Purpose: The purpose of this study was to investigate the dosimetric characteristics of the GD-301 glass dosimeter for clinical dosimetry in a high-energy proton beam and to compare it with LiF TLD-100. Materials: The dose distribution measured with the glass dosimeter was evaluated by comparing them to those from GEANT4 MC simulation. We also compared dose measured with glass dosimeter and calculated with treatment planning system, Eclipse calculated dose of plan delivery in order to evaluate its potential as a new dosimeter in clinical proton beams. All measurements were performed in a proton beam (IBA Proton Therapy System-Proteus 235) at the National Cancer Center in Korea. Dosimeters were irradiated in a water phantom using a stair-like holder specially designed for this study. Maximum height was 100 mm with each step of 1 mm in ten layers. Results: Reproducibility in the 200 MeV proton beam was within 1.5% for the glass dosimeter, and within 1.7% for TLD-chip responses. The glass dosimeter signal was linear as a function of applied dose in the range of 1–10 Gy. The fading effect of the glass dosimeter after a received dose of 2 Gy was initially found to be within 1.6% for six months. Angular dependence of the glass dosimeter was measured to be approximately 1.3% for angles ranging 80° from the beam axis using a cylindrical phantom. Depth-dose distributions in the non-modulated and modulated proton beams obtained with the glass dosimeter were estimated to be within 3.0% lower than those with the ionization chamber and simulation model using GEANT4 code. The difference between delivery dose calculated by the Eclipse and measured by the glass dosimeter is within 5.0%. Conclusions: Measurements comparing the glass dosimeter and TLD-100 dosimetric characteristics demonstrated the suitability of the glass dosimeter for dose measurement in high-energy proton beam therapy.