Celanese
The chemistry inside innovation™

CELSTRAN® LFRT

LONG FIBER REINFORCED THERMOPLASTICS

Short Term Properties Guide

1 Introduction

Celstran® LFRT and Compel® LFRT are long fiber reinforced thermoplastics (LFRT) made by Celanese. These materials can be turned into high-strength components through various processing methods. Nearly all partially crystalline and amorphous thermoplastics are suitable as thermoplastic matrix materials.

Celstran® LFRT and Compel® LFRT grades are produced in a special, patented, pultrusion process.

The fibers incorporated in this process can be glass, carbon, aramid or stainless steel. In pultrusion, the continuous filaments are pulled through the thermoplastic melt. Process control and die are optimized to achieve a high-quality impregnation without any damage to the fibers **(Fig. 1)**.

Celstran® LFRT and Compel® LFRT have markedly higher quality mechanical properties than comparable short fiber reinforced thermoplastics. The most important application properties of the long fiber reinforced thermoplastics compared with the corresponding short fiber reinforced materials are the following:

- reduced creep tendency
- very good stability at elevated temperatures in humid conditions
- very low warpage

The special effect of the long fiber reinforcement is manifested by the fiber skeleton, whose outer shape remains unchanged after the resin matrix is burned off **(Fig. 2)**. By absorbing impact energy and allowing it to dissipate into the molding, this fiber skeleton imparts, among other benefits, the good impact strength of Celstran® LFRT materials. The long fiber reinforcement also has a beneficial effect on the properties at elevated service temperatures, and on the creep properties.

Celstran® LFRT products are comprised of a number of possible matrix-fiber combinations, and this applies to the entire scope of products. The combinations are intended mainly for injection molding, but they can also be used for compression molding, extrusion or blow molding.

Fig. 1

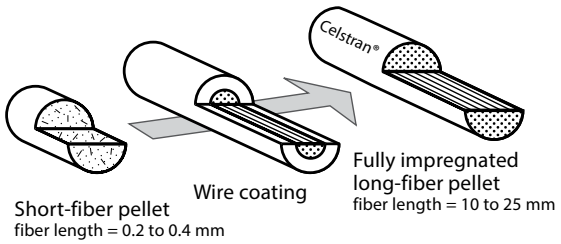


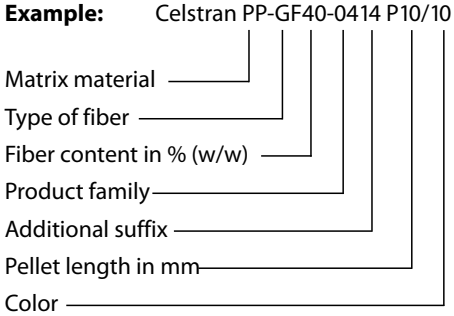
Diagram of a fully impregnated long-fiber pellet (right) compared with wire coating (center) and short-fiber pellets (left)

Fig. 2

After burning off, a molding (example: pump head made from Celstran PA66-GF50, top) retains its geometry almost intact as a fiber skeleton (bottom)

Fig. 3a

Example: Celstran PP-GF40-0414 P10/10

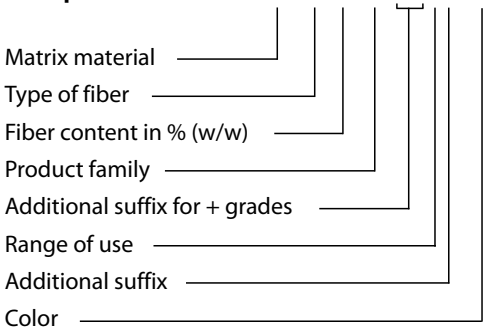


Matrix material:	PP
Type of fiber:	GF (glass), SF (stainless steel)
Product family:	04 = homopolymer 05 = copolymer
Additional suffix:	01 = Standard formulation Copolymer 03 = Standard formulation Homopolymer 05 = UV stabilized 14 = Standard formulation GF40 53 = low-C-emission 55 = low-C-emission and UV stabilized
Color:	without = natural 10 – 19 = black

Celstran PP

Fig. 3b

Example: Celstran + PP-GF40-04 CN 0 3/10



Matrix material:	PP
Type of fiber:	GF
Product family:	04 = homopolymer 05 = copolymer
Range of use:	0 = Ready-to-use 1 = concentrate for blending unreinforced PP
Additional suffix:	1 = standard formulation 2 = improved heat stabilization 3 = standard formulation 5 = low-C-emission
Color:	without = natural 10 – 19 = black

Celstran+ PP

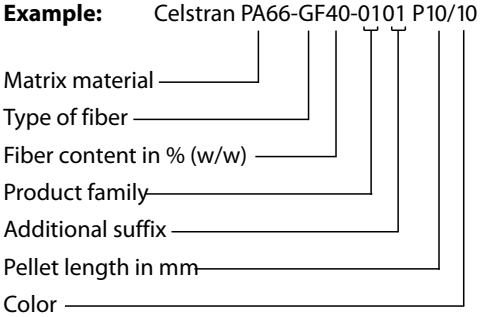
Nomenclature

Figures 3a, 3b and 3c show examples of the nomenclature for the standard product ranges Celstran® LFRT PP, Celstran® LFRT +PP and Celstran® LFRT PA.

In principle, grade names follow the logic demonstrated by these three examples; however, exceptions do exist. A Celanese representative or authorized distributor will gladly guide you to the ideal material based on your specific technical requirements.

Fig. 3c

Example: Celstran PA66-GF40-0101 P10/10



Matrix material:	PA66
Type of fiber:	GF (glass), CF (carbon), SF (stainless steel)
Product family:	01 = high gloss 02 = heat stabilized
Additional suffix:	01 = standard formulation 11 = standard formulation 12 = UV stabilized
Color:	without = natural 10 – 19 = black

Celstran PA66

Polymer			
Group			
Grade-Nomenclature			
Physical property	**Unit**	**Test method**	**Test specimen**
Density	g/cm³	ISO 1183	10 x 10 x 4 mm
Water absorption (at 23°C after 24 h)	% by wt.	ISO 62	80 x 80 x 1 mm
Water absorption to saturation at 23°C / 50% rel. humidity	% by wt.		80 x 80 x 1 mm
Mechanical properties, measured under standard conditions, ISO 291-23/50			
Tensile strength at 23°C	MPa	ISO 527 part 1/2; test speed 5 mm/min	Multi-purpose test specimen to ISO 31670
Tensile strength at 80°C	MPa	ISO 527 part 1/2 test speed 5 mm/min	Multi-purpose test specimen to ISO 31670
Elongation at break at 23°C	%	ISO 527 part 1/2; test speed 5 mm/min	Multi-purpose test specimen to ISO 31670
Elongation at break at 80°C	%	ISO 527 part 1/2; test speed 5 mm/min	Multi-purpose test specimen to ISO 31670
Tensile modulus at 23°C	MPa	ISO 527 part 1/2; test speed 5 mm/min	Multi-purpose test specimen to ISO 31670
Tensile modulus at 23°C	MPa	ISO 527 part 1/2; test speed 5 mm/min	Multi-purpose test specimen to ISO 31670
Flexural strength at 23°C	MPa	ISO 178	80 x 10 x 4 mm from multi-purpose test specimen to ISO 31670
Flexural strength at 80°C	MPa	ISO 178	80 x 10 x 4 mm from multi-purpose test specimen to ISO 31670
Flexural strain at flexural strength at 23°C	%	ISO 178	80 x 10 x 4 mm from multi-purpose test specimen to ISO 31670
Flexural strain at flexural strength at 80°C	%	ISO 178	80 x 10 x 4 mm from multi-purpose test specimen to ISO 31670
Flexural modulus at 23°C	MPa	ISO 178	80 x 10 x 4 mm from multi-purpose test specimen to ISO 31670
Flexural modulus at 80°C	MPa	ISO 178	80 x 10 x 4 mm from multi-purpose test specimen to ISO 31670
Impact strength (Charpy) at 23°C	kJ/m²	ISO 179 1eU	80 x 10 x 4 mm from multi-purpose test specimen to ISO 31670
Impact strength (Charpy) at –30°C	kJ/m²	ISO 179 1eU	80 x 10 x 4 mm from multi-purpose test specimen to ISO 31670
Notched impact strength (Charpy) at 23°C	kJ/m²	ISO 179 1eA	80 x 10 x 4 mm from multi-purpose test specimen to ISO 31670
Notched impact strength (Charpy) at –30°C	kJ/m²	ISO 179 1eA	80 x 10 x 4 mm from multi-purpose test specimen to ISO 31670
Thermal properties			
Heat deflection temperature HDT/A (1.8 MPa)	°C	ISO 75 part 1/2	80 x 10 x 4 mm from multi-purpose test specimen to ISO 31670
Heat deflection temperature HDT/C (8.0 MPa)	°C	ISO 75 part 1/2	80 x 10 x 4 mm from multi-purpose test specimen to ISO 31670

Celstran PP				
Standard grades				
PP-GF30-0403P10/10	PP-GF30-0501P10/13	PP-GF40-0414P10/10	PP-GF40-0501P10/13	PP-GF50-0403P10/10
1.13 ± 0.03	1.13 ± 0.03	1.22 ± 0.03	1.22 ± 0.03	1.34 ± 0.03
<0.1	<0.1	<0.1	<0.1	<0.1
100	90	115	100	130
55	46	60	48	70
2.3	2.8	2.0	2.2	1.8
2.6	3.0	2.4	2.4	2.2
7000	6000	9000	8000	12000
4600	4000	6200	5100	7500
160	150	180	160	205
85	80	110	80	120
2.6	3.8	2.5	3.0	2.3
3.5	3.4	3.2	3.2	3.0
7800	6000	9000	8200	12200
5000	4500	6600	5800	8900
54	65	55	68	55
42	80	42	70	54
14	26	17	22	16
15	24	19	22	22
155	155	157	157	157
122	118	135	125	135

Celstran PP					
UV stabilized grades			Low-C-Emission		Low-C-Emission and UV
PP-GF30-0405P10/10	PP-GF40-0405P10/10	PP-GF50-0405P10/10	PP-GF30-0453P10/10	PP-GF50-0453P10/10	PP-GF50-0455P10/10
1.13 ± 0.03	1.22 ± 0.03	1.34 ± 0.03	1.13 ± 0.03	1.34 ± 0.03	1.34 ± 0.03
<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
100	115	130	100	130	130
55	60	70	55	70	70
2.3	2.0	1.8	2.3	1.8	1.8
2.6	2.4	2.2	2.6	2.2	2.2
7000	9000	12000	7000	12000	12000
4600	6200	7500	4600	7500	7500
165	180	205	160	205	205
85	110	120	85	120	120
2.8	2.5	2.3	2.6	2.3	2.3
3.2	3.2	3.0	3.5	3.0	3.0
7800	9000	12200	7800	12200	12200
5000	6600	8900	5000	8900	8900
54	45	45	54	55	45
42	42	42	42	54	42
14	13	13	14	16	13
15	14	17	15	20	17
155	155	157	155	157	157
122	135	135	122	135	135

Celstran + PP					
Standard + grades				Low-C-Emission	
+PP-GF30-05-CN01/10	+PP-GF40-04CN03/10	+PP-GF30-04CN02/10	+PP-GF45-04CN11/10 *)	+PP-GF45-04CN15/10 *)	PA66-GF40-0101P10/11 DAM / cond.
1.13 ± 0.03	1.22 ± 0.03	1.13 ± 0.03	1.28 ± 0.03	1.28 ± 0.03	1.46 ± 0.03
<0.1	<0.1	<0.1	<0.1	<0.1	ca. 1.2
					ca. 1.7
85	100	95	115	115	230 / 165
50	60	55	60	55	145 / -
2.5	1.8	2.2	1.8	1.8	2.2 / 2.5
2.8	2.0	2.5	2.6	2.5	2.8 / -
5600	8000	6100	10000	9800	13000 / 9000
3500	4800	4200	4500	4900	8400 / -
150	160	150	180	185	350 / 270
85	100	90	105	95	240 / -
3.2	2.3	3.0	2.6	2.4	3.0 / 4.2
3.0	3.0	3.2	2.8	3.4	4.0 / -
6500	8200	6500	9500	10500	11500/ 8300
4800	6000	4900	6500	6400	8300 / -
55	40	41	48	48	80 / 105
70	35	35	40	42	75 / -
22	14	14	15	15	45 / 35
22	13	16	18	18	42 / -
156	157	157	157	157	235
130	135	130	135	130	220

Celstran PA66					
High gloss		Improved heat stabilization			Improved heat stabilization, high gloss
PA66-GF50-0111P10/11 DAM / cond.	PA66-GF60-0101P10 DAM / cond.	PA66-GF40-02P11/15 DAM / cond.	PA66-GF50-02P11/14 DAM / cond.	PA66-GF60-02P11/12 DAM / cond.	PA66-GF50-20 AD3007 DAM / cond.
1.57 ± 0.03	1.67 ± 0.03	1.46 ± 0.03	1.57 ± 0.03	1.67 ± 0.03	1.57 ± 0.03
ca. 1	ca. 0.8	ca. 1.2	ca. 1	ca. 0.8	ca. 1
ca. 1.3	ca. 1.1	ca. 1.7	ca. 1.3	ca. 1.1	ca. 1.3
260 / 180	280 / 185	180 / 160	220 / 170	260 / 200	250 / 175
150 / -	160 / -	130 / -	140 / 115	165 / 140	165 / 150
2.2 / 2.5	2.1 / 2.2	1.5 / 2.0	1.6 / 2.0	1.8 / -	2.0 / 2.1
2.8 / -	2.8 / -	2.0 / -	1.8 / 1.7	1.8 / 1.7	2.0 / -
16500 / 11600	19500 / 13300	13700 / 10000	16800 / 12000	19000 / 15000	16500 / 12000
9500 / -	13000 / -	9000 / -	10000 / 9500	13400 / 11500	10000 / 10600
380 / 300	450 / 320	260 / 250	330 / -	450 / 350	400 / 290
260 / -	290 / 230	250 / -	260 / -	260 / 230	255 / -
3.2 / 4.0	2.8 / 3.8	2.2 / 3,2	2.2 / 3.2	2.6 / 3.0	3.0 / 2.5
4.0 / -	3.4 / 3.0	3.5 / -	3.0 / -	3.0 / 2.6	3.3 / -
14000 / 11500	18000 / 13000	12600 / 9800	15500 /12100	18100 / 14500	14200 / 11500
9500 / -	13000 / 11500	8000 / -	10500 / -	13000 / 12500	10000 / -
100 / 50	100 / 120	52 / 45	60 / 65	96 / 94	87 / 85
80 / -	84 / 87	45 / -	58 / 46	77 / 77	78 / 62
40 / 36	44 / 38	26 / 18	30 / 25	48 / 42	45 / 38
42 / -	40 / 44	26 / -	30 / 30	46 / 44	45/ 42
235	235	258	258	258	255
220	220	240	240	250	235

*) Concentrate for blending unreinforced PP

The Celstran® LFRT portfolio includes many different grades that can be used in a wide variety of applications. Please find more information on the major application areas and the Celstran® LFRT product portfolio below. More detailed information on the properties of these grades is listed in the table "Physical properties."

Celstran® LFRT products are comprised of a number of possible matrix-fiber combinations, and this applies to all of our product line, (for example, PC/ABS, PBT, POM, PPS, TPU; and, as fiber materials, carbon, aramid or stainless steel). There are and additional color options.

Many grades can be further customized on request. In some cases, Celstran® LFRT concentrates are available (PP-GF and resins with stainless-steel fibers) that allow more flexibility, depending on the final dilution ratio. Not all of these grades are listed in this brochure. More information is available upon request.

Industry	Description	Main Applications	Celstran® Long Fiber Solutions
Automotive	Celstran® LFRT is present in nearly every automobile on the road.	Interior (IP, Airbag, Center Console), Exterior (Mirror Housing, Mirror Lever Arm)	Celstran® PP, Long Glass Fiber [1,2,3,4,5] Celstran® PA, Long Glass Fiber [1,3,4] Celstran® POM, Long Aramid Fiber Celstran® POM, Long Stainless Steel Fiber [4]
Consumer Electronics	Celstran® LFRT is a unique and high-tech choice in consumer electronics applications.	Electrically conductive and dissipative applications (laptops, sensor housings, shielded connectors)	Celstran® PA, Long Carbon Fiber Celstran® PPS, Long Carbon Fiber Celstran® PPS, Long Stainless Steel Fiber [4,5] Celstran® PCABS, Long Stainless Steel Fiber [3,4]
Building & Construction	Delivering exceptional toughness, structural durability and aesthetics, Celstran® LFRT is used to replace wood and metal.	Building profiles, scaffolding, furniture, solar panels, industrial power tools	Celstran® PA, Long Glass Fiber [1,3,4] Celstran® TPU, Long Glass Fiber [1,3,4] Celstran® PP, Long Glass Fiber [1,2,3,4,5] Celstran® PBT, Long Glass Fiber [1,2,3,4]
Oil & Gas	Celstran® offers solutions that stand up exceptionally well to oil and salt water and retain their properties under extreme performance requirements.	Fuel tank connectors, seismic cable connectors, sensor housings on oil rigs	Celstran® TPU, Long Glass Fiber [1,3,4] Celstran® PPS, Long Glass Fiber
Agriculture	Celstran® LFRT delivers weight reduction and resistance to corrosion as a metal replacement solution.	Heavy agricultural equipment, ventilation fans, gardening equipment, spray nozzles	Celstran® PP, Long Glass Fiber [1,2,3,4,5] Celstran® PA, Long Glass Fiber [1,3,4] Celstran® PP, Stainless Steel Fiber [4,5] Celstran® PA, Stainless Steel Fiber [4,5]

Possible specialty formulations:
1) UV stabilization,
2) Low emission,
3) Heat stabilization,
4) Speciality appearance options,
5) High % fiber loaded concentrate

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ENGINEERED MATERIALS

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