

MTBF CALCULATION

The following is the procedure to calculate **MTBF** (Mean Time Between Failure), and to determine **FIT** (Estimated Failure Rate: 10^{-9} /HR) for inverters.

1. To determine **FIT**:

Given: The number of units under consideration, the number of failures, and the number of hours per year (10,000 used for simplicity).

Total Hours of Operation = Number of Units x Hours per Year (eq. 1)

$$\text{Failure Rate} = \frac{\text{Number of Failures}}{\text{Total Hours of Operation}} \quad (\text{eq. 2})$$

$$\text{FIT} = 10^9 \times \text{Failure Rate} \quad (\text{eq. 3})$$

2. To determine **MTBF**:

$$\text{Hours per Failure} = \frac{1}{\text{Failure Rate}} \quad (\text{eq. 4})$$

Rearranging (eq. 3):

$$\text{Failure Rate} = \text{FIT} \times 10^{-9} \quad (\text{eq. 5})$$

Substituting (eq. 5) into (eq. 4), we obtain:

$$\text{Hours per Failure} = \frac{1}{\text{FIT} \times 10^{-9}} = \frac{10^9}{\text{FIT}} \quad (\text{eq. 6})$$

$$\text{MTBF} = \frac{\text{Number of Failures}}{\text{Total Hours of Operation}} \quad (\text{eq. 7})$$

Actual Hours per Year = 24 hours/day x 365 days/year = 8,760 hours/year (eq. 9)

Substituting (eq. 6) and (eq. 9) into (eq. 7), we obtain:

$$\text{MTBF} = \frac{10^9}{\text{FIT} \times 8,760} \quad (\text{eq. 10})$$

3. Example Calculation:

Given:

15 failures
10,000 units under evaluation

$$\begin{aligned} \text{Total Hours of Operation} &= \text{Number of Units} \times \text{Hours per Year} \\ &= 10,000 \times 10,000 \\ &= 10^8 \text{ Hours} \end{aligned}$$

$$\begin{aligned} \text{Failure Rate} &= \frac{\text{Number of Failures}}{\text{Total Hours of Operation}} \\ &= \frac{15}{10^8} \\ &= 1.5 \times 10^{-7} \text{ Failures per Hour} \end{aligned}$$

$$\begin{aligned} \text{FIT} &= 10^9 \times \text{Failure Rate} \\ &= 10^9 \times 1.5 \times 10^{-7} \\ &= 150 \text{ FIT} \end{aligned}$$

$$\begin{aligned} \text{MTBF} &= \frac{10^9}{\text{FIT} \times 8,760} \\ &= \frac{10^9}{150 \times 8,760} \\ &\cong 761 \text{ MTBF} \end{aligned}$$

Therefore, if an installation had 200 inverters, 0.26 random failures per year could be expected:

$$\left(\frac{200}{761} = 0.26 \right)$$