

# Field Experienced MTBF for the Rosemount™ 5900 is **741 YEARS**

## Rosemount 5900 with Field Proven Reliability

The Field Experienced MTBF (Mean Time Between Failure) for the Rosemount 5900 has been conservatively estimated to be 741 years. Statistically, this means that 1.3 spare units are required to support the operation of 100 units during 10 years.



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# ROSEMOUNT TANK GAUGING SYSTEM

## ROSEMOUNT 5900

Rosemount 5900 is a non-contacting radar level gauge with custody transfer accuracy, suitable for virtually any tank farm liquid storage application in refineries and tank terminals with high requirements on level measurements.

## MEAN TIME BETWEEN FAILURE

Reliability of a product can be quantified as Mean Time Between Failure (MTBF). MTBF is the statistical average (mean) period of time between failures in a group of complete units, caused by 'random' failures in one of the unit's components. Failures due to mistakes (so called systematic failures) are not included in MTBF.

MTBF can be divided into two groups: Theoretical MTBF and Field Experienced MTBF. While Theoretical MTBF is a result of analysis of a unit tested under strict conditions (e.g. in a lab), the Field Experienced MTBF is a result of data gathered from units installed on site. In this paper, we have chosen to estimate and present the Field Experienced MTBF. As a complement, the Theoretical MTBF can be found in the Raptor 5900 IEC 61508 Certificate available on [www.rosemount-tg.com](http://www.rosemount-tg.com).

The estimated MTBF does not advise product life time. Rather, it aims to statistically determine how many units are needed to support a certain number of units in operation. To provide a describing example: if MTBF for a specific type of radar level gauge is 100 years, then one spare-unit is needed to support a group of 100 units during one year. Conversely, in a group of 200 radar level gauges with MTBF equals to 100 years, then during 10 years, the number of units that statistically will fail is 20 units (2000 unit-years / 100 years).

## RANDOM FAILURES

It is generally accepted that a component's failure will go through three phases during its life cycle: *Infant Mortality*, *Imaginable Constant*, and *Wear-Out*. This life cycle when plotted is visualized in what is commonly referred to as a bathtub curve (see Figure 1).

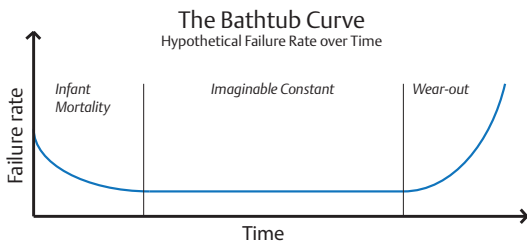


Figure 1: The bathtub curve

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As a rule, MTBF is the value determined during a unit's imaginable constant phase, and only verified failures from this phase are to be considered in the calculation. We have chosen to include all random failures occurring both in the Infant Mortality phase and Imaginable Constant phase. Thus, the estimated MTBF above is likely to be underestimated and is consequently a conservative estimate of the true MTBF.

## THE MODEL

MTBF has been estimated by taking the accumulated time-in-operation of all gauges delivered, divided by the accumulated random and verified failures reported on these units. MTBF is usually expressed in 'years', but theoretically the unit is 'unit-years per failure'.

$$MTBF = \frac{\text{Accumulated Time in-Operation}}{\text{Accumulated No. of Random Failures}} = \frac{1}{\lambda}$$

Alternatively, MTBF can be expressed as a failure rate (lambda,  $\lambda$ ). The failure rate of electronic devices is usually expressed in FIT (Failures In Time), where 1 FIT equals one failure per billion hours (or 1 FIT =  $10^{-9}$  failures per hour).

## THE CALCULATION

The data used in the calculations is based on all 5900 shipped from the original product launch date (September, 2010) to the creation date of this document. Units with the 2-in-1 feature have been excluded from the data.

The accumulated time-in-operation has been estimated as the time interval between shipment date to the creation date of this document subtracted by six months. Here, five months represent the average time between shipment of a unit and the time of commissioning. Additionally 1 month is used to represent the average time it takes a user to notify the manufacturer of the device failure. (5+1 = 6 months)

For Rosemount 5900 (1-in-1) in the given time period:

- Accumulated Time-In-Operation = 48900 years
- Accumulated No. of Random and Verified Failures = 66
- Field Experienced MTBF = 48900 / 66 years

Field Experienced MTBF Rosemount 5900
741 years

An MTBF-result of 741 years equals a failure rate ( $\lambda$ ) of 154 FIT (or 154 failures per billion of hours).

