CONTINENTAL HYDRAULICS

## FAILURE RATE / MTBF DECLARATION

**MTBF/CER 1016793**
**VSD*S Monitored Valves**
**Rev. A - 04/01/16**

Continental Hydraulics Inc. hereby declares the below calculated value of dangerous failure rate / MTTFd estimated for the valve family reported above.

The value has been calculated according to MIL-HDBK-781 following a predicted method, as detailed in the document MTBF-FMECA-1016793-A (VSD*S 1016793 Catalog), that has been developed using the best technical knowledge available of the common failure mode related to the valve under declaration as well as using information's obtained from official reliability databases, e.g. Exida.

The MTTFd is a portion of the basic failure rate/MTBF, calculated considering only the "dangerous" failure mode reported in the following tables. Under this scope, any electronics used in the coils are not considered in the analysis being only passive type. The power supply should be interrupted using an adequate reliable switch-off device in case of emergency.

It has to be underlined that the value is valid assuming that the valve application fulfills the recommendations available in our general catalog especially in the datasheet 1016793. For special application and/or more detailed data's and information's, Continental Hydraulics reserves the right of reviewing the estimation in conjunction with Customer's needs.

Table 1 – Specific calculated value using a predicted method (Direct Operated D03 with DIN coil Connection)

| | | |
|---|---|---|
| VSD03S -3*- *R0-** (double coil) | λ | 2.23 [fails/million_hours] |
| | MTBF | $0.45 \cdot 10^6$ [hours] |
| | | 51 [years] |
| | λd | 0.46 [fails/million_hours] |
| | MTTFd | $2.17 \cdot 10^6$ [hours] |
| | | 248 [years] |
| | The "dangerous" failure mode considered is unintended spool movement from neutral position or a wrong signal from the monitoring sensor. | |
| VSD03S -1*- *MA/MB*-** (single coil) | λ | 1.53 [fails/million_hours] |
| | MTBF | $0.65 \cdot 10^6$ [hours] |
| | | 74 [years] |
| | λd | 0.31 [fails/million_hours] |
| | MTTFd | $3.22 \cdot 10^6$ [hours] |
| | | 368 [years] |

Table 2 – Specific calculated value using a predicted method (Direct Operated D05 with DIN coil Connection)

| | | |
|---|---|---|
| VSD05S -3*- *R0-** (double coil) | λ | 2.37 [fails/million_ hours] |
| | MTBF | $0.42 \cdot 10^6$ [hours] |
| | | 48 [years] |
| | λd | 0.48 [fails/million hours] |
| | MTTFd | $2.10 \cdot 10^6$ [hours] |
| | | 240 [years] |
| | The "dangerous" failure mode considered is unintended spool movement from neutral position or a wrong signal from the monitoring sensor. | |
| VSD05S -1*- *M*-** (single coil) | λ | 1.63 [fails/million_hours] |
| | MTBF | $0.61 \cdot 10^6$ [hours] |
| | | 70 [years] |
| | λd | 0.31 [fails/million hours] |
| | MTTFd | $3.22 \cdot 10^6$ [hours] |
| | | 368 [years] |

Table 3 – Specific calculated value using a predicted method (Pilot Operated D05 with DIN coil Connection)

| | | |
|---|---|---|
| VSD005*S -3*- *R0-** Pilot Operated (double coil) | λ | 4.05 [fails/million_hours] |
| | MTBF | $0.25 \cdot 10^6$ [hours] |
| | | 28 [years] |
| | λd | 0.66 [fails/million_hours] |
| | MTTFd | $1.51 \cdot 10^6$ [hours] |
| | | 173 [years] |
| | The "dangerous" failure mode considered is unintended spool movement from neutral position or a wrong signal from the monitoring sensor. | |
| VSD05*S -1*- *M*-** Pilot Operated (single coil) | λ | 3.33 [fails/million_hours] |
| | MTBF | $0.3 \cdot 10^6$ [hours] |
| | | 34 [years] |
| | λd | 0.49 [fails/million_hours] |
| | MTTFd | $2.04 \cdot 10^6$ [hours] |
| | | 233 [years] |

Table 4 – Specific calculated value using a predicted method (Pilot Operated D07 with DIN coil Connection)

| | | |
|---|---|---|
| VSD07S -3*- *R0-** (double coil) | λ | 3.92 [fails/million_hours] |
| | MTBF | $0.26 \cdot 10^6$ [hours] |
| | | 29 [years] |
| | λd | 0.66 [fails/million_hours] |
| | MTTFd | $1.51 \cdot 10^6$ [hours] |
| | | 173 [years] |
| | The "dangerous" failure mode considered is unintended spool movement from neutral position or a wrong signal from the monitoring sensor. | |
| VSD07S -1*- *M**-** (single coil) | λ | 3.20 [fails/million_hours] |
| | MTBF | $0.31 \cdot 10^6$ [hours] |
| | | 36 [years] |
| | λd | 0.49 [fails/million_hours] |
| | MTTFd | $2.04 \cdot 10^6$ [hours] |
| | | 233 [years] |

Table 5 – Specific calculated value using a predicted method (Pilot Operated D08 with DIN coil Connection)

| | | |
|---|---|---|
| VSD08S -3*- *R0-** (double coil) | λ | 3.94 [fails/million_hours] |
| | MTBF | $0.25 \cdot 10^6$ [hours] |
| | | 29 [years] |
| | λd | 0.66 [fails/million_hours] |
| | MTTFd | $1.51 \cdot 10^6$ [hours] |
| | | 173 [years] |
| | The "dangerous" failure mode considered is unintended spool movement from neutral position or a wrong signal from the monitoring sensor. | |
| VSD08S -1*- *M**-** (single coil) | λ | 3.62 [fails/million_hours] |
| | MTBF | $0.28 \cdot 10^6$ [hours] |
| | | 31 [years] |
| | λd | 0.49 [fails/million_hours] |
| | MTTFd | $2.04 \cdot 10^6$ [hours] |
| | | 233 [years] |

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This calculated data can be used for the safety analysis in the purpose of European Standards IEC61508-1 to IEC61508-7 and EN ISO 13849-1 & EN ISO 13849-2. The use of the "dangerous" value is recommended only if safety calculations are performed and the dangerous failure mode addressed to the valve is the one declared in table 1. In case of general reliability evaluation or if the dangerous failure mode does not fit the one declared above, it is recommended to contact Continental for more specific evaluation.

Moreover, Continental Hydraulics is certified ISO 9001:2008 and follows the continuous improvement philosophy looking for the highest quality. In this spirit, endurance tests, field observations and design review are continuously performed to improve product reliability and to better define and calculate the declared values. Any discrepancy of the hereby declared value from the reality measured by the Customer on a real field application, together with any consistent product failure, should be notified to Continental Hydraulics Inc. to keep the calculation updated. As a result, calculated or observed data, documentation and result are subject to change without prior notice, then Continental Hydraulics Inc. suggest to check the last updated information on the website.
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