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Linking knowledge with action

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Material Selections for Roof Vent Project

This is a summary of general recommendations for the six roof vent parts. One group of parts contains the Base and Cap since it has been indicated that these parts need to be resistant to UV, need to perform across a specific temperature range of -20 to +150^{o}F, and that the Base needs to be impact resistant so that it can be nailed at temperatures as low as 20^{o}F. These parts will be dark brown or bronze in color. For the other four parts no specific application conditions have been identified, however it is expected that the temperature environment will be similar to that of the Base and Cap and it was indicated that these parts will be black and could be made from high-density polyethylene (HDPE).

Generally, plastics used in roofing applications, including shingles and vent parts, are made from either polyethylene or impact copolymer polypropylene. Those applications that require long-term UV stability employ antioxidant and UV stabilizer packages at a level commensurate with the desired lifetime of the product. Some of these products are expected to last 20-25 years and occasionally longer. In most cases these additives are incorporated through concentrates that may include the colorant or be added along with the colorant as a second concentrate. Applications where nailing is required typically use either linear low-density polyethylene (LLDPE), a high-density polyethylene on the lower end of the density spectrum (0.944-0.950 grams/cm^{3}), or an impact polypropylene copolymer. These same products can also be suitable for applications where the impact of nailing is not a requirement since they are cost effective.

The number of suppliers of polyethylene and polypropylene, so the specific supplier chosen is a procurement decision. This evaluation is focused on properties, which can be varied across a very wide range depending upon the molecular weight of the materials and their structure. In the case of polyethylene the structure is primarily a function of density. Lower density materials have better impact, especially at cold temperatures while higher density materials are stronger and more rigid. In the case of polypropylene, copolymers are recommended for outdoor applications where cold temperatures are part of the application environment. The level of copolymerization can be varied across a wide range to provide different balances of load-bearing performance and toughness.

In the area of linear low-density polyethylene materials, here are a few recommendations that cover a range of molecular weights as characterized by melt flow rate. Higher melt flow rates allow for easier processing but are associated with lower molecular weight products that may not perform as well.

Table of LLDPE Materials
(All Products Are From ExxonMobil Product Line)

Grade	Melt Flow Rate (grams/10 minutes)
LL 8460	3.3
LL 8450	5.0
LL 8555	6.8
LL 6202.19	12.0
LL 5100.09	20.0

The first three of these materials incorporate a UV stabilizer. This is not an endorsement of the ExxonMobil product line over competitive products. It simply identifies a general property range that is considered to be compatible with the objectives of this project. Other manufacturers will likely offer similar compounds. ExxonMobil does not list the actual densities of these materials. However, based on their melting points they are expected to be in the range of 0.925-0.935 grams/cm^3.

High-density polyethylene grades on the lower end of the density spectrum and with relatively high molecular weight can also provide low-temperature toughness while offering considerably higher strength and stiffness. Below is a table of select products that fall in the range that would be suitable for this application.

Table of HDPE Materials
(All Products Are From LyondellBasell)

Grade	Melt Flow Rate (g/10 min)	Density (grams/cm^3)
Alathon M4621	2.2	0.946
Alathon M4645	4.5	0.946
Alathon M5040	4.0	0.950

Once again, there will be other product lines that can offer materials with similar properties to these materials. This is simply intended to provide a desired performance range.

Polypropylene copolymers, even those with relatively high melt flow rates, have a history of working very well in long-term roof vent applications. The table below summarizes some of these materials. Concentrates that contain additional antioxidant and UV stabilizer are added to these materials.

Table of Polypropylene Copolymers

Supplier	Grade	Melt Flow Rate (g/10 min)
ExxonMobil	PP7032E2	4.0
ExxonMobil	PP7033E3	8.0
LyondellBasell	Pro-fax SG722	25.0
LyondellBasell	Pro-fax SG802N	35.0
LyondellBasell	Pro-fax SG899	35.0

Finally, some manufacturers of roofing products have added calcium carbonate to a polyethylene or polypropylene. In some cases this helps the material pass building code flammability tests, but it has the added advantage of reducing shrinkage and making it more predictable as well as reducing cycle time without damaging impact resistance. In addition, calcium carbonate is the best filler for retaining weld line strength. The table below lists some representative grades all based on polypropylene copolymer.

Table of Calcium Carbonate-Filled PP Copolymers
(All Products from Washington Penn)

Grade	Percent Filler	Melt Flow Rate (g/10 min)
PPC1CF2	20	1.8
PP2CF-2	20	5.0
PPC4CF3.2	32	10.0

In addition, Washington Penn makes a 72% calcium carbonate filled natural polypropylene copolymer with a UV stabilizer that can be added as a concentrate to tailor filler content as well as impart weatherability. This can be used as a tool to fine tune dimensions in materials where the shrinkage rates can be variable.

The antioxidant that has had success in this market is a mixture of Irganox 1010 or Irganox 1076 and Irgafos 168. The UV stabilizer that has worked very well for extended life is Tinuvin 791, a mixture of a HALS-based stabilizer, Tinuvin 770, and a UV absorber, Chimassorb 944. If a HALS-based stabilizer is used in conjunction with carbon black as the active ingredient in the black colorant, it is important that the carbon black not be acidic as this will reduce the effectiveness of the HALS material.

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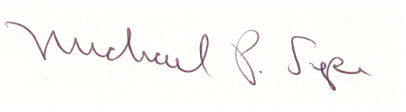

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