



# Diablo technology: the new standard for high-heat plastic AIM/CAC combinations

## DSM's portfolio of high-performance plastics helps to revolutionize the design of air intake manifolds

New legislation places very tight limits on car emissions, with strict targets on CO<sub>2</sub> emissions. DSM focuses on driving forward solutions that significantly decrease environmental impact, leading to the development of a complete portfolio of thermoplastic products that answer the changing needs of the automotive industry.

One of the latest developments in turbo systems is to integrate the charge air cooler (CAC) into the air intake manifold (AIM), using liquid to more effectively cool the air instead of air-to-air systems. This drives up the temperature in the AIM (currently up to 230°C), as well as the mechanical requirements for the materials used. Integrating the CAC into the AIM reduces the length of piping previously needed to reach the air-to-air cooler in the front



of the car, leading to increased engine responsiveness. For car manufacturers, this makes it possible to deliver higher performing engines while still meeting the new emission limits. DSM offers a complete portfolio of high-performance materials for air intake manifolds whether they have an air-to-air CAC or an integrated liquid-cooled CAC. This includes Akulon® polyamide 6, Akulon Diablo polyamide 66, Stanyl® and Stanyl Diablo polyamide 46. The Diablo technology is engineered specifically for elevated continuous-use temperatures of 180-230°C.

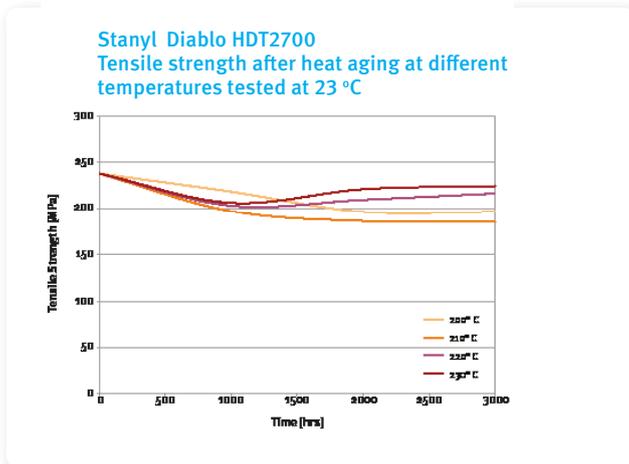
### AIM with integrated liquid-cooled CAC

Air intake manifolds with integrated liquid-cooled CACs achieve a giant step forward in improving engine responsiveness and reducing turbo lag, yet they require a great deal more from the plastic materials used to create them. Integrating the cooler into the AIM drastically changes the geometry of the manifold in a way that could cause a loss of stiffness and strength, which are critical at higher temperatures. The new geometry also requires materials with high weldability and weld line-aging resistance to maintain the part's integrity. At the same time, the material must withstand exhaust gas recirculation (EGR) and blow-by.

## Outperforming the competition: Stanyl Diablo

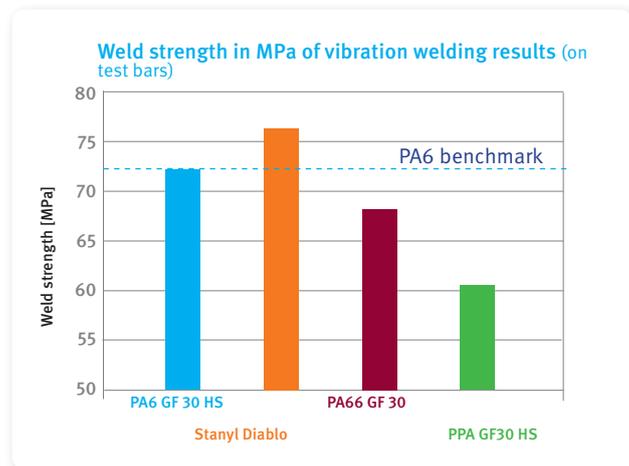
DSM's solutions for high temperature and high pressure applications are Stanyl Diablo OCD 2100 and our latest innovation Stanyl Diablo HDT2700. These high-heat thermoplastics outperform competitive materials in thermal oxidative stability, maintaining high stiffness at elevated temperatures and pressure loads.

### Best-in-class: Thermal stability



### Best-in-class: Heat Deflection Temperature under load (HDT)

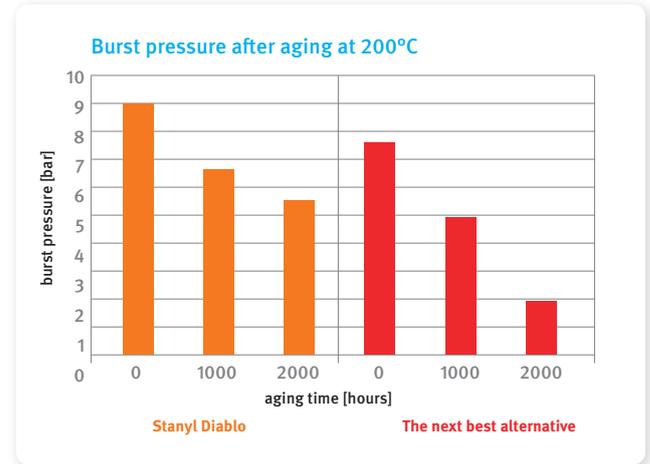
The new Stanyl Diablo HDT2700 has an improved HDT. The melting point in combination with the Heat Deflection Temperature (HDT) gives a good impression of the peak temperature resistance under a certain load.



Stanyl and Akulon offer excellent weldability for injection molded ducts.

Both Stanyl Diablo HDT2700 and Stanyl Diablo OCD2100 have excellent mechanical strength to provide best-in-class weld strength and ensure part integrity under pressure pulsation loads. Stanyl Diablo, like our other grades for intake systems, withstands the current exhaust gas recirculation (EGR) and blow-by requirements. It maintains high stiffness, even while exposed to continuous-use temperatures up to 230°C.

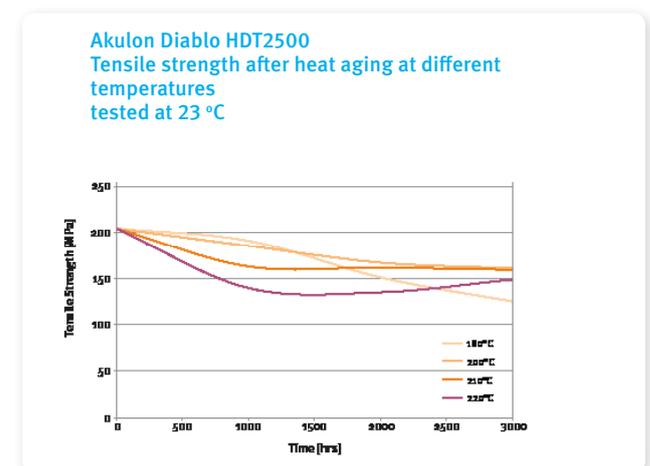
Our Diablo materials eliminate the need to return to metals due to the increasing temperature requirements under the hood, and enlarges the possibility to integrate functions and be more flexible in designing efficient parts. Stanyl provides a weight reduction of up to 40% over aluminum, and its optimized processing characteristics reduce material and production costs.



Stanyl Diablo performance after 2000 h is 189% higher than performance of the next best alternatives

### Meet the new Akulon Diablo polyamide 66

The new Akulon Diablo HDT2500 withstands a 220°C continuous-use temperature and has a HDT of 245°C. Looking at long term heat aging, this new grade has a stable performance up to 220°C.



Akulon Diablo fills the gap between Akulon PA6 and Stanyl Diablo by combining long term heat aging performance and mechanical properties at 180-200°C.

## Akulon® polyamide 6, the proven solution

For lower temperature AIM applications, Akulon polyamide 6 glass-filled, provides an optimal balance between density and mechanical properties. For increased safety and flexibility in manifold design, we also offer grades with improved burst pressure or laser weldability.

### Case: Meet the extreme in high heat:

Mahle and DSM have jointly developed the world's first high-volume use of high-heat plastic in an air intake manifold (AIM) that integrates a water-cooled charge air cooler (CAC). Stanyl® Diablo OCD 2100 is selected for this high-heat plastic AIM/CAC combination for use in BMW's B48 engine. BMW uses the B48 engine in several different car models.

"Such a design can drive the AIM's continuous operating temperature up to 220°C, which in turn boosts the mechanical demands on the materials used in those components. This new geometry also requires materials with robust weldability and weldline aging resistance in order to maintain the part's integrity. The Stanyl Diablo fulfilled all customer requirements" says Mr. Valecka, project manager integrated manifold BMW B48 at Mahle.

The excellent mechanical properties of the OCD2100 material provide superb weld strength and ensures part integrity under pressure pulsation loads. The material outperforms competitive materials in regards to thermal oxidative stability, maintaining high stiffness at elevated temperatures and pressure loads.

## DSM Engineering Plastics

For further information, please see:  
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## Inventor of the Diablo technology

DSM is a market leader in the development of high temperature resistant thermoplastics for automotive engines. Diablo technology, invented and patented by DSM, improves the long term temperature resistance of materials such as Stanyl PA46 and Akulon PA6 that already has better high temperature performance than standard polyamides; and DSM is also using it to upgrade performance in its Akulon polyamide 6. DSM licenses the Diablo technology to other high temperature thermoplastics suppliers.



**Contact us today to discuss how DSM can help redesign your air intake manifolds to integrate a liquid charge air cooler, and create lighter and more efficient air induction systems.**

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