Report on MTBF for Eletta Flow Monitors and Meters

Theoretical calculation of
”MeanTime Between Failures".

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Background

In order to give customers and end-users a formal description on how we calculate MTBF (Mean Time Between Failure) we have made this document as an explanation to our process in evaluating our Products. The process has included the following products:

V-series

D-series

S-series

m-series

Definition of the Products

The products are all of the principle of Differential Pressure Flow Monitors and Meters and the scope is from pure mechanical to electromechanical and electronic monitors and meters. However, the working principle is common for all types and only the reading or communication differs in between them. The product was originally designed In the early 1950 and has been manufactured in Sweden in our factory ever since. The Products has been exported all over the world and only 10% of the lot are sold within Sweden. The annual amount of produced products are apx 10 000 units and the total units on the market is + 600 000 units since the start of the production back in the 1950´s. All figures in the report are taken from actual and verified numbers.

Mean Time Between Failure

As an explanation of this parameter in instrumentation specifications, it is a statistic parameter we use to calculate the accessibility and reliability of an instrument. In this way, it shows the expected and statistically average time between two failures. It is often used to evaluate regular maintenance and to evaluate a possible breakdown. Also, it can act as an important parameter when deciding the correct and most reliable instrument for both critical and non-critical installations in the process industry.

Our principle used to calculate

MTBF = number of operational hours divided by number of failures

We have used the following methodology; the accumulated number of sold Flow Monitors multiplied with the average hours that the Flow Monitor is used.

$$\text{MTBF} = \frac{\text{Number of flow Monitors sold x 90\% x hours in use}}{\text{Numbers of failures}}$$

We then give the MTBF in years as a failure rate ;

Failure rate : $\lambda = 1/\text{MTBF}$

MTBF principle and function of an Eletta Product

An Eletta Flow Monitors are designed and used for supervising a fluid in a closed conduit and works with a Differential Pressure (DP) principle. An obstruction is placed in the process pipe filled with a fluid or a gas and the Monitor is detecting the DP either mechanically through a diaphragm design or electronically through electronic pressure sensors. The device is equipped with adjustable alarm settings which can activate an output through a micro switch or relay. The Flow Monitors are pre-calibrated for correct flow measurement and alarm settings in the factory before shipment to customer and then ready to install without any further actions from the customer. In this way, the Monitors can be used as a recalibrated safety device supervising the pipe system for irregularities in the flow, which could damage other sensitive parts in the installation.

Important failures which can occur which can seriously affect the function of the Flow Monitor:

- Blockage of the flow in the pipe by foreign substance; this will affect the function of the Flow Monitor but will not affect the function when the blockage is removed. So, this is not a part of our theoretical calculation.

- A deterioration of the rubber parts in the design which can cause a leakage of the fluid or a gas.

- A small hole in the casted part of the Monitor and this will cause a leakage.

- A breakdown of the micro switch/ relay which will stop the alarm function but the Flow Monitor will still show the actual flow of the fluid or gas in the pipe.

As the quality system in Eletta Flow AB (manufacturer) is audited and approved according to ISO 9000: 2015 and ISO 14000: 2015, the company is obliged to continuously record and follow all quality issues reported. These records from the year 2018 and 2019 has been following the procedures in the Quality system. The number of sold units are collected from the ERP system which is also recorded and saved in special files in the company computer system.

MTBF calculation for a Flow Monitor in operation

We assume: a Flow Monitor will be in continuous use during its operational lifetime i.e. the Flow Monitor is installed in a pipe system and is assumed to be operational 100% of the time. In this case we have 8760 hours for one year and 17 520 hours for the two year period we are using. Most of the customer is running the systems a 100% of the time and we need to calculate with this 100%. However, in order to put in a safety margin, we anticipate that 90% of the delivered Flow Monitors are installed and functional.

$$\text{MTBF}_{\text{operational hours}} = \frac{\text{Number of Monitors sold x 90\% x years in use (2year)}}{\text{Number of failures}}$$

In this case:

Period: 2018 and 2019 (2 years = 2x8760 = 17520 hours

Numbers sold: 14605 x 90% = 13 144 pcs

Reclamations: 39 pcs

$\text{MTBF}_{\text{operational hours}}$ = 14 605 x 0,9 x 17 520/39 = 5 864 887 hours = 669 year

This gives a **MTBF of 669 years** for the period of 2018 and 2019.

Failure rate is = 1/MTBF (in hours) which equals 1,7 E-7 hourly failure rate.
These figures show that the Products are compatible to come in the SIL2 group for PFH (Probably of Dangerous Failure per hour).

We need to point out that this is not only a theoretical calculation but derived from real figures and is also often called ” Field Experienced MTBF” while there is a laboratory tests under controlled conditions which is called Theoretical MTBF.

The data used in this calculation of MTBF is derived from a delivery of 14605 units (2018 and 2019 full year) less the safety margin where we remove 10% of this, as per discussion above.

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