Chirped probe pulse (CPP) femtosecond (fs) coherent anti-Stokes Raman scattering (CARS) thermometry at 5 kHz has been successfully applied for single-laser-shot flame temperature measurements in a mildly turbulent hydrogen-air jet diffusion flame, sooting methane-air jet diffusion flame, and most recently a turbulent combustor of practical interest. Measurements were performed at various heights and radial locations within each flame and resulted in temperatures ranging from 300 K to 2400 K. In the turbulent combustor every laser shot produced some resonant CARS signal; no loss of signal due to beam steering, pressure fluctuations, or shear layer density gradients was noticeable. Furthermore, the measurement volume spatial resolution is better than has previously been reported for other CARS experiments. Flame temperature measurements compare well with those previously reported in similar flames. These results indicate high repetition rate CPP fs-CARS is an excellent technique for the study of turbulent combustion.