

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 (λ , 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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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 ⁹ 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 10⁹ 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 ⁹ 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 10⁹ 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 ⁹ 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 10⁹ hours.