

How rebuilt circuit boards can maintain equipment reliability and benefit your bottom line?



SAVINGS - of 50-60% over the cost of a new board.



GREEN - Repairs keep defective circuit boards out of the landfill. 70% of the toxic materials in landfills come from electronics.



Increased Reliability - Repaired circuit boards are actually more reliable than new ones - because repaired boards have already been through the “Infant mortality” phase.



AVAILABILITY - Repairing obsolete circuit boards keeps them available when they are no longer being manufactured.



EXTENDED EQUIPMENT LIFE - Repairs can extend the life span of expensive capital equipment.



REPAIRED CIRCUIT BOARDS ARE STILL OEM BOARDS - They are not clones or after-market products.

How can GTS help you save money while increasing your reliability?

Greenbrier Technical Services Inc, (GTS) has been repairing and rebuilding Printed Circuit Boards since 1989 for service companies and OEM's in the Elevator, Mining, and Financial Security markets to name a few. GTS also repairs Audio/Video systems for the pharmaceutical and financial industries. We are ISO 9001:2008 Certified (including engineering).

- **Why Repair or Rebuild?**
- When done properly, rebuilt electronics can greatly lengthen the life and improve the reliability of your capital equipment without compromising their integrity. Repairing/Rebuilding Printed Circuit Boards (PCB's) offers 50-60% cost saving, increased equipment life and is very environmentally friendly.



Did you know that of the Toxic Materials in a landfill, about 70% come from Electronics? Electronic Waste is only a very small percentage of the volume of material in the landfill, but the truly toxic materials with long-term consequences like lead, mercury, cadmium, etc. largely comes from the electronics.

- **Electronic Life Cycle**

- In order to provide repaired printed circuit boards of the highest integrity it is necessary to understand the nature of electronic components and a relatively simple concept. The hypothetical Failure Rate versus Time for Electronics (Figure 1).

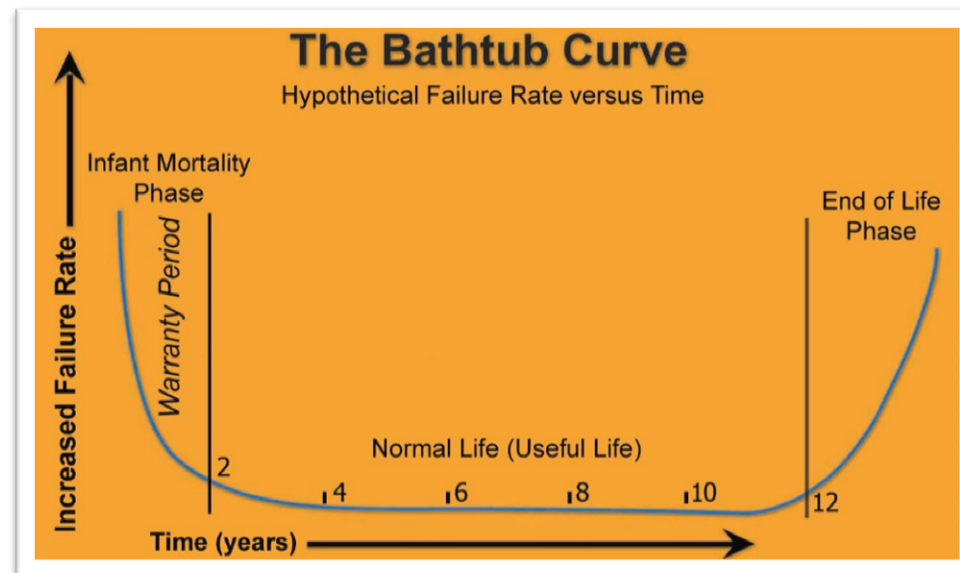


Figure 1 – The Bathtub Curve

The Bathtub Curve is often used to illustrate Relative Failure Rate versus Time.

- **Electronic Life Cycle (continued)**

- Electronics, meaning capacitors, semiconductors and passive components have higher failure rates due to manufacturing or material defects early in the component's life. This is referred to as the **"Infant Mortality Phase"** (Figure 1). This phase starts when a circuit board is first powered up and generally is of short duration. During this phase failures are normally covered under warranty by the manufacturer.
- The second phase is the "Normal (Useful) Life" (Figure 1), which is from the end of the infant mortality phase to the "End of Life Phase". **This is where GTS' repair/rebuild services are of great value.** The goal during this phase is to keep the capital equipment reliable & operating as intended when purchased. During most of the normal useful life of the equipment the electronics are not covered by the manufacturer's warranty.
- At some point, whether 10-12 or 14 years out, a piece of equipment has reached the End of Life. It has paid for itself, but mechanical and electronic parts are wearing out, reliability and availability have decreased and it is time to move on to newer technology and replace worn out equipment. This is the **"End of Life Phase"** (Figure 1).

Reliability Issues During Normal Life:

- There are several factors which play into the reliable function of electronics and the most adverse, in normal food service operation, is temperature.
 - *A good rule of thumb is: For every 10 degrees Centigrade rise in temperature, the average reliability is decreased by 50 percent. Another way to look at this is that Meantime Between Failures or MTBF will, on average, double if the operating temperature is lowered 10 degrees.*
- Other factors which can impact the reliability of a circuit board include the effects of moisture and contamination (grease, dirt, etc.) on the board. These problems can be mitigated by applying a conformal coating to seal the board, either during manufacture or after repair/rebuild.

- **Reliability with Repaired and Rebuilt Circuit Boards**

- *When a circuit board has been operating the field for a while it has already passed thru the infant mortality phase, so the higher failure rate during the infant mortality phase is no longer relevant to the repaired/rebuilt circuit board.*

- **Typical Component Service Life**

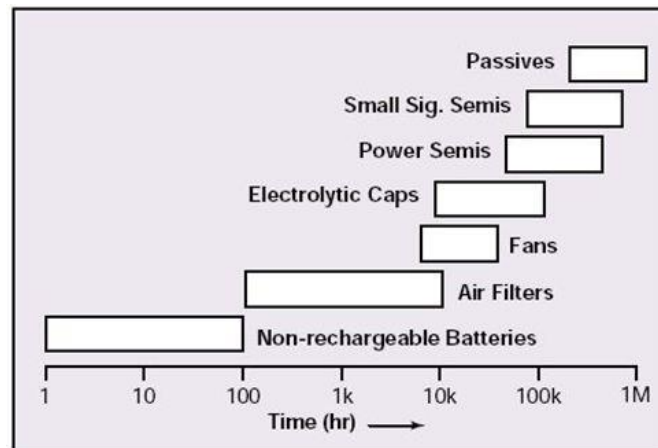


Figure 2 – Typical Component Service Life

- When a circuit board is properly repaired the defective component or components are replaced. Additionally, the components nearing the end of their Service Life (Figure 2) and any distressed components are also replaced. All boards are tested for proper operation and then conformally coated to protect against moisture and contamination. A rebuild like this can extend the effective service life of the circuit board and also the useful life of the capital equipment.



ISO 9001:2008 CERTIFIED

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