



THE COLORS OF TURBULENCE

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Thermochromic liquid crystals (TLCs) possess unique physical properties which make them a powerful tool for temperature visualizations/measurements. The images above illustrate a variety of turbulent flows for which surface heat transfer is reflected by the color change of TLCs applied to a unique thin-film constant heat flux surface. All of the images display color patterns which are proportional to the instantaneous convective coefficients.

Figure 1 illustrates the surface heat transfer patterns for a jet of cool fluid impinging onto a warm surface. Figure 2 shows a temporal sequence of patterns generated by a pass-

ing turbulent jet of cool fluid. Instantaneous endwall temperature distributions at the base of a turbine cascade are illustrated in Fig. 3. Figure 4 illustrates patterns created by free-convection cells distorted by a sink above the center of the heated plate. Finally, the sequence shown in Fig. 5 shows the transition of a laminar to a fully turbulent boundary layer, as illustrated by the development of the classic low-speed streak patterns.

While TLC thermography is a useful visualization technique, it is even more valuable as a quantitative sensor of surface heat transfer. Employing a unique experimental apparatus, TLC measurements have been simultaneously combined with high resolution PIV to yield quasi three-dimensional results. To see details of this technique and selected results, visit: <http://www.lehigh.edu/~fluids/main.html>.