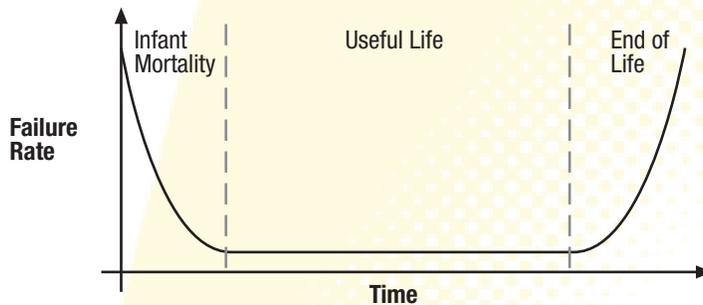


# Predicting ERT Module Life

How long does a gas ERT module last? This is a complex question without an easy answer, however life expectancy in an electronic hardware product can be predicted and represented by Mean Time Between Failures (MTBF) -calculated statistically & by analyzing field performance data.

## Reasons for Failure

Hardware failures are typically illustrated by a bathtub curve such as the one shown below. The chance of failure is high during the infant life of the module. The failure rate during the rated useful life of the product is fairly low. Once the end of the life is reached, failure rate of modules increases again.



Failures during an ERT module's life can usually be attributed to the following causes:

### Design failures

This class of failures takes place due to inherent flaws in an electronic design. In an Itron's gas ERT module, this class of failure is practically non-existent. Itron's enormous field experience of millions of ERTs are a testimony to Itron's efforts to design a truly world class product.

### Infant Mortality

This class of failure includes newly manufactured hardware and can be attributed to manufacturing issues. Itron's state of the art manufacturing facilities and its best in the class manufacturing practices helps ensure that any infant mortality failures rarely occur, in our products that are shipped to customers.

### Random Failures

Random failures can occur at any point during the life of an ERT module. Redundancy in design and several Accelerated Life Tests (ALT) conducted by Itron's product development group, ensures that these failures are very rare in Itron's Gas ERT modules.

### Wear Out

Once an ERT module has reached the end of its useful life, general degradation of components may cause the modules to fail. It is usually prudent, before this stage arrives, to analyze if any maintenance, including changing the battery, would be useful. It is important that this analysis is done before an ERT module reaches this stage so that system and performance degradation are avoided. A comparison of a battery change program vs. an ERT change out program with extended life will determine the best solution from both an operational and a financial standpoint.

## Predicting Future Failures

Mean Time Between Failure calculations are done using two different methodologies: statistical and field data.

**Statistical MTBF:** This is the process used to determine the MTBF of a product based upon its design, choice and behavior of components, their layout, and the design threshold levels. This is achieved by performing a prediction analysis based upon the performance of the product in simulated accelerated test environments and temperature cycling. Itron has one of the best-equipped test facilities in the nation and follows one of the most stringent testing regimens of any industrial electronics designer and manufacturer.

Itron's test facility in Minnesota is a dedicated test laboratory. Design Verification Testing (DVT) is performed on all new products and anytime a significant change is made to the design, materials or manufacturing process of an existing product. Some of the tests performed during DVT assess the product's conformance to customer requirements, design requirements and regulatory agency requirements (UL, ANSI, FCC, etc.). At the same time, the new or significantly changed products are subjected to several types of accelerated life tests. These tests include temperature cycling (with or without added humidity), steady-state elevated temperature and humidity testing, and multivariate, highly accelerated life testing (HALT). Most programs include controlled samples of existing product to verify the validity of the tests.

Itron's Gas ERT modules are designed for a useful life of 20 years. Various DVT ensures that these products meet these criteria.

Statistical MTBF analysis is a useful tool to evaluate whether the product is adequately designed to meet the requisite performance criteria.

**Field MTBF.** The real proof of reliability is the analysis of field performance data. Field MTBF is the result of determining the reliability of a product based upon its operational performance in the field in real life conditions. Itron has proven track record of exceptional, ever improving high field performance over last two decades. It has a well-established process, designed to collect regular field data and perform regression analysis of the failure data of ERT modules.

As a part of the field MTBF analysis, Itron Quality Assurance in Minnesota analyzes a sample of ERT modules returned under warranty. The analysis of returned modules is used to track and report the annual failure rate of early-life units. Reliability models and predictions are developed from this data. Itron performs complete, root-cause failure analysis of the first thirty (30) units returned from each customer and product combination and 5% of all subsequent returns.

