ECP、TCP & REINFORCED PLASTICS

MODIFIED PLASTICS

Company Overview

Established in Shenzhen, China, in 1993, FRD manufactures a wide range of products including EMI Shielding Materials, Thermal Interface Materials and other related electronic materials. FRD is a registered National Hi-Tech Enterprise and certificate of ISO9001, ISO14001, QC080000 and OHSAS18001.

FRD works to satisfy the needs of its customers and we excels in speed and flexibility. FRD has long-term business relationships with customers such as Huawei, ZTE, Cisco, Nokia, Alcatel-Lucent, Juniper, Dell, H3C, Microsoft, Lenovo, Xiaomi, Samsung, Foxconn, Flextronics, Jabil, PEGATRON, SANMINA-SCI, O-Film Emerson, GREE, BYD, FUJI XEROX, TOSHIBA, etc.

As a leading manufacturer in its industry, FRD is growing tremendously. We are willing to provide quality products and services for more customers in various industries than our competition. These industries include networks & telecommunication equipment, consumer electronics, automotive, power supplies, lighting, military, aerospace, etc.

In future, FRD will continue to meet the challenge, to grow the FRD brand name, and to strive to become a world-class technology leader in new materials for all of our manufacturing processes.

FRD Building (Shenzhen)

New South China Base
Shenzhen Guangming FRD New Materials Park

East China Base
Kunshan FRD Electronic Materials Co.,Ltd.

North China Base
Tianjin FRD Science & Technology Co.,Ltd.

ISO 9001 ISO 14001 QC 080000 OHSAS 18001 ISO/TS 16949 UL CSA

CONTENTS

Modified Plastics

FRD ® Modified Plastics

FRD modified plastics include electrically conductive plastics (ECP), thermally conductive plastics (TCP) and reinforced plastics; In addition, FRD is the domestic leading manufacturer of metalized carbon fiber. FRD product covers general plastics (ABS, PP, PE, PS, etc.) , engineering plastics (PC, PPO, PC/ABS, PA6, PA66, POM, PBT/PET, etc.) and high-performance plastics (PPS, PEEK, LCP, PPA, etc.) , modifying agent including glass fiber, metal fibers, carbon nanotubes, carbon black and a variety of minerals.

By virtue of many original technologies with independent intellectual property rights of FRD, product performance indicators in the domestic leading level, and to meet or exceed the international advanced level, is gradually substituting the foreign similar products. With strong technical strength, FRD In addition to providing a series of standard products can also be tailored to fit the customers' needs the customer needs, providing customers with the overall solution of plastic modification.

FRD Company is one of the earliest factory began to research and manufacture modified plastics in 2006 and owns some patents.

ECP Introduction

ECP consists conductive fillers in resin, is functional polymer material in the form of plastics. Generally, there are four kinds of object conductivity: isolator, semiconductor, conductor and superconductor. ECP realized the great change from isolator to semiconductor then conductor. Compared with traditional material, it is low weight, easy to form and able to adjust conductivity.

They can also get complicate structure through molecular design. ECP can be used as antistatic material, conductive material and EMI shielding material by different purposes.

- Base material include: PC/ABS, PC, ABS, PA, PPE, etc.;
- Conductive fiber mainly include: nickel plated carbon fiber, stainless steel fiber, etc.;
- ECP has the function of EMI shielding and grounding.

Leading Technology of Nickel Plated Carbon Fiber Composite Material

Compared with other fibers, nickel plated carbon fiber has higher strength, higher modulus and lower density.

Good heat/ electrical conductivity, flame retardant and extremely low coefficient of thermal expansion , it can withstand high temperature and corrosions. Meanwhile, carbon fiber is an important development orientation in EMI shielding material for its good mechanical and good processing property.

Nickel plated carbon fiber (metalized fiber)

Nickel graphite powder compounded into PC/ABS polymer system and cross head extruded on top of fiber.

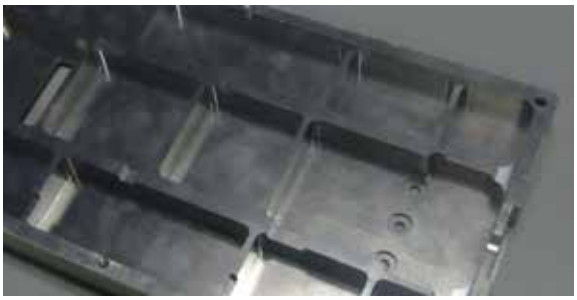
FRD Leading technology of nickel plated carbon fiber raw material

The Advantages of ECP Compared with Metal

- Design the shielding effectiveness as requirement
- Good corrosion resistance, long service life
- Possible to process complicated structure
- No secondary processing, less waste and quick delivery
- Low loss lead to decrease cost
- Remove shielding gasket at seams, decrease assemble time and cost
- Low density, reduce transportation costs.

Revolutionary Replacement of Die-casting Metal

Metal is the most widely used EMI Shielding material. The main shielding way is reflection loss and rarely absorbing loss. The advantages include high strength, good flexibility, and excellent conductivity of electric, magnetic, thermal and high shielding effectiveness. Meanwhile, it has some weaknesses such as: high energy loss, fixed shielding effectiveness, high density, poor corrosion resistance, hard to forming, poor human comfort and high cost in complicated processing case, hence it's a trend that metal will be replaced by new shielding material.



ECP consist conductive filler into polymer, is the most widely researched new EMI shielding material. The main shielding modes are reflection (especially 10GHz below) loss and absorption loss when transmission.

Advantage:

- One-processing forming can short the manufacturing time for mass production;
- The main components are recyclable for EOL products and don't need expensive treatment as coated or plated parts. It does completely solve the recycle problem.

ECP have been widely concerned since 80th last century. The US, UK and Japan commenced to research it earlier, hence they had marketed lots of varieties and replaced Aluminum alloy with ECP in some areas (automotive, electric, etc). Here are some comparisons between aluminum alloy and ECP:

（1）Shielding effectiveness

The shielding effectiveness of ECP could be adjusted by change plastics thickness which is between 30 and 90dB. ECP is both electrically conductive and paramagnetic, which provides levels of EMI shielding beyond the indicated performance of surface conductivity tests. A surface conductivity test of a ECP part can't represent its total shielding performance. The total amount of shielding effectiveness of any EMI shield is equal to the reflective and absorptive losses. The greater the conductivity, permeability, thickness and frequency, the greater the attenuation due to absorption. The greater the conductivity and the lower the frequency, the greater the reflective losses.

Commonly used metals, such as aluminum and magnesium alloys, shield based upon their conductivity with little to no permeability. EMI shielding is achieved primarily by reflection (especially below 10GHz) and absorption due to skin depths. ECP permeability provides incremental shielding effectiveness above the reflective losses by way of enhanced absorption at all frequencies.

Compared to surface coatings (such as vacuum deposited Al, Ni/Cu plating or conductive paints), higher grades of ECP can be equal in conductivity, providing comparable reflective losses. All grades of ECP provide significantly higher shielding absorption due to the permeability and thickness. ECP is used as the structural element with thicknesses at least an order of magnitude greater than the coating. Shielding from absorption is directly proportional to thickness, allowing ECP to outperform surface coatings. ECP nickel, graphite and carbon fiber components all possess intrinsic loss properties. By using these materials, ECP absorptive properties exceed any other commercially available ECP EMI shielding material. Excellent shielding effectiveness is obtained by adding ECP reflective and absorptive performance together.

(2) Corrosion resistance

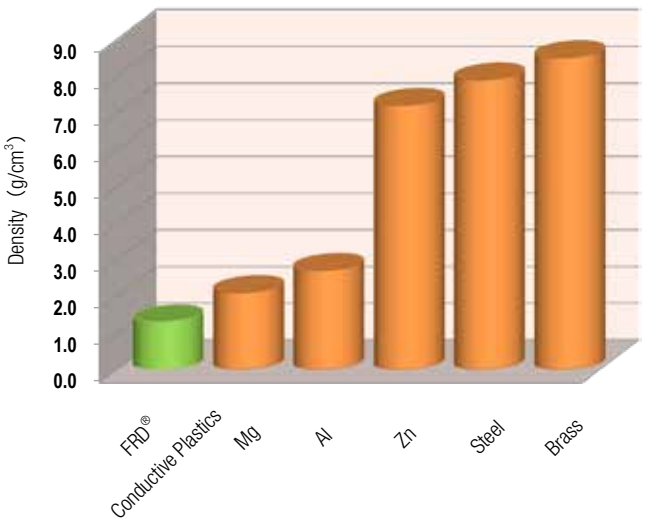
ECP are high performance engineering plastics based (ABS/PC etc), hence get good chemical corrosion resistance, process capability and low manufacturing energy loss.

Making it a excellent choice for outdoor application in harsh environment. After 360 hours of salt spray exposure (ASTM B117), electromagnetic shielding effectiveness has no change.

This performance is the direct result of the intrinsic corrosion resistance of the highly stable nickel plated carbon fiber and nickel graphic powder. Now ECP shielding can achieve a stable status in harsh environment without expensive painting or plating.

(3) Weight savings

ECP parts can weigh up to four times less than commonly used metal parts. The density of ECP at 1.2 to 1.4g/cm^3 is one-half the density of aluminum (2.7g/cm^3), and far less than other commonly used metals. ECP light weight, coupled with the ability to mold walls as thin as 1.0mm or one-half as thick as Al die castings allow ECP parts to weigh 75% less. Although ECP must have thicker walls than a stamped-bent metal stainless steel part due to the large reduction in density, ECP can Weigh 50% less than the stainless steel part. For weight sensitive transportation or handheld device applications, ECP can help reduce weight and save cost.



(4) Part costs comparison

ECP is expensive than Al alloy of raw material for the parts at same volume.

But for processing cost, Al alloy processes are more complicated (raw material → heat treatment → casting → precision forging → machining → precision cutting → polishing → sandblasting → wiredrawing → laser engraving → anodizing → oxidation colored), but the processes of conductive plastics are rather simple(fiber metallization → resin coating → pelletizing → injection → forming → co loring), ECP is less demanding of processing machine, short process cycle and high manufacturing effectiveness hence get low processing cost. In above, ECP parts have equal price with Al alloy parts when the structures are simple; and ECP parts have lower price than Al alloy parts when the structures are complicate.

(5) Energy consumption comparison

Engineering plastics such as ABS/PC have a further less energy consumption than Al alloy material.

(6) Designability comparison

Although it's very hard for ECP to get a shielding effectiveness beyond Al alloy in frequency range from 30-1680MHz, but Al alloy is not shielding effectiveness designable.

For example, Al alloy could not meet the EMI shielding requirement in low frequency. Meanwhile ECP are able to adjust the shielding effectiveness through changing the fillers to meet different requirements to meet different frequency range.

(7) Conclusion

ECP are light weight, high strength, anti-corrosion, low cost and easy forming material. Compared with aluminum alloy, which have irreplaceable advantages in the aspect of either performance or cost (especially for complicated part). Hence ECP will have widely and optimized prospect. It is becoming a trend that to replace commonly used metal shells or parts with ECP in electric industry.

ECP is Environmentally Friendly

ECP complies with worldwide directives for ecological compatibility, such as the European Union Restriction on Hazardous Substances (EU-RoHS), TCO (Swedish Confederation of Professional Employees), and U.S. Environmental Protection Agency standards, by containing no halide or banned compounds. ECP allows for compliance with Ecma Product-related Environmental Declarations by containing no substances listed as hazardous for plastic components.

If a device's function includes prolonged skin contact, ECP material complies with EN1811 for Ni extraction, allowing for use on hand-held devices. The specification, developed by CEN (Comité Européen de Normalisation, European Committee for Standardization) in response to dermatological reaction to nickel plated jewelry, sets a threshold limit of 0.50µg/cm^2/week of nickel leaching when the item comes in contact with perspiration. ECP performance is well under the limit.

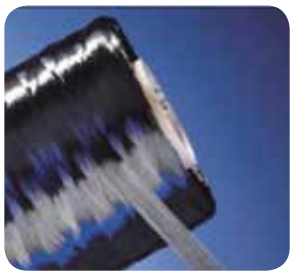
At the end of product life, ECP parts can be recycled by regrinding using a grinder to comply with stringent disposal regulations. Unlike painting or plating, no costly stripping is required, solving the recycling problem. Scrap may occur in normal production from runners, startup, shutdown or other sources can be re-ground and re-used eliminating waste during the production cycle. Re-ground ECP parts may be used up to 15% by weight without affecting performance. ECP allows for cost effective compliance with end-of-vehicle-life (EoVL), TCO and the EU Waste in Electrical and Electronic Equipment (WEEE) directives.

EMI Shielding Level* ECP Performance

- Surface resistivity (Ω) : 0.5~250
- Shielding effectiveness (30MHz - 10GHz) (dB) : 40~85
- Density (g/cm^3) : 1.2 ~1.4
- Tensile strength (MPa) : 50~120
- Bending strength (MPa) : 70~150
- Bending modules (MPa) : 2400~6000
- Working temperature (℃) : -40~90
- Flame retardant: UL 94 V-0 /1.6 mm
- Color: black、gray、blue-gray、etc.

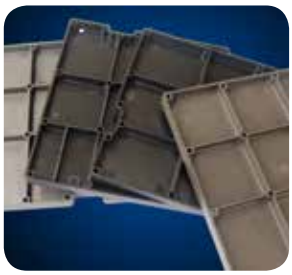
*Note: Conductive plastics can be classified into: antistatic material, (surface resistance 10^9~ 10^{12}Ω/sq)、static elimination material (surface resistance 10^6~10^9Ω/sq)、electrically conductive material (surface resistance 10^3~10^5Ω/sq) EMI shielding material (surface resistance 10^0~10^3Ω)

Manufacturing Process of ECP



Fiber

Palletizing



Injection Mold

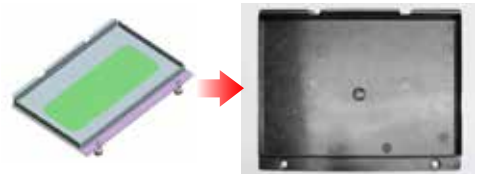
Application Field

ECP can be widely used for Anti-electromagnetic interference (EMI/RFI) and antistatic (ESD) in electronic/micro-electronic, telecommunication, medical machinery, petroleum & chemical, military, aerospace and other fields.

Application Cases of ECP

>> C Company Project PS Cover

- The customer at early stage using plastic parts plus sheet metal, then FRD recommended ECP with convenient assembly.

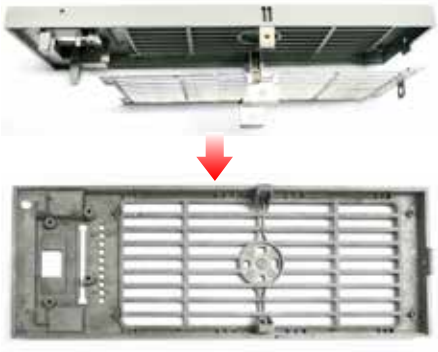


>> D Company Shielding Cavity

- Customers previously used aluminum alloy castings with high cost of production and low efficiency;
- Using FRD CP-SS-103 material, the performance meet customers shielding requirements with much lower cost and half weight .

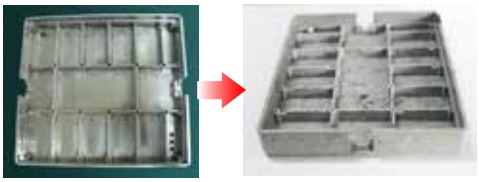
>> E Company Power Supply Cover

- The customer at early stage using plastic parts plus sheet metal with high cost and low efficiency.
- Then FRD recommended ECP integration scheme with convenient assembly and low cost.



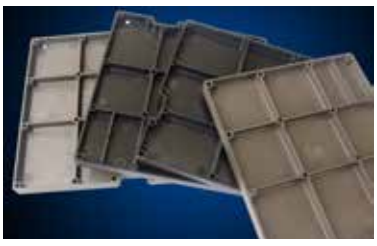
>> T Company Shielding Cavity

- Customers previously used ordinary ABS chrome, long-term use Coating easy to fall off so that the product function failure;
- Using FRD CP-SS-106 material , product reliability got better with no cost increase.



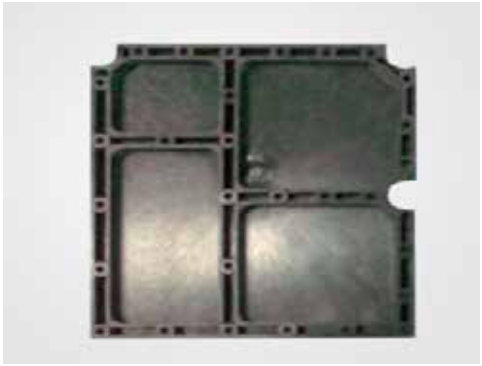
>> Z Company Shielding Cavity

- Customers previously used aluminum alloy castings with high cost of production and low efficiency;
- Using FRD CP-SS-103 material, the performance meet customers shielding requirements with lower cost and half weight.

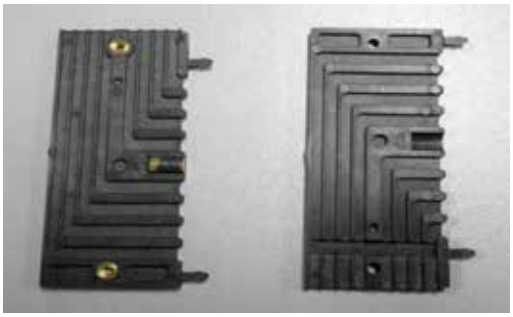


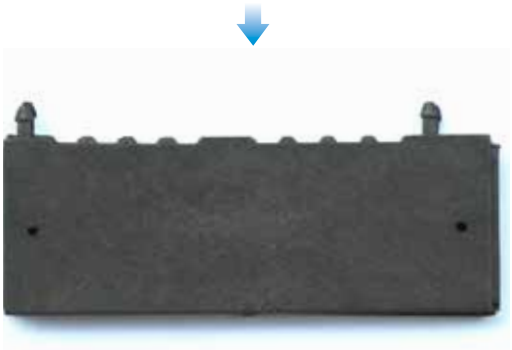
Application Cases of ECP

Shielding Cavity（CP-SS-106）

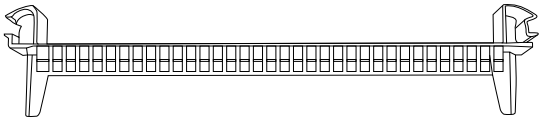


Flashlight Guide Box

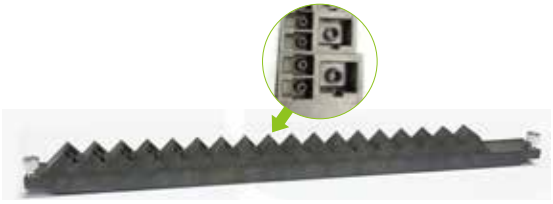




Faceplate（CP-SS-105）



Faceplate(CP-SS-1010RHA)



Using ECP integration solution

Thermally Conductive Plastics (TCP) Introduction

TCP is a kind of polymer composites filled with high thermally conductive fillers.

- Heat evenly and avoid burning point, reduce the local deformation caused by high temperature of parts;
- Light weight, 40-50% lighter than aluminum;
- Easy to form, no secondary processing;
- Flexible product design.

Main matrix material: PPS, PA6 / PA66, LCP, TPE, PC, PP, PPA, PEEK, etc.

Main filler: AlN, BN, SiC, Al_2O_3, $Mg(OH)_2$, Graphite, etc.

TCP - Product Categories

According to the ways to improve thermal performance, TCP can be divided into:

Synthetic TCP

► Synthesis of a polymer having a high thermal conductivity, such as a complete crystal, through the phonon realize thermal conductivity;

Filling TCP

► The polymer filled by a high thermally conductive filler particles, fibers, and the layer sheet.

Filling TCP can be divided into two categories:

Thermally conductive but electrically non -conductive

► Thermal conductivity is not high, about 1.5 W/m.k;

► Main fillers include metal oxide Al_2O_3 , MgO, SiO_2 , metal nitrides AlN , Si_3N_4 , BN and SiC , B_4C_3 , etc.

Thermally and electrically conductive

► The thermal conductivity can reach 5.0 W/m.k or higher

► The main fillers include metal powder / fiber, graphite, carbon fiber, CNT, graphene, etc.

TCP - Thermal Conductivity of Typical Polymer Materials

Thermal Conductivity of Typical Polymer Materials

Material	PE	LDPE	HDPE	PVC	PS	PP	PMMA	PA
Thermal Conductivity λ W/(m·K)	0.33	0.33	0.44	0.13-0.17	0.08	0.24	0.17-0.25	0.25

Thermal Conductivity of the Common Fillers

Material	Ag	Al	Ca	Mg	Fe	Cu	Au	BeO
Thermal Conductivity λ W/(m·K)	417	190	380	103	63	398	315	219
Material	**MgO**	**Al_2O_3**	**CaO**	**NiO**	**AlN**	**SiN**	**c-BN**	**h-BN**
Thermal Conductivity λ W/(m·K)	36	30	15	12	320	270	1300	40-120

TCP - Conduction and Convection Leading Role

- The temperature difference primarily associated with the cold side convection (convection limited) when thermal conductivity above a certain threshold. The plastic with low coefficient of thermal conductivity can replace metal of cooling and temperature won't significantly increase;
- The temperature difference is mainly restricted by the thermal conductivity of materials (conduction limited) when that below a certain threshold.

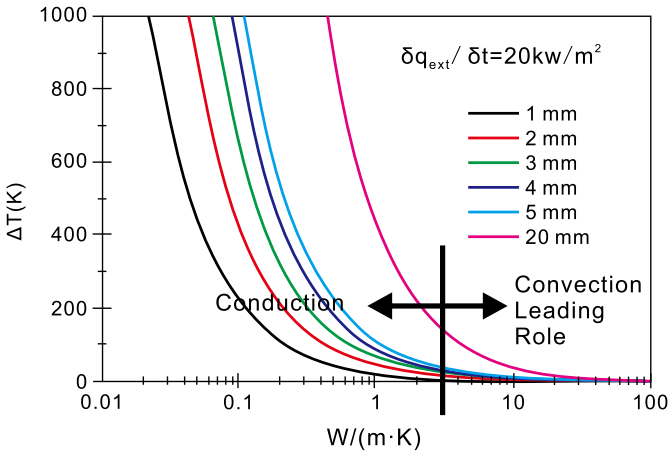


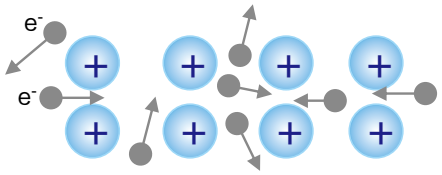
Diagram shows the relationship between the coefficient of thermal conductivity and the heat dissipation: the abscissa is the coefficient of thermal conductivity, ordinate is the temperature difference of heat source and the environment. The curve of all sorts of color is the distance between heat source and the surface of radiator. If the distance is less than 5 mm (green curve), as long as the coefficient of thermal conductivity is greater than 5 w/m K, the cooling ability is completely determined by convection. And for the ideal radiator, about 70% heat by convection, 30% heat by radiation

Note: The smaller temperature difference, the smaller the distance, the coefficient of thermal conductivity is less important.

TCP - Thermal Conducting Mechanism

Thermally & Electrically

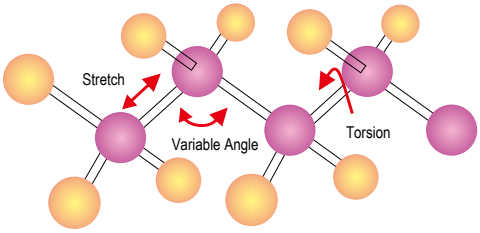
Heat Conduction by Free electron



Higher Thermal Conductivity

Thermally Conductive but Insulated

Heat Conduction by Phonon



A Good Balance Between Thermal Conductivity and Processability

TCP - Filling Type Thermal Plastics Heat Conduction Mechanism

1. The thermal performance of TCP depends on the interaction between the polymer and thermally conductive filler

2. Different kinds of fillers with different thermal conducting mechanism
   - Metal packing heat conduction by electron motion;
   - Nonmetallic filler heat conduction by phonon, its thermal diffusion rate mainly depends on the vibration of neighboring atom or a bonding group.

3. Influence factors of thermal conductivity of fillers on thermal performance
   - Filler types;
   - Filler form and particle size;
   - Filler content;
   - Filler surface treatment.

TCP - Products Applications

>> Battery Case

- Reduce cell surface temperature, improve safety;
- Extend battery life;
- Shorten battery charging time.

>> LED Lamp Shade

- Reduce the weight of LED light, improve safety;
- Reduce LED lamp temperature, improve the light quality, prolong the life of the lamp;
- More environmentally friendly low-carbon.

>> Electric Tool Shell

- Reduce the shell surface temperature, improve the comfort and safety;
- Prolong the life of the tool.

>> Motor Coil Skeleton

- Reduce the skeleton temperature, improve the reliability;
- Prolong the service life.

Other Applications

Video conference system shell
(TH-AO-303RH)

Smart phones card shell
(TH-AO-303RH)

Wireless network card shell
(TH-AO-303RH)

Reinforced Plastics Introduction

The reinforced plastics is using high-intensity discontinuous fibers (such as carbon fiber, glass fiber, etc.) reinforced resin matrix composite;

Fiber-reinforced plastics products produced by independent research and development of technology have long residual fiber length, close interfacial bonding and fibers uniform dispersion

Reinforced Plastics - Compared with Metal Material, Reinforced Plastics has the Following Advantages

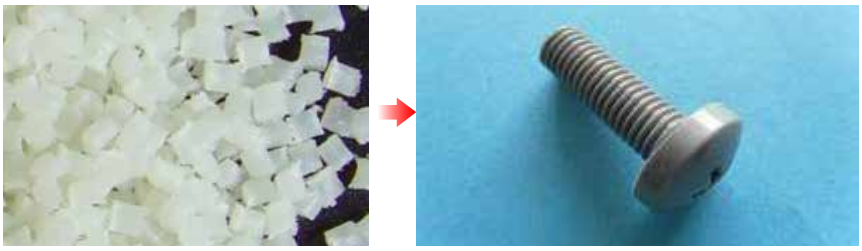
- Light weight, high strength, reduce transportation costs;
- Corrosion resistant, high temperature resistant;
- Easy processing, environmental protection, recycling etc;
- Meet the current and future trend of plastic to replace steel.

Reinforced Plastics Types

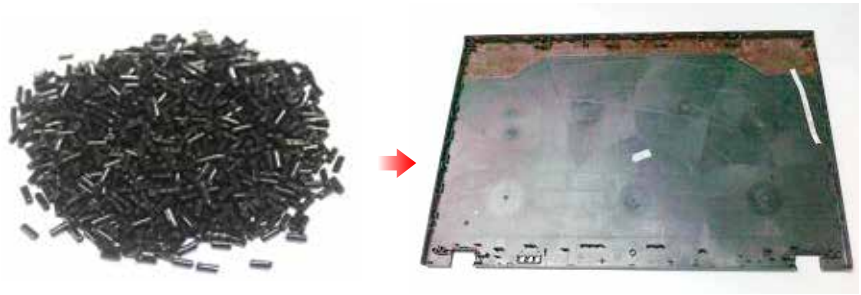
- Glass fiber reinforced plastics
- Carbon fiber reinforced plastics
- Low temperature resistant reinforced plastics
- Anti-UV reinforced plastics

Reinforced Plastics Types

Glass Fiber Reinforced Plastics



Carbon Reinforced Plastics



Low Temperature Resistant Reinforced Plastics and Anti-UV Reinforced Plastics

ABS Modified Plastics

PP Modified Series

PBT Modified Plastics

Flame Retardant PA66

*Products can be customized according to the customer's requirements.

Stainless Steel Fiber ECP

>>Technical Data Sheet

Properties[1]	Test Standards	Units	Typical Values[2]			
			CP-SS-103	CP-SS-105	CP-SS-106	CP-SS-1010RH
Mechanical						
Tensile Strength	ISO 527	MPa	65	42	65	45
Elongation at Break	ISO 527	%	1.60	0.98	3.20	2.00
Tensile Modulus	ISO 527	GPa	4.3	5.0	3.0	3.0
Bending Strength	ISO 178	MPa	90	74	100	75
Flexural Modulus	ISO 178	GPa	3.8	4.9	3.6	3.5
Impact Strength （Notched）	ISO 179	kJ/m^2	6.5	7.0	9.0	7.0
Electrical						
Volume Resistivity	ISO 3915	Ω·cm	10^{-2}	10^{-2}	10^{-2}	10^{-2}
Surface Resistance	FRD Company Standard	Ω	10^{1}	10^{1}	10^{1}	10^{1}
Shielding Effectiveness @1.2mm/30MHz-10GHz	MIL-DTL-83528C	dB	40~60	45~70	35~55	40~60
Shielding Effectiveness @3.0mm/30MHz-10GHz	MIL-DTL-83528C	dB	45~70	55~85	40~60	50~70
Thermal						
Heat Distortion Temperature	ISO 75/1.8MPa	℃	110	80	115	100
Flame-Retardant Grade	UL-94/1.6mm		V0	V0	V2	V0
Others						
Density	ISO 1183	g/cm^3	1.39	1.62	1.31	1.45
Color			Gray, Black	Gray, Black	Gray, Black	Gray
Processability						
Melt Temperature		℃	230~260	180~210	230~260	220~270
Mold Temperature		℃	80~100	60~80	80~100	70~100
Back Pressure		MPa	10~15	10~15	10~15	2~10
Pre Drying			100℃，4~6h	80℃，4~6h	100℃，4~6h	80℃，4~6h

Note：[1] Properties may change after colored.
[2] Typcial value is mean value from laboratory tests, which will not be construed as specification and is for reference only.
The company can customize product according to customer's requirements, and provide samples and technical support.

Nickel Plated Carbon Fiber ECP

>>Technical Data Sheet

Properties[1]	Test Standards	Units	Typical Values[2]		
			CP-NC-203N	CP-NC-203R	CP-NC-204N
Mechanical					
Tensile Strength	ISO 527	MPa	90	70	100
Elongation at Break	ISO 527	%	0.8	0.6	0.6
Tensile Modulus	ISO 527	GPa	11	10	14
Bending Strength	ISO 178	MPa	140	90	170
Flexural Modulus	ISO 178	GPa	9.0	8.5	12
Impact Strength （Notched）	ISO 179	kJ/m^2	5.5	4.0	5.5
Electrical					
Volume Resistivity	ISO 3915	Ω·cm	10^{-2}	10^{-2}	10^{-3}
Surface Resistance	FRD Company Standard	Ω	10^{1}	10^{1}	10^{1}
Shielding Effectiveness @1.2mm/30MHz-10GHz	MIL-DTL-83528C	dB	55~75	55~75	60~80
Shielding Effectiveness @3.0mm/30MHz-10GHz	MIL-DTL-83528C	dB	65~90	65~90	75~90
Thermal					
Heat Distortion Temperature	ISO 75/1.8MPa	℃	115	115	115
Flame-Retardant Grade	UL-94/1.6mm		V2	V0	V2
Others					
Density	ISO 1183	g/cm^3	1.40	1.33	1.45
Color			Gray	Gray, Black	Gray
Processability					
Melt Temperature		℃	220~250	220~250	220~250
Mold Temperature		℃	70~100	70~100	70~100
Back Pressure		MPa	5~10	5~10	5~10
Pre Drying			85℃，4~6h	85℃，4~6h	85℃，4~6h

Note：[1] Properties may change after colored.
[2] Typcial value is mean value from laboratory tests, which will not be construed as specification and is for reference only.
The company can customize product according to customer's requirements, and provide samples and technical support.

Carbon Fiber ECP

>>Technical Data Sheet

Properties[1]	Test Standards	Units	Typical Values[2]		
			CP-CF-1051D	CP-CF-3001RH	CP-CF-3002RH
Mechanical					
Tensile Strength	ISO 527	MPa	70	120	120
Elongation at Break	ISO 527	%	1	0.7	0.7
Tensile Modulus	ISO 527	GPa	9	16	16
Bending Strength	ISO 178	MPa	90	190	190
Flexural Modulus	ISO 178	GPa	6	12	12
Impact Strength （Notched）	ISO 179	kJ/m^2	5	6.5	6.5
Electrical					
Volume Resistivity	ISO 3915	Ω·cm	10^2	10^{-1}	10^{-1}
Surface Resistance	FRD Company Standard	Ω	10^2	10^2	10^2
Shielding Effectiveness @1.2mm/30MHz-10GHz	MIL-DTL-83528C	dB	10~30	10~30	10~30
Shielding Effectiveness @3.0mm/30MHz-10GHz	MIL-DTL-83528C	dB	20~40	20~40	20~40
Thermal					
Heat Distortion Temperature	ISO 75/1.8MPa	℃	90	210	210
Flame-Retardant Grade	UL-94/1.6mm		HB	V0	V0
Ultraviolet Aging Test			---	---	PASS
Others					
Density	ISO 1183	g/cm^3	1.09	1.25	1.25
Color			Black	Black	Black
Processability					
Melt Temperature		℃	190~210	220~255	220~255
Mold Temperature		℃	50~80	80~100	80~100
Back Pressure		MPa	2~10	4~8	4~8
Pre Drying			80℃，4~6h	80℃，4~6h	80℃，4~6h

Note：[1] Properties may change after colored.
[2] Typcial value is mean value from laboratory tests, which will not be construed as specification and is for reference only.
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Nickel Plated Carbon Fiber

>>Product Introduction

Surface metalized carbon fiber can get 10 times electrical conductivity than before which is ideal filler for ECP. FRD has owned technology and became the unique manufacturer of metalized carbon fiber in China. Meanwhile, our fibers have better performances than the similar products from oversea.

>>Advantages

- Metal plating is dense uniform structure;
- No damage to fiber and keep the high mechanical performance;
- Excellent thermal, electrical conductivity, very low coefficient of expansion;
- High EMI shielding effectiveness.

Nickel Plated Carbon Fiber

>>Application Fields

Military, aerospace, automotive, electronic, machinery, chemical industry

>>Processing Parameters

Properties[1]	Test Standards	Units	NC-12A[2]
Mechanical			
Tensile Strength	ISO 11566	MPa	3000
Tensile Modulus	ISO 11566	GPa	160
Elongation at Break	ISO 11566	%	1.3
Electrical			
Resistivity	QJ 3074	Ω·cm	$0.9x10^{-4}$
Density			
Density	ISO 10119	g/cm^3	3.3
Linear Density	ISO 10120	g/km	1460
Tow		Piece	12000
Filament Diameter		μm	8.4
Nickel Thickness		μm	0.7
Nickel Content		%	69
Cross Section Area		mm^2	0.67
Twist / Twistless			Twistless

Note: [1] Contact FRD company to get more product information.
[2] Typcial value is mean value from laboratory tests, which will not be construed as specification and is for reference only.
The company can customize product according to customer's requirements, and provide samples and technical support.

Thermally Conductive Plastics

>>Technical Data Sheet

Properties[1]	Test Standards	Units	Typical Values[2]					
			TH-A0-302	TH-A0-301RG	TH-C-301	TH-C-302RH	TH-MH-3001RH	TH-MH-3002RH
Mechanical								
Tensile Strength	ISO 527	MPa	90	75	60	60	70	80
Elongation at Break	ISO 527	%	3.0	0.5	0.6	0.8	0.5	1.2
Bending Strength	ISO 178	MPa	170	140	85	90	140	130
Flexural Modulus	ISO 178	GPa	4.0	10.0	10.0	6.0	10.0	5.0
Impact Strength (Notched)	ISO 179	kJ/m^2	7.0	3.0	3.0	2.0	2.0	2.5
Mold Shrinkage (Cross-flow)	ASTM D995	%	0.90	0.15	0.50	0.80	0.15	0.30
Shore Hardness	ISO 868	HD	89	90	80	80	80	85
Electrical								
Volume Resistivity	IEC 60093	Ω·cm	10^{14}	10^{14}	10^{6}	10^{14}	10^{14}	10^{14}
Surface Resistance	IEC 60093	Ω	10^{14}	10^{14}	10^{6}	10^{14}	10^{14}	10^{14}
Thermal								
Thermal Conductivity (Z-Axis)	FRD Company Standard	W/(m·K)	1.0	1.1	3.5	1.2	1.0	0.6
Heat Distortion Temperature	ISO 75 /1.8MPa	℃	80	120	170	90	140	95
Flame-Retardant Grade	UL-94 /1.6mm		N/A	V0	N/A	V2	V0	V2
Others								
Density	ISO 1183	g/cm^3	2.00	2.10	1.36	1.37	1.60	1.45
Melt Index	ISO 1183	g/10min	20 (250 ℃ /2.16kg)	10 (275 ℃ /2.16kg)	9 (265 ℃ /2.16kg)	9 (265 ℃ /2.16kg)	10 (275 ℃ /2.16kg)	30 (275 ℃ /2.16kg)
Color			Gray	White	Black	Black	White	White
Halogen-Free			Yes	No	Yes	Yes	Yes	Yes
Processability								
Melt Temperature		℃	235~275	230~275	235~275	230~275	240~280	235~275
Mold Temperature		℃	80~100	80~100	80~100	80~100	80~100	80~100
Back Pressure		MPa	1~3	1~3	1~3	2~4	1~3	2~4
Pre Drying			100℃, 4~6h	100℃, 4~6h	100℃, 4~6h	100℃, 4~6h	100℃, 4~6h	100℃, 4~6h

Note: [1] Contact FRD company to get more product information.
[2] Typcial value is mean value from laboratory tests, which will not be construed as specification and is for reference only.
The company can customize product according to customer's requirements, and provide samples and technical support.

Carbon Fiber Reinforced Plastics

>>Product Introduction

FRD has selected carbon fibers and owned cladding process so to produce the reinforced plastics which can achieve the highest mechanical performance level of the world.

Application Fields: Aerospace, automotive, military, sports equipments

>>Advantages

- Decrease 20%~ 30% usage of fiber to get the same performance hence get greatly cost down
- Replace traditional metal as sub-structure components hence get greatly weight saving.
- Excellent oil, fiction resistance, processability and dimensional stability

>>Processing Parameters

Properties[1]	Test Standards	Units	Typical Values[2]	
			FP-GF-3001	FP-GF-7001
Mechanical				
Tensile Strength	ISO 527	MPa	150	95
Elongation at Break	ISO 527	%	1.0	0.8
Tensile Modulus	ISO 527	GPa	14	12
Bending Strength	ISO 178	MPa	220	130
Flexural Modulus	ISO 178	GPa	10	9
Impact Strength （Notched）	ISO 179	kJ/m^2	8	4.5
Electrical				
Volume Resistivity	ISO 3915	Ω·cm	10^1	10^1
Surface Resistance	FRD Company Standard	Ω	10^{14}	10^3
Thermal				
Heat Distortion Temperature	ISO 75/1.8 MPa	℃	190	180
Flame-Retardant Grade	UL 94/1.6mm		HB	HB
Others				
Density	ISO 1183	g/cm^3	1.21	1.36
Color			Black	Black
Shrinkage Rate	ASTM D955	%	0.5~1.0	0.5~1.0
Processability				
Melt Temperature		℃	230~250	245~260
Mold Temperature		℃	80	80
Back Pressure		MPa	10~20	5~15
Pre Drying			85℃，4h	110℃，2~3h

Note：[1] Properties may change after colored.
[2] Typcial value is mean value from laboratory tests, which will not be construed as specification and is for reference only.
The company can customize product according to customer's requirements, and provide samples and technical support.

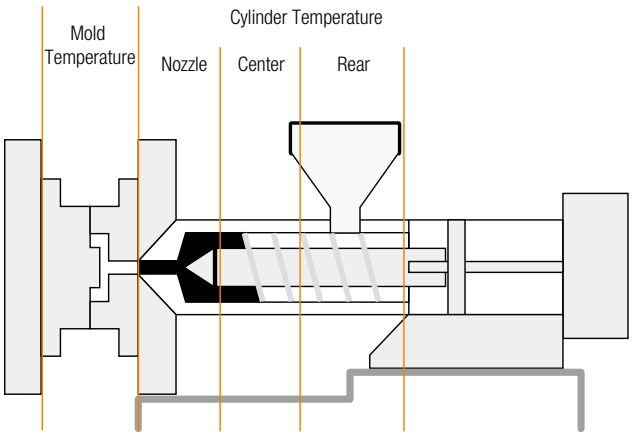
Glass Fiber Reinforced Plastics

>>Technical Data Sheet

Properties[1]	Test Standards	Units	Typical Values[2]				
			FP-GF-603	FP-GF-604	FP-GF-715	FP-GF-3001	FP-GF-9001
Mechanical							
Tensile Strength	ISO 527	MPa	165	170	75	125	62
Tensile Modulus	ISO 527	GPa	10	12	6	7.5	5
Elongation at Break	ISO 527	%	2.0	1.8	1.3	2.2	1.8
Bending Strength	ISO 178	MPa	250	245	95	190	83
Flexural Modulus	ISO 178	GPa	7	10	4.5	7.5	3.8
Impact Strength（Notched）	ISO 179	kJ/m^2	10	18	7	23	12
Thermal							
Heat Distortion Temperature	ISO 75/1.8MPa	℃	240	230	95	183	130
Flame-Retardant Grade	UL-94/1.6mm		HB	HB	HB	HB	HB
Others							
Color			Natural Color	Natural Color	Natural Color	Natural Color	Natural Color
Density	ISO 1183	g/cm^3	1.37	1.49	1.26	1.37	1.13
Shrinkage Rate	FRD Company Standard（3mm）	%	0.5~0.9	0.6~1.1	0.2~0.5	0.4~0.6	0.4~0.7
Fiber Content	Combustion Method	%	30	40	20	---	---
Processability							
Melt Temperature		℃	260~290	260~290	235~260	220~260	195~235
Mold Temperature		℃	80	80	30~80	90~110	40~60
Back Pressure		MPa	5~15	5~15	5~10	4~10	4~10
Pre Drying			85℃，4h	85℃，4h	80℃，2~4h	110℃，4~6h	85℃，3~5h

Note：[1] Properties may change after colored.
[2] Typcial value is mean value from laboratory tests, which will not be construed as specification and is for reference only.
The company can customize product according to customer's requirements, and provide samples and technical support.

>>Reinforced Plastic Parts Molding Guide



SHENZHEN FRD SCIENCE & TECHNOLOGY CO., LTD.
FRD Building, 8# Gaofa Industrial Park, Beihuan Blvd,
Nanshan District, Shenzhen, China
Tel: 86-755-8608-1680 8608-1686
Fax: 86-755-8608-1689

FRD (HONG KONG) CO., LTD.
Unit 503, 5/F, Silvercord, Tower 2, 30 Canton Road,
Tsimshatsui, Kowloon Hong Kong
Tel: 852-3519-5726
Fax: 852-3013-7466

KUNSHAN FRD ELECTRONIC MATERIALS CO., LTD.
FRD Industrial Park, 258 Dongping Road, Bacheng, Kunshan,China
Tel: 86-512-5785-1188
Fax: 86-512-5785-1199

TIANJIN FRD SCIENCE & TECHNOLOGY CO., LTD.
FRD Industrial Park, 160 Xiangyuan Road, JINGJIN Science&Tech Valley,
Wuqing District, Tianjin, China
Tel: 86-022-5969-5716
Fax: 86-022-5969-5718

BEIJING SHANGHAI XI'AN WUHAN TAIPEI SAN JOSE (USA) SEATTLE (USA) NETHERLANDS

www.frd.cn **info@frd.cn**

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