During the process of laser welding, the material consecutively melts and solidifies by a laser beam with a peak high power. Several parameters such as the laser energy, pulse frequency, pulse duration, welding power and welding speed govern the mode of the welding process. The aim of this paper is to investigate the effect of peak power, incident angle, and welding speed on the weld bead geometry. The first investigation in this context was conducted using 2205-316L stainless steel plates through the varying of the welding speed from 1.3 mm/s to 2.1 mm/s. The second investigation was conducted by varying the peak power from 1100 W to 1500 W. From the results of the experiments, the welding speed and laser power had a significant effect on the geometry of the weld bead, and the variation in the diameter of the bead pulse-size. Due to the decrease in the heat input, welding speed affected penetration depth more than bead width, and a narrow width of heat affected zone was achieved ranging from 0.2 to 0.5 mm. Conclusively, weld bead geometry dimensions increase as a function of peak power; at over 1350 W peak power, the dimensions lie within 30 μm.