The only way to combine high temperature and flexibility
Rilsan® HT, a new product line in Arkema’s polyamide 11 and polyamide 12 product family, is the first flexible polyphthalamide (PPA)-based material to replace metal in tubing for high temperature automotive and other demanding industrial applications. This entirely new class of flexible polyphthalamide of vegetable origin combines the high temperature resistance of conventional PPA grades with a flexibility unprecedented in this material class, creating opportunities to replace metal that were previously unthinkable.

Surpassing the Limits of other PPA Materials

Since classic PPA resins are known for their inherent brittleness limiting their use to rigid or injection-molded parts, Arkema has developed Rilsan® HT specifically to fill this gap. Due to its specific polymer matrix, which is based largely on long-chain chemistry, Rilsan® HT stands out above all by a flexibility previously unknown in this material group. This revolutionary flexibility of Rilsan® HT offers a step change in PPA-based materials and makes Rilsan® HT the first flexible PPA extending metal substitution to yet unimagined possibilities for severe engine-compartment service or other demanding industrial uses.

In contrast to other high temperature thermoplastics, Rilsan® HT is additionally characterized by its excellent long-term resistance to thermooxidative and chemical aging at high temperatures as well as its very low moisture absorption resulting in exceptional dimensional stability and low tendency to creep.

Unprecedented opportunities for metal replacement

Cost-Efficient Manufacturing

With processing characteristics similar to those of high-performance long-chain aliphatic polyamides, Rilsan® HT can be economically processed on standard extrusion equipment, easily thermoformed and assembled, lowering the overall system cost by up to 50% and offering optimum design flexibility compared with metal tubing assemblies.

Function Integration

Rilsan® HT is the first complete PPA-based product line suitable for all kinds of process technologies, ranging from extrusion to blow or injection molding. This facilitates high function integration when used, for example, as quick-connectors or other temperature-resistant injection molded components in combination with flexible Rilsan® HT tubing.

Protecting the Environment

By being lighter than metal, Rilsan® HT contributes to significant weight reduction and thereby helps to reduce emissions and fuel consumption of vehicles. But Rilsan® HT also offers a further benefit for the environment. Up to 70% of this new PPA is based on a renewable non-food-crop vegetable feedstock, resulting in a significant reduction in CO2 emissions and a lower dependence on oil resources.

Key characteristics

Rilsan® HT offers the optimum properties of long-chain Rilsan® PA11 and classic PPA and combines the high temperature resistance of conventional PPA grades with a flexibility previously unknown in this material class. Low moisture uptake, excellent long-term resistance to thermooxidative and chemical aging as well as ease of processing complete the unique performance spectrum of Rilsan® HT.
What Makes Rilsan® HT so Different and Unique?

The unique property profile of Rilsan® HT opens up yet unimagined metal replacement possibilities for highly technical flexible tubing applications for under the hood components and other demanding industrial uses. Rilsan® HT provides the perfect answer, in particular for the automotive market which, today more than ever, demands lower component costs and light-weight construction to minimise the environmental impact, all combined with rising expectations in terms of performance and in the light of increasing temperatures.

Rilsan® HT features high temperature resistance...

**Plus:**

- **Flexibility**
- **Processability:**
  - processing similar to aliphatic polyamides
  - no need for special heating and cooling system
  - excellent thermoforming and fitting insertion
- **Long term heat resistance (thermooxidation) and chemical resistance at high temperatures**
- **Integrity of mechanical properties at high temperatures**
- **Spin-welding**
- **Low density**
- **Low moisture uptake**
- **Biobased**

**Rilsan® HT...**

- > is the first flexible PPA to replace metal in tubing for high temperature applications
- > can be easily manufactured on standard processing equipment
- > offers cost efficient manufacturing and system costs reduction
- > features high design flexibility
- > surpasses other high temperature thermoplastics with superior long term resistance to thermooxidation and chemical aging at high temperatures
- > is the only PPA being spin-weldable on aliphatic PA
- > is a lightweight PPA resin
- > offers exceptional dimensional stability
- > naturally fits into eco-design concepts

**Economical**

- System cost reduction through substitution of metal, aluminium, rubber and costly polymeric materials (i.e. ETFE, PTFE, PPS, etc.)

**Environmental**

- Weight reduction (emission reduction, fuel efficiency)
- Renewable resource

**Technical**

- Rilsan® HT lowers the system cost by up to 50%
- Rilsan® HT significantly lowers total system weight
- Rilsan® HT contains up to 70% renewable carbon
- Rilsan® HT increases the long term usage temperature and service time
Rilsan® HT tubing assemblies are more cost-effective in series production and lower the overall system costs by up to 50% compared to classic metal tubing assemblies. With processing characteristics similar to those of high-performance long-chain aliphatic polyamides, Rilsan® HT can be economically processed on standard extrusion equipment, easily thermoformed and assembled. Ease of thermoforming and processing in all kinds of tube manufacturing technologies (smooth and corrugated tube extrusion, extrusion blow molding) makes for optimum design flexibility and further adds to cost-effectiveness.

As result, Rilsan® HT significantly cuts the overall system costs through reduced manufacturing costs, parts consolidation and production gains (reduction in the number of costly process steps, elimination of secondary operations) compared to classic metal tubing processing and assembly.

Rilsan® HT sets new standards for metal replacement. Tubing for demanding high-temperature applications can now be manufactured in light-weight flexible tubing made of Rilsan® HT. Thanks to these new opportunities for metal and rubber replacement and to Rilsan® HT’s low density - even compared to other polymeric materials as well as classic high-temperature thermoplastics (Rilsan® HT is more than 10% lighter than classic PPA!) - Rilsan® HT allows significant weight savings without compromise regarding its long-term heat and chemical resistance and its ease of processing.

Key Features and Values

System Cost Reduction: Metal Replacement and Cost-Efficient Manufacturing

- Rilsan® HT generates up to 50% cost savings vs. metal based tubing assembly

Low Density for Reduced Weight

- Rilsan® HT sets new standards for metal replacement. Tubing for demanding high-temperature applications can now be manufactured in light-weight flexible tubing made of Rilsan® HT. Thanks to these new opportunities for metal and rubber replacement and to Rilsan® HT’s low density - even compared to other polymeric materials as well as classic high-temperature thermoplastics (Rilsan® HT is more than 10% lighter than classic PPA!) - Rilsan® HT allows significant weight savings without compromise regarding its long-term heat and chemical resistance and its ease of processing.

Density of Rilsan® HT compared to metal, rubber and other polymeric materials - Rilsan® HT, a light-weight PPA
Compared to conventional PPA materials, Rilsan® HT stands out for its very low moisture absorption (more than 50% less humidity uptake than classic PPA grades), resulting in:

- exceptional dimensional stability
- low tendency to creep
- a large processing window.

Rilsan® HT therefore provides a double environmental benefit and fits naturally into the eco-design concepts of many vehicle manufacturers.

Rilsan® HT is the first PPA to combine the high temperature resistance of conventional PPA grades or other high-temperature materials with unprecedented flexibility for this class of materials. Largely based on long-chain chemistry, Rilsan® HT offers the optimum synergy of long-chain Rilsan® PA11 and classic PPA resulting above all in unprecedented flexibility and ease of processing.

Rilsan® HT offers more than 50% less humidity uptake compared to classic PPA

By being lighter than metal, Rilsan® HT helps not only to reduce emissions and fuel consumption, but also offers a further advantage for the environment:

Rilsan® HT:
- is a durable high-temperature thermoplastic derived largely from renewable non-food-crop vegetable feedstock
- contains up to 70% of renewable carbon (ASTM D6866-06)
- helps to lower CO2 emissions compared to conventional petroleum-based high-temperature plastics and to protect fossil resources.

“Rilsan® HT therefore provides a double environmental benefit and fits naturally into the eco-design concepts of many vehicle manufacturers.”
Rilsan® HT is the first complete PPA-based product line suitable for all kinds of process technologies, ranging from extrusion to blow or injection molding. The processing characteristics of Rilsan® HT are similar to those of high-performance, long-chain aliphatic polyamides. As a result, this new PPA can be economically processed on standard extrusion or injection equipment as used for PA11/PA12, and on conventional extrusion blow molding equipment as used for PA/PE materials. In addition, Rilsan® HT is also amenable to further processes such as spunbonding (a nonwoven manufacturing technique), coating, and filament production. Thanks to its very low moisture absorption, Rilsan® HT offers a large processing window compared to classic PPA-based resins and is easy to handle overall (for example also in comparison to PPS). This avoids additional upstream or downstream production steps, and scrap levels are reduced.

“Detailed information and recommendations on processing temperatures and conditions for Rilsan® HT grades are given in respective processing data sheets.”
Rilsan® HT stands out from classic PPA-based injection resins for its easy and cost-efficient manufacturing. This means that Rilsan® HT offers the same excellent fitting-insertion properties, reliability, durability and safety as, for example, Rilsan® PA11. Ease of thermoforming and processing in smooth or corrugated tube manufacturing technologies makes for optimum design flexibility and contributes further to cost-effectiveness.

Injection

Rilsan® HT stands out from classic PPA-based injection resins for its easy and cost-efficient manufacturing. A further benefit of Rilsan® HT over traditional PPA injection resins is its feasibility to be spin-welded with aliphatic high-performance polyamides, a completely new feature in this material group and thereby further adding to function integration.

Extrusion Blow Molding

Rilsan® HT allows easy processing on conventional extrusion blow molding equipment as used for PA/PE materials. Compared to classic PPA resins, the new flexible PPA Rilsan® HT accommodates low transformation temperatures, excellent cycle times and the use of non-heated molds.

Process parameters for Rilsan® HT (extrusion, thermoforming)

Process parameters for Rilsan® HT (injection molding)

Process parameters for Rilsan® HT (extrusion blow molding)
Rilsan® HT provides a breakthrough in metal replacement. This new flexible PPA allows metal replacement in tubing for demanding high-temperature applications that were previously unthinkable. Rilsan® HT enables the cost-efficient manufacturing of light-weight high-performance technical tubings that are characterised by:

- Flexibility
- Integrity of mechanical properties at high temperatures
- Excellent long-term thermooxidative aging resistance
- Excellent long-term resistance to chemicals, all kinds of fluids and aggressive media at high temperatures
- High dimensional stability and low tendency to creep
- Sustainability (renewable raw materials)

Rilsan® HT’s unique property profile - with above all its revolutionary flexibility - opens up unprecedented opportunities to replace metal in tubing in demanding high-temperature applications in the fields of:

- Automotive
- Industry
- Energy
- Cables
- Consumer Goods

The performance spectrum of Rilsan® HT is particularly well suited to automotive applications under the hood in which materials need to withstand attack from a wide range of fluids and chemicals at continuously rising temperatures, all combined with a flexibility previously unknown in the PPA material group.

Rilsan® HT has already established itself in many applications under the hood as an alternative to classic metal tubing assemblies. The possibility of producing flexible, light-weight tubing with excellent long-term resistance when exposed to high temperatures, all kinds of fluids and chemicals - all at reduced cost - is a property profile that is being hailed in this segment.

Typical examples of the use of Rilsan® HT to replace metal in tubing for automotive powertrain applications, include:

- Air management (pressure and vacuum management): pneumatic tubing to steer EGR (exhaust gas recirculation) valve or turbo charger valve, brake booster tubing, hoses in the brake or air intake system
- Oil management (hydraulic fluids or lubricants): hydraulic brake hoses, clutch and power steering tubing, transmission oil cooling and engine oil lines, oil filler tubing
- Aqueous media management: engine cooling hoses and AdBlue® tubing for SCR (selective catalytic reduction)
- Aggressive media management: blow-by and PCV (positive crankcase ventilation) tubing

"More detailed information on Rilsan® HT, its use in different applications, OEM approvals and its use in series production is given in specific data sheets and is available upon request."
Rilsan® HT Flexible Tubing

The genuine alternative to metal tubing assemblies

- Air management (pressure and vacuum management)
- Oil management (hydraulic fluids, lubricants)
- Aqueous Media Management (Cooling, SCR)
- Aggressive Media Management (Blow By, PVC)
Rilsan® H T injection resins, available as glass-fiber-reinforced and conductive injection molding grades, accommodate a high level of function integration if used, for example, as quick-connectors or other temperature-resistant injection molded components in combination with flexible Rilsan® H T tubing.

Rilsan® H T injection grades are ideally suited as a cost-efficient metal substitute - using conventional injection molding machines and injection molds designed for PA11 and PA12:

- in connectors or other temperature-resistant injection molded components under the hood
- in fuel system applications requiring low permeation and low swelling in contact with alcoholic fuels at high temperatures
- in components requiring conductivity at high temperatures
- in components requiring high dimensional stability and parts properties exhibiting low variation by water absorption (thanks to the very low moisture pick-up of Rilsan® H T)
- in ductile components (thanks to its exceptional ductility, Rilsan® H T provides a designer-friendly balance of toughness, strength and elongation reducing the risk of failures that can occur with brittle plastics such as conventional PPA-based injection materials or PPS).

A further benefit of Rilsan® H T is its spin-welding capability with aliphatic high-performance polyamides. This represents a completely new performance characteristic in the PPA material group and further facilitates function integration.
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