

Flame - retardant PS

| Product Introduction |

Kumho Flame-Retardant PS resin has a balance of superior physical properties, excellent impact strength, flowability, heat stability and mold ability but also has outstanding secondary process abilities such as painting and adhesion.

| Characteristics & Applications |

	Grade	Characteristics	Applications
Non-DECA Type	HFH 402ND	Non-toxic, V-2	Non-toxic V-2 applications as Tonor cartridge, TV and VCR housings
	HFH 407 HFH 430U	Non-toxic, General Purpose Non-toxic, UV Resistance	Non-toxic V-0 applications as Tonor cartridge, TV and VCR housings
	HFH 412	Non-toxic, High melt viscosity, V-2	Non-toxic V-2 application as OA Housing
Non-Halogen Type	HFH 405	Non-toxic, V-2	Non-Halogen V-2 applications as Tonor cartridge, TV and VCR housings

| Flame - retardant PS |

Typical Properties

Properties / Unit	Test Method [ASTM]	Test Condition	Non-DECA Type				Non-Halogen Type
			HFH-402ND Low Flammability	HFH-407 General Purpose	HFH-430U UV Resistance	HFH-412 Low Flow	HFH-405 Low Flammability
Tensile Strength [kg/cm (psi)]	D638	23°C	250 (3,550)	260 (3,690)	250 (3,550)	260 (3,690)	250 (3,550)
Elongation [%]	D638	23°C	40	35	40	40	40
Flexural Strength [kg/cm (psi)]	D790	23°C	340 (4,830)	320 (4,540)	310 (4,400)	320 (4,540)	310 (4,410)
Flexural Modulus [kg/cm (psi)]	D790	23°C	20,500 (291,000)	21,000 (298,000)	21,000 (298,000)	21,000 (298,000)	17,000 (240,000)
IZOD Impact strength [Kg · cm/cm(ft · lb/in)]	D256	3.2mm, Notched, 23°C (73°F)	10 (1.8)	10 (1.8)	9 (1.6)	9 (1.6)	10 (1.8)
Rockwell Hardness	D785	L scale	55	55	52	60	55
Heat Distortion Temp., [°C (°F)]	D648	18.6kgf/cm ² (264psi) Unannealed	75 (167)	75 (167)	74 (165)	77 (171)	72 (162)
VICAT Softening Temp., [°C (°F)]	D1525		91 (196)	91 (196)	89 (192)	94 (201)	86 (187)
Melt Flow Index [g/10min]	D1238	200°C, 5kg	13	10	17	7	13
Molding Shrinkage [%]	D955		0.3-0.6	0.3-0.6	0.3-0.6	0.3-0.6	0.3-0.6
Specific Gravity	D792		1.12	1.18	1.18	1.11	1.06
Water absorption [%]	D570		0.05	0.05	0.05	0.05	0.05
Flammability	UL94*	1/16" (1.6mm)	V-2	V-0	V-0	V-2(0.8)	V-2
		1/8" (3.2mm)	V-2	V-0	V-0	V-2(0.8)	V-2

(*JUL File No. E654224 (CSA File No. LS66457)
Note 1) These are typical property values, not specifications.
Note 2) In case of colored products, the values could vary slightly by color.
Note 3) Values are measured at 23°C and in RH of 50% on injection molded specimens.



KUMHO PS

Polystyrene

PS

| Product Introduction |

Having not only high strength and mold ability but also excellent secondary process ability in terms of dimensional and thermal stability, color ability, adhesion and paint ability, polystyrene resin is considered one of the five major general purpose resins, widely used for various electrical appliances, structural components, general merchandise, etc.

As a non-crystalline resin possessing various properties, such as PE, PP, etc. in molecular structure, polystyrene resin shows no change in properties and dimensions for changes in the degree of crystallinity.

Furthermore, having a low melt viscosity, it is not easily decomposed by heat, processing, thermoforming and expanded forming.

Generally, polystyrene resin is divided into two categories: General Purpose Polystyrene (GPPS) and High Impact Polystyrene (HIPS), with or without "impact modifiers"

GPPS, which can be polymerized by heat or chemical initiators, has high stiffness and high transparency compared with PE, PP and PVC. So-called, Crystal Polystyrene is a clean polymer that exhibits high stiffness, good dimensional stability, low specific gravity and excellent electrical properties.

Transparency, residual monomer content and molecular weight are very important factors in determining the properties of GPPS and should be considered when selecting a grade.

Kumho GPPS has good transparency, mold ability, and heat stability; therefore, processing by injection molding or extrusion molding is very economical.

GPPS has excellent transparency and stiffness but very low impact resistance. HIPS is a resin that provides enhanced impact strength through rubber-grafting. Rubber toughening makes possible a wide range of properties, depending on rubber content, morphology, size, degree of grafting, molecular weight of matrix PS, and other conditions.

Kumho HIPS has excellent impact strength, mold ability and heat-resistance. Its wide range of grades with various melt flows and impact strengths allows the selection of the appropriate grade for a specific application.

Furthermore, Kumho HIPS has excellent process ability for various molding techniques and also excellent secondary process ability, such as adhesion.



| Characteristics & Applications |

GPPS(General Purpose Polystyrene)

Because Kumho GPPS resins possess excellent transparency, mold ability, heat stability and low specific heat, they are very economical in injection or extrusion processes. In addition, because they are available in various grades, the range of choice is very wide, depending on use. Grades are classified depending on manufacturing method, in other words, changes in processing conditions or quantity of additives. There are general purpose, high flow, high heat resistance, high rigidity, extrusion molding and high transparent grades.

Grade	Characteristics	Applications
GP 125	Excellent Demoldability	Kitchen utensils, Cosmetic case, Dust covers for electronic
GP 125EB	High Strength	PSP (Tray, Cup)
GP 125E	Heat Resistance, Flow	XPS
GP 150K	Super High Strength	Refrigerator food trays, Humidifiers, Optical parts, Lighting equipment
GP 150I		
GP 150E		XPS

HIPS(High Impact Polystyrene)

Kumho HIPS resins have excellent impact resistance, mold ability and heat stability. In addition, as they have a wide range of melt flow and impact strength, they can provide a range of choices, depending on their use: general purpose grade, high flow grade, high heat resistance grade, extrusion molding grade, blow molding grade, high gloss grade, transparent grade and other special grades. Besides, their very high mold ability, they provide excellent productivity in various fabricating systems, such as extrusion, injection and other secondary processes.

Grade	Characteristics	Applications
HI 425	High Impact Strength	Office equipment, Electronic home appliances, Toys, Kitchen utensils, Miscellaneous goods, Leisure goods
	General Purpose	
HI 425TVL	High Flow	TV cabinet for low pressure gas injection molding, Key board
HI 425TV	High Heat Resistance	TV cavinet, Humidifier, Typewriter, Audio housings, Sports equipment, OA equipment
HI 450W	High Impact Strength	
HI 425E	High Strength Extrusion	Door liners, Disposable cups, Food packing sheet, Wrapping films, Trays, Washing machines, Refrigerator inner liner(HI 425EP)
HI 425EH	Cold Resistance Extrusion	
HI 425EP	ESCR	
HI 450PG	High Gloss, High Impact	PC swivel, Washing machine cover, Leisure table, Office equipments,
MIB IT	Demoldability	Disposable cups, Yogurt beverage bottles
MIB 237	Demoldability	

| Typical Properties of PS |

Properties / Unit	Test Method (ASTM)	Test Condition	Typical Properties							Typical Properties									
			GPPS							HIPS									
			GP 125 Excellent Demoldability	GP 125EB High Strength	GP 125E Heat Resistance, Flow	GP 150K Super High Strength	GP 150I Super High Strength	GP 150E Super High Strength	HI 425 High Impact Strength	HI425TVL High Flow	HI 425TV High Heat Resistance	HI450W High Impact Strength	HI425E High Strength Extrusion	HI425EH Cold Resistance Extrusion	HI425EP ESCR	HI450 PG High Gloss High Impact	MIB IT Demoldability	MIB237 Demoldability	
Tensile Strength [kg/ (psi)]	D638	GPPS 5mm/min HIPS 50mm/min	460 (6,532)	500 (7,100)	510 (7,240)	540 (7,668)	540 (7,668)	550 (780)	260 (3,692)	240 (3,408)	300 (4,260)	280 (3,976)	300 (4,260)	240 (3,408)	230 (3,266)	370 (5,254)	250 (3,550)	285 (4,047)	
Elongation [%]	D638	GPPS 5mm/min, HIPS 50mm/	2.0	3.0	2.0	3.5	3.5	3.5	40	40	40	50	40	50	60	30	40	30	
min Flexural Strength [kg/ (psi)]	D790	23	580 (8,236)	720 (10,224)	720 (10,224)	720 (10,224)	720 (10,224)	900 (12,780)	300 (4,260)	300 (4,260)	350 (4,970)	330 (4,686)	350 (4,970)	300 (4,260)	310 (4,402)	500 (7,100)	350 (4,970)	380 (5,396)	
Flexural Modulus [kg/ (psi)]	D790	23	29,200 (414,640)	30,000 (426,000)	30,000 (426,000)	30,000 (426,000)	30,000 (426,000)	35,000 (49,700)	17,000 (241,400)	16,500 (234,300)	17,500 (248,500)	16,500 (234,300)	17,500 (248,500)	17,500 (248,500)	15,500 (220,200)	21,000 (298,200)	17,000 (241,400)	19,000 (269,800)	
Rockwell Hardness	D785	GPPS M scale, HIPS L scale	74	74	74	74	74	76	60	60	64	60	65	60	50	74	60	70	
IZOD Impact strength [Kg · cm/cm(ft · lb/in)]	D256	3.2mm, Notched, 23 (73)	1.5 (0.28)	1.5 (0.28)	1.5(0.28)	1.5(0.28)	1.5 (0.28)	1.5(0.28)	9.0 (1.67)	10.0 (1.85)	9.5 (1.76)	10.0 (1.85)	9.5 (1.76)	10.0 (1.85)	10.0 (1.85)	12.0 (2.22)	9.0 (1.67)	9.0 (1.67)	
Heat Distortion Temp [()]	D648	18.6kg/cm(264psi) Unannealed	83 (181)	85 (185)	87 (189)	87 (189)	87 (189)	92 (198)	77 (168)	76 (169)	80 (176)	79 (172)	80 (176)	74 (165)	79 (172)	82 (183)	74 (165)	75 (167)	
Vicat Softening Temp [()]	D1525		99 (210)	102 (217)	105 (221)	105 (221)	105 (221)	105 (224)	97 (211)	95 (207)	99 (210)	97 (207)	97 (207)	95 (207)	95 (207)	98 (208)	97 (207)	98 (208)	
Melt Flow Index [g/10min]	D1238	200 , 5kg	9.0	5.5	7.0	7.0	7.0	2.5	13.0	4.5	5.5	4.5	4.5	3.5	4.0	9.0	9.0		
Molding Shrinkage [%]	D955		0.3'0.6	0.3'0.6	0.3'0.6	0.3'0.6	0.3'0.6	0.3'0.6	0.3'0.6	0.3'0.6	0.3'0.6	0.3'0.6	0.3'0.6	0.3'0.6	0.3'0.6	0.3'0.6	0.3'0.6	0.3'0.6	
Specific Gravity	D792		1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	
Water Absorption [%]	D570	24hr, Immersion water	0.03	0.03	0.03	0.03	0.03	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	
Flammability	UL*	1/16"(1.6mm)	HB	HB	HB	HB	HB	HB	HB	HB	HB	HB	HB	HB	HB	HB	HB	HB	

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