Thermoplastic versus metal counterparts

Plastics specialties for filigree speaker- and ventilation-grilles

The covering at top center and the two so-called diffuse grilles in the instrument panel are molded from black Ultradur® S4090 GX, a PBT/ASA blend reinforced with 14 % glass fibers. The three parts have a very finely structured surface. They function as coverings and provide diffusive ventilation of the windshield as well as the interior of the vehicle

Loudspeaker and ventilation grilles in vehicle interiors present special requirements when it comes to the properties of materials used. These coverings – especially in the case of speaker grilles – must be very finely structured in order to avoid distorting the sound, but also very rugged at the same time, since they are part of the vehicle interior and are thus often touched and bumped. As with many other interior components, the trend is to use plastics here as well. Painted expanded metal is now used for speaker grilles in only a few individual cases.

The engineering plastic Ultraform® is ideal for use in ventilation and speaker grilles because of its good mechanical properties. For this application in particular, the material combines high stiffness with mechanical strength, offers good spring characteristics, toughness and dimensional stability

The requirements for the plastics include many different aspects such as: depending on the need, a matte or high-gloss surface, good replication of the mold's structure, and design freedom – such as the ability to incorporate snap fits into the part, for example. Additional requirements include dimensional stability, mechanical strength, impact strength, scratch resistance, good flow characteristics – especially in order to fill thin ribs and details during injection molding. Not to be forgotten: elimination of painting and thus good colorability, good acoustic performance and high productivity, i.e. low piece costs compared to a metal counterpart. In convertibles, UV stability is very important as well; in models where the speaker is not located in its classical position in the door, but directly on the top of the instrument panel instead, hot light aging is a major concern. Some companies also offer special low-emission grades when needed.

There is hardly any plastic that has all of these properties and can still be manufactured economically. However, various specialty plastics

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offer individual combinations of properties that can then help to satisfy special requirements. BASF and its subsidiary Styrolution can offer a wide spectrum of materials comprising three families.

Different plastics available: PBT, POM and ABS/PA

If, for instance, a solution is needed for large ventilation grilles that must be resistant to light aging, because they are located on the top of the instrument panel and beneath the ever more inclined windshield where they must withstand exposure to a great deal of sunlight, then Ultradur® S, an ASA (acrylic ester-styrene-acrylonitrile) modified PBT (polybutylene terephthalate), is a suitable material. In this application, it easily withstands the required 120 °C, offers a high heat deflection temperature under the hot sun as well as great design freedom, which is just as important for large parts as dimensional stability.

On the other hand, a material from the Ultraform® family (POM: polyoxymethylene) is preferred when, for instance, speaker grilles for subwoofers are located in the footwell of the vehicle. Its high strength, toughness and scratch resistance are especially in demand here, since they protect the grille if struck by the foot or other objects. Since the material is not only very dimensionally stable but also exhibits very good mechanical resilience and a low tendency to creep, unpleasant clattering noises can be prevented: frequently, the speaker grille is simply clipped on during assembly and could loosen if a high-grade plastic is not used.

Other properties are offered by Terblend® N, above all in the new improved-flow EF grades (EF: excellent flow). The material is now being marketed by Styrolution GmbH, the company's new home for styrenic plastic activities since the beginning of 2011. Terblend® N is a blend of ABS (acrylonitrile-butadiene-styrene copolymer) and polyamide. One of its exceptional properties is its appearance: the plastic can replicate the surface of the injection mold cavity extremely accurately, making possible very coarse- or fine-grained, leather-like and matte surfaces as desired without the need to apply a coat of matte paint. This effect can be described reliably by measuring the degree of gloss. Terblend® N is considerably lower than PC/ABS in this regard; that is, it appears to be more matte.

Some auto manufacturers also use „Ultramid“ (PA 6) grades for their speaker grilles because of the material's toughness and ruggedness; polypropylene is also used frequently.

How to combine delicate structure, dimensional stability, aesthetics and stability?

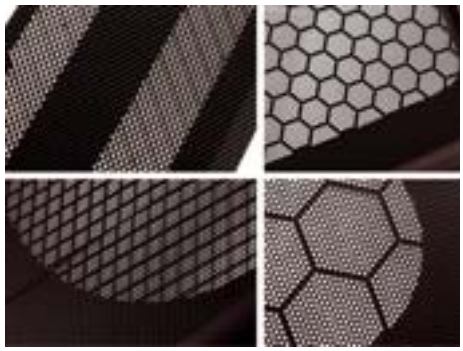
Speaker and ventilation grilles must have very delicate structures. In the case of ventilation grilles, the objective is to have very uniform distribution of air in the vehicle's interior. In the case of a loudspeaker, the quality of the thin ribs has an effect on tonal quality. Moreover, tweeters have different requirements than woofers, which are optimized for reproducing bass tones. The latter require very good processability of the plastic. The exact sound quality of the finished speaker is ultimately tested in the auto manufacturer's sound laboratory. Rib thickness is also important for special combustibility tests.

Sometimes, a very specific compromise is needed to find the solution for a particular task: a high glass-fiber content increases the strength and stability of the plastic, but also leads to warping. Accordingly, large parts should be manufactured from plastics that have either a minimal intrinsic tendency to warp or do not require glass-fiber reinforcement at all. Terblend® N and Ultradur® S both contain styrene copolymers as a component of the blend. These amorphous polymers reduce the tendency to warp. If, in addition, the focus is on a high heat deflection temperature, the decision should be for a – reinforced – Ultradur® S; if the application calls for extremely little warpage, an unfilled or minimally reinforced Terblend® N represents a practical choice.

Aesthetics and surface quality are always the primary focal points when amorphous styrenics such as Terblend® N are involved: the objective is a highly matte appearance without recognizable joint lines. Even a glass-reinforced Terblend® N can satisfy these requirements with a glass fiber content of less than 10 %. This level of glass fiber reinforcement provides improved dimensional stability and greater part stiffness without having to compromise surface appearance, e.g. accepting the so-called glass-fiber effect.

All of these plastics are used unpainted, which translates into a cost benefit of at least 30 % over a painted expanded metal equivalent. Furthermore, many small parts must be manufactured separately and attached to the metal counterpart; this is no longer necessary with an integrated injection molded plastic part. This combination of processing, cost and performance benefits, not to mention the weight advantage of various thermoplastics over metal, will contribute to the continuing trend to shift away from metal towards plastic grilles in vehicle interiors.

Woofer speaker grilles are manufactured from Terblend® N NM 21 EF. The improved-flow blend of ABS and PA is not only easier to process than its predecessor. Working together with Peguform, D-Bötzingen, it was possible to develop speaker grilles for series-production use in door trim, where the plastic is required in many demanding colors



Fine mesh structures and thin ribs are the characteristic features of ventilation and speaker grilles. High tones have different requirements than low tones – sometimes, thin-walled, precise hexagonal structures are used to ensure optimal sound transmission

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