We report a thorough study of the thermal hysteretic behaviour of a single phase sample of the magnetocaloric material La$_{0.67}$Ca$_{0.33}$MnO$_3$. Previous reports in the literature have variously found hysteretic and non-hysteretic behaviour. We show the importance of measuring under carefully defined heating and cooling procedures. Careful analysis of the specific heat, measured at five different temperature ramp rates, and the magnetic entropy change indicates that there is no observable hysteresis, even though the behaviour of both quantities is consistent with a first-order phase transition. We discuss the reasons for this and for the differing results previously found.