BUffet and Transition delay control investigated within European-Russian cooperation for improved FLIght performance

D3.14 Final actuator hardware producing a spanwise row of wall-normal jets

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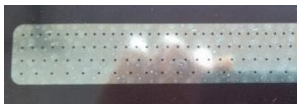
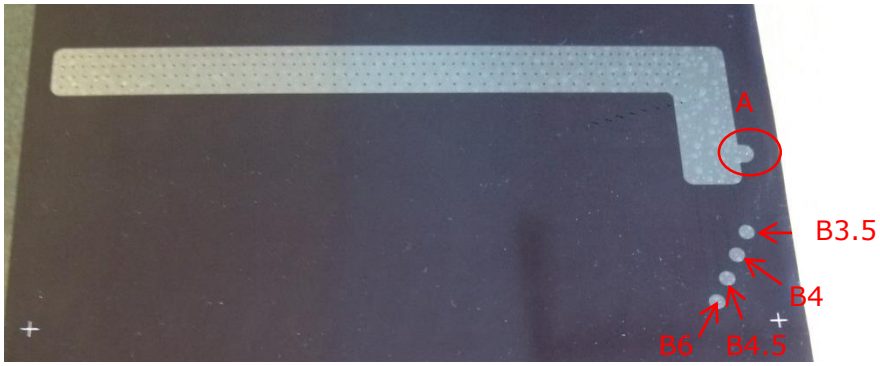
Instruction on the use of the Nottingham plasma actuator

1. List of Items and Specifications

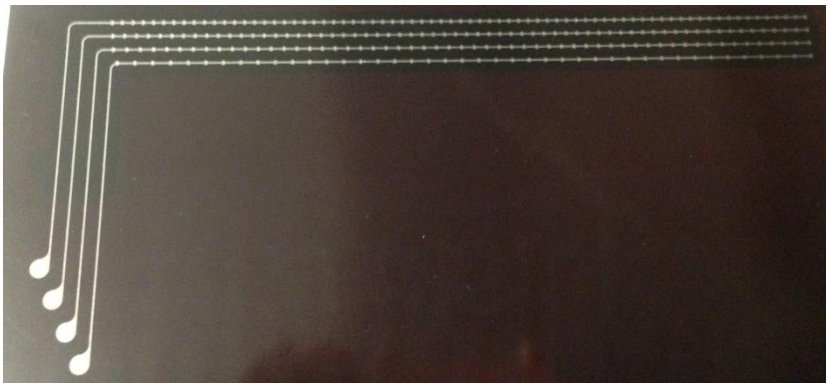
Name	Spanwise Spacing (wave length) mm	Qty.	Picture	Cirlex (Kapton) Dielectric Sheet	
				Size mm x mm	Thickness mm
G4	4	1		297 x 400	0.15
G6	6	1			
GA	3.5, 4, 4.5 and 6 (on one sheet)	3			

2. Wiring

Required items: A copper tape, conductive paint, high voltage cables with the one end connected to the high-voltage power supply (TREK), a soldering iron, soldering lead and a cutter



(a)



(b)

Fig. 1 Photos of (a) the upper and (b) the lower (ground) surface in the 'GA' plasma actuator

To connect an electric wire to the exposed (upper) electrode, a conductive copper tape with the wire soldered by lead can be attached on the 'A' area in Fig. 1 (a). For the wiring to the enclosed (ground) electrodes, 'B' spots on the upper surface can be used. The numbers beside B's indicate the spanwise spacing of ring actuators (in mm) on the upper surface, where the corresponding lower electrodes are wired, see Fig. 1 (b). In order to do this, about 3 mm rectangular holes should be cut out from the centres of the 'B' spots. Turning over the actuator sheet, a piece of copper tape as big as the size of these spots should be attached to cover each spot on the lower (ground) surface.

After that, the spots within the holes should be filled with conductive paint over the upper surface. After the paint is dried, conductivity must be checked between the conductive painted area on the upper surface and the copper tape on the bottom surface. Finally, a conductive copper tape with a wire soldered by lead can be attached on the each 'B' area, where the soldered spots should be covered with a thin Kapton tape. Sometimes, it may be easier to position and attach the actuator sheet on the airfoil first, then to attach the copper tape with the wire soldered. Wiring to the G4 and the G6 is similar to the way in the one to the GA.

3. Positioning and Attachment of the plasma actuators on the airfoil

3.1 Positioning

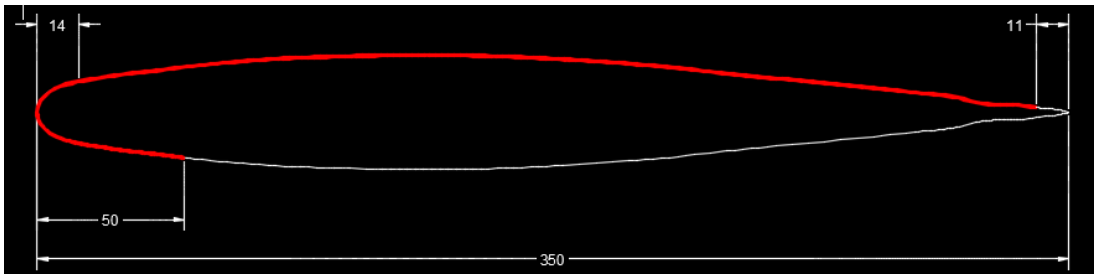


Fig. 2 Drawing of the ONERA D airfoil with the dielectric sheet (red line) mounted

For the G4 and G6 actuator sheets, the ring actuators should be positioned at 4% chord (14 mm) from the leading edge on the suction surface of the airfoil. Here, the top edge of the sheet is located at the 50 mm down from the leading edge on the pressure surface, see Fig. 2.

The GA actuator sheet will be used to test the effect of spanwise wave length on the cross-flow instability control *without reattaching the actuators sheet*. All we need to do it to connect the power supply to each row of ring actuator (B3.5, B4, B4.5 and B6) *in turn*. Here, the mid-chord wide position of four rows of ring actuators should be located at 4% chord from the leading edge. The means that each row of ring actuators will be positioned at 1.9%, 3.3%, 4.7% and 5.4%, respectively.

3.2 Attachment

It is important to make sure that the area on the lower (ground) surface directly behind the upper electrode should be firmly attached to the insulated surface of the airfoil by a double sided tape, since no plasma should be allowed to be generated there. *Please take extreme care in handling both upper and lower electrodes, as they are very thin and delicate.*

4. Finishing

Plasma may also be generated in the area at 'C' in Fig. 3. Therefore, a thin Kapton tape should be used to cover this area to stop the glow discharge.

Fig. 3 Photograph of GA; Glow discharges will be generated from the ring actuators as well as in the area designated by 'C'.

5. AC voltage

In our experiments at Nottingham, the AC voltage with about 3 kV peak-to-peak at 40 kHz was supplied to these actuators.