Accurate knowledge of electron stopping powers is crucial for radiation dosimetry and related calculations. The theoretical stopping powers listed in ICRU report 37 have an estimated standard uncertainty of 1% for electron energies greater than 100 keV. We have completed the first measurements of electron collision stopping powers that demonstrate sufficient accuracy to test these theoretical values. A large sodium iodide spectrometer was used to measure the change in electron energy spectrum when an absorber of known thickness was placed in the beam. Detailed Monte Carlo simulations were used to account for the interactions that take place in the detector, absorber, and surrounding materials. The calculated spectra were broadened to account for detector response, shifted and normalized to fit the measured spectra. Energy offsets from the fit were used to relate the ICRU 37 stopping powers employed by the Monte Carlo simulation to the true stopping powers. Measurements were performed for incident electron energies from 5 to 30 MeV. Materials covering a wide range of atomic numbers and densities were studied, and the measured values were found to agree with the ICRU 37 stopping powers within the experimental uncertainties of 0.4 to 0.6%. This level of uncertainty represents an order of magnitude improvement over the best previous measurements, and is sufficiently low to differentiate between the grain and bulk density stopping powers of graphite, allowing the appropriate graphite stopping power to be identified for the first time.