The lowest possible minimum detectable dose (MDD) enables more accurate determination of human and environmental doses, is potentially important for discriminating small experimental changes, and vital for low level radiation dose health effects research. For this work, the effects of time temperature profiles (TTPs) for thermoluminescent dosimeters (TLDs) on the MDDs was studied. Two hundred LiF:Mg,Ti TLDs, Harshaw TLD-100, were calibrated at a standard TTP. A selected group of 50 TLDs that had very close sensitivities were selected to test ten different TTPs, which contained different preheat, acquisition, and annealing, times and temperatures. To determine the individual sensitivity correction factors for the optimal batch of 50 TLDs, further calibrations were performed for each TTP studied. Each TLD in the optimal batch was irradiated to 15 mGy air kerma of and read out three times in the Rexon UL-320. To minimize and correct for experimental variability, a circle experiment was performed monthly. This was especially helpful in understanding both the uniformity of irradiations and consistency in actual delivered dose. The calibration experiments confirmed a Gaussian sensitivity distribution. The optimal dosimeter batch had a 5.1% average deviation in mean dose response. Each TLD's MDD was calculated utilizing the mean response of the batch, the individual dosimeter response, the TLD dose correction factor, depletion correction values, total dosimeter counts recorded, and background count measurements. The optimal TTP, a function of the reader, for TLD-100 and the Rexon UL-320 consists of a preheat at 50 ℃ for 10 s, and an acquisition heating rate of 15 ℃ s^{-1} at 300 ℃ for 20 s. This TTP fully anneals the dosimeter. The MDDs for different TTPs will be presented.