

KOPA®
Polyamide (PA)



KOLON ENP at a glance

KOLON ENP is dedicated to making the world a better place by drawing on the DNA of KOLON Group, 'LifeStyle Innovator.' As a leading engineering plastics manufacturing company in Korea, it has developed a diverse product portfolio, which includes POM, PA, PBT, TPEE, and supplies these products to over 90 countries worldwide.

KOLON ENP is committed to providing unique value to its customers, through continuous research and development and by improving the competitiveness of its products.

KOLON ENP has gained market recognition and the trust of its customers. In the future, We will continue to grow as a company that garners attention in the market and earns the trust of its customers by providing even greater value to them.



ESTABLISHMENT
March 15, 1996



HEAD OFFICE
Korea



SALES
350 mil. USD (2023)



PRODUCTS
8 Brands, 400 Grades

KOPA®

Polyamide (PA)

KOPA® (PA6, PA66)

KOPA® from KOLON ENP consists of polyamide as chemical formula (PA), PA6 and PA66.

KOPA®6 is a high-performance resin made from ring-opening polymerization of caprolactam, which is reinforced by compounding technology with different properties such as mechanical stiffness, impact resistance and heat resistance. It is widely used in automobile industry and general industry.

KOPA®66 is a material made by polymerization of HXMD (hexamethylenediamine) and APA (adipic acid) reinforced with properties such as stiffness, flame retardancy, heat resistance and chemical resistance. Widely used in automotive engine part, the electrical and electronics industry, and other areas where heat resistance is more important than PA6.

DIFFERENCES BETWEEN KOPA®6 & KOPA®66

KOPA®6 and KOPA®66 have melting points of 225°C and 260°C, respectively.

Since KOPA®6 has a high water absorption rate compared to KOPA®66, it has a tendency to decrease stiffness, but toughness increases.

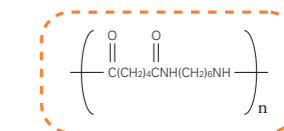
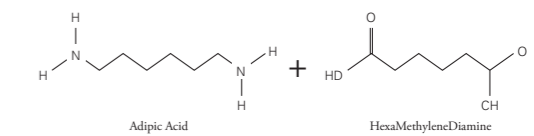
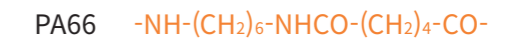
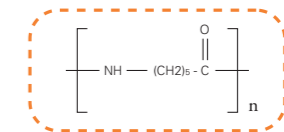
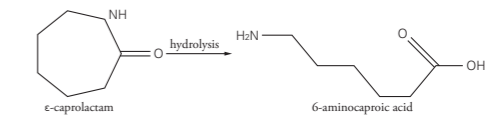
KOPA®66 is a material superior in stiffness, dimensional stability and chemical resistance compared to KOPA®6.

COMPARISON WITH OTHER ENGINEERING PLASTICS

The greatest feature of the KOPA® is its excellent mechanical strength and abrasion resistance.

In addition, KOPA® has excellent oil resistance and chemical resistance required for automotive parts and maintains a stable state in alkaline aqueous solution.

PA66 basically meets UL94 V2, and a higher flame retardant grade can be obtained by using flame retardant additive.



APPLICATIONS

ENGINE COVER

KN133HB20BL

- ▶ High strength
- ▶ Good surface



AIR INTAKE MANIFOLD

KN133G35LH, KN133G30LH

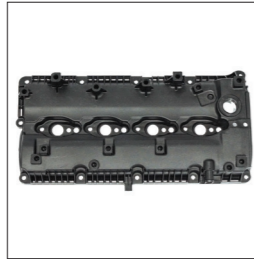
- ▶ High strength
- ▶ Long-term heat resistance
- ▶ Dimensional stability



NVH CYLINDER HEAD COVER

KN333HB40HSBL

- ▶ Heat resistance



INSIDE DOOR HANDLE ASSEMBLY

KN133G15BL-Bracket, KN135G15HSBL-Housing

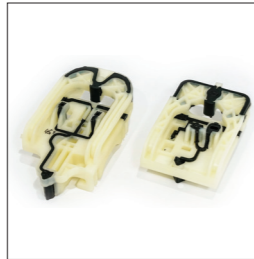
- ▶ Wear resistance
- ▶ Light resistance
- ▶ Low gas



CARRIER PLATE

KN333G35HS

- ▶ Wear resistance
- ▶ Great strength



OUTSIDE DOOR HANDLE

KN153HB40WBL, KN113G60WBL

- ▶ Weather resistance
- ▶ Excellent surface



HEADREST GUIDE

KN136, KN131HI, KN331HI

- ▶ High impact
- ▶ Dimensional stability



AIR VENT WING

KN135G40WBL, KN113G60WBL

- ▶ High strength
- ▶ Light resistance



A/T LEVER MOUNTING BRACKET

KN333G30HS

- ▶ High strength
- ▶ Heat stability
- ▶ Good surface



RADIATOR HEAD TANK

KN333G30CR

- ▶ Hydrolysis resistance
- ▶ Heat resistance



DOOR FRAME INNER COVER

KN133G15BRN

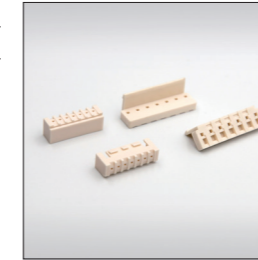
- ▶ High strength
- ▶ Excellent flowability



CONNECTORS (NON-HALOGEN)

KN3322V0

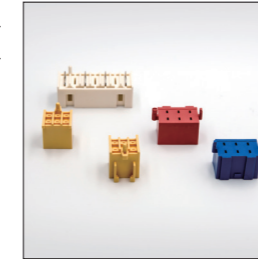
- ▶ Halogen Free
- ▶ CTI (PLC0), GWI (960°C)



CONNECTORS (HIGH-VOLTAGE INSULATION)

KN3321G10V0Y

- ▶ High Voltage Insulation
- ▶ CTI (PLC2), GWI (850°C)



CHARGING DOOR MODULE (EV)

KN333G30BL

- ▶ High Stiffness
- ▶ Dimension Stability



CHARGING INLET (EV)

KN132G30VFBK

- ▶ Halogen Free
- ▶ UL94 V0
- ▶ Weather resistance



H2 PRESSURE VESSEL LINER (FCEV)

KN193HIIM, KN193HIBM

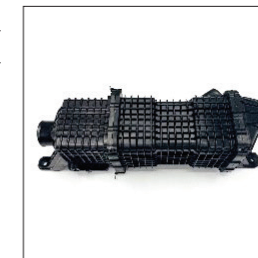
- ▶ Hydrogen Barrier Property
- ▶ High Impact
- ▶ Blow-molding Possible



MEMBRANE HUMIDIFIER (FCEV)

KN163G40LIBL

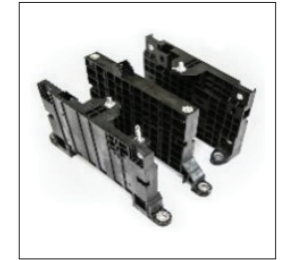
- ▶ Minute Cation Migration
- ▶ Anti Hydrolysis Performance



BATTERY PLATE (EV)

KN333G30BL

- ▶ Thermal Resistance
- ▶ Dimension Stability



HIGH VOLTAGE CONNECTOR (EV)

KN333G250R

- ▶ Flame Retardance
- ▶ Vivid Orange Color



VIRTUAL ENGINE SOUND SYSTEM (EV)

KN333G30BL

- ▶ High Stiffness
- ▶ Chemical Resistance



COOLANT PIPE

KN173G15BM

- ▶ Blow Molding Grade
- ▶ Thermal Resistance



BAND CABLE, CLIP

KN333HF (BK, DG, GR, OR)

- ▶ Mold releasing
- ▶ Heat resistance



OVERVIEW PRODUCT PORTFOLIO

KOPA®6

MATERIAL CATEGORY	GRADE	FEATURES OF MATERIAL	TYPICAL APPLICATION
UNREINFORCED	KN111	PA6, easy mold-release	Clip & Fastener, Webbing guide
	KN126K	PA6, easy mold-release, fast processing	Clip & Fastener, Canister Filter
	KN136	PA6, easy mold-release, fast processing (additive pre-mixed)	Clip & Fastener
	KN171	PA6, high viscosity, easy mold-release	Clip & Fastener
GF/MF - REINFORCED	KN133G15	PA6 GF15, general use	Door frame inner cover
	KN133G20	PA6 GF20, general use	HVAC nozzle flap
	KN133G30	PA6 GF30, general use	Door handle
	KN133G40	PA6 GF40, general use	Various applications
	KN133G45	PA6 GF45, general use	Various applications
	KN133G50	PA6 GF50, general use	Various applications
	KN133G30BLW	PA6 GF30, UV-stabilized (@660kJ)	Active air flap
	KN133G30BLL1	PA6 GF30, UV-stabilized (@660kJ)	FEM Carrier
	KN163G40LIBL	PA6 GF40, low cation dissolved	Humidifier housing (FCEV)
	KN178MT40	PA6 MF40, low warpage	Fuel filler door
	KN135HB6	PA6 HB6, UV-stabilized (@126kJ), mold shrinkage equal to PC/ABS	Front defrost nozzle, Window shade housing
	KN135HB10	PA6 HB10, UV-stabilized (@126kJ), mold shrinkage equal to PC/ABS	Front defrost nozzle, Window shade housing
	KN135G15HS	PA6 GF15, UV-stabilized (@84kJ), scratch resistance	Inside handle housing
	KN133HB20BL	PA6 HB20, low warpage	Engine room cover
	KN153HB40BL	PA6 HB40, low warpage, paintable surface	Remote key, Roof side molding
	KN135HB40SIBL	PA6 HB40, low warpage	Roof rack
	KN133HBRR40BN1	PA6 HB40, UV-stabilized, weather resistance	Outside handle grip
	KN113G60	PA6 GF60, easy flowing	Various applications
	KN721G60	PA6-alloy GF60, high moduls, UV-stabilized	HVAC nozzle flap (air vent wing)
	IMPACT - MODIFIED & STABILIZED	KN131HI	PA6, Impact modified & stabilized
KN173HI5		PA6, Impact modified & stabilized	Retainer, Seat sub part
KN175HI		PA6, Impact modified & stabilized	Retainer, Seat sub part
KN131HIHS		PA6, Impact modified & stabilized, heat resistance	Various applications
HEAT RESISTANCE	KN173G15BM	PA6 GF15, extended long term heat resistance, blow molding use	Intercooler pipe
	KN133G30LH	PA6 GF30, heat resistance, (black color)	Air intake manifold
	KN133G35LH	PA6 GF30, heat resistance, (black color)	Air intake manifold
	KN133G50HS	PA6 GF50, heat resistance	Various applications
UV STABILIZED & WEATHER RESISTANCE	KN153HB40WBL	PA6 HB40, weather resistance	Roof rack
	KN135G50BK	PA6 GF50, weather resistance, easy flow	Window wiper
	KN135G40W	PA6 GF40, weather resistance	Various applications
FLAME RETARDANT (FR)	KN1322V0	PA6 FR, non-halogen, V0 (@0.4mm) GWIT 960 (@0.75mm), CTI 0	Connector & EV parts
	KN132G15VF	PA6 G15 FR, non-halogen, V0 (@0.4mm) GWIT 750 (@0.75mm), CTI 0	Connector & EV parts
	KN132G25VF	PA6 G25 FR, non-halogen, V0 (@0.4mm) GWIT 750 (@0.75mm), CTI 0	Connector & EV parts
	KN132G30VF	PA6 G30 FR, non-halogen, V0 (@0.4mm) GWIT 750 (@0.75mm), CTI 0	Connector & EV parts
LASER TRANSPARENT	KN111LTBL	PA6, high laser transparent, black color	ECU & Sensor housing
	KN111G30LTBL	PA6 GF30, laser transparent, black color	ECU & Sensor housing
THERMAL CONDUCTIVE	KN113W15EC	PA6, thermal conductive 15W, surface resistance 10^1 ohms	ECU housing, Camera module
	KN113W20EC	PA6, thermal conductive 20W, surface resistance 10^1 ohms	ECU housing, Camera module

KOPA®66

MATERIAL CATEGORY	GRADE	FEATURES OF MATERIAL	TYPICAL APPLICATION
UNREINFORCED	KN3311	PA66, general use	Clip & Fastener
	KN333MS	PA66, low friction	Stopper, Clip
GF/CF/MF - REINFORCED	KN333C22	PA66 CF22, carbon fiber, dimensional stability, low warpage, anti-static	Outlet filter
	KN333HB440	PA66 HB40, low warpage	Fan & Shroud
	KN333HB38BL	PA66 HB38, low warpage	Engine room cover
	KN333G15	PA66 GF15, general use	Assist grip handle
	KN333G20	PA66 GF20, general use	Various applications
	KN333G25	PA66 GF25, general use	Various applications
	KN333G25OR	PA66 GF25, orange color	High voltage connector
	KN333G30	PA66 GF30, general use	A/T Gear shift bracket
	KN333G33	PA66 GF33, general use	A/T Gear shift cover
	KN333G40SIBL	PA66 GF40, easy flow, good surface appearance	Accelerator pedal
	KN333G45	PA66 GF45, general use	Foot parking brake
	KN333G60F	PA66 GF60, high modulus	Various applications
	KN753G60	PA66 alloy GF60, high strength & high modulus	Various applications
	HEAT RESISTANCE	KN333HS	PA66, heat resistance
KN333HB40HS		PA66 HB40, NVH reduction, heat resistance	Timing belt cover
KN333G35UHS		PA66 GF35, extended long term heat resistance	Resonator for turbo charger
IMPACT - MODIFIED & STABILIZED	KN353G35UHS	PA66/6 GF35, extended long term heat resistance	Various applications
	KN333HI4	PA66, Impact modified & stabilized	Various applications
ENGINE COOLANT RESISTANCE	KN333HI5	PA66, Impact modified & stabilized	Wire harness protector
	KN333G30LD	PA66 GF30, engine coolant resistance, heat resistance, transparent with heat aging	Reservoir tank
LASER TRANSPARENT	KN333G30CR1	PA66 GF30, engine coolant resistance, heat resistance	Radiator header tank
	KN333G35CRBK1	PA66 GF35, engine coolant resistance, heat resistance	Coolant control module
	KN211LT	PA66/6, unreinforced, laser transparent	ECU & Sensor housing
FLAME RETARDANT(FR)	KN311G30LTBL	PA66 GF30, laser transparent, black color	ECU & Sensor housing
	KN211G35LTBL	PA66/6 GF35, high laser transparent, black color	ECU & Sensor housing
	KN3321G10V0Y	PA66 GF10, halogen, V0 (@0.4mm), GWIT 825 (@0.8mm), CTI 2	Connectors, EV parts
	KN332G25GW	PA66 GF25, halogen, V0 (@0.4mm), (f1), GWIT 825 (@0.8mm), CTI 2	EV parts
	KN332G30V0	PA66 GF30, non-halogen, V0 (@0.4mm), GWIT 960 (@0.4mm), CTI 0	EV parts (Battery module)
	KN3322V0	PA66, non-halogen, V0 (@0.4mm), GWIT 960 (@0.4mm), CTI 0	Connectors
	KN332G15VF	PA66 GF15, non-halogen, V0 (@0.75mm), GWIT 750 (@0.75mm), CTI 0	EV parts
	KN332G25VF	PA66 GF25, non-halogen, V0 (@0.75mm), GWIT 750 (@0.75mm), CTI 0	EV parts
	KN332G30VF	PA66 GF30, non-halogen, V0 (@0.75mm), GWIT 750 (@0.75mm), CTI 0	EV parts



NOMENCLATURE

The name of KOPA® commercial products generally follows the scheme below:

RESIN			VISCOSITY	CHARACTERISTICS 1	ADDITIVES	CONTENT	CHARACTERISTICS 2	COLOR
K	N	1	4	2	G	30	V0	BL

RESIN

KN1	PA6
KN3	PA66

CONTENT

20	20%
30	30%
40	40%

VISCOSITY

1	Low viscosity
3	Middle viscosity
2, 5, 6	Alloy
7	High viscosity
8	High viscosity
9	High viscosity

CHARACTERISTICS 2

V0	Halogen UL 94 V0
VF	Non-halogen UL 94 V0
SI	Excellent appearance
W	Weather/Light resistance
LT	Laser transmission
HI	High impact
EX	Extrusion
HS	Heat resistance
UHS	Heat resistance
CR	Chemical resistance
HF	High flow
EC	Non-isolated EMI shield or Heat dissipation
EI	Isolated EMI shield or Heat dissipation

CHARACTERISTICS 1

0	General
1	Mold releasing
2	Flame retardance
3	Heat resistance
5	Weather resistance
6	Fast crystallization
7	Extrusion

ADDITIVES

G	Glass fiber (%)
C	Carbon fiber (%)
MT	Mineral (%)
MC	Mineral (%)
HB	G/F + Mineral (%)
W	Heat dissipation (W/mK)
D	EMI shield (dB)

COLOR

N	Natural
BL, BK	Black
WH	White
GY, GR	Grey
DG	Dark Grey
GN	Green
BU	Blue
RD	Red
YE	Yellow
BR	Brown
IV	Ivory
OR	Orange

KN133HBRR40BN1

WEATHER RESISTANCE ENHANCEMENT

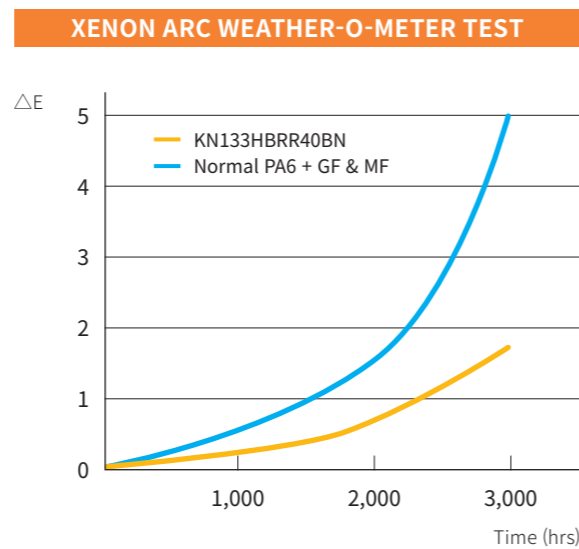
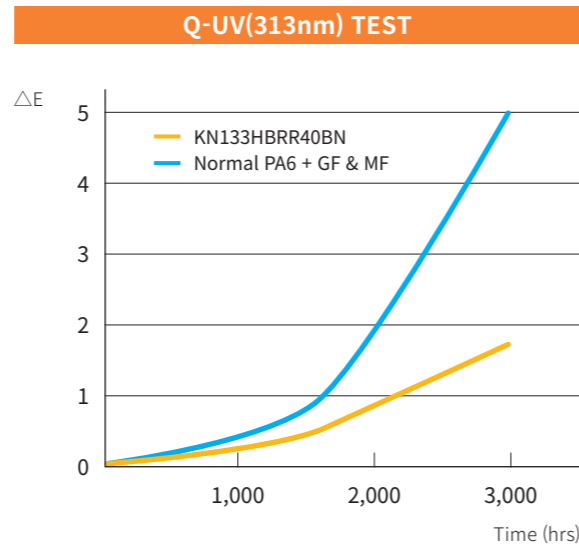
It is a material suitable for automotive exterior parts requiring high weather resistance.

Especially, it is widely applied to parts such as Roof Rack and has the following advantages.

- Excellent dimensional stability
- Excellent ultraviolet shielding property
- Improved appearance and surface quality
- High mechanical strength

Products that are reinforced with resistance to ultraviolet rays through compounding meet the requirements of the vehicle's exterior part.

The Q-UV (313 nm) and Xenon arc evaluation show that the KN133HBRR40BN material exhibits a lower level of discoloration than the regular PA6 hybrid reinforced products.



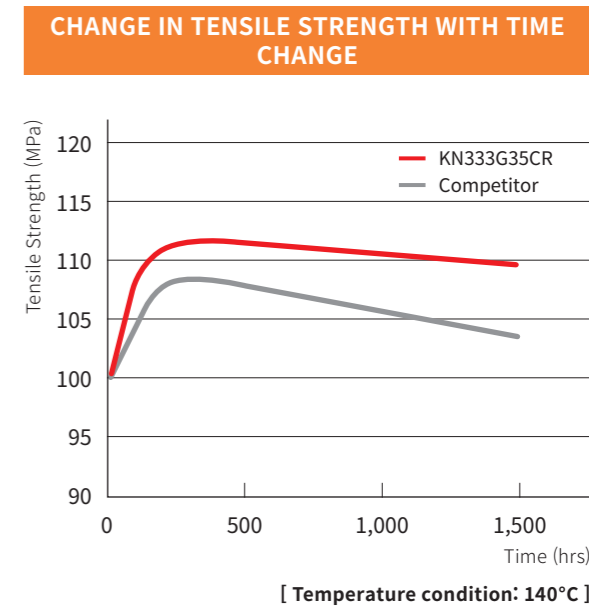
KN333G35CRBK1

CHEMICAL RESISTANCE & HEAT RESISTANCE ENHANCEMENT

It is suitable for parts requiring high chemical resistance and heat resistance. It is being applied to engine parts including automobile cylinder head covers.

We offer differentiated value as below.

- Vehicle weight reduction (about 40% weight reduction, replacement of aluminum parts)
- Cost reduction (about 10~15% cost reduction, replacement of aluminum parts)
- Excellent thermal stability
- Good chemical resistance to oils and antifreeze

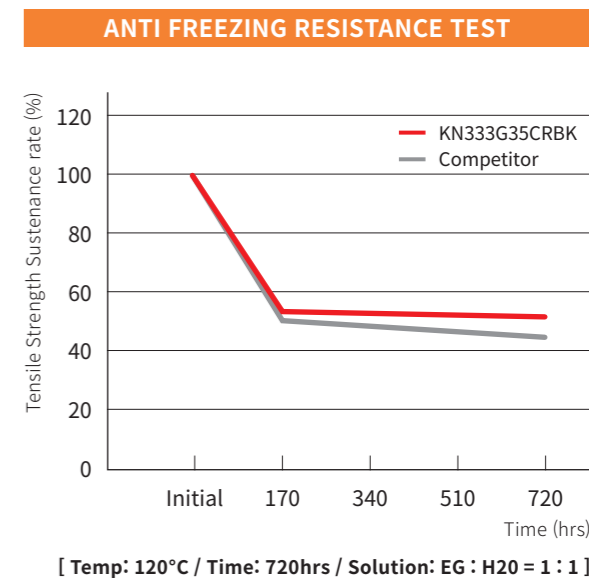


KN333G30CR1

CHEMICAL RESISTANCE & ANTI-FREEZING PROPERTY ENHANCEMENT

It is the material that is suitable for the engine coolant application parts of automobile.

- Superior thermal stability
- Chemical resistance to oil and antifreeze
- Superior Hydrolysis Resistance

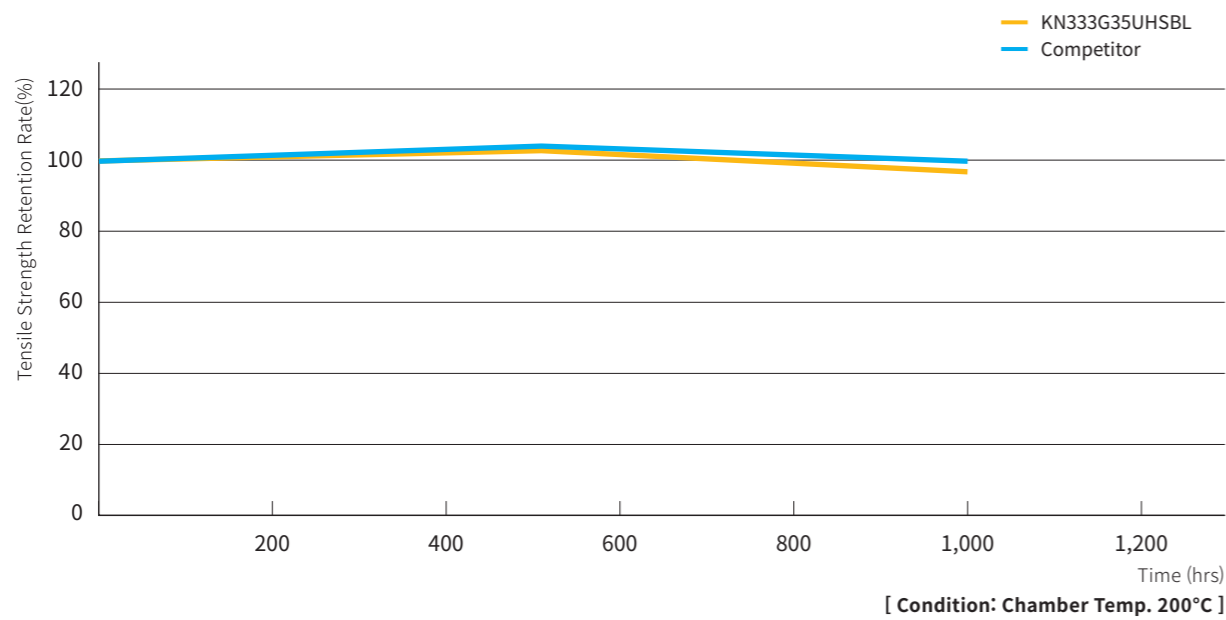


KN333G35UHSBL

HEAT RESISTANCE ENHANCEMENT

Heat-resistant grades are suitable for high-temperature parts inside the engine room, especially intercooler parts.

- Vehicle weight reduction (about 40% weight reduction, replacement of aluminum parts)
- Superior thermal stability



TENSILE STRENGTH RETENTION RATE(%)	0 hr	500 hr	1,000 hr
KN333G35HSBL	100	103	98
COMPETITOR	100	102	99

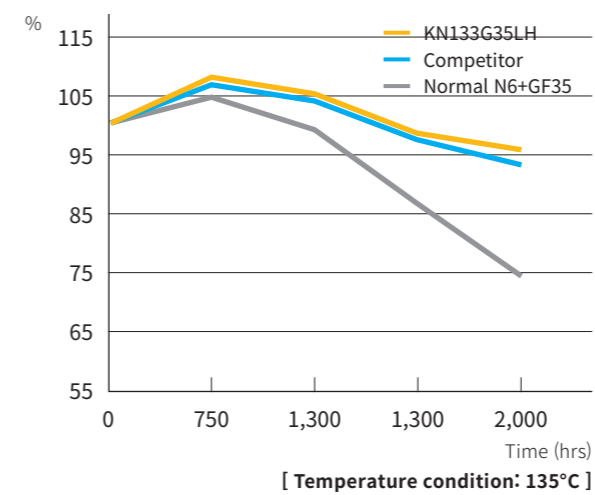
KN133G35LH

LONG-TERM HEAT STABILITY ENHANCEMENT

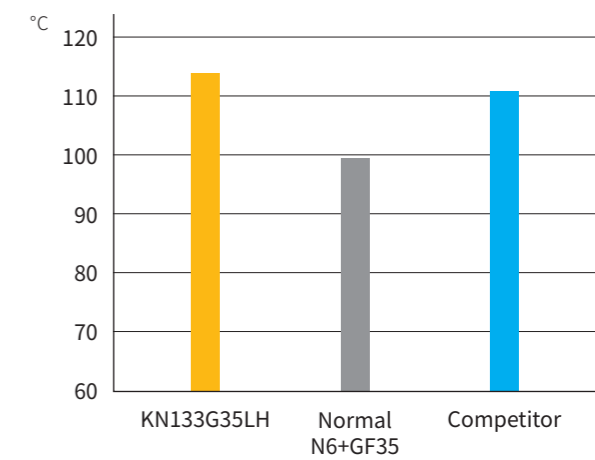
It is material that has excellent long-term heat stability. It is mainly developed for long-term exposure to high temperature such as AIM (Air Intake Manifold) parts for automobile.

- Suitable for light weight of vehicle
- High heat resistance
- Excellent chemical resistance

TESILE STRENGTH RETENTION RATE (%)



CONTINUOUS USE TEMPERATURE (°C)



Note: KOLON ENP has prepared this report based on the data obtained up to the time of writing. The figures in all tables are representative values, not quality assurance values. Numerical values in the table can not be used as basic data for semi-finished product and finished product design. As the product quality improves, the figures in the table may change without notice.

INJECTION CONDITIONS & HANDLING PRECAUTIONS

KOPA®

PRE-DRYING

KOPA® has a high water-absorption rate. When resin absorbs water, it causes hydrolysis during the injection molding process, resulting in degradation of properties and unsatisfactory molded parts. Therefore, pre-drying is essential prior to injection molding. Drying equipment may include a hot-air dryer or a dehumidified dryer, the latter being more efficient. Normally, a dehumidified dryer operated 4 to 6 hours at a temperature of 75~85°C will reduce water content to 0.1% or lower.

EXTRUSION MOLDING

KOPA® has very low melt viscosity and is highly sensitive to temperature changes. Generally, a temperature of 15~60°C above the melt point should be maintained. Consideration should also be given to the fact that KOPA® is highly water-absorbent and its residual monomer is easily melted down. Being affected by moisture, extrusion molded parts may contain bubbles and result in degradation of mechanical properties, and the lowered melt viscosity caused by the residual monomer, which adhere to the die mouth or its surroundings and the part itself after being extruded from die in a sublimate. This may produce defective molded products. Therefore, moisture content must be controlled at 0.1% or lower, the residual time inside the extruder must be minimized, and a die without dead space should be used.

INJECTION MOLDING

SELECTION OF INJECTION MOLDING MACHINE

For molding KOPA®, a screw-type injection molding machine works best, with a minimum 20 L/D screw and a compression ratio of 3-4, and a chrome-plated nitrogenous steel base. As KOPA® has such low viscosity when melted, compared with other resins, this may cause reverse flow of molten polymer. Therefore, the injection molding machine must be equipped with a screw head having a reverse-flow blocking valve. It is also advisable to use an intermittent nozzle to prevent nozzle drool.

CYLINDER & NOZZLE TEMPERATURE

Resins are melted by the heater located inside the cylinder and by the shear stress generated between the screw and cylinder barrel. Generally, the bottom side of a hopper is sufficiently cool for smooth transportation of pellets. The melting zone is set at a temperature suitable for melting down resins, and the nozzle area is set a temperature 10°C lower than the melting zone, thus preventing nozzle drool. If the temperature of the melting zone is too high, thermal degradation and substance volatility can occur, causing bubbles or silver streaks in the produced part. Conversely, if the temperature of the melting zone is too low, the flowability of the resin is reduced. This necessitates excessive injection pressure, thus degrading the properties of the produced part.

MOLD TEMPERATURE


Mold temperature affects product appearance and the accuracy of product dimensions, and has a direct effect on productivity due to shortened cycles. If the mold temperature is too low, productivity increases due to faster cooling, but cosmetic and mechanical properties are degraded due to reduced material flow. It is essential to set the proper mold temperature necessary to maintain properties as required by the particular product specification, because KOPA® is a crystalline polymer, and crystallization varies based on cooling speed. (Normally, the mold temperature of KOPA®-PA6 should be set at 60~80°C) If the mold temperature is uneven, product warpage can occur.

INJECTION PRESSURE

Molten polymer flows through the mold cavity under the force of injection pressure, and a considerable amount of pressure is lost as material flows through the narrow sprue, runner, gate, etc. Normally, the pressure applied to the cavity may require about 300~500kg/cm² per projected area of the produced part. If injection pressure is too great, residual stress is increased due to over-charge that can cause horizontal strength degradation. If the pressure is too low, it can cause short shots, shrinkage, and bubbling. Also, in order to compensate for the volume decrease incurred during material cool-off, a holding pressure of 30~80% of the initial injection pressure is required.

CONDITION OF INJECTION MOLDING (KOPA®)

INJECTION MOLDING PARAMETERS		UNFILLED KOPA®6	REINFORCED 25~35% KOPA®6	UNFILLED KOPA®66	REINFORCED 25~35% KOPA®66
Recommended Moisture Contents (%)		≤ 0.1			
Melting Temperature (°C)		225 ± 5	225 ± 5	260 ± 5	260 ± 5
Cylinder Temperature (°C)	Nozzle	235 ~ 255	250 ~ 270	270 ~ 290	285 ~ 315
	Front	235 ~ 255	250 ~ 270	270 ~ 290	285 ~ 315
	Middle	235 ~ 255	245 ~ 260	270 ~ 285	275 ~ 305
	Rear	220 ~ 235	235 ~ 255	260 ~ 275	270 ~ 295
Mold Temperature (°C)		50 ~ 90		60 ~ 100	
Holding Pressure (%)		35%~65% of maximum injection pressure			
Cushion (mm)		5 ~ 10			

 For more detailed information regarding injection molding conditions, please contact the technical support representative at KOLON ENP.



GLOBAL SALES NETWORK

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