

RELIABILITY STUDIES OF LAMP CELLS FOR USE IN RUBIDIUM VAPOR FREQUENCY STANDARDS

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Abstract

Atomic vapor frequency standards, and in particular rubidium vapor frequency standards utilize electrodeless discharge lamps in order to measure the atomic hyperfine frequency. These lamps have been isolated as a reliability problem in commercially available frequency standards, and have been associated with failures of rubidium standards on GPS satellites. For satellites systems, lifetimes of ten years or more are required.

An extensive study has been undertaken at FEI and the Aerospace Corporation to establish reliability data for rubidium lamp cells. In this study, lamp cell failures are attributed to one of two mechanisms; either random failures in which the probability of failure is constant with time but the physical mechanism of failure is unknown, or wear out failures due to consumption of Rb in the cell. An upper bound random failure rate has been established for lamp cells manufactured at FEI. In addition, Over thirty-five FEI lamp cells have been continuously operated for the last three years, with regular Rb mass measurements to determine Rb consumption. The major Rb consumption mechanisms have been clearly identified and techniques to minimize total consumption have been established.

The results of this study are reported, with special attention to the implications for future space programs. It is shown that adoption of precise lamp acceptance criteria is critical to the attainment of extended lamp life. It is concluded that 20 year continuous operation of Rb lamps can be achieved without difficulty.

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but the text was not available for publication.