

MTBF User Guide

Measuring Mean Time Between Failure (MTBF)

Most companies do not measure Mean Time Between Failure (MTBF). Yet, it is one of the first and most basic measurements you can use to measure reliability. MTBF is the average time an asset will function before it fails.

Understanding Definitions

It is important to have definitions because, in reality, the true meaning of a term is not always what typical industry believes. You need to ensure that everyone in your organization has a common understanding of a definition. Here are the definitions of some key terms related to MTBF:

- **Bad Actors** = Equipment or assets that have typically long standing reliability issues. Some companies identify “bad actors” by the amount of maintenance dollars spent on assets in labor and material, not production losses. MTBF is a simple measurement to pinpoint these poor performing assets. Note that the most systematic, technically-based method of determining if an asset is critical is to conduct an assessment based on consequence of failure and risk of failure to the business.
- **Total Equipment Failure** = Total Equipment Failure occurs when an asset completely fails or breaks down, is not operating at all.
- **Functional Failure:** The inability of an asset to fulfill one or more of its functions (for example, it no longer produces product that meets quality standards).
- **Partial Equipment Failure** = Equipment continues to run to standard but some component of the asset is in failure mode. For example, the equipment may now be operating at a reduced speed.
- **MTBF** = The average time an asset will function before it fails.
- **Emergency work order** = a formal document that is written anytime an asset has failed and a maintenance person is called to make a repair.

- **Reliability** = The ability of an item to perform a required function under stated conditions for a stated period of time.

The MTBF Process

Step 1: Ensure all emergency work is covered by a work order no matter how minor of equipment failure, and that the asset information is captured in your CMMS/EAM by asset number.

Step 2: Begin tracking MTBF, focusing on one production area or asset group. Calculate on a daily basis the mean time between failures:

$$\text{MTBF} = \frac{\text{Time}}{\text{Number of emergency work orders (for all failures: total, and functional)}}$$

Step 3: Trend the data you find in this production area or asset group daily on a line graph and post it for everyone to see.

**Many people may not like to see this data or even believe it, but it provides knowledge of how the equipment has been performing to-date, and increases the need to find a solution to improve reliability.

Step 4: Once you start tracking MTBF, another useful metric to track is the percentage change in MTBF. This allows you to set a target or goal and work towards this goal. This approach often gains support by management for improving reliability.

$$\text{MTBF \% Change} = \frac{\text{Current MTBF} - \text{Previous MTBF}}{\text{Previous MTBF}}$$

Step 5: Trend the percentage change.

Step 6: Once you feel comfortable tracking and trending MTBF for this one production area or asset group, begin stepping down to the next level in your asset group. This group is typically called 'child' in your equipment hierarchy. What you have been measuring thus far is what I call the 'father'

or 'parent' in the equipment hierarchy. You may define the hierarchy differently but in general the message is understood.

- Continue the process throughout your organization's production areas and assets.

Example:

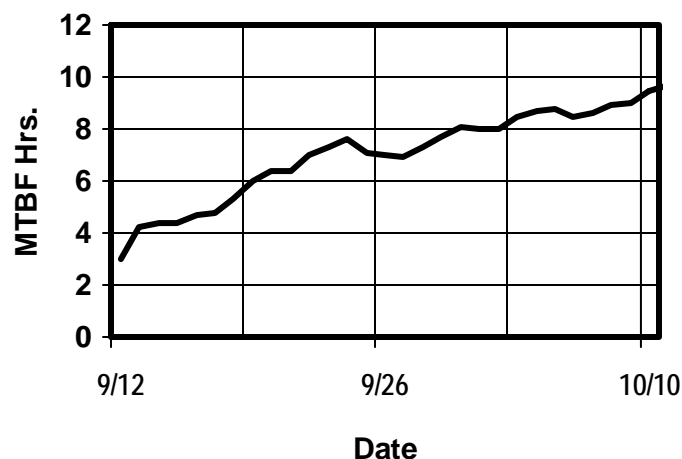
- Asset: Packaging area for a plant I am defining as the production area.
- Number of emergency work orders in the past 24 hours = 8:
 - Total equipment failure = 3
 - Functional equipment failure = 5

(Note: do not worry about the exact definition of each type of failure. An emergency work order needs to be written anytime an asset has a problem and a maintenance person is called to the asset to investigate or make a repair)

- Time: 24 hours
- Calculation:

$$\text{MTBF} = \frac{24 \text{ hours}}{8 \text{ emergency work orders}} = 3 \text{ hours}$$

Trending this information is valuable when identifying whether an asset's health is improving or getting worst. An example this trending is seen below.



MTBF Percentage Change:

Over a 5 day period the MTBF improved from having failures every 3 hours to having a failure every 4.2 hours.

- Time: 5 days
- Previous MTBF: Day 1 = 3 hours
- Current MTBF: Day 5 = 4.2 hours
- Calculation:

$$\text{MTBF \% change} = \frac{4.2 \text{ hours (current MTBF – Day 5)} - 3 \text{ hours (MTBF – Day 1)}}{3 \text{ hours (MTBF – Day 1)}} = 1.4 \text{ or } 40\%$$

Total Plant MTBF:

MTBF calculated for all assets in a plant is an indicator of the total plant reliability.

Summary:

The process of MTBF is the most basic measurement in understanding the current status of reliability of all of your company assets. From here it can be determined which assets are in need of improved reliability.