Erosion Protection of Aircraft Radomes and Leading Edges

Protect Your Asset and Your Image

Aircraft leading edges suffer erosion from water droplets and solid particles which strike at high speed in flight and can cause unsightly damage as well as the potential for more serious structural problems.

Causes of erosion

Aircraft travel at speeds well in excess of 200mph through all varieties of climate. Small water droplets striking the surface at this very high speed deform on impact and transfer a lot of energy into the surface. This energy typically travels in waves through the substrate (often a painted surface) and can cause delamination or splitting of a paint system at one of the interfaces between layers. Solid particles such as dust entrapped within water droplets, ice or dry particles of sand/salt etc. also strike the surface and cause a different mode of erosion, wearing away the surface or "blasting" material from the upper layer of the eroding surface.

Effects

The effects of erosion are many. Firstly from a decorative aspect many aircraft nose radomes exhibit signs of wear which detracts from their appearance. These effects may also be present on wing leading edges and other prominent surfaces such as fairings.

The protective coating may eventually break through and more damage can occur. Erosion of the composite itself is possible, which can cause more severe damage requiring repair or replacement. Moisture ingress can be damaging to the resin matrix of the composite. Freezing and thawing of moisture exacerbates such damage and can eventually result in a failure of the composite. High levels of moisture in the composite can also impair radar transparency.

When paint or substrate edges are exposed by erosion, accelerated lifting of the edges can occur creating even more exposure of the composite.

Solutions

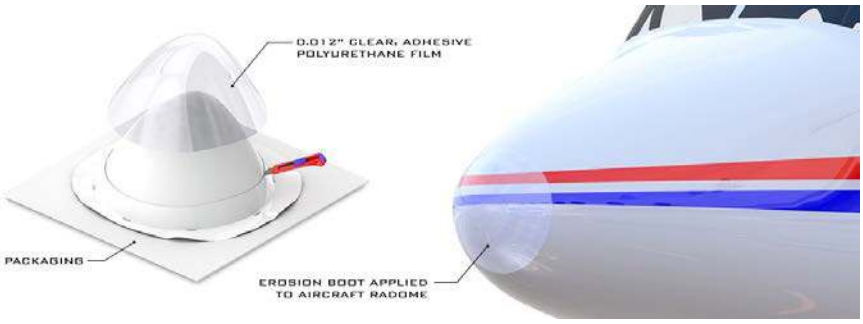
Theory

Increasing the thickness of the first layer to be impacted by erosion is a good step as this increases the distance that energy imparted by droplet strike must travel within the film and reduces that energy before it reaches any of the interfaces between layers. There is an additional benefit for solid particle erosion as this also increases the amount of material which must be eroded away before any substrate is exposed.

Other technical characteristics of the coating can be modified, such as increasing its elastomeric properties, this allows energy to dissipate and also permits recovery of the deformation at the surface. In addition, improving the compatibility between layers is helpful to maximise the adhesion of the different interfaces.

Practice

So, a thicker layer of more elastomeric material is a good solution. There are various ways in which this can be accomplished. The "old school" method is to apply several layers of additional paint to add ≥250µ of additional elastomeric polyurethane coating. This is very effective at preventing erosion and can be applied in either a clear "over layer" or as a coloured finish to match the rest of the aircraft. It is time consuming to apply, as the layers need to be built up over time to allow solvents to evaporate. As a multi-day process this is much more suitable for an OEM



application. The desired mode of failure is gradual erosion, whilst paint is easily applied to a 3 dimensional shape such as a radome.

In an MRO application the application of a polyurethane film is a much quicker solution and offers at least an equal performance. PM Research has created a clear polyurethane film matched to the exact dimensions of the radomes of >350 aircraft types in service today. Pexa is the authorised stockist and distributor of these products in Europe.

Commonly called radome masks or “boots”, as they fit like a boot over the 3D surface. The film has excellent elastomeric properties. It is a completely clear, non-yellowing polyurethane film of thickness 300µ. Tested and certified with very high peel strength, resistance to aviation chemicals and offering 500% elongation before breaking. The film functions well in the full range of temperatures in which aircraft operate. It is practically invisible to the eye and to radar. This approach mimics the elastomeric paint solution but without the additional down time.

PM Research has manufactured these products at its Wellsville, New York facility since 1973. The product range includes preformed boots for all sizes of aircraft from the smallest general aviation models right up to the largest commercial passenger jets. In addition to plain erosion resistant tapes for application to wing leading edges.

The boots are supplied on a 3D plastic support which makes it easy to apply them directly to the surface. Application can be achieved in a very short time frame and has little effect on aircraft down time.

Pexa supplies PM Research boots to radome OEMS, repair stations and aircraft maintenance facilities.