We fabricated an electronically controlled polymer optical fiber cleaver, which uses a razor-blade guillotine and provides independent control of fiber temperature, blade temperature, and cleaving speed. To determine the optimum cleaving conditions of microstructured polymer optical fibers (mPOFs) with hexagonal hole structures we developed a program for cleaving quality optimization, which reads in a microscope image of the fiber end-facet and determines the core-shift and the statistics of the hole diameter, hole-to-hole pitch, hole ellipticity, and direction of major ellipse axis. For 125μm in diameter mPOFs of the standard polymer PMMA we found the optimum temperatures to be 77.5°C for both blade and fiber. For 280μm in diameter mPOFs of the humidity insensitive polymer TOPAS® (grade 8007) the optimum temperature was 40° for both blade and fiber. A 100μm thick flat-edge blade was found to minimize the core-shift by the cleaving to only 298nm or 5% of the pitch for the PMMA mPOF at the optimal temperature.