

Detecting Changes in Field Reliability Using Data from a Complex Factory Screen

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Background

- Early-field reliability is usually determined using field tracking studies
- These studies
 - Provide good information
 - But are costly
 - Provide untimely information

Alternative to Field Tracking Studies

Statistical Analysis of factory Screens (SAFS)

- To predict early-field reliability (ideally)
- To detect sudden changes in early-field reliability (more realistically)

SAFS Compared to FTS

Advantages

- Cheaper
- More timely information

Disadvantages

- Less accurate
- More assumptions are needed

Problem: Screens are designed to weed out “bad” product not for easy data analysis

A Particular Reliability Screen

Three test in sequence

- **Oven:** to verify operation in a worst case ambient temperature (36 hrs. at 130°)
- **Burn-In:** simulates field use conditions through two days of power cycling
- **System:** Assures that the product functions before shipment

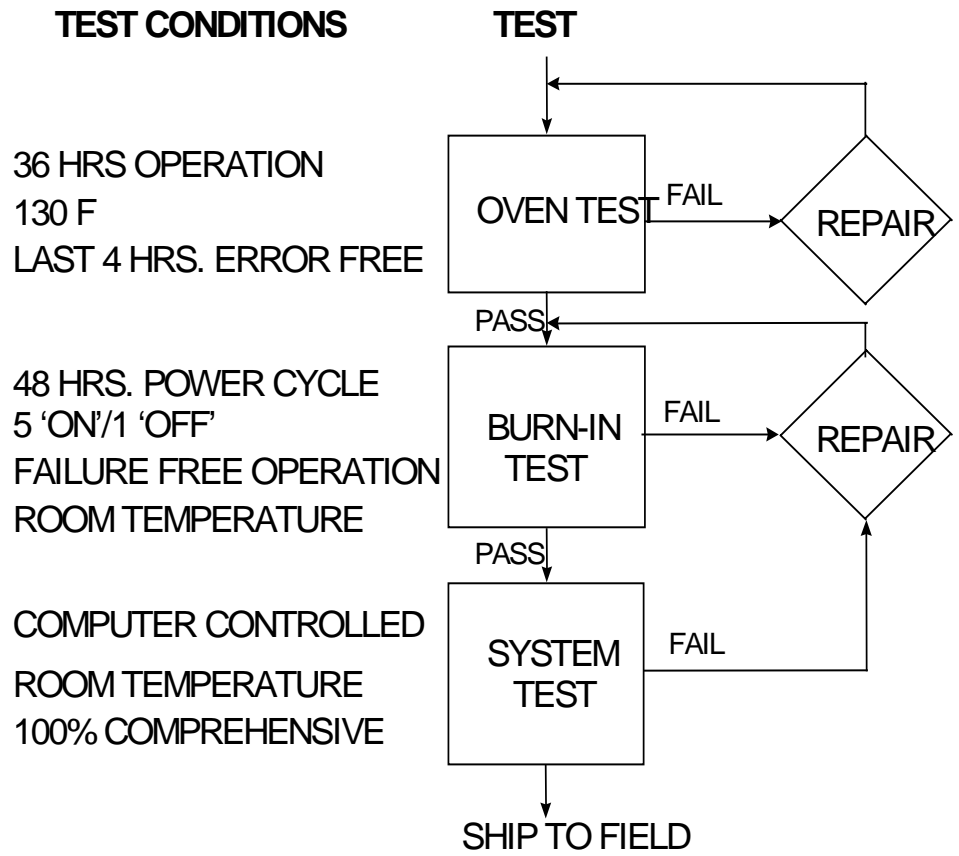


FIGURE 6. Reliability Screening Process and Test Conditions. (Sets with intermittent failure symptoms are returned to the oven after repair. The entire sequence is then repeated.)

Complications

- During the oven and burn-in test the product is in the self-test mode which does not detect all the failures
- Acceleration during oven test
- Dead-on-Arrivals (DOAs) seen in all three test
- Interval censoring

Failure Rate During Reliability Screen

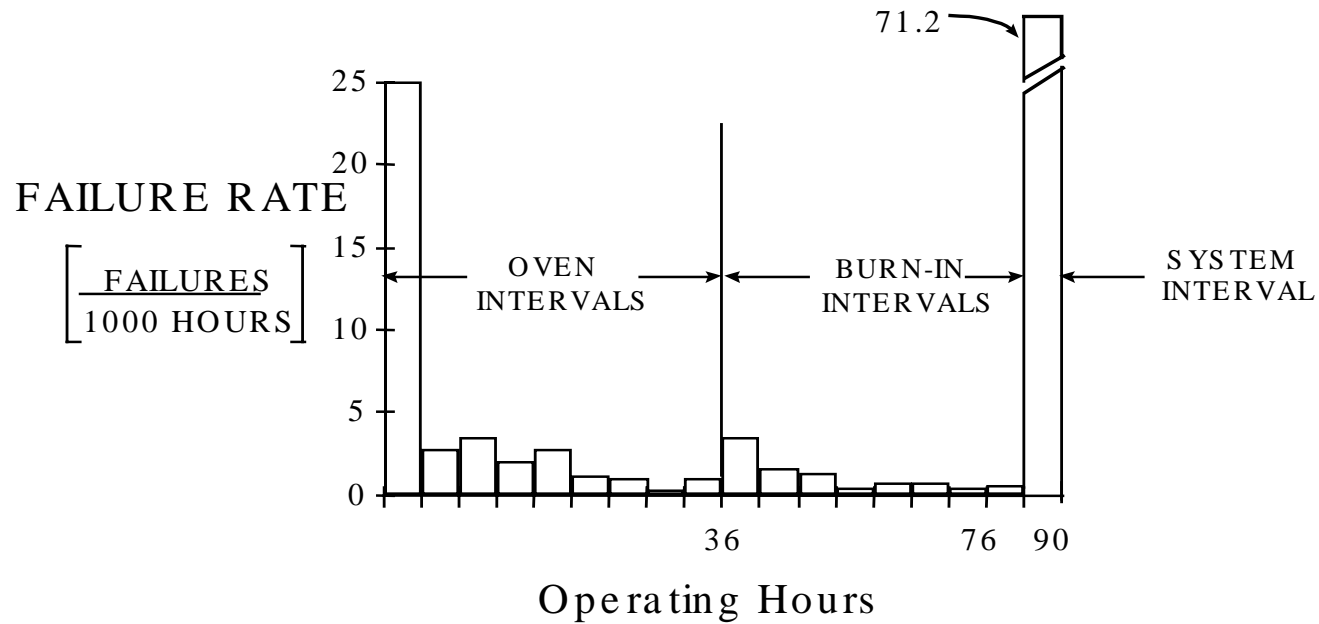


FIGURE 1. Average failure rate for the 2024A model during reliability screening.

Factory Screen Model Parameters

p_1 = Probability of a fatal shock in first oven interval

p_2 = Probability of a fatal shock in first burn-in interval

p_3 = Probability of a fatal shock in the system test

p = Probability of failure detection in oven or burn-in

A = Acceleration of time in the oven test

Two parameter Weibull to model the probability of failure due to continuous stresses

Model Fitting Procedure

- Maximum Likelihood Estimation
- Need a tailored optimization algorithm to maximize seven parameter likelihood function

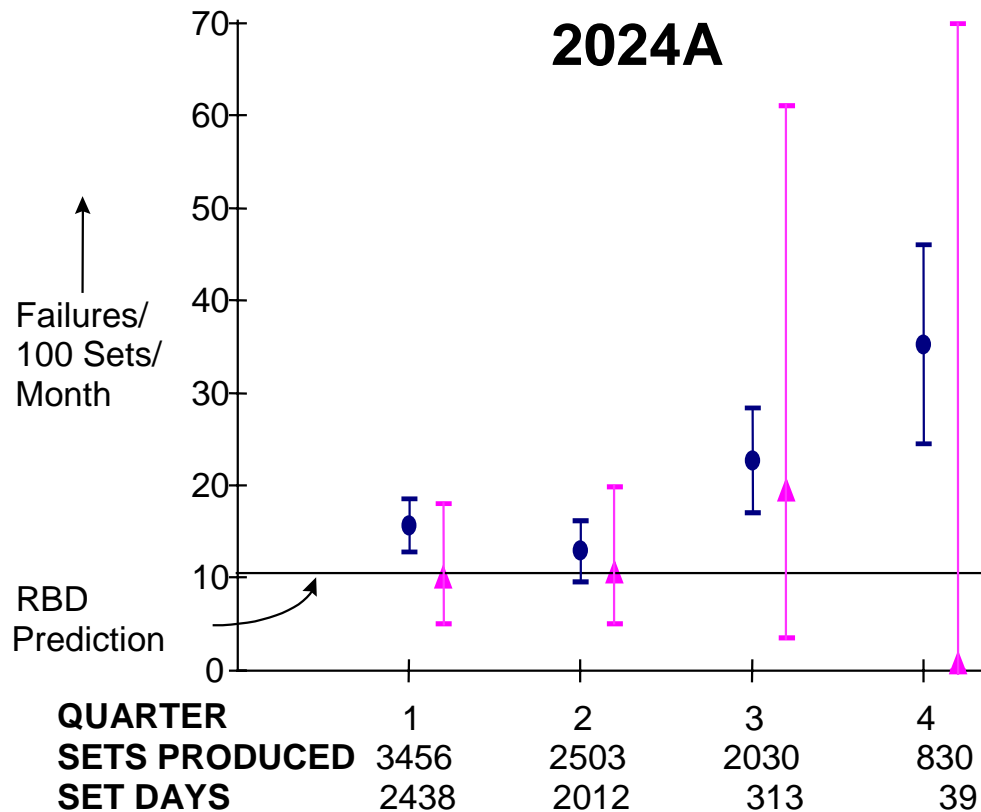


FIGURE 3. Point estimates of the first month failure rate with 90% confidence bounds are shown for model 2024A. The circles correspond to estimates from factory data and the triangles to estimates from field data. A theoretical Reliability Block Diagram (RBD) prediction based on part data is also provided. The numbers along the bottom indicate the size of the factory and field samples, and explain the extreme width of the confidence bands for the third and fourth quarter field estimates.

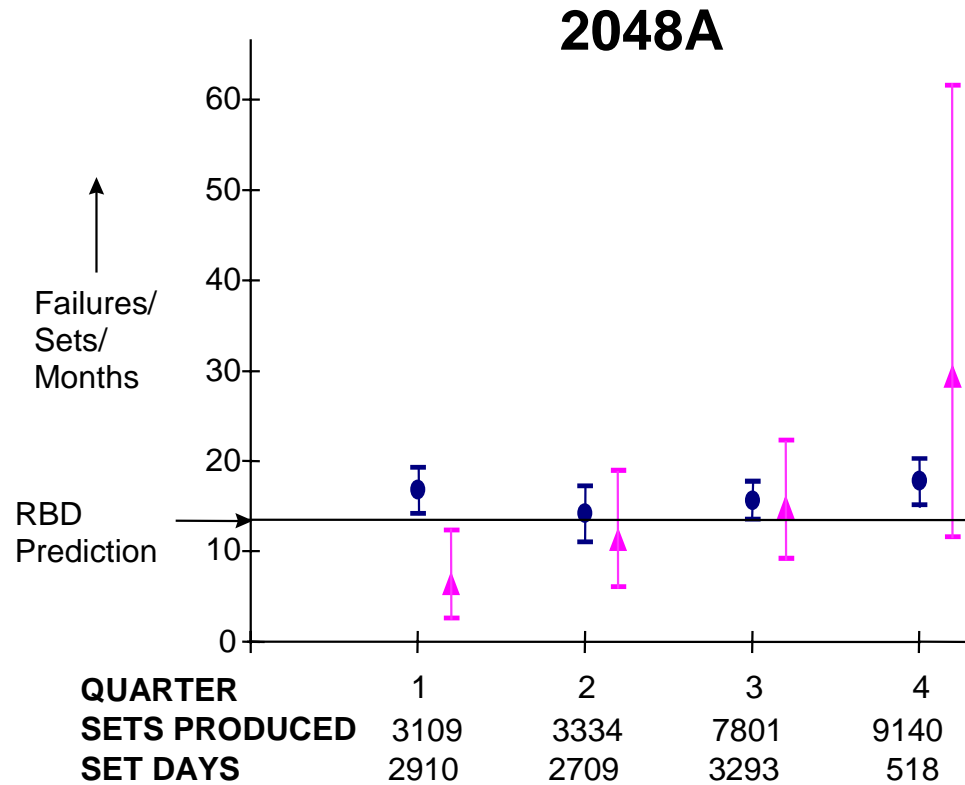


FIGURE 4. Point estimates of the first month failure rate with 90% confidence bounds are shown for model 2048A. The circles correspond to estimates from factory data and the triangles to estimates from field data. A theoretical Reliability Block Diagram (RBD) prediction based on part data is also provided. The numbers along the bottom indicate the size of the factory and field samples.

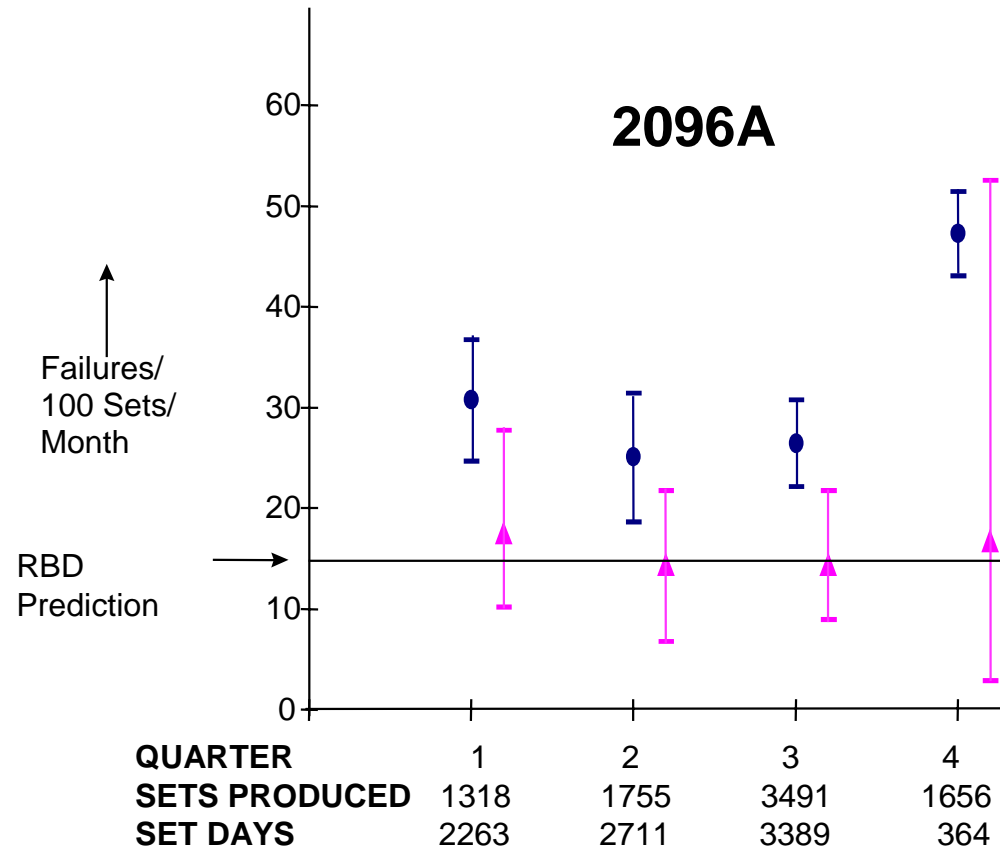


FIGURE 5. Point estimates of the first month failure rate with 90% confidence bounds are shown for model 2096A. The circles correspond to estimates from factory data and the triangles to estimates from field data. A theoretical Reliability Block Diagram (RBD) prediction based on part data is also provided. The numbers along the bottom indicate the size of the field samples. The fourth quarter factory estimate is based solely on December data as data for October and November were unavailable.

Conclusion

- Statistical models of factory reliability screens can be use to detect sudden changes in early-field reliability
- These estimates can be more timely than those obtained from field tracking studies