

# Statement regarding Mean Time Between Failure (MTBF)

## LOW FLOW FLUIDICS HANDLING TECHNOLOGY

The MTBF calculation performed by Bronkhorst® concerns the hardware of the product series equipment. The failure rate and Failure In Time (FIT) for the equipment, in combination with their internal component application and component load, has been determined. The EXIDA component database (Electrical & Mechanical Component Reliability Handbook, edition 3) is used as source for all technical failure rates which is also a trusted source for failure rate calculations for industrial applications and FMEA's within scope of IEC 61508.

The FIT of the equipment is then converted to failure rate ( $\lambda$ , failures per hour) from which the MTBF is calculated. The conversion and calculation relations are as follows:

$$1 \text{ FIT} = 1 \times 10^{-9} \text{ failures per hour} = \lambda; \quad \lambda = 1 / \text{MTBF};$$

The environmental profile used for these calculations is EXIDA profile 1:

- cabinet mounted/climate controlled
- 60°C average component temperature
- 0-95% RH non-condensing

It is to be noted that the MTBF figures derived from this analysis serves as the reference calculation and this MTBF figure will be applicable to all the Bronkhorst® equipment with comparable build and specifications as mentioned on the following pages.

Product Management  
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**Bronkhorst®**

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Page 1/3

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## LOW FLOW FLUIDICS HANDLING TECHNOLOGY

### Product series

EL-FLOW *Select*

EL-FLOW *Low-ΔP*

IN-FLOW

IN-FLOW *Low-ΔP*

IN-FLOW *High-Flow*

Version	Mass Flow Meter (MFM)	Mass Flow Controller (MFC)
Elastomeric sealed	All	Direct acting valve

Results	FIT Per 10 <sup>9</sup> hours	For use up to 100 bar(g) MTBF [years]	For use up to 3.5 bar(g) MTBF [years]*
MFM analogue	1187.633	96	113
MFM digital (RS232/485)	972.333	117	144
MFC analogue	1458.233	78	89
MFC digital (RS232/485)	1242.933	92	107

\*The FIT for 'For use up to 3.5 bar(g)' is reduced by 176 per 10<sup>9</sup> hours.

### Product series

FLEXI-FLOW *Compact*

Version	Mass Flow Meter (MFM)	Mass Flow Controller (MFC)
Elastomeric sealed	All	Direct acting valve

Results	FIT Per 10 <sup>9</sup> hours	For use up to 16 bar(g) MTBF [years]	For use up to 3.5 bar(g) MTBF [years]*
MFM digital (RS485)	786.233	145	171
MFC digital (RS485)	1073.533	105	118

\*The FIT for 'For use up to 3.5 bar(g)' is reduced by 120 per 10<sup>9</sup> hours.

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### Product series

MASS-STREAM D-6400

Version	Mass Flow Meter (MFM)	Mass Flow Controller (MFC)
Elastomeric sealed	All	Integrated direct acting valve

Results	FIT Per 10 <sup>9</sup> hours	For use up to 20 bar(g) MTBF [years]	For use up to 3.5 bar(g) MTBF [years]*
MFM analogue	1186.017	96	113
MFM digital (RS232/485)	952.317	120	147
MFC analogue	1468.417	78	88
MFC digital (RS232/485)	1234.717	92	108

\*The FIT for 'For use up to 3.5 bar(g)' is reduced by 178 per 10<sup>9</sup> hours.

### Product series

IQ+FLOW Mass Flow Meters / Controllers

IQ+FLOW Pressure Meters / Controllers

Results	FIT Per 10 <sup>9</sup> hours	For use up to 10 bar(g) MTBF [years]	For use up to 3.5 bar(g) MTBF [years]*
IQF(D)-100C	946.617	121	140
IQF(D)-200C	1255.617	91	111
Chip based pressure sensor			
IQP(D)-500C	848.717	135	159
IQP(D)-600C	1157.717	99	117
IQP(D)-700C	1157.717	99	117
Media-isolated pressure sensor			
IQP(D)-500C	920.717	124	145
IQP(D)-600C	1229.717	93	109
IQP(D)-700C	1229.717	93	109

\*The FIT for 'For use up to 3.5 bar(g)' is reduced by 224 per 10<sup>9</sup> hours.