C A R E
CONSORTIUM FOR
AUTOMOTIVE RECYCLING

The Consortium for Automotive Recycling and The British Plastics Federation

Recycled Plastic Specification - Generic Family A : Polypropylene

Reference: CARE/BPF/PP001

Scope:

This specification is intended to provide base requirements for plastics, containing post-consumer derived recyclate, which has the potential to be used in automotive or similar quality oriented engineering applications. It is indicative of the performance and quality demanded within the automotive sector which, in turn, reflects the environmental extremes encountered by materials used in vehicles constructed for use in a global market.

Material Description:

Polypropylene (PP) containing 40% talc (mineral) filler. The polymer content should contain a minimum of 25% post consumer sourced recyclate.

Typical applications:

Air cleaner housings.
Lighting units.
Air conditioning unit housings

The applications are primarily underbonnet locations which require stability of the material at elevated temperatures.

Colour and Appearance:

The material supplied should be in a pellet form and be black in colour. It should be free from any objectionable odour and free of any excessive visible inclusions.

Material Performance / Properties:

The following criteria should be regarded as a minimum set of data to be submitted to the 'customer' as an initial qualification prior to any final approval process.
Tests should be conducted on standard moulded test pieces (where applicable) that have been conditioned prior determining the particular parameter.

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Material Properties:

Typical Property	Method	Units	Value *	Range
Melt Flow Index @ 230 C.	ISO 1133	g/10min	15	12 - 18
Ash content @ 550 C for 30 min	ISO 3451/1. Method A	%	37	37 - 40
Specific Gravity	ISO 1183/A	g/cm3	1.25	1.2 - 1.25
Flexural Modulus @ 23 C	ISO 178	MPa	4300	3500 (min)
Flexural Modulus @ 140 C	ISO 178	MPa	300	250 (min)
Flexural Yield Strength @ 23 C	ISO 178	MPa	47	40 - 50
Flexural Yield Strength @ 140 C	ISO 178	MPA	6	5 - 10
Tensile Strength @ yield @ 23 C	ISO 178	MPa	28	22 - 25
Tensile Strength @ Yield @ 120 C	ASTM D638	MPa	7.5	
Tensile Strength @ Yield @ 140 C	ASTM D638	MPA	3.3	
Tensile Strength at Maximum Load	ISO R527	MPa		24 (min)
Elongation @ Yield @ 23 C	ISO R527	%	8	5- 10
Elongation @ Yield @ 140 C	ASTM D638	%	8	
Elongation @ Break @ 23 C	ISO R527	%	8	8 (min)
Elongation @ Break @ 140 C	ASTM D368	%	>150	
Notched Izod Impact Strength @ 23 C	ISO R180/A	KJ/m2	2.3	2 (min)
Notched Izod Impact Strength @ 10 C	ISO R180/A	KJ/m2	2.1	1.6(min)
Notched Izod Impact Strength @ -20 C	ISO R180/A	KJ/m2	2	1.5 (min)
Notched Izod Impact Strength @ -40 C	ISO R180/A	KJ/m2	2	1.4 (min)
Heat Distortion Temperature	ISO 75/ 0.47MPa	C	137	118 (min)
Heat Distortion Temperature	ISO 75/ 1.81MPa	C	80	67 (min)
Coefficient of linear thermal expansion	ASTM D696	per 1C	5.6 x 10-5	
Flammability	ISO 3795	mm/min	81	100(max)
Mould Shrinkage (48hrs @ 23 C)	ISO 2577	%	1	0.5 - 0.9
Mould Shrinkage (48hrs @ 80 C)	ISO 2577	%	0.21	0 - 0.15
Mould Shrinkage (30 mins @ 120 C)	ISO 2577	%	0.46	0.1 - 0.3
Hardness, Durometer D	ISO 868	No	71	68 (min)

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Fog number (passenger compartment applications)	SAE J1756	No	50	90 (min)

Properties after heat ageing at:				
500 hours at 140 C (engine bay use)				
Tensile strength change	*ISO R527*	*%*	*5*	*+/- 15*
Impact strength, Izod change	*ISOR180/A*	*%*	*5*	*+/- 15*
500 hours at 120 C (non engine bay use				
Tensile strength change	*ISO R527*	*%*	*5*	*+/- 15*
Impact strength, Izod change	*ISOR180/A*	*%*	*5*	*+/- 15*

Restricted contaminants		***Value ****	***Range***
Antimony	*Sb*	*2 ppm*	*<5 ppm*
Arsenic	*As*	*4 ppm*	*<5 ppm*
Chromium	*Cr*	*3 ppm*	*<25 ppm*
Cadmium	*Cd*	*14 ppm*	*<100 ppm*
Lead	*Pb*	*15 ppm*	*<100 ppm*
Mercury	*Hg*	*<1 ppm*	*<1 ppm*
Halogens (combined value)	*Cl, Br,F,I*	*20 ppm*	*<50 ppm*

Thermal Analysis:

In addition to the above data a Shear Modulus Vs Temperature curve shall be obtained (using a Dynamic Mechanical Analysis Technique) between -50 C and +160 C. Subsequent batches should not deviate by more than +/- 10% of the original curve. The curves being generated on similar equipment using a standard heating rate (and the appropriate DIN Specification. *Ref to be included*)

Infra Red Analysis:

Each batch of material should be accompanied by a 'fingerprint' trace derived from an infra red spectrophotometry scan. No significant deviations from the original curve should be observed.

Health and Safety:

All grades of material should be accompanied by the necessary Health and Safety Handling Data Sheet and Environmental Impact Assessment.

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** Indicative values. Refer to customer for specific limits and / or the legislative requirements applicable at that time.*

Storage and Handling:

Non-toxic, chemically inert material.
Store in a dry, ventilated area away from direct sunlight exposure.
This product is insoluble in all common solvents at room temperature.
Drying of the granules (80°C to 90°C for 3 to 4 hours) before moulding is recommended.

Typical processing conditions:

Melt temperature range	200°C - 250°C	
Mould temperature range	30°C - 50°C	
Back pressure	Low	*Adjust pressure and times to fill and pack properly.*
Screw speed	Low - Medium	
Fill speed	Low - Medium	

Explanatory notes on the test parameters requested:

Melt Flow Index:
An inverse measure of molecular weight. i.e. an increase in molecular weight results in a decrease in melt flow index. Indicative of degradation. Key characteristic when setting mould flow conditions.

Ash content:
Needs to be kept within close tolerance limits. Effects stiffness (modulus) and vibration characteristics.

Specific Gravity:
Important parameter for weight calculations.

*Temperature ranges:
Strength and stiffness measurements are determined at typically two temperature extremes e.g. 23°C and 140°C. This is to assess the performance of the material in, for example, an engine bay application where temperatures up to 140°C can be experienced.

Flexural modulus*:
Is a key measure of stiffness. Components made from this material must remain rigid and dimensionally stable. The measure will also give some indication as to the materials' vibration / damping characteristics, which is significant when considering the resonant effects of an air filter for example.

Tensile strength*:

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Used to quantify the mechanical strength, and in combination with the elongation data, the toughness of a material.

Other tensile properties including elongation at yield and at break:
These parameters are usually determined within the same test protocol as the tensile strength. When the results are combined they give an overall assessment that the material is strong enough and tough enough to do the job required.

Notched Izod Impact Strength:
Most commonly employed method used to determine resistance of plastic materials to withstand impact. Conducted at a range of temperatures between ambient and -40°C to reflect the most vulnerable circumstances to which a component can be exposed i.e. cold climate.

Heat Distortion Temperature:
Used to determine if the material will distort under load at elevated temperature. It can also indicate the presence of significant levels of polyethylene (contamination) by lowering the HDT and having an increase in impact performance. The material must not distort excessively under load.

Coefficient of linear thermal expansion:
Components often fit in close proximity to or in direct contact with other components. Excessive expansion / contraction under extreme environmental conditions can give rise to squeaks, rattles and distortion (load) effects.

Flammability:
Legislative requirement to minimise fire risk potential.

Mould shrinkage:
Although dependent on the actual component design and moulding conditions, Mould shrinkage variations have often been cited as a problem with recycled material. Determination of this parameter will go some way to achieving a satisfactory confidence level.

Hardness:
More applicable to interior ‘visual’ components but a simple test worth quoting.

Fog number:
A test that will determine volatile material within the compound. A low volatility is required to ensure no potential Health and Safety issues arise from volatile species. The test originated in determining the potential to fog (re-condense) on the interior of a vehicle windscreen.

Heat ageing:
Ensures that the potential for degradation of the polymer in service is minimal. The compound should be stable and not undergo any structural change during the life of the vehicle.