Boundary Layer Separations in a Multistage Axial Compressor

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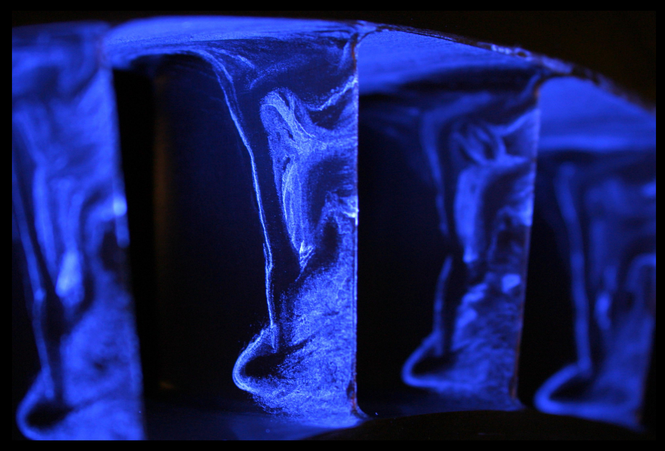
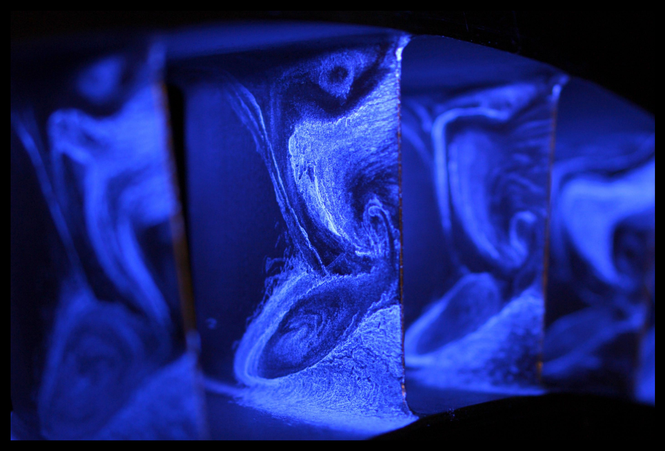
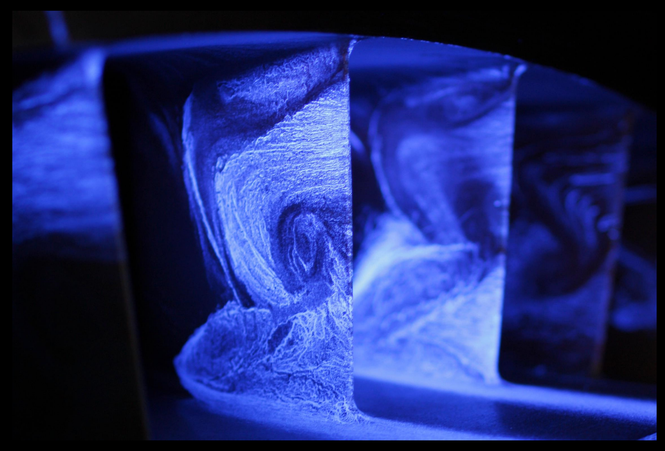
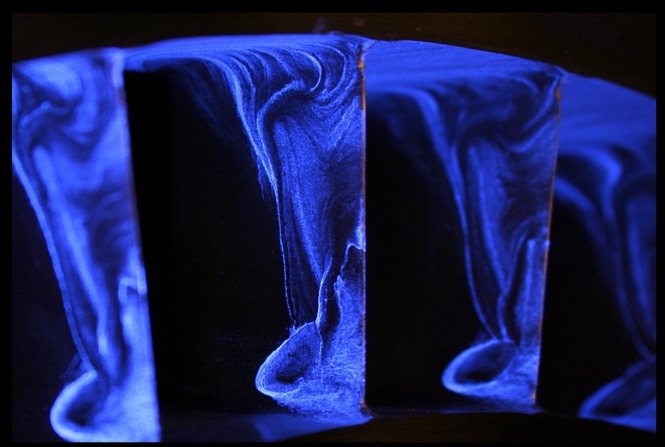
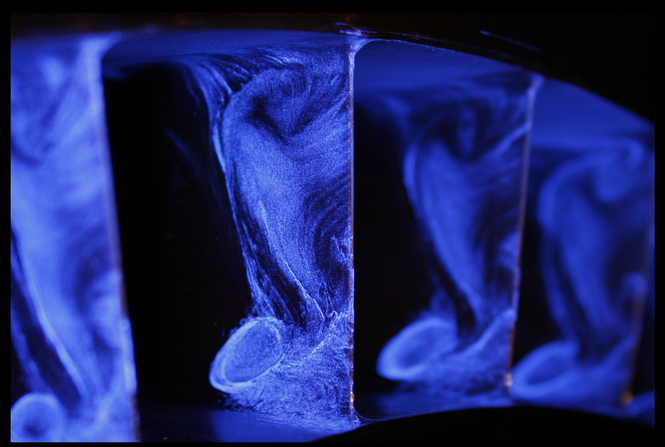
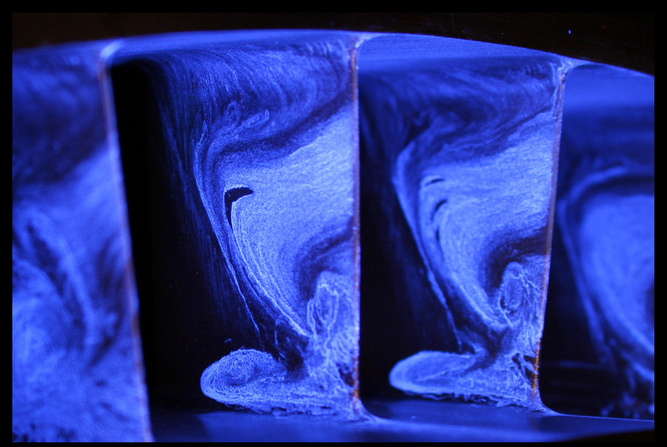
Stator 1 | Stator 2 | Stator 3

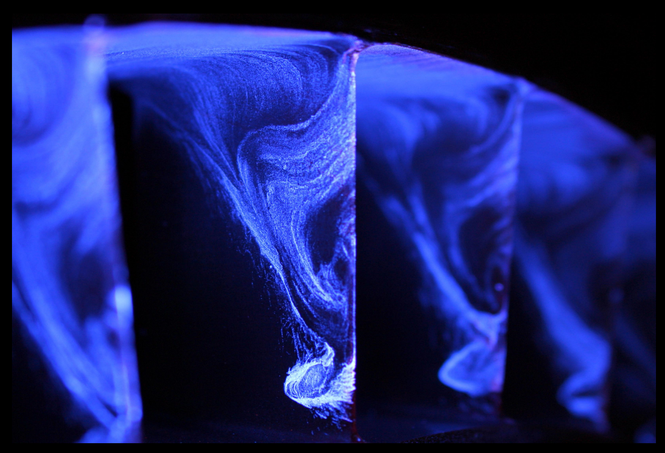
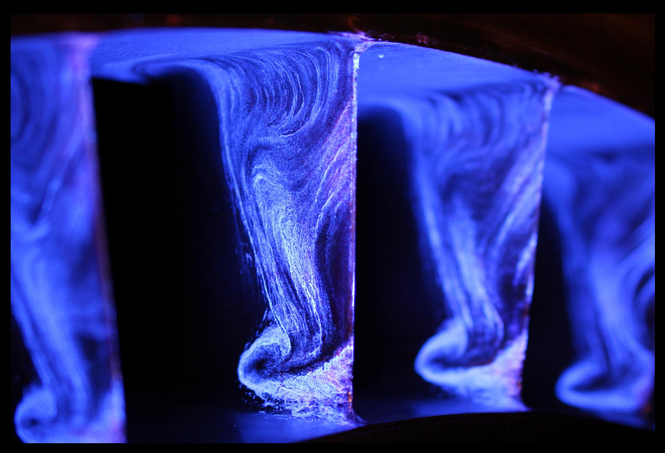
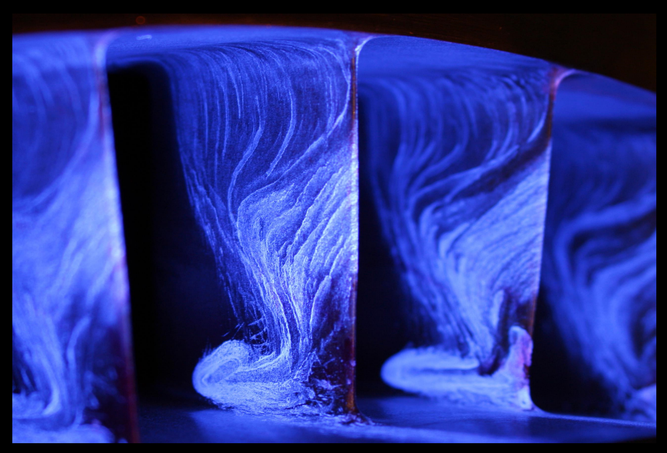
1.5% TC

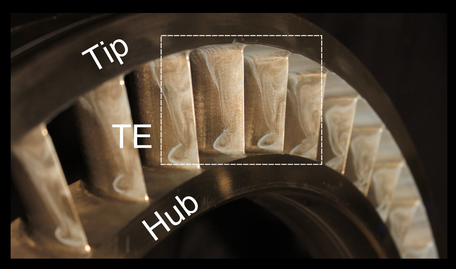
3.0% TC

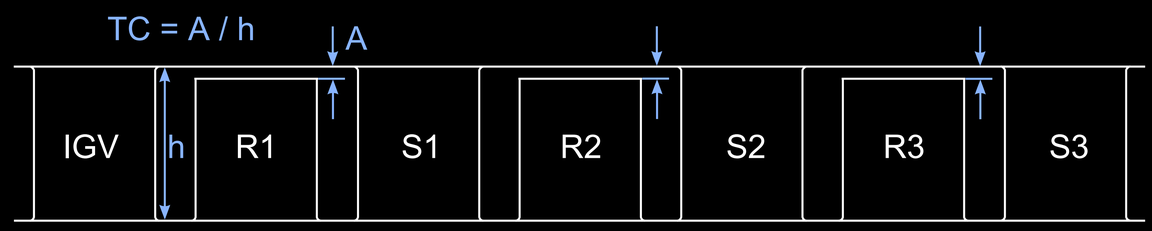




4.0% TC

In the rear stages of a high pressure compressor, the relative size of the clearance (A) between the rotor tip and casing endwall is large compared to the front stages, resulting in a larger tip leakage vortex. This flow feature contributes significantly to the overall loss, including that of the stators. Increased blockage in the tip region downstream of each rotor from the tip leakage vortex weakens the stator boundary layer near the tip. The redistributed fluid locally unloads and strengthens the hub region. Powder-paint-based flow visualization highlights the areas of recirculation (boundary layer separation) on the suction surface of each stator for three rotor tip clearance heights (TC) based on annulus height (h).





TE = trailing edge IGV = inlet guide vane R = rotor S = stator