

JAL, JAXA, O-Well, and Nikon Conduct Flight Test with Aircraft for which the World's First Riblet Shape was Applied over External Paint

~ Contributing to the reduction of CO₂ emissions by improving aircraft fuel efficiency and to the realization of a sustainable society ~

Japan Airlines Co., Ltd. (hereinafter “JAL”), Japan Aerospace Exploration Agency (hereinafter “JAXA”), O-Well Corporation (hereinafter “O-Well”), and Nikon Corporation (hereinafter “Nikon”) have been aiming to reduce CO₂ emissions by improving aircraft fuel efficiency since July 2022. The four companies are conducting flight tests using the world’s first*1 aircraft with riblets*2 applied over the aircraft’s external paint. Although there are cases such as processing riblets to decals and films and attaching them to the airframe, in this case, weight reduction and improved durability are expected as a result of applying riblets directly over the coating.

Riblets, where a skin friction reduction effect*3 was confirmed by JAXA, were applied locally to the bottom of the fuselages of two Boeing 737-800 aircraft. For one aircraft, O-Well’s processing technology was used, and for the other, that of Nikon was used.

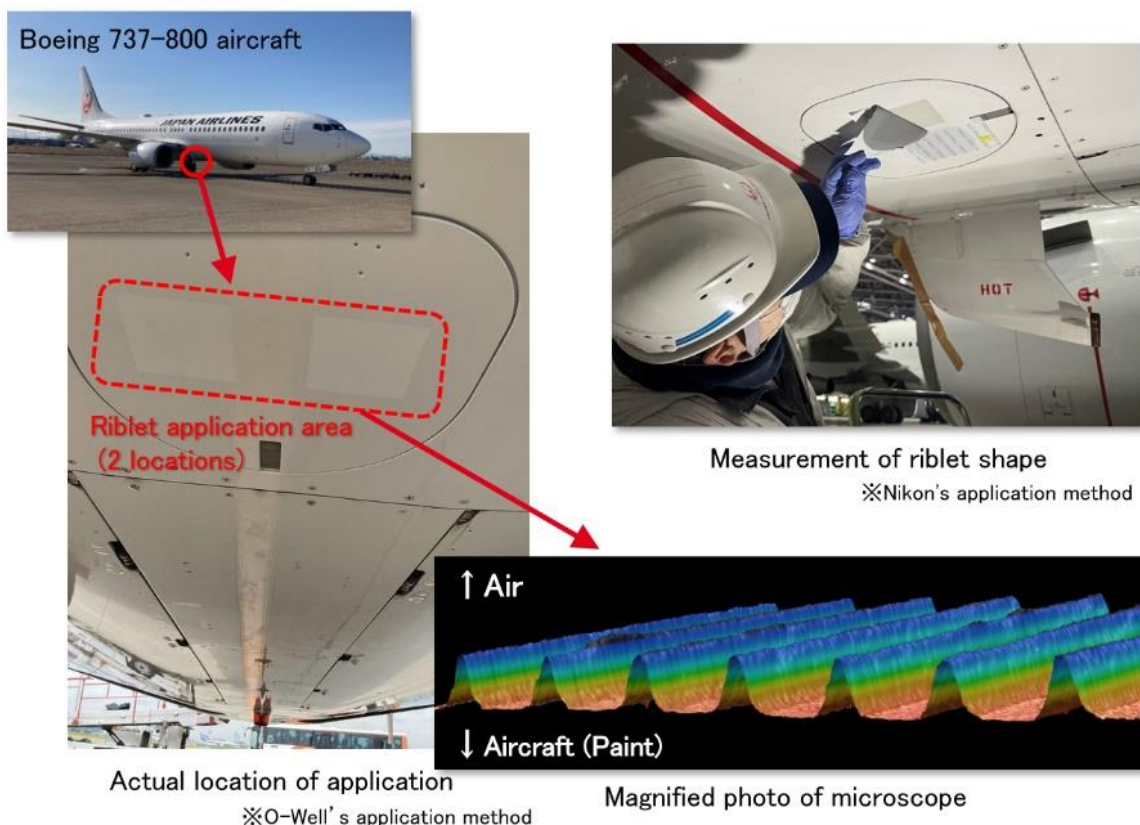
Durability tests are currently being carried out by performing repeated inspections, measuring the changes in the shapes of the riblets incurred during test flights.

As of now, more than 1,500 flight hours have been accumulated in the O-Well method aircraft, and more than 750 hours in the Nikon method aircraft, and the riblets applied by both O-Well and Nikon have been confirmed to have sufficient durability.

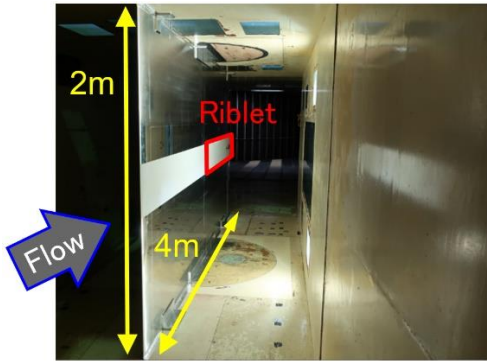
(*1) In the operated aircraft as of February 28, 2023. According to JAL, JAXA, O-Well, and Nikon.

(*2) Riblet: Fine groove structure inspired by the shape of shark skin which reduces water resistance.

The skin friction can be reduced by forming a fine groove structure on the aircraft exterior panel along the air flow during flight of the aircraft.

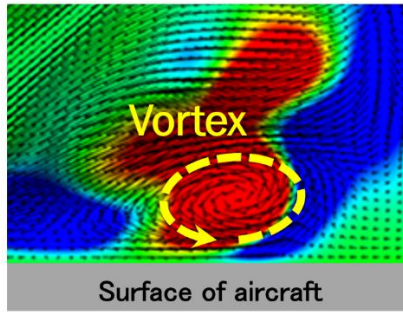


(*3) Evaluation of skin friction reduction effect by riblets at JAXA



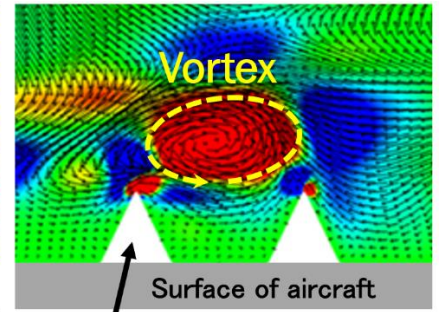
Wind tunnel test

Skin friction reduction resulting from riblets is evaluated in a series of ground tests simulating flight conditions.



Surface of aircraft

Smooth surface



Surface of aircraft

Riblet : Triangular heap

Simulation on JAXA supercomputer: Flow is perpendicular to the paper surface.

Rotating flows called vortices near the surface of the aircraft increase skin friction (left figure). Skin friction is reduced because the riblets (right figure) move the vortex away from the aircraft surface wall.

■ About “Refresh (Riblet Flight REsearch for carbon neutral)” program (*4)

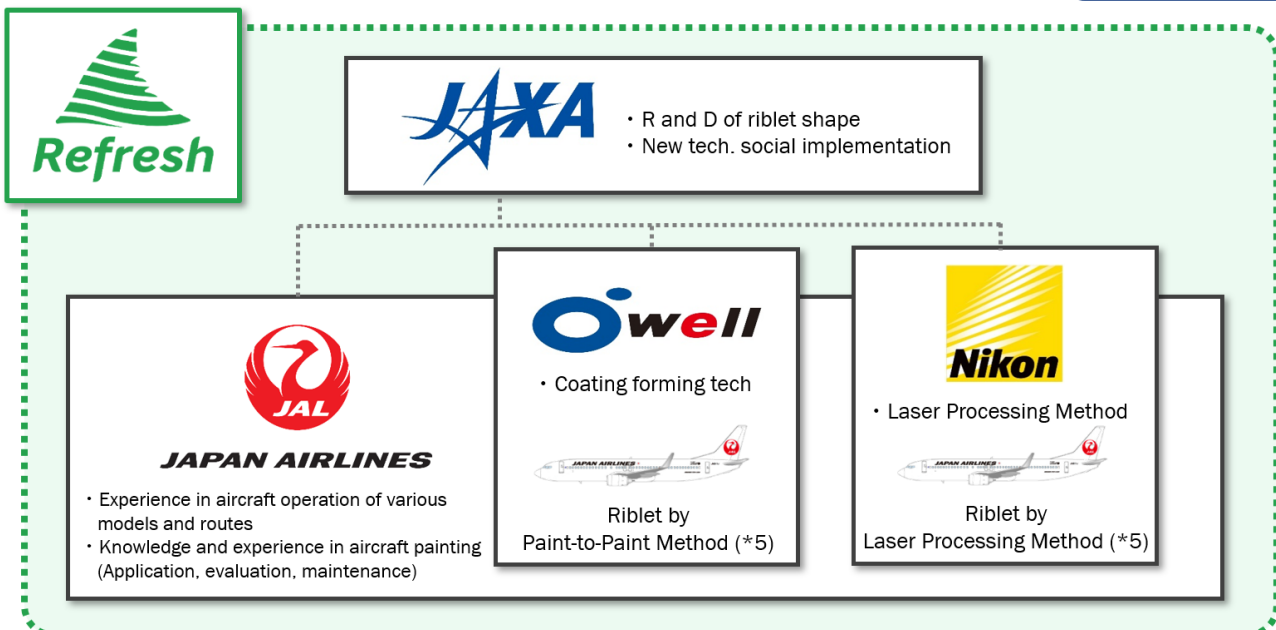
By leveraging their respective strengths, JAL, JAXA, O-Well, and Nikon aim to develop eco-friendly aviation technology towards the realization of a decarbonized society in this program.

In the field of aviation, various initiatives, such as updating to fuel-saving equipment, and promotion of utilizing SAF (Sustainable aviation fuel) are underway. Among them, the introduction of fuel efficiency improvement technology that reduces skin friction (resistance with the strongest effect during flight), and riblet technology inspired by shark skin, are attracting attention from all over the world. Skin friction is reduced by applying riblets on the aircraft coating surface, resulting in a fuel efficiency improvement of up to 2%, which contributes to reducing CO₂ emissions. JAXA, which researches and develops the riblet shape, has focused on O-Well’s paint and coating technology and Nikon’s laser processing technology, promoting efforts to apply the riblets in practical use with the JAL group’s knowledge of and operation experience in aircraft, and expertise in aircraft coatings.

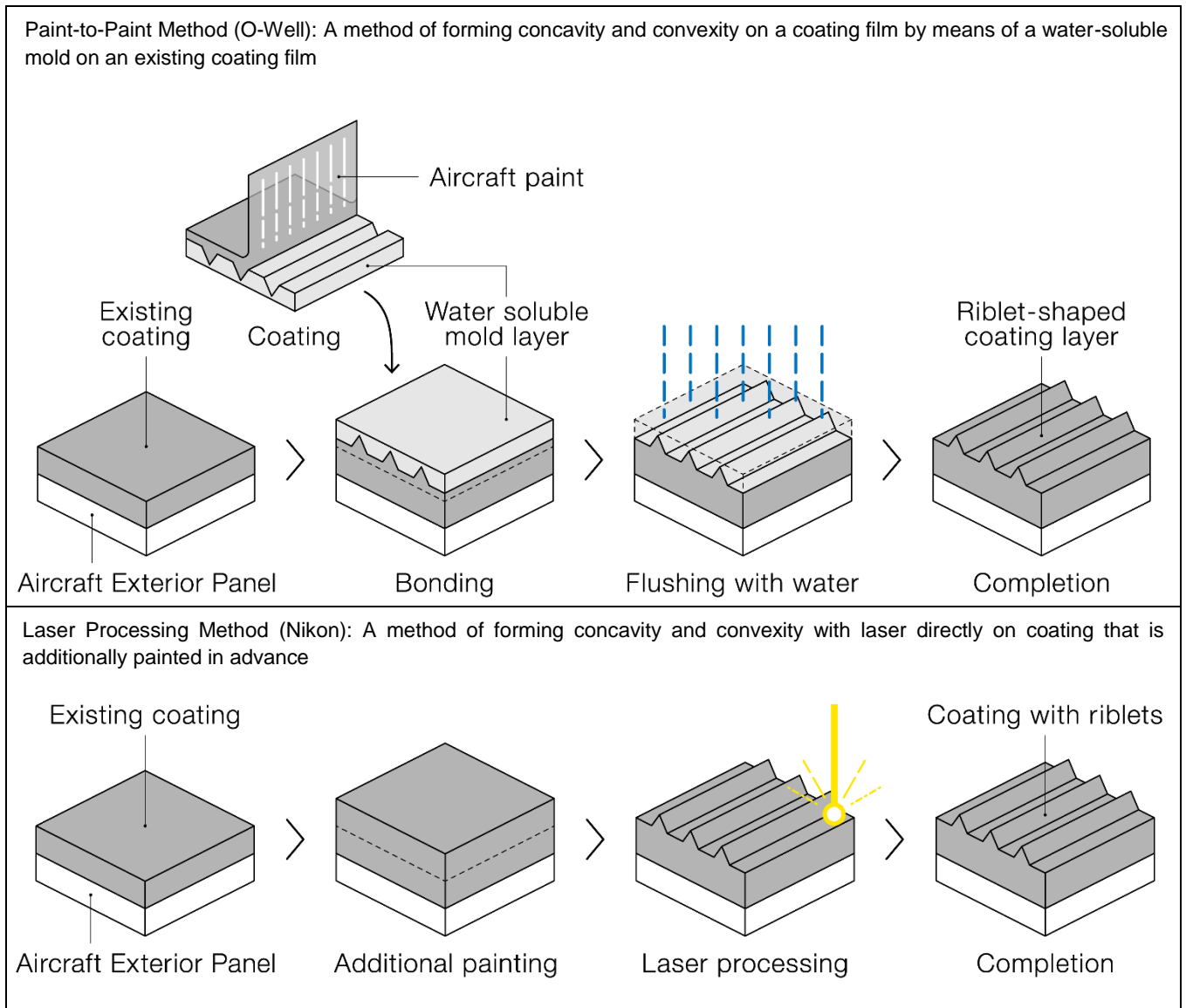
Refresh
Refresh Mark

This mark is the symbol of this program. With the motif of a shark’s dorsal fin, which was the inspiration behind the riblet, the white lines flow smoothly along the riblet and the green lines represent environmental friendliness. The powerful image of a shark reflects the strength of this program and provides a compelling promotional tool.

(*4) “Refresh” program promotion system



(*5) Overview of each company's application method



JAL aims to achieve net zero CO2 emissions by 2050 based on the JAL Group Medium-Term Management Plan for FY2021-2025.

In this initiative, JAL Engineering Co., Ltd. (hereinafter "JALEC"), which is in charge of aircraft maintenance for the JAL Group, is working to optimize the application process with the cooperation of Boeing, an aircraft manufacturer, in order to implement the results of JAXA, Orwell, and Nikon. The depth of the riblet grooves is 50 microns (about the thickness of a human hair), so JAL skilled craftsmanship of the painting work is required to apply the minute shapes on the paint as designed. In addition, the riblet coating of the paint is very sensitive depending on various factors such as the type of paint, temperature and humidity during work. Therefore, extensive knowledge and experience with paint and painting work in general are required to finish the coating as designed. As part of its aircraft maintenance, JALEC not only performs partial paint repairs, but also periodically the entire fuselage. Utilizing the knowledge and experience of its painting technology experts and other related technical staff, JALEC was the first in the world to successfully apply the riblet shape, which has been proven to reduce friction resistance, to the outer fuselage paint film. In the future, JAL will establish an optimal method on a large area that will reduce CO2 emissions as early as FY2023, and will further improve fuel efficiency by increasing the number of aircraft with riblet coating, especially aircraft for international flights that are more effective in reducing fuel consumption.