁷	10 ¹⁷	10 ¹⁷	10 ¹⁷	10 ¹⁷	10 ¹⁷	10 ¹⁷	10 ¹⁶	10 ¹⁶	10 ¹⁶	10 ¹⁶	
				General molding materials, resistant to deformation under load, weldable						Ram extrusion	General compression molding				General compression molding, automatic and isostatic molding, ram extrusion			
				Large cylinder for skived-film production	Tall, thick-walled cylinders for skived-film production	Automatic and general compression molding	Automatic and general compression molding	Isostatic molding	Ram extruded continuous rods	Skived films >20µm	Isostatic molding	Isostatic and automatic molding	Automatic, isostatic and general compression molding	Bearings	Seals/gaskets			
				Skived films >20µm	Higher stability in the gel state	Linings Skived films >500µm		Large sheets	Pipes and profiles with higher wall thickness	Skived films >200µm	Skived films >200µm	Seals/gaskets		Moldings	Valve seats			
					Skived-films >20µm			Large cylinders		High flexural fatigue strength		Small parts		Piston rings				
					High flexural fatigue strength			Skived films >200µm		Higher stability in the gel state								

¹⁾ not for specification purposes

²⁾ measured with a dilatometer 2 °C/min

³⁾ compression molding powder (suspension polymers)

⁴⁾ paste extrusion grades (emulsion polymers)

⁵⁾ compounds (free-flowing)

⁶⁾ a comprehensive service offering a wide range of customized products is available

3M™ Dyneon™ PTFE.

Physical properties (typical values)¹⁾

Emulsion polymer powders (fine powder extrusion grades)													
3M™ Dyneon™ TFM™ Modified PTFE – 2nd generation PTFE				3M™ Dyneon™ PTFE									
Powder properties	Unit	Test method	Test specimen	TFM 2001Z	TFM 2033Z	TFM 2070Z	TF 2021Z	TF 2025Z	TF 2029Z	TF 2035Z	TF 2071Z	TF 2072Z	TF 2073Z
ASTM D 4894 ³⁾ , D 4895 ⁴⁾ , ASTM D 4745 ⁵⁾				type I grade 1/class B	type I grade 1/class B	type I grade 1/class B	type I grade 1/class B	type I grade 1/class B	type I grade 1/class C	type I grade 1/class B	type I grade 1/class C	type I grade 1/class C	type I grade 1/class C
Bulk density	g/l	DIN EN ISO 60		460	460	460	480	480	450	480	490	480	490
Average particle size	µm	ISO 13320		520	520	350	500	500	640	550	400	430	400
Powder flow properties				free-flowing	free-flowing	free-flowing	free-flowing	free-flowing	free-flowing	free-flowing	free-flowing	free-flowing	free-flowing
Extrusion pressure													
at RR ²⁾ 400	MPa	ASTM D 4895		23	32	19	30	40	51	38	-	-	-
at RR ²⁾ 1600	MPa	ASTM D 4895		-	-	-	-	-	-	-	50	40	26
Min. RR ²⁾		internal Dyneon method		20	20	20	20	20	5	15	20	50	50
Max. RR ²⁾		internal Dyneon method		1000	100	2000	500	300	100	300	1600	3000	4400
Mechanical properties, measured at 23 °C on sintered moldings													
Specific gravity	g/cm ³	DIN EN ISO 12086		2.15	2.16	2.16	2.15	2.15	2.15	2.16	2.16	2.17	2.17
Tensile strength	MPa	DIN EN ISO 12086 / ASTM 4895	test specimen thickness, mm	38 1.6	37 1.6	36 1.6	34 1.6	34 1.6	34 1.6	37 1.6	34 1.6	35 1.6	35 1.6
Elongation at break	%	N EN ISO 12086 / ASTM 4895	test specimen thickness, mm	440 1.6	430 1.6	400 1.6	380 1.6	370 1.6	380 1.6	460 1.6	410 1.6	470 1.6	460 1.6
Electrical properties, measured at 23 °C													
Volume resistivity	Ω·cm	IEC 60093		-	-	-	10 ¹⁸	10 ¹⁸	10 ¹⁸	10 ¹⁸	10 ¹⁸	10 ¹⁸	10 ¹⁸
Surface resistance	Ω	IEC 60093		-	-	-	10 ¹⁷	10 ¹⁷	10 ¹⁷	10 ¹⁷	10 ¹⁷	10 ¹⁷	10 ¹⁷
				High performance tubing	High performance pipes	Small sized high performance tubing	Unsintered tapes	Unsintered tapes	Electrically insulating tapes	Pipe liners with medium to large diameter thick wall	Tubing	Very high reduction ratio	Extreme high reduction ratio
				High pressure resistance under surge stress	Denser polymer structure with lower permeability	High pressure resistance under surge stress	Sealing cords	Pipe liners	Yarn production		Wire/cable insulation	More cost-efficient	Even more cost-efficient
				Denser polymer structure with lower permeability		Denser polymer structure with lower permeability	Thick wall cable insulation					Wire/cable insulation „Spaghetti“ tubing	Wire/cable insulation „Spaghetti“ tubing

¹⁾ not for specification purposes

²⁾ RR = reduction ratio

³⁾ compression molding powder (suspension polymers)

⁴⁾ paste extrusion grades (emulsion polymers)

⁵⁾ compounds (free-flowing)

3M™ Dyneon™ PTFE Micropowders.

Typical properties (not for specification purposes)

Property	Method	Unit	J14	J24	TF 9201Z	TF 9202Z	TF 9205	TF 9207Z
Average particle size	ISO 13320	µm	2	12	9	4	8	4
Primary particle size	DIN ISO 13321	nm	200	-	200	200	-	120
Bulk density	DIN EN ISO 60	g/l	250	400	350	280	400	260
Specific surface area BET	DIN ISO 9277	m ² /g	-	-	10	12	2	17
Melting point	DIN EN ISO 12068	°C	323	327	330	330	325	330
Melt flow rate MFR ¹⁾	DIN EN ISO 1133	g/10 min	-	-	<2	6	12	4
Thickening effect			very good	good	very good	very good	good	excellent
Food contact use	EU ²⁾		no	no	yes	yes	no	yes
Applications								
Plastics								
Thermoplastics			+	++	++	++	+	+
Elastomers			+	++	+	+	++	+
Thermosets			+	++	+	+	++	+
Lubricants								
Silicone oils			++	+	+	+	+	+
Engine oils			+	-	+	+	-	+
Greases			+	+	+	+	+	+
Printing inks			-	+	-	-	++	+
Combinations with PE waxes are possible								
Non-stick and antifriction coatings			+	+	-	-	++	++
Non-stick and antifriction sprays			+	-	+	+	-	+
Dry lubricants			+	+	+	+	+	++

- not recommended + recommended ++ good experience

¹⁾ The measurements are carried out at 372 °C with different test weights and nozzle diameters. The melt viscosity of micropowders can be calculated from the melt flow rate (MFR) by Hagen Poiseuille's law to obtain an indication of molecular weight. The molecular weight of the micropowder products increases in the following order: TF 9205, TF 9207Z, TF 9202Z, TF 9201Z.

²⁾ The monomers used for the production of these products comply with EU-Directive 2002/72/EC about materials and articles made of plastics and intended to come into contact with foodstuffs or toys and with the new edition of the German „Bedarfsgegenständeverordnung“ of December 23rd, 1997.

3M™ Dyneon™ PTFE Dispersions.

Typical properties (not for specification purposes)

Property (average values)	Method	Unit	TF 5135GZ ¹⁾	TF 5033Z ¹⁾	TF 5041GZ ¹⁾	TF 5060GZ ¹⁾	TF 5066GZ ¹⁾	TF 5070GZ ¹⁾	TFM 5001GZ ¹⁾
Solid Content	DIN EN ISO 12086	%	58	24	58	59	59	50	58
Emulsifier			non-ionic	ionic	non-ionic	non-ionic	non-ionic	non-ionic	non-ionic
Emulsifier content	DIN EN ISO 12086	%		5					5
	Dyneon internal	%	5.5		6	8	6	8	
Viscosity	DIN EN ISO 3219	mPas	12	n.a.	130	25	15	12	12
pH value	DIN ISO 976		>9	>9	>9	>9	>9	>9	>9
Density	DIN 51757	g/cm ³	1.6	1.1	-	1.5	2.2	1.4	2.2
Particle size	DIN ISO 13321	nm	190	195	-	210	210	120	200

¹⁾ Grades made without the use of APEO (Alkyl Phenyl Ethoxylates)

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General recommendations on health and safety in processing, on work hygiene and on measures to be taken in the event of accident are detailed in our "safety data sheets (SDS)."

You will find further notes on the safe handling of fluoropolymers in the brochure "Guide for the safe handling of Fluoropolymers Resins" by PlasticsEurope, Box 3, B-1160 Brussels, Tel. +32 (2) 676 17 32.

The present edition replaces all previous versions. Please make sure and inquire if in doubt whether you have the latest edition.

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