Expendable Bathythermograph (XBT) data has dominated the ocean database since 1960s, but has been diagnosed biased. A new technique is developed to estimate three major biases of XBT probes. Different from the well-known and standard “temperature error free” differential method proposed by Hanawa et al. 1995, the new method analyzes temperature profiles instead of vertical gradient temperature profiles. Consequently, it seems to be more noise resistant because it uses the integral property over the entire vertical profile instead of gradients. Its validity and robustness have been checked by both simulated experiments and actual XBT/CTD experiments, where two sets of profiles from actual XBT versus CTD comparisons, collected near Barbados in 1990 and in the western Mediterranean (2003–04 and 2008–09), have been used. The new fall-rate model including an initial fall-rate term, probe deceleration term and a constant term representing start-up transient is validated, and then the overall pure temperature error can be diagnosed as well. After correction by using our results, the temperature difference is reduced to less than 0.1℃ and depth error is less than 1.1%. Furthermore, the proposed method is applied to more than 2000 XBT/CTD pairs that are distributed globally, and the time-varying errors in XBT data are diagnosed in detail: the biases in XBT data are significantly temperature-dependent, recording system-dependent and probe type-dependent. Our work helps to improve the understanding on XBT data quality and contribute directly to the global XBT data quality control.