Post Curing can be used to facilitate volatile removal and thus produce polydimethylsiloxane (PDMS) films with stable elastic and electrical properties over time. In this study, the effect of post curing was investigated for commercial silicone elastomer thin films as a means of improving long-term elastomer film reliability. The Young’s moduli and electrical breakdown strengths of commercial (silica-reinforced) PDMS elastomer films, with and without additional 35 parts per hundred rubber titanium dioxide (TiO2), were investigated after high-temperature (200°C) post curing for various time spans. The elastomers were found to contain less than 2% of volatiles (significantly higher for TiO2-filled samples), but nevertheless a strong effect from post curing was observed. The young’s moduli as well as the strain-dependent behavior were found to change significantly upon post curing treatment, where Young’s moduli at 5% strain increase with post curing. Furthermore, the determined dielectric breakdown parameters from Weibull analyses showed that greater electrical stability and reliability could be achieved by post curing the PDMS films before usage, and this method therefore paves a way toward more reliable dielectric elastomers.