

# Safety Systems



Arnitel®

Akulon®



Almost all of the safety restraint systems used today utilize airbags as part of the system to protect the occupant from serious injury. Airbag systems require highly sophisticated inflation, sensing, and electronics technologies to orchestrate the proper deployment of the airbag.

Airbag modules have several main components including the inflator housing, inflator, air bag, retainer ring and the air bag cover which require very versatile and high quality materials. Traditionally, the structural components, the inflator housing, and bag retainer ring, have used metals due to structural, chemical and thermal performance needs. Replacing metal with engineering plastics is a mainstream activity in the automotive industry that is driven by the need to reduce weight, integrate innovations and/or technology into fewer parts and ultimately to reduce system costs. DSM has many years of experience in replacing metal with engineering plastics to yield all of the above advantages.

**Proven Performance —** If you care about the safety performance of the airbag module, the cold temperature deployment characteristics of Arnitel® PM471 are the best in the industry for airbag door covers.

No other TPE used today for an airbag cover door can surpass the cold temperature performance of Arnitel® PM471. The material is the most recent offering in the Arnitel product portfolio for airbag covers. When we designed Arnitel® PM471, we literally put ourselves in the driver's seat of the vehicle. We asked ourselves what could be done to improve materials that can improve the safety performance of the supplementary restraint system during the controlled explosion that is typical of an airbag module deployment. The DSM Engineering Plastics team also asked ourselves what could we do to improve materials performance to add value to the safety system assuming that our own children would be driving the vehicle. The answer was Arnitel® PM471.

Cold temperature module testing has traditionally been done allowing a time lag between the time the module is removed from freezer after the cold temperature soak and before the actual deployment. This allowed for a necessary interval to place the module on the test fixture, make the required electronic connections, and get people safely out of the deployment chamber. Characterization work done within the industry thermo coupling tear seams during the allowed time interval demonstrates the tear seam rises in temperature — dramatically — much more than originally anticipated. To address this shortcoming, the industry has been moving towards in chamber cold temperature testing. Arnitel® PM471 has been specifically designed to survive the in chamber cold temperature validation requirements of the most demanding OEMs.



**Arnitel® delivers excellent adhesion for airbag systems with uncompromising performance.**

Dräxlmaier Automotive Group chose Arnitel® PM471 copolyester elastomer for its unique ability to perform at cold temperatures and adhere to ABS, PC, PBT and PC/ABS. Dräxlmaier chose PC/ABS as the structural high strength module component for the back of the system housing. DSM's Arnitel® PM471 was used for the softer walls and cover of the module. The parts were molded using a multi-shot technique perfected by Dräxlmaier in concert with DSM. The structural stability of the PC/ABS outer housing was complemented by Arnitel®'s ductility during deployment which continued to perform even at -35°C (-31°F).

DSM has been heavily involved in airbag covers for a number of years. Arnitel® is currently being commercially supplied for covers for multiple airbag module applications. Its use includes driver side, side airbag, and knee bolster airbag covers. Arnitel® is either in use or specified for future production on multiple new programs at Daimler-Chrysler, BMW, Porsche, Audi, VW, Citroen, Peugeot, Rolls Royce, PSA Fiat and Ford.

The driver's airbag is considered one of the most important parts of a vehicle's occupant restraint system. In the unfortunate circumstance of a crash requiring its use, the drivers side cover is the one SRS system in the vehicle that will be used almost every time. It is crucial that the function is guaranteed under the most extreme conditions over time.

**Arnitel® Extends the Performance Envelope - Arnitel® PM471 offers the industry best in class in chamber cold temperature performance.**

The latest development in airbag materials is Arnitel® PM471 which has enhanced ductile behavior at -40°C (-40°F). If the tear seam is designed for use with Arnitel®, then Arnitel® PM471 meets OEM specs for -35°C to -40°C (-31°F to -40°F) in chamber deployment. Daimler-Chrysler has found that this was the only material to meet this stringent performance specification.

The Dynamic Shear Modulus value at the various temperatures gives an indication of the stiffness of the material at that given temperature. As can be seen below, Arnitel® PM471 has a significantly lower stiffness at -40°C (-40°F) while maintaining stiffness at higher temperatures when compared to competitive materials.

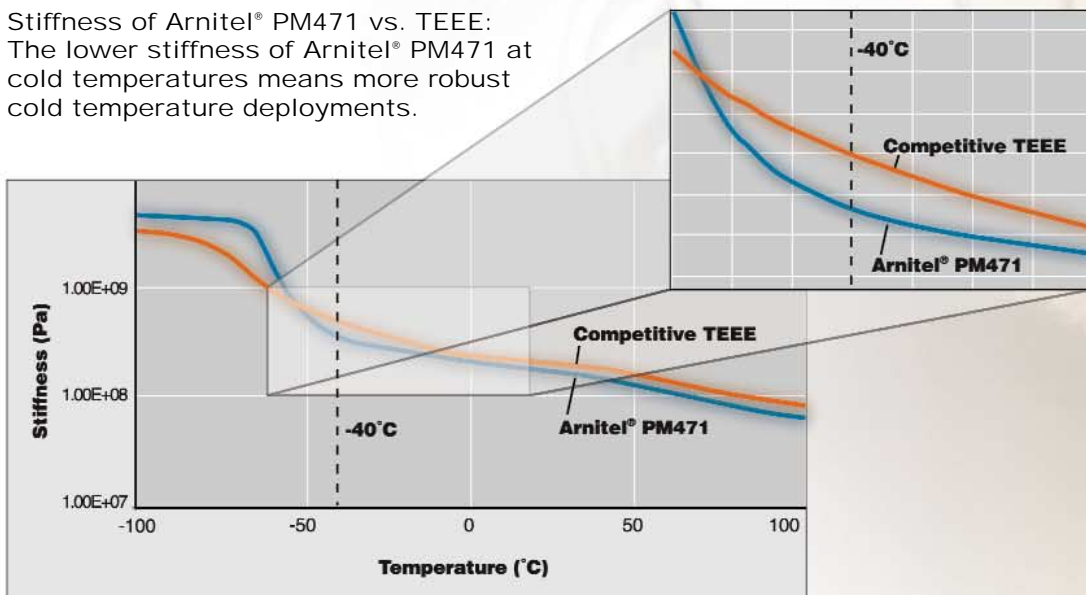
Arnitel® airbag door cover materials portfolio.

Grade	Application
PL420-H	100 MPa modulus material
PL471	300 MPa modulus material
PM471	300 MPa modulus material -40°C in chamber capable

In addition to low temperature performance Arnitel® delivers:

- improved aesthetics
- easier processing (lower fill pressures, faster cycles)
- increased design flexibility
- Paints with solvent and water based paints without primers.

Stiffness of Arnitel® PM471 vs. TEEE:  
The lower stiffness of Arnitel® PM471 at cold temperatures means more robust cold temperature deployments.





## Akulon® provides weight reduction and cost savings for airbag containers.

Almost all of the safety restraint systems used today utilize airbags as part of the system to protect the occupant from serious injury. Airbag systems require highly sophisticated technologies to orchestrate the proper deployment of the airbag. The constant cost reduction and weight reduction pressures on the automotive industry force many compromises on component designs. The uses of non-traditional manufacturing methods and materials have become necessary for new designs to achieve both economic goals as well as performance goals.

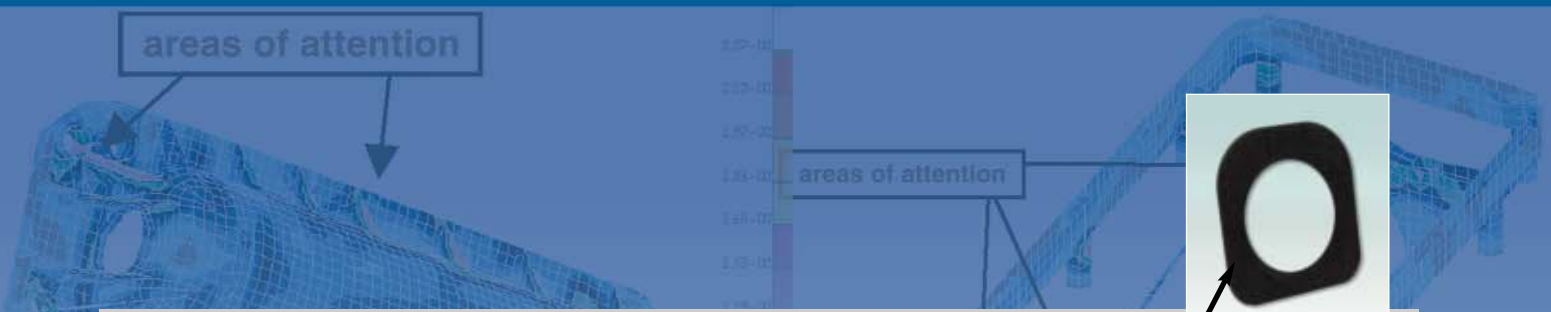
DSM has many years of experience in replacing metal with engineering plastics. DSM's Akulon® can withstand the challenging requirements of the automotive OEMs and enable system suppliers to design cost effective and state-of-the art airbag containers.

## Akulon® is the first choice for tough performance conditions where others fail.

It's unusual in engineering to design a system that the owner hopes they will never have to use. There's only one chance when called upon to have the airbag container work perfectly and no pre-testing of the system is possible. When the need arises, that system must perform exactly as it is designed to do the one time it is deployed. The system is rigorously tested and inspected to assure the highest level of reliability.

When developing an airbag system there are several key safety features to consider:

- Every part of the system must contribute to a safe deployment.
- After deployment the airbag container must remain in the same condition as before deployment.
- There can be no cracks or brittle failure.
- Manufacturers must be sure it will work as intended.



Akulon® was chosen to replace metal in their airbag retainer ring to reduce costs and weight. By using a plastic design the retainer ring weight was reduced by 50%. Akulon® K224-PG8 provides both low (-40°F) and high temperature performance that the retainer ring requires. Akulon® was selected over other thermoplastics as it offers the optimum safety performance and ensures structural integrity during deployment. Specifically, at cold temperatures when most plastics are brittle you need a material that can survive deployment to prevent injury to the passenger. Akulon® displays excellent impact resistance and tensile strength making it the best fit for airbag retainer rings.



Akulon® delivers excellent performance at both high and low temperatures

Plastic airbag containers require more than tight dimensional tolerances. They have to work in extreme conditions and perform at extreme low temperatures [down to -35°C(-31°F)] and at extreme high temperatures [up to 85°C (185°F)]. With low temperatures, the risk is that the housing will crack and brittle fracture, leading to inadequate or failed airbag deployment and splinter generation. At high temperatures, the materials have to retain sufficient strength or fracture will occur with similar consequences. Materials that have identical mechanical property profiles perform very differently in actual airbag testing, since standard plastic testing does not simulate the accelerated and explosive forces that are unleashed when an airbag is activated. Few materials, even toughened ones, will survive these conditions. Qualifying a new airbag design involves testing

75 units at three different temperatures: -35°C(-31°F), 23°C (73°F), and 85°C (185°F). Airbag containers made from Akulon® constantly delivered zero failures during deployment tests. For the most reliable airbag systems, manufacturers know that Akulon® will not let them down.

Toughened Akulon® grades K224-PG6 (30% glass fiber reinforced, impact modified nylon 6) and K224-PG8 (40% glass fiber reinforced, impact modified nylon 6) have been specially developed to meet the stringent practical requirements of airbag housing applications. They are formulated to have the best low temperature impact performance while retaining more than enough strength to perform at the higher environmental conditions.



Akulon® lends toughness and thermal stability to airbag canister housings.

