more than you expect

WÜRTH ELEKTRONIK

WE Standard:
WES_FIT - Reliability Data

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Issued by:
Toby Kangas

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1 Document Control

No	Page	Change Description	Issued	Date
1	all	Change previous WE_FIT - paper to WES_FIT	MBar	04.04.2014
2	4,5	Add series WE-CMBNC	MBar	10.06.2014
3	9 - 30	Add Capacitors (Chapter 4.6), Restructure Curves	MBar	10.11.2014
4	7	Add series WE-MAPI	MBar	20.11.2014
5	5	Add series WE-ZB	MBar	02.03.2015
6	6	Add series WE-GDTI	MBar	19.05.2015
7	7	Change series WE-RJ45 into WE-RJ45 LAN	MBar	18.06.2015
8	6	Add series WE-MAIA, WE-PDA	MBar	09.12.2015
9	5,7	Add Series WE-XHMI, WE-TVSP, WE-PMMI, WE-PMCI, WE-TIF	COt	25.01.2016
10	4 - 7	Add series WE-UCF, WE-ExB, WE-FCL, WE-GFH, WE-FAMI, WE-PoEH, WE-LLCR, WE-CAIR	COt	06.06.2016
11	3	Update the text of chapter 3.1; Update the temperature of chapter 8.b	COt	21.07.2016
12	13	Change part description	HaK	19.10.2016
13	7 - 15	Add series WCAP-CSMH, WCAP-FTBE, WCAP-FTBP, WL-SBRW, WL-SBSW, WL-SFCD, WL-SFCW, WL-SFRW, WL-SFSW, WL-TIRW, WL-SIMW, WL-SUMW, WE-LQSH, WE-LQFS, WE-KIHC, WE-PD2SA	COt	03.11.2016
14	7 - 10	Add series WL-SBCW, WE-LAN AQ, WE-PDeco, WE-HCLW	COt	01.09.2017
15	5 - 7	Add series WE-CMBHV, WE-LPCC, WE-DPC, WE-DPCHV, WE-FLEX HV, WE-RJ45 10G, WE-CHSA, WE-TIeco	COt	11.07.2018
19	4 - 32	Add series WL-SFTD, WL-SMCD, WL-SMCC, WL-SICW, WL-SISW, WL-SIRW, WL-SITW, WL-SMDC, WE-RCIT, WE-RCIS, WE-LHCA, WE-TPB, WE-TPBHV, WE-XTAL, WE-SPXO	COt	05.12.2018
20	all	Add series WE-LQS Eco, WCAP-CSST, WCAP-CSRF, WCAP-STSC, WCAP-PHGP, WCAP-PHET, WCAP-PHLE, WCAP-PHSE, WE-LAN 10G, WCAP-ATLL; Update of the Capacitor: change the Unit from mF to µF; Implementation of Resistance	COt / TKa	13.05.2019
21	7,12, all	Add series WE-HCFA, WE-HCIT, WL-STCB, WL-STCW,WL-STRB, WL-STSW, WL-STTB, WL-SDCB, WL-SDSB, WL-TDRW, WL-TDRB Re-format tables for easier reading.	TKa	17.07.2019
22	12	Update graphs 5.7, 6.7 to be more precise; Correct typographical errors; Add series WE-HIDA, WE-LHMD, WL-SBCD, WL-SFCC, WL-STSB, WL-STTW, WL-TTRB, WL-TTRW, WE-STST, WE-CLFS, WE-CCMF, WE-RJ45 LAN TH Reflow; Add Section 4.9 Connectors, Add graphs 5.11-5.15, 6.11-6.15; Correct the classification of aluminum polymer cap series WCAP-PTG5, -PTHR, -PTHT, -PT5H, -PSLC, -PSLP, -PSHP, -PHGP, -PHLE, -PHSE and -PHET to Unlisted.	TKa	18.11.2019
23	6, 8, 12, 13, 19, 20	Correct the classification of WE-CBA, -CBF, -CBF HF, -MPSB, - PBF, -PF and -TMSB from 'Coil, Chip/Ceramic Filter' to 'Coil, Ferrite Beads' (FIT rate is unaffected); Add series WE-MCRI, WE-MTCI, WE-MPSA, WL-OCPT, WL-TIRC; WP-BUCF, WP-BUFU, WP-BUTR, WP-RAFU, WP-RATR, WP-SHFU, WP-TGCF, WP-TGTR, WP-TPSE, WP-SMBU, WP-SMSH, WP-SMRT, WP-THRBU, WP-THRSH; Add section 4.10 MagI^{3}C Power Modules	TKa	10.07.2020

No	Page	Change Description	Issued	Date
24	5, 6, 8-13, 24, 36, 39	Add series WE-ACHC, WE-AGDT, WE-BMS, WE-CMDC, WE-HCFT, WE-MCI, WL-SIQW, WL-VCSL, WL-SMTD, WL-S7DS, WL-T7DS; Re-classify WE-CAIR; Remove WE-TFCH; Add Custom CMC, Custom Power Inductor, Custom Power Transformer, Custom LAN, Custom Signal Transformer	TKa	27.10.2020

2 General Information

Through this document Würth Elektronik provides FIT data for parts of our portfolio. The FIT data is shown for each Matchcode of a product family. The Matchcode for a specific product is stated in the specifications of each product.

The provided reliability values are based on the calculation Models of Telcordia SR-332 Issue 3, except for section 4.10. The reliability values in section 4.10 are based on MIL-HDBK-217F and supported by reliability testing. All given FIT values are based on an operating time of 10^9 hours.

WE provides the following values:

- FIT – λ : Mean Device Failure Rate
- FIT – σ: Standard Deviation of Failure Rate

As you can see in the curves within the tables 1 - 15 and the example in Chapter ***"Example: FIT-Calculation for WE PD2 with 90% UCL"***, the increase of temperature directly influences the initial FIT data (λ /σ). Please keep in mind that the usage of a component in a higher operating temperature will increase the FIT values and may shorten the effective product life. Thus the design of your application and the related operating temperature will have a direct influence on the reliability of the used components. So directly during the design stage the base factors for later product / module reliabilities are being set.

3 Determination of FIT values

If you need a FIT value for a specific product, then please follow the procedure described below:

1. Select your Matchcode: The Matchcode is shown in the specifications of a product. Use the tables in Chapter ***4*** to find your Matchcode.
2. Within the rows you can find in the columns FIT – λ and FIT – σ the table (numeralized) and the curve (alphabetized) where you can look up the desired FIT – λ and FIT – σ values.
3. Go to the specified table and read the desired values at the operating temperature of your application.

WARNING: The maximum allowed operating temperature can be less than 125°C. Please check the specific Data Sheet. For each product the maximum operating temperature given in the datasheet is obligatory.

4 Matchcode Mappings to Tables

4.1 EMC Components (1)

		FIT - λ		FIT - σ	
Matchcode	**Product Category**	**Table**	**Curve**	**Table**	**Curve**
WE-CMB	Coil, Power Filter	**5.1**	**B**	**6.1**	**O**
WE-CMB HC					
WE-CMB NiZn					
WE-CMBH					
WE-CMBHV					
WE-CMBNC					
WE-CNSW					
WE-CMDC					
WE-CNSW HF					
WE-ExB					
WE-FC					
WE-FCL					
WE-FI					
WE-LF					
WE-LF SMD					
WE-LPCC					
WE-RCIS					
WE-RCIT					
WE-SCC					
WE-SD					
WE-SL					
WE-SL1					
WE-SL2					
WE-SL3					
WE-SL5					
WE-SL5 HC					
WE-SLM					
WE-TFC					
WE-TPB					
WE-TPBHV					
WE-UCF					
WE-ZB					

		FIT - λ		FIT - σ	
Matchcode	**Product Category**	**Table**	**Curve**	**Table**	**Curve**
Custom CMC	Coil, Power Filter	**5.1**	**B**	**6.1**	**O**
WE-CBA	Coil, Ferrite Beads	**5.1**	**C**	**6.1**	**O**
WE-CBF					
WE-CBF HF					
WE-CMS					
WE-MI					
WE-MLS					
WE-MPSA					
WE-MPSB					
WE-PBF					
WE-PF					
WE-SUKW					
WE-TMSB					
WE-UKW					
WE-WAFB					

4.2 EMC Components (2)

			FIT - λ		FIT - σ	
Matchcode	**Product Category**	**Electrical Stress**	**Table**	**Curve**	**Table**	**Curve**
WE-TVS Standard **WE-TVS High Speed** **WE-TVS Super Speed** **WE-TVSP**	Voltage Regulator, < 1.5 W	50% 100%	**5.1** **5.2**	**A** **F**	**6.2** **6.2**	**S** **R**
WE-VE **WE-VE ULC** **WE-VEA** **WE-VS** **WE-VD**	Varistor, Metal Oxide	50% 100%	**5.2** **5.2**	**E** **D**	**6.2** **6.2**	**Q** **P**
WE-CLFS, Single Stage	Line Filter (direct solder)	50% 100%	**5.11** **5.12**	**ba** **bd**	**6.11** **6.12**	**ca** **cd**
	Line Filter (connector used)	50% 100%	**5.13** **5.13**	**bg** **bh**	**6.13** **6.13**	**cg** **ch**
WE-CLFS, Single Stage Advanced	Line Filter (direct solder)	50% 100%	**5.11** **5.12**	**bb** **be**	**6.11** **6.12**	**cb** **ce**
	Line Filter (connector used)	50% 100%	**5.13** **5.13**	**bg** **bi**	**6.13** **6.13**	**cg** **ci**
WE-CLFS, Two Stage	Line Filter (direct solder)	50% 100%	**5.11** **5.12**	**bc** **bf**	**6.11** **6.12**	**cc** **cf**
	Line Filter (connector used)	50% 100%	**5.13** **5.13**	**bg** **bj**	**6.13** **6.13**	**cg** **cj**

4.3 Power Magnetics

		FIT - λ		FIT - σ	
Matchcode	**Product Category**	**Table**	**Curve**	**Table**	**Curve**
WE-CFWI					
WE-CHSA					
WE-DCT					
WE-DD					
WE-DPC					
WE-DPC HV					
WE-EHPI					
WE-FAMI					
WE-GF					
WE-GFH					
WE-HCC					
WE-HCF					
WE-HCFA					
WE-HCFT					
WE-HCI					
WE-HCIT					
WE-HCLW	Coil, Load Coil	**5.1**	**A**	**6.1**	**N**
WE-HCM					
WE-HCRW					
WE-HIDA					
WE-LHCA					
WE-LHMD					
WE-LHMI					
WE-LQ					
WE-LQFS					
WE-LQS					
WE-LQS ECO					
WE-LQSH					
WE-MAIA					
WE-MAPI					
WE-MCRI					
WE-MTCI					
WE-PD					

		FIT - λ		FIT - σ	
Matchcode	**Product Category**	**Table**	**Curve**	**Table**	**Curve**
WE-PD HV	Coil, Load Coil	**5.1**	**A**	**6.1**	**N**
WE-PD2					
WE-PDeco					
WE-PD2 HV					
WE-PD2A					
WE-PD2SA					
WE-PD2SR					
WE-PD2 HV					
WE-PD2A					
WE-PD2SA					
WE-PD2SR					
WE-PD3					
WE-PD4					
WE-PDA					
WE-PDF					
WE-PFC					
WE-PMCI					
WE-PMI					
WE-PMMI					
WE-SI					
WE-SPC					
WE-TDC					
WE-TI					
WE-TI eco					
WE-TI HV					
WE-TIF					
WE-TIS					
WE-TPC					
WE-WPCC					
WE-XHMI					
Custom Power Inductor					
WE-CST	Transformer, Pulse Low Level	**5.2**	**F**	**6.3**	**T**
WE-GDT					
WE-GDTI					

		FIT - λ		FIT - σ	
Matchcode	**Product Category**	**Table**	**Curve**	**Table**	**Curve**
WE-AGDT	Transformer, Power (> 1W)	**5.3**	**G**	**6.3**	**U**
WE-FB					
WE-FB3751					
WE-FLEX					
WE-FLEX+					
WE-FLEX HV					
WE-LLCR					
WE-PoE					
WE-PoE+					
WE-PoEH					
WE-PPTI					
WE-Unit					
WE-UOST					
Custom Power					

4.4 Signal & Communication

		FIT - λ		FIT - σ	
Matchcode	**Product Category**	**Table**	**Curve**	**Table**	**Curve**
WE-ASI	Coil, Load Coil	**5.1**	**A**	**6.1**	**N**
WE-BAL	Coil, Chip/Ceramic Filter	**5.1**	**C**	**6.1**	**O**
WE-BPF					
WE-CCMF					
WE-KI					
WE-KI HC					
WE-LPF					
WE-MCA					
WE-MCI					
WE-MK					
WE-RFH					
WE-RFI					
WE-TCI					
WE-CAIR	Coil, Radio Frequency, Fixed	**5.1**	**C**	**6.1**	**r**
WE-ACHC					
WE-BMS	Transformer, Radio Frequency	**5.3**	**H**	**6.3**	**V**
WE-LAN					
WE-LAN AQ					
WE-LAN 10G					
WE-RJ45 LAN					
WE-RJ45 LAN TH Reflow					
WE-RJ45 LAN 10G					
Custom LAN					
WE-STST	Transformer, Pulse Low Level	**5.2**	**F**	**6.3**	**T**
Custom Signal					

4.5 Opto-Electronic Parts

		FIT - λ		FIT - σ	
Matchcode	**Product Category**	**Table**	**Curve**	**Table**	**Curve**
WL-SBCD					
WL-SBCW					
WL-SBRW					
WL-SBSW					
WL-SBTW					
WL-SFCC					
WL-SFCD					
WL-SFCW					
WL-SFRW					
WL-SFSW					
WL-SFTD					
WL-SFTW					
WL-SICW					
WL-SIMW					
WL-SIQW					
WL-SIRW					
WL-SISW	Single LED / LCD Segment	**5.4**	**I**	**6.4**	**W**
WL-SITW					
WL-SMCC					
WL-SMCD					
WL-SMCW					
WL-SMDC					
WL-SMRW					
WL-SMSW					
WL-SMTD					
WL-SMTW					
WL-SUMW					
WL-SWTC					
WL-SWTP					
WL-TIRC					
WL-TIRW					
WL-TMRC					
WL-TMRW					

		FIT - λ		FIT - σ	
Matchcode	**Product Category**	**Table**	**Curve**	**Table**	**Curve**
WL-VCSL	Single LED / LCD Segment	**5.4**	**I**	**6.4**	**W**
WL-S7DS	LED / LCD Array	**5.4**	**s**	**6.4**	**t**
WL-T7DS					
WL-STCB	Phototransistor	**5.10**	**as**	**6.10**	**at**
WL-STCW					
WL-STRB					
WL-STSB					
WL-STSW					
WL-STTB					
WL-STTW					
WL-TTRB					
WL-TTRW					
WL-SDCB	Photodiode	**5.10**	**au**	**6.10**	**av**
WL-SDSB					
WL-TDRW					
WL-TDRB					
WL-OCPT	Optocoupler Phototransistor	**5.10**	**as**	**6.10**	**at**

4.6 Capacitors

			FIT - λ		FIT - σ	
Matchcode	**Product Category**	**Electrical Stress**	**Table**	**Curve**	**Table**	**Curve**
WCAP-FTBE	Fixed, Plastic	30%	**5.5**	**J**	**6.5**	**X**
WCAP-FTBP		50%	**5.5**	**K**	**6.5**	**Y**
WCAP-FTX2		70%	**5.5**	**L**	**6.5**	**Z**
WCAP-FTXX		100%	**5.5**	**M**	**6.5**	**a**
WCAP-AI3H	Fixed, Aluminum, Electrolytic, Fixed, < 400 µF	30%	**5.6**	**b**	**6.6**	**j**
WCAP-AIE8		50%	**5.6**	**c**	**6.6**	**k**
WCAP-AIG5		70%	**5.6**	**d**	**6.6**	**l**
WCAP-AIG8		100%	**5.6**	**e**	**6.6**	**m**
WCAP-AIL5						
WCAP-AIL8						
WCAP-AS5H						
WCAP-ASLI						
WCAP-ASLL						
WCAP-ASLU						
WCAP-ASNP						
WCAP-AT1H						
WCAP-ATET						
WCAP-ATG5						
WCAP-ATG8						
WCAP-ATLI						
WCAP-ATLL						
WCAP-ATUL						
WCAP-PHET						

			FIT - λ		FIT - σ	
Matchcode	**Product Category**	**Electrical Stress**	**Table**	**Curve**	**Table**	**Curve**
WCAP-AI3H	Fixed, Aluminum, Electrolytic, Fixed, > 400 µF	30% 50% 70% 100%	**5.9** **5.9** **5.9** **5.9**	**ai** **aj** **ak** **al**	**6.9** **6.9** **6.9** **6.9**	**am** **an** **ao** **ap**
WCAP-AIE8						
WCAP-AIG5						
WCAP-AIG8						
WCAP-AIL5						
WCAP-AIL8						
WCAP-AS5H						
WCAP-ASLI						
WCAP-ASLL						
WCAP-ASNP						
WCAP-AT1H						
WCAP-ATET						
WCAP-ATG5						
WCAP-ATG8						
WCAP-ATLI						
WCAP-ATLL						
WCAP-ATUL						
WCAP-CSGP	Fixed, Ceramic	30% 50% 70% 100%	**5.7** **5.7** **5.7** **5.7**	**f** **g** **h** **i**	**6.7** **6.7** **6.7** **6.7**	**n** **o** **p** **q**
WCAP-CSMH						
WCAP-CSRF						
WCAP-CSSA						
WCAP-CSST						
WCAP-PHET	Unlisted					
WCAP-PHGP						
WCAP-PHLE						
WCAP-PHSE						
WCAP-PSHP						
WCAP-PSLC						
WCAP-PSLP						
WCAP-PTG5						
WCAP-PTHR						
WCAP-PTHT						
WCAP-PT5H						
WCAP-STSC						

4.7 Frequency Products

		FIT - λ		FIT - σ	
Matchcode	**Product Category**	**Table**	**Curve**	**Table**	**Curve**
WE-XTAL	Quartz Crystal	**5.8**	**AA**	**6.8**	**AE**
WE-SPXO	Crystal Oscillator, Quartz Controlled	**5.8**	**AB**	**6.8**	**AF**

4.8 Resistance

		FIT - λ		FIT - σ	
Matchcode	**Product Category**	**Table**	**Curve**	**Table**	**Curve**
WRIS-KSKE	Unlisted				
WRIS-KWKB	Unlisted				
WRIS-KWKH	Unlisted				
WRIS-PSMB	Unlisted				
WRIS-PSMC	Unlisted				
WRIS-PWMC	Unlisted				

4.9 Connectors

Wire, cable, solder connections, wire wrap connections and printed wiring boards may be excluded from the unit failure rates, as these correlate to workmanship and control of manufacturing processes.

Failures of connectors are counted as one failure per *mated pair*. Therefore, the FIT rates given below should be counted only once per *mated pair*.

Only pins that are used need to be counted in determination of the FIT rates.

Multi-Pin connectors are assumed to *not* be power connectors. Power connectors distribute AC or DC power throughout the system, and are typically larger than other circuit connectors in order to handle higher current. For connectors used with power distribution, refer to the charts for “General Purpose, Power.”

		FIT - λ		FIT - σ	
Matchcode	**Product Category**	**Table**	**Curve**	**Table**	**Curve**
WR-BHD	Multi-Pin	**5.14**	**bk**	**6.14**	**ck**
WR-BTB					
WR-COM HDMI					
WR-COM USB					
WR-CRD					
WR-DSUB					
WR-FPC					
WR-LECO					
WR-MJ					
WR-MM					
WR-PHD					
WR-WST					
WR-WTB					
WR-SMA	Coaxial, Electric	**5.14**	**bl**	**6.14**	**cl**
WR-RPSMA					
WR-MCX					
WR-ADPT					
WR-MMCX					
WR-DC	General Purpose, Power	**5.15**	**bn**	**6.15**	**cn**
WR-MPC3					
WR-MPC4					
WR-TBL					
WR-WTB					
WR-CAB	Ribbon Cable	**5.14**	**bm**	**6.14**	**cm**
WR-FFC					

		FIT - λ		FIT - σ	
Matchcode	**Product Category**	**Table**	**Curve**	**Table**	**Curve**
WP-BUCF	General Purpose, Power (Consider as 1 pin) ***See Press Fit note below*	**5.15**	**bn**	**6.15**	**cn**
WP-BUFU					
WP-BUTR					
WP-RAFU					
WP-RATR					
WP-SHFU					
WP-TGCF					
WP-TGTR					
WP-TPSE					
WP-SMBU	General Purpose, Power (Consider as 1 pin)	**5.15**	**bn**	**6.15**	**cn**
WP-SMSH					
WP-SMRT					
WP-THRBU					
WP-THRSH					

** Regarding Press-Fit board connections: The Telcordia standard excludes solder connections from failure rate predictions, as it is assumed that manufacturers control their manufacturing processes which results in negligible contribution to unit failure rates. Although the board connection is excluded from the FIT rate, evidence indicates that the Press-Fit technology is superior to standard SMT and TH solder connections.

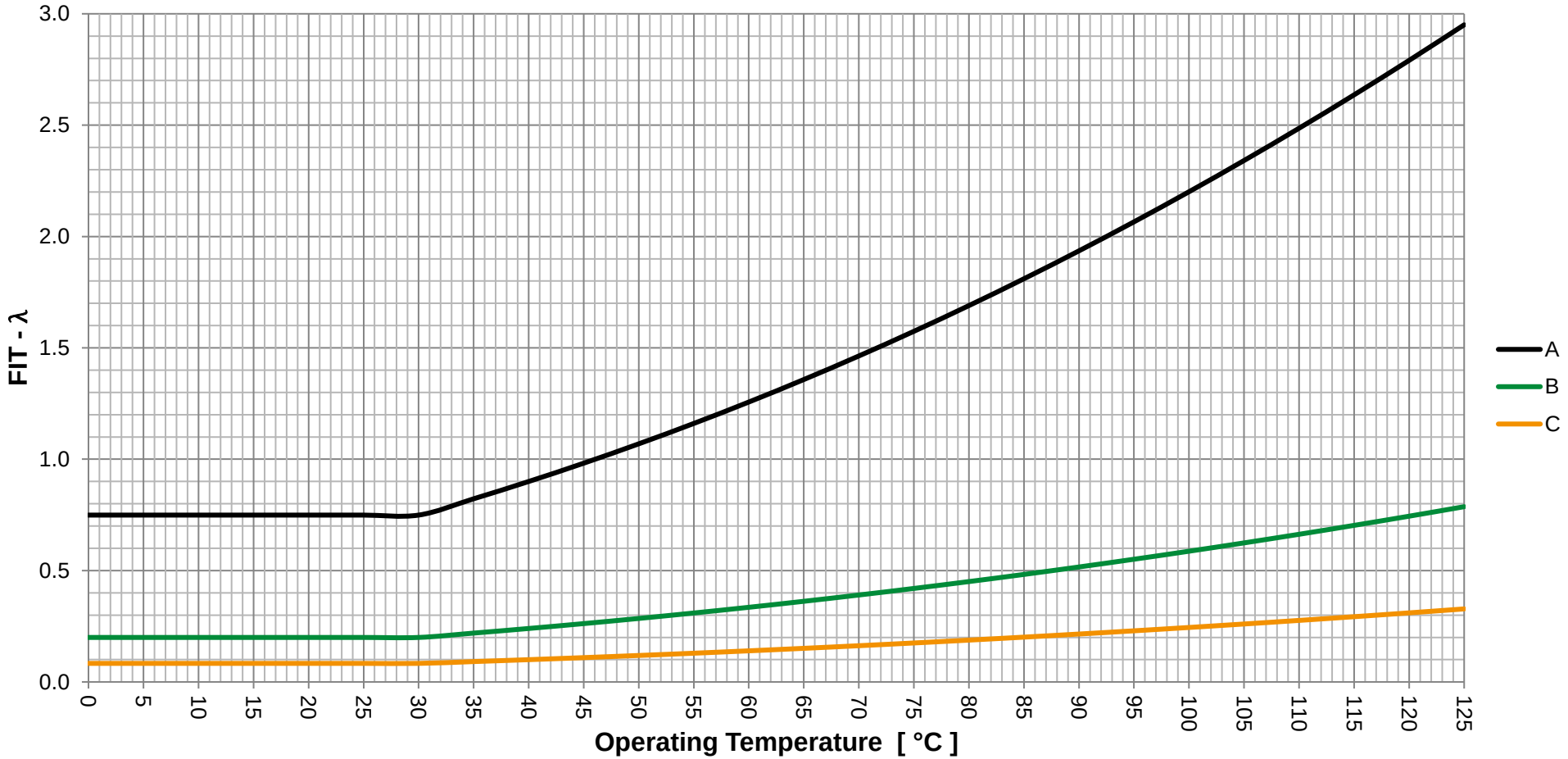
4.10 MagI³C Power Modules

The FIT rates for the MagI³C Power Modules are provided in accordance with MIL-HDBK-217F and supported by reliability testing. These rates are typical values at 60% UCL. (Unless otherwise noted, the FIT rates for all other products in this document are based on the calculation models of Telcordia SR-332.)

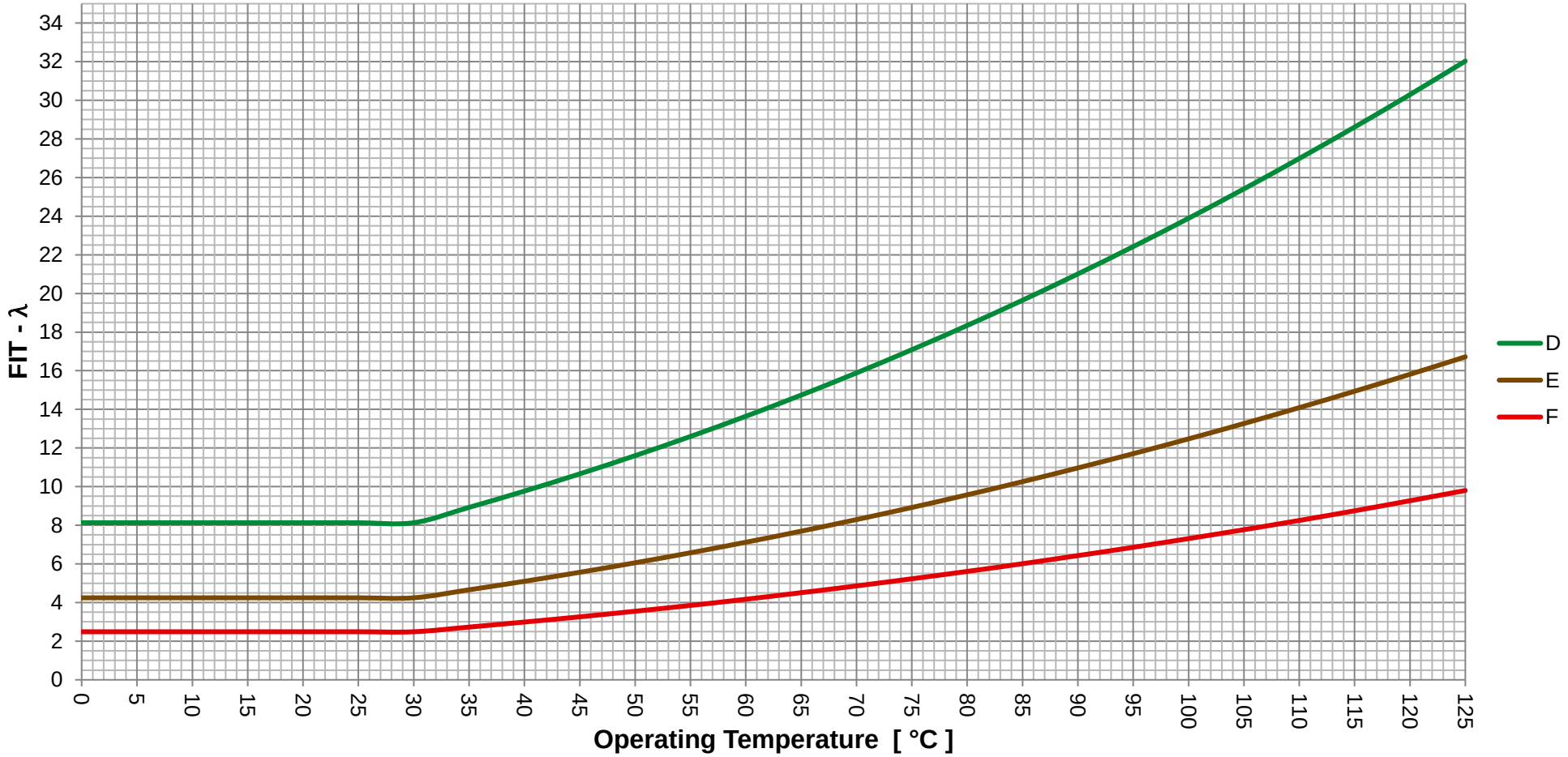
		FIT - λ	
Matchcode	**Size / Order Code**	**Condition**	**Value**
MagI³C-FDSM	SIP-3 / 173950*x*36 or 173010*x*35	**25 °C**	**500**
	SIP-3 / 173010*x*42	**25 °C** **70 °C**	**116** **296**
	SIP-3 / 173950*x*78 or 173010*x*78	**25 °C** **70 °C**	**239** **458**
MagI³C-FISM	SIP-4 / 1779205*x*1	**25 °C** **85 °C**	**44.7** **108**
	SIP-7 / 1779205*x*4	**25 °C** **85 °C**	**75.8** **192**
	SMT-8 / 1769205*x*2 or 1768*x*1*x*12	**25 °C** **100 °C**	**333** **1053**
MagI³C-LDHM	TO263-7EP / 172946001	**55 °C**	**1.81**
MagI³C-VDMM	LGA-6EP / 1710105*xx*	**70 °C**	**23.8**
	LGA-6EP / 171960501	**100 °C**	**471**
MagI³C-VDRM	BQFN-39 / 1710*x*0302	**55 °C**	**0.100**
	BQFN-41 / 171021501	**55 °C**	**0.559**
	LGA-16EP / 1710*x*1801	**55 °C**	**0.029**
	TO263-7EP / 1710*x*0601 (*x* = 1, 2 or 3)	**55 °C**	**1.81**
	TO263-7EP / 1710*x*0601 (*x* = 5)	**55 °C**	**28.9**
	TO263-7EP / 17101240*x*	**55 °C**	**1.81**
	TO263-7EP / 171032401	**55 °C**	**1.83**
MagI³C-VISM	SIP-8 / 17791063215	**55 °C**	**2.54**

5 λ Tables

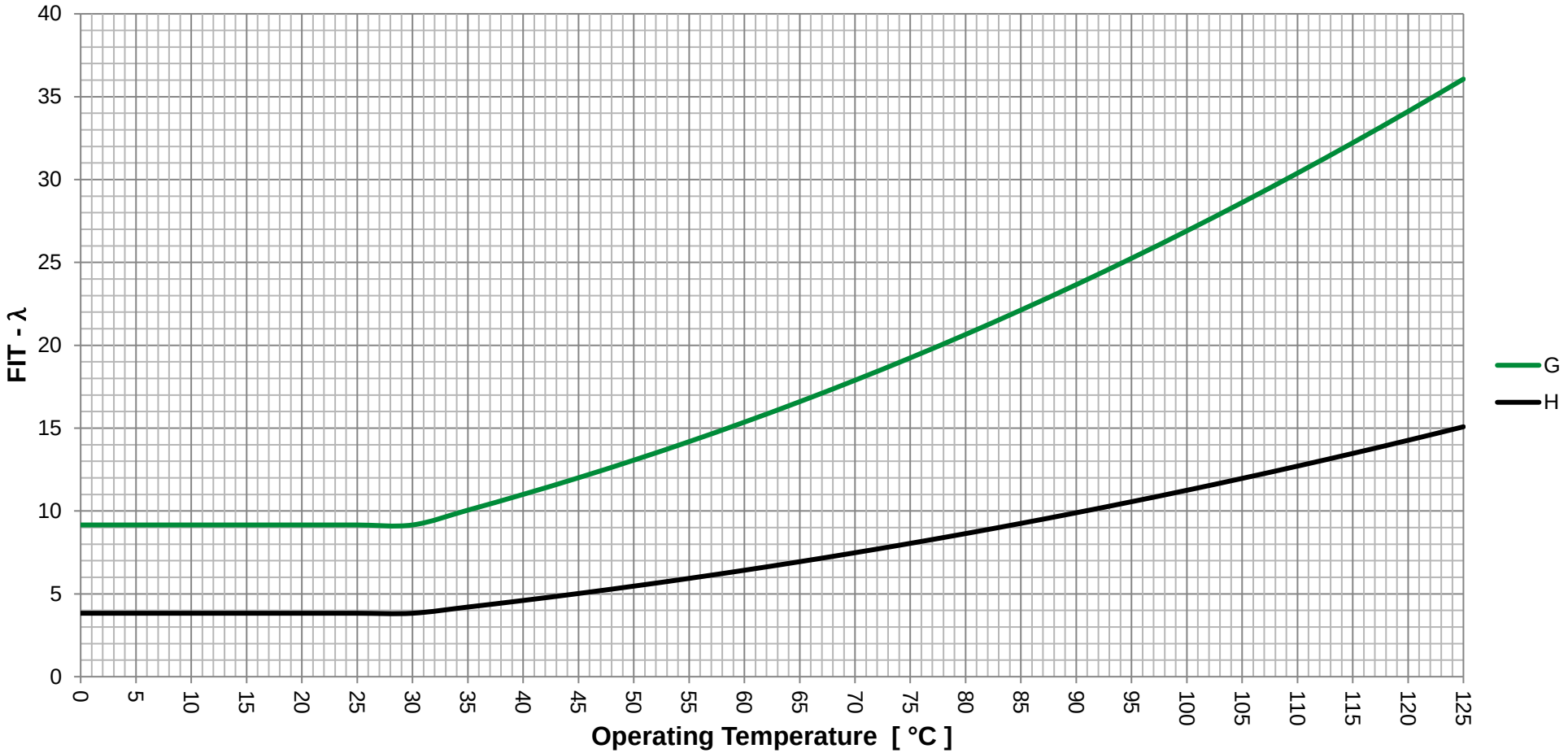
5.1 Table λ-Values



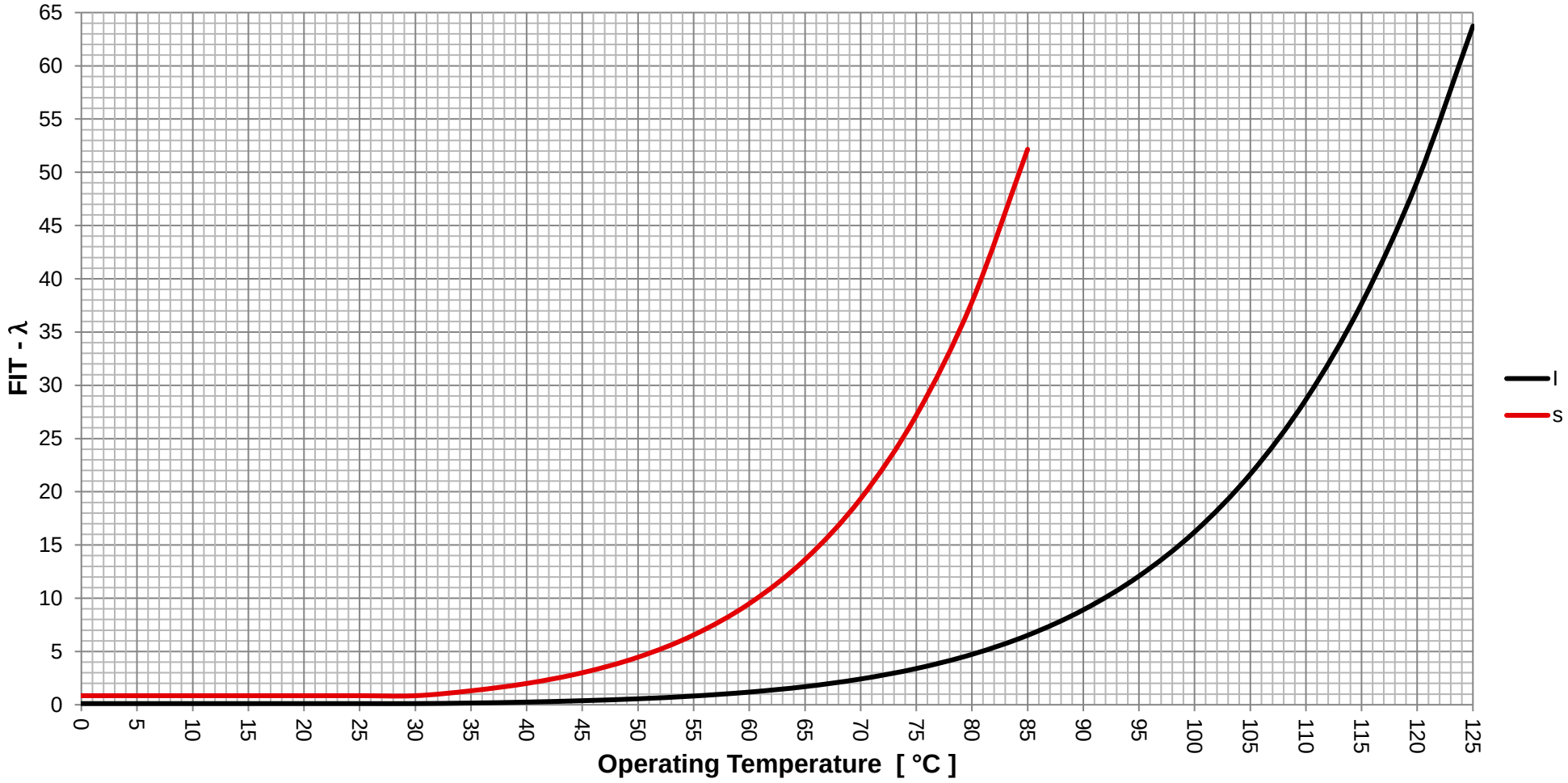
5.2 Table λ-Values



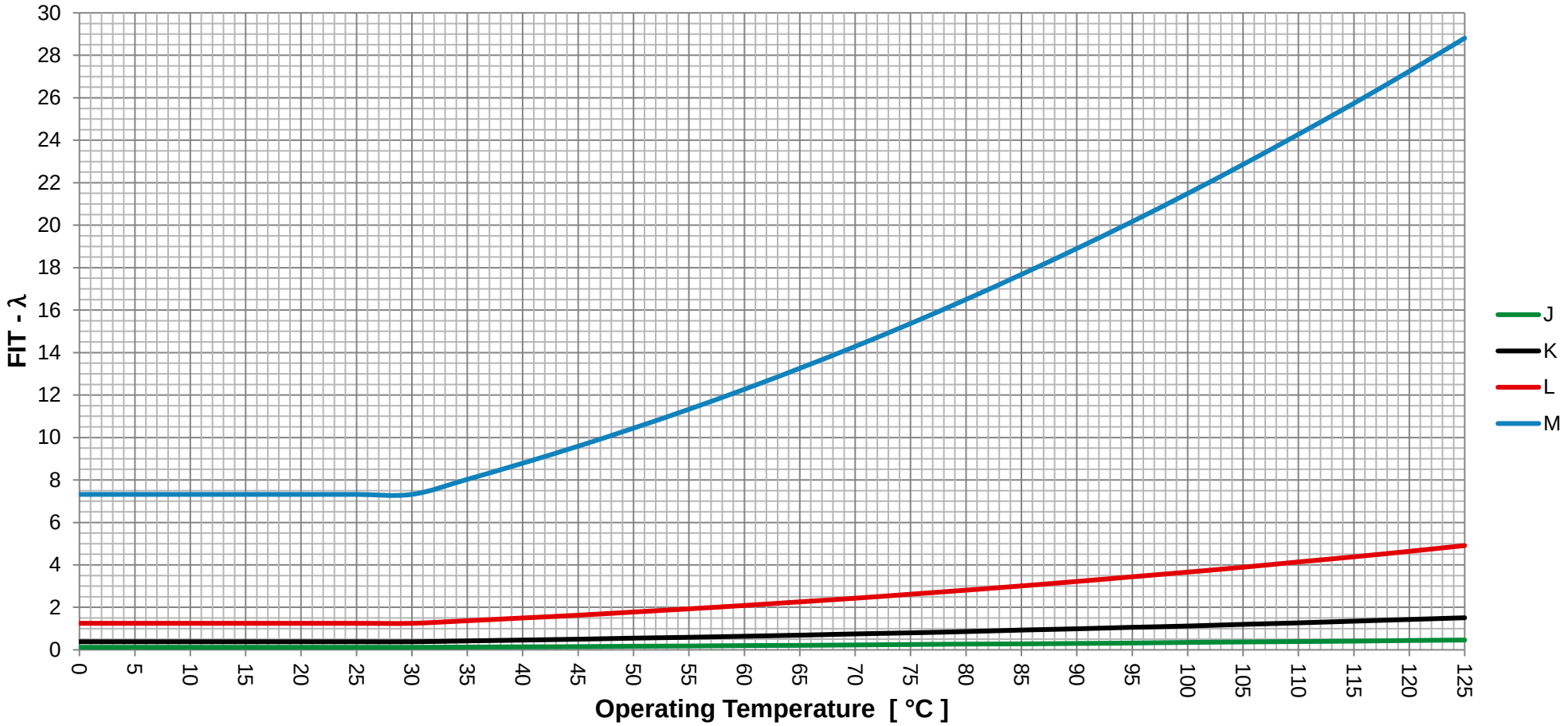
5.3 Table λ-Values



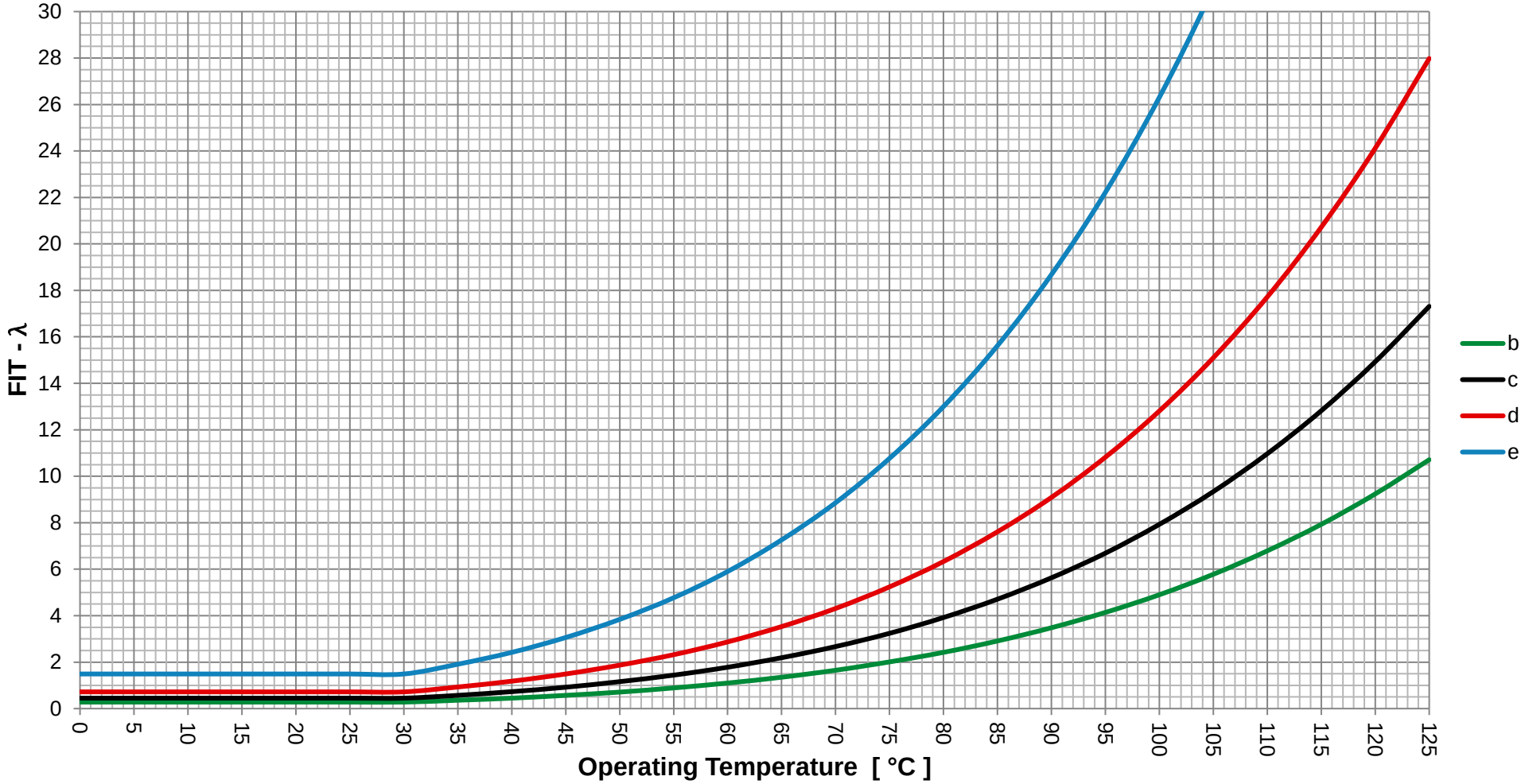
5.4 Table λ-Values



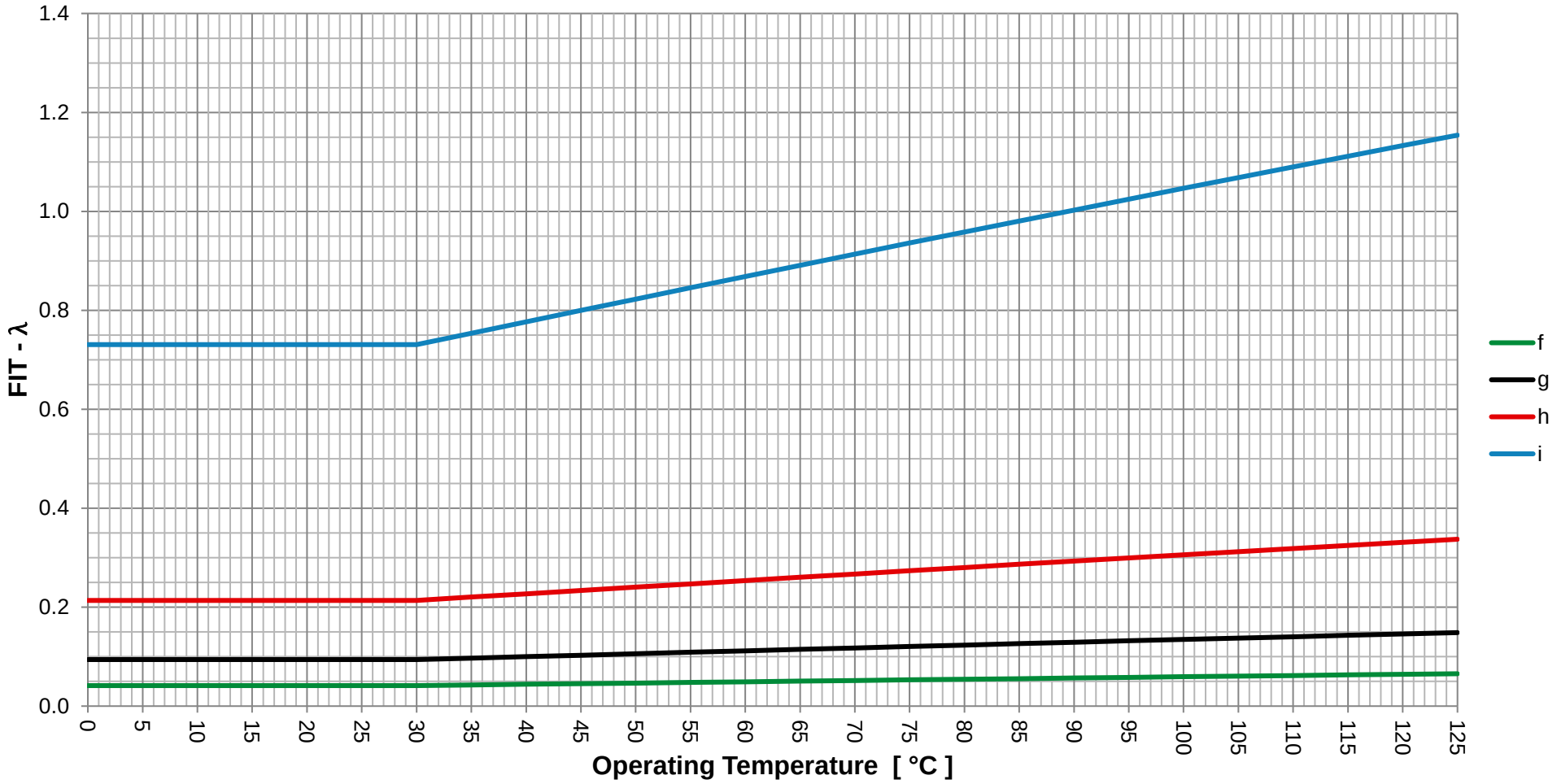
5.5 Table λ-Values



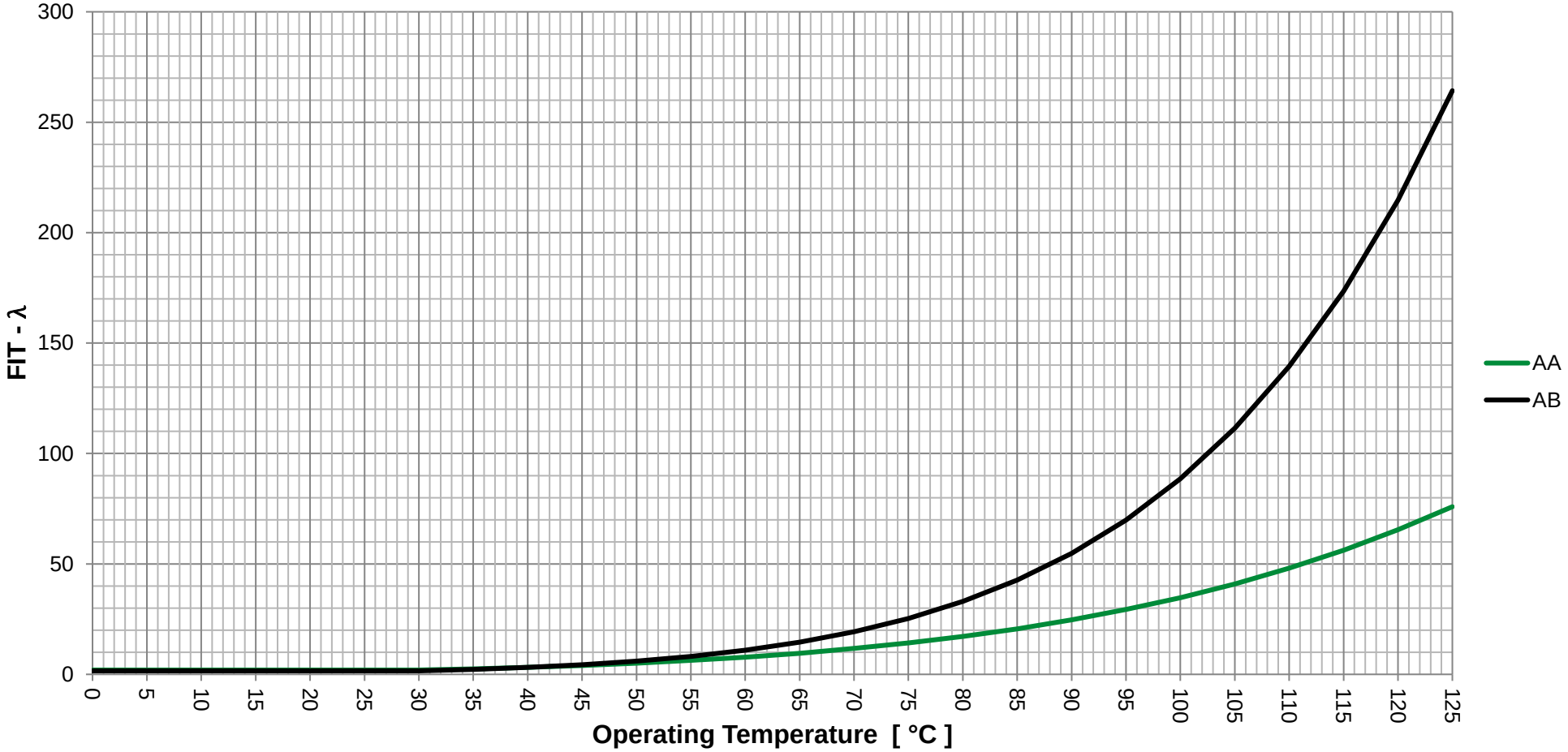
5.6 Table λ-Values



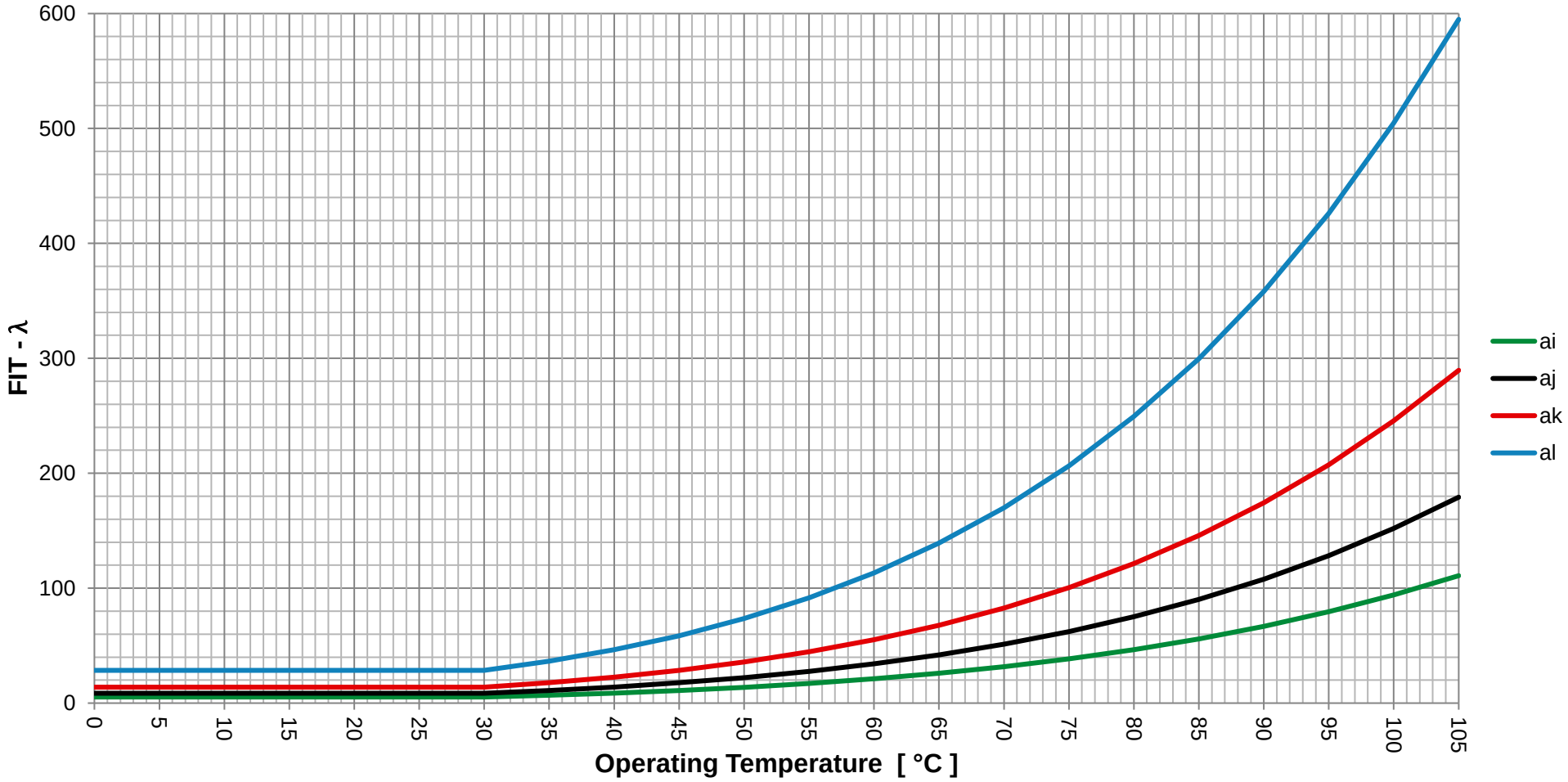
5.7 Table λ-Values



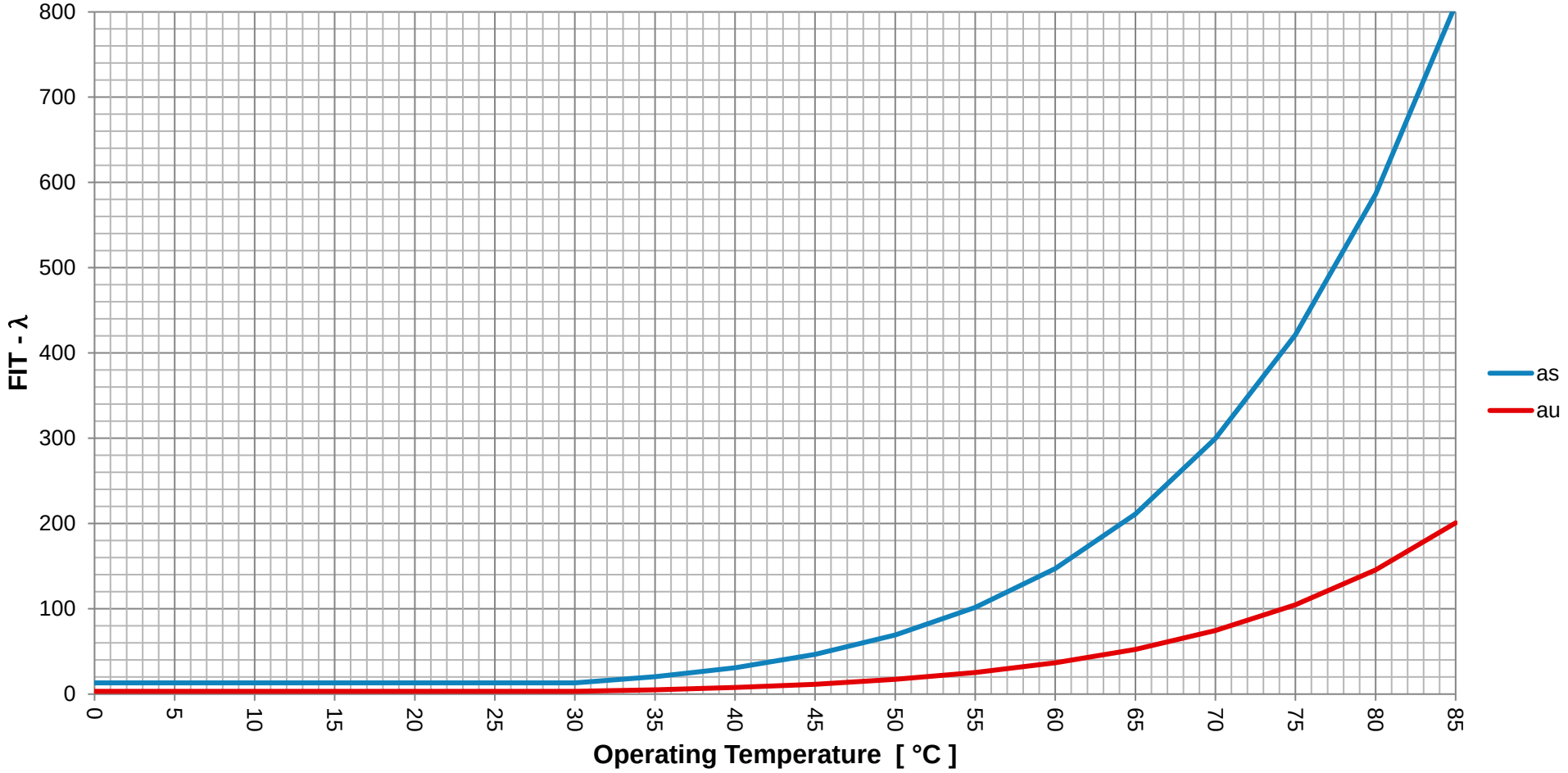
5.8 Table λ-Values



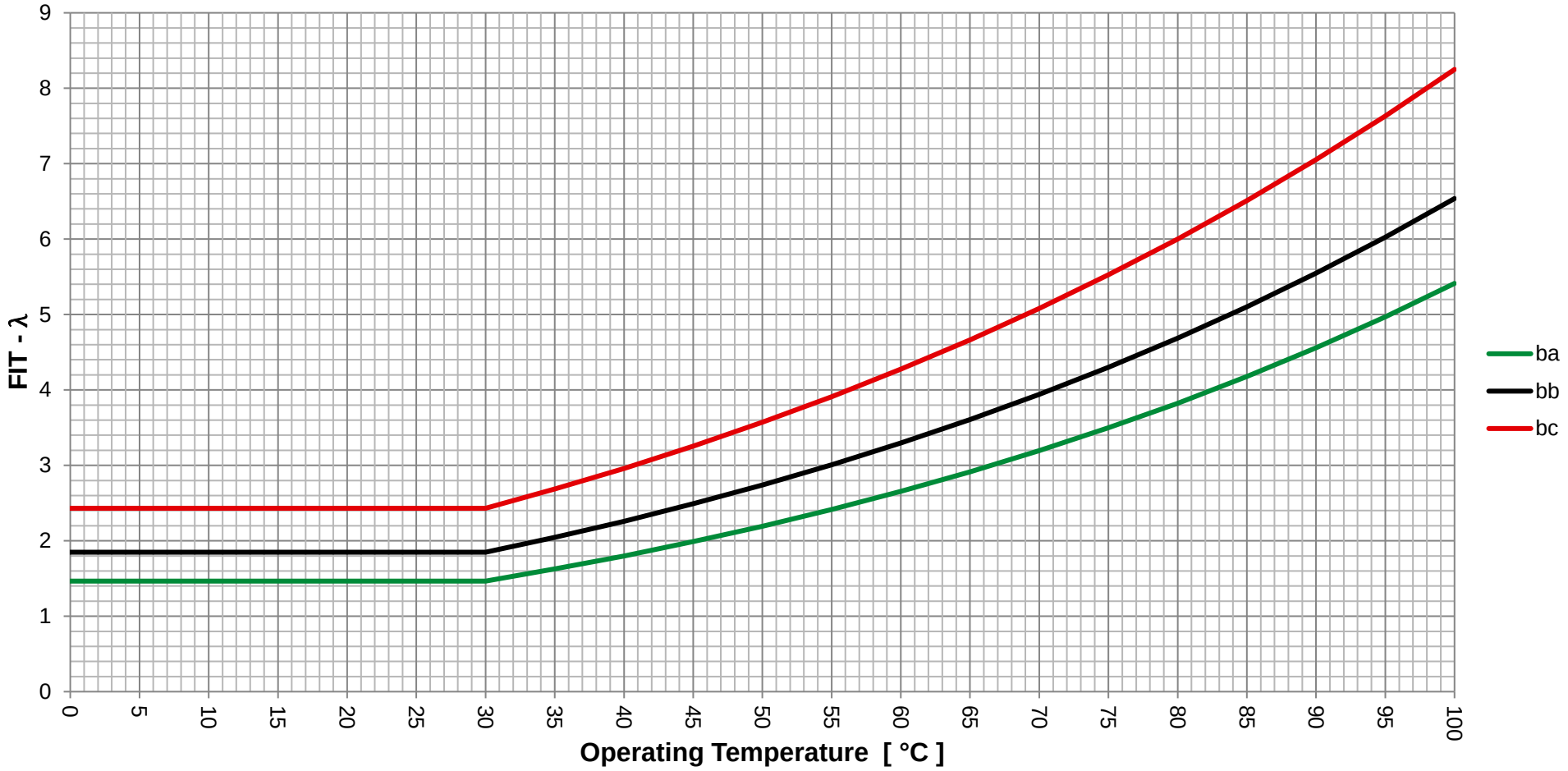
5.9 Table λ-Values



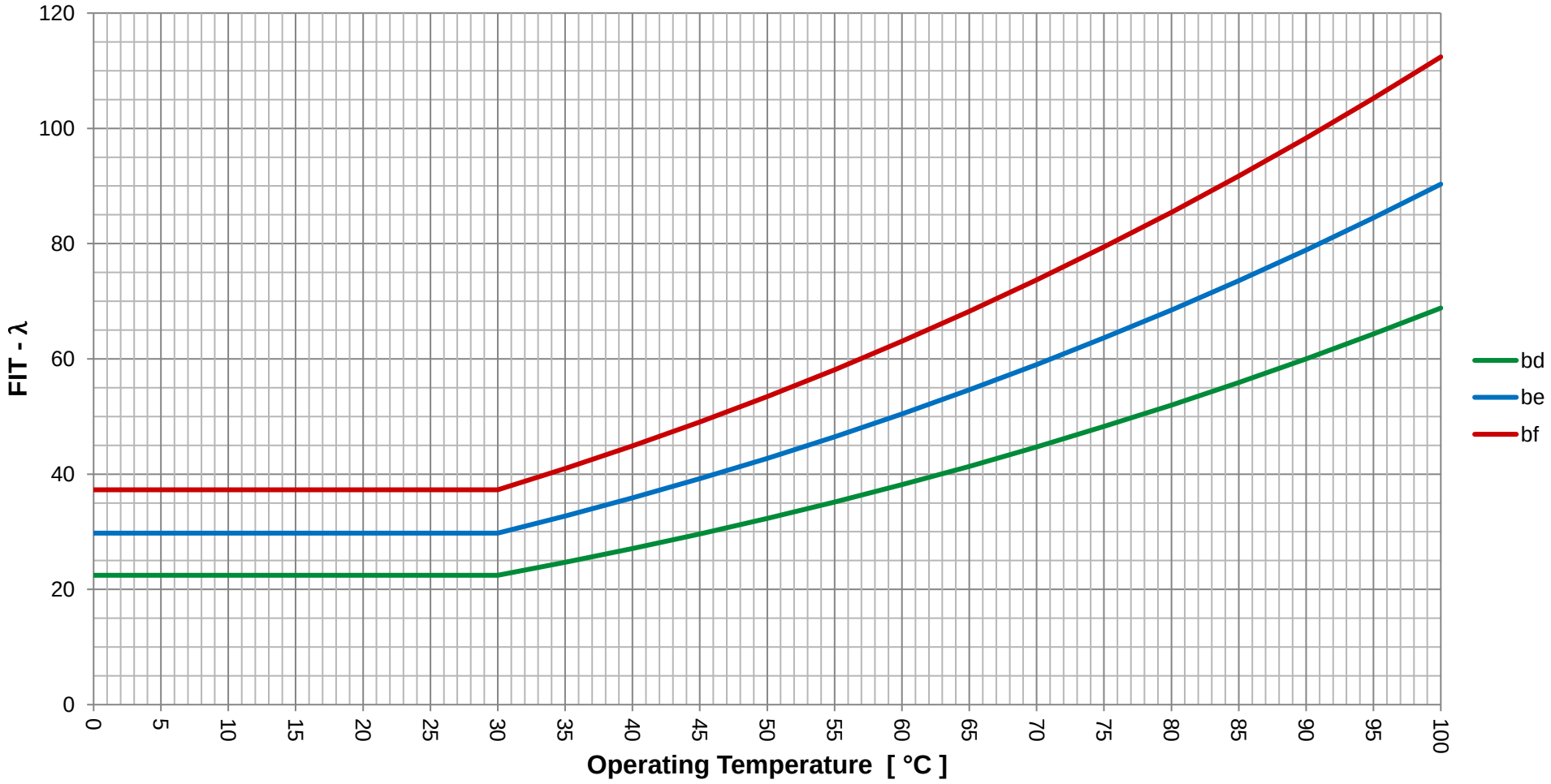
5.10 Table λ-Values



5.11 Table λ-Values

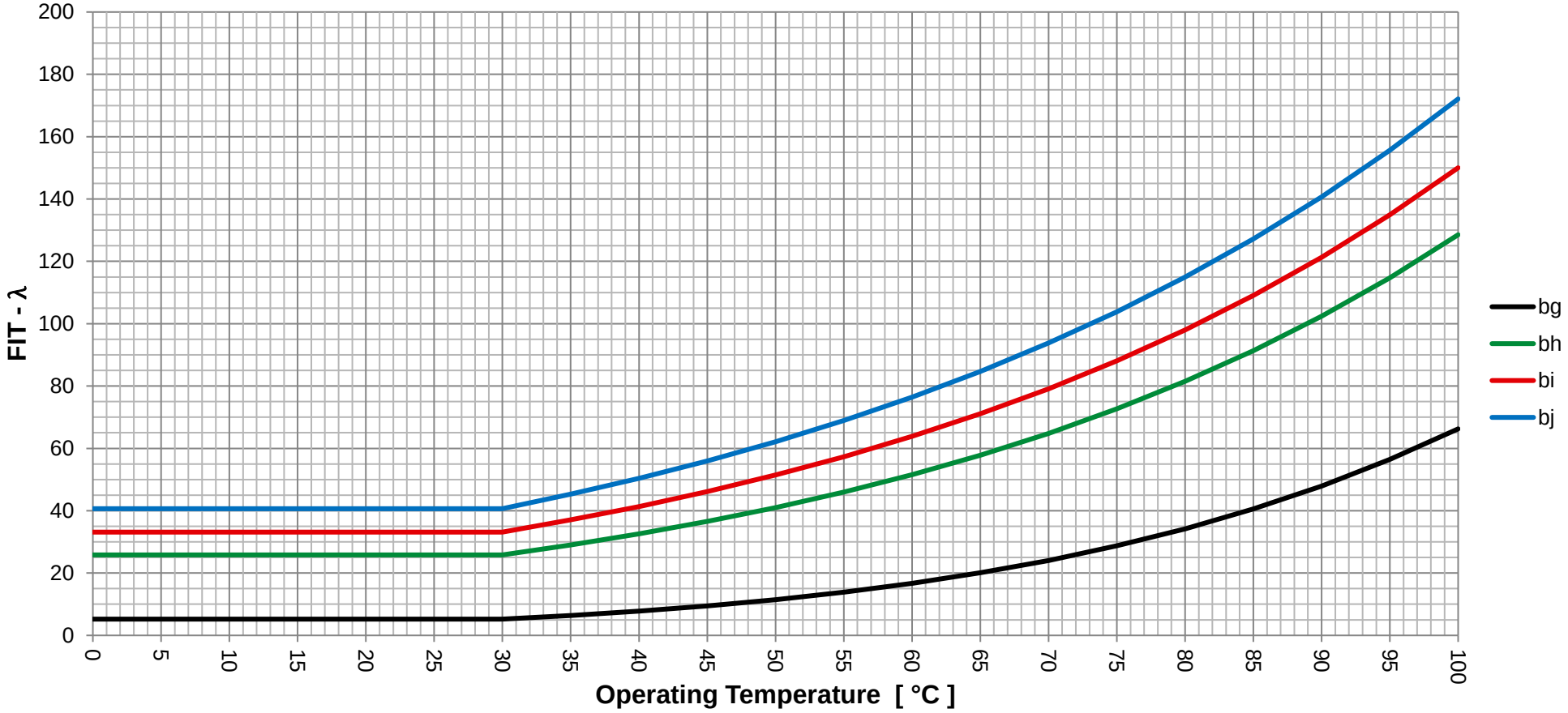


5.12 Table λ-Values

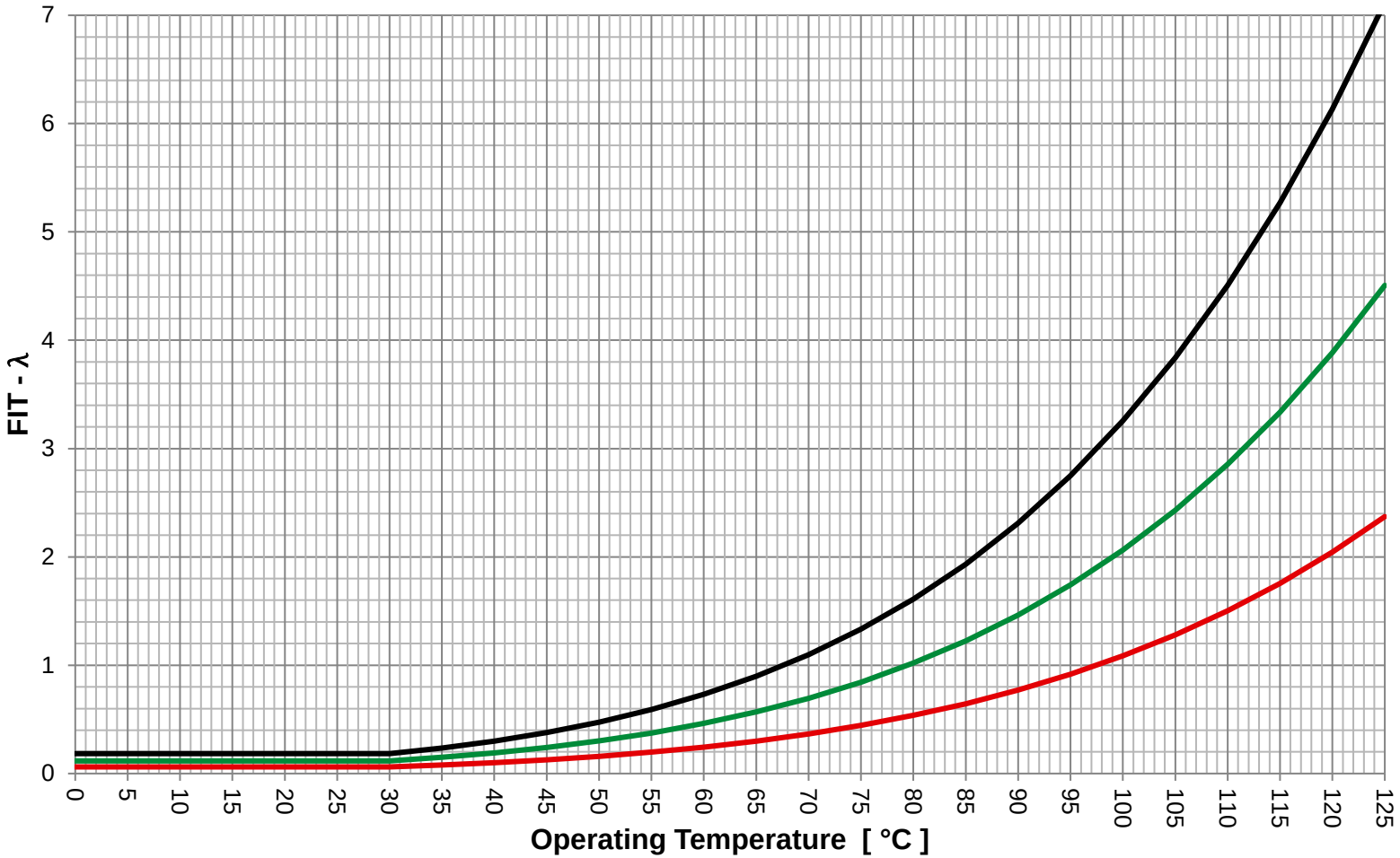


5.13 Table λ-Values

Failures of connectors are counted as one failure per mated *pair*. The FIT rate of WE-CLFS using connectors considers the terminals as 50% of the mated connection pair. The failure rate of the female connectors that are mated to the terminals in this component should be counted at 50%.



5.14 Table λ-Values

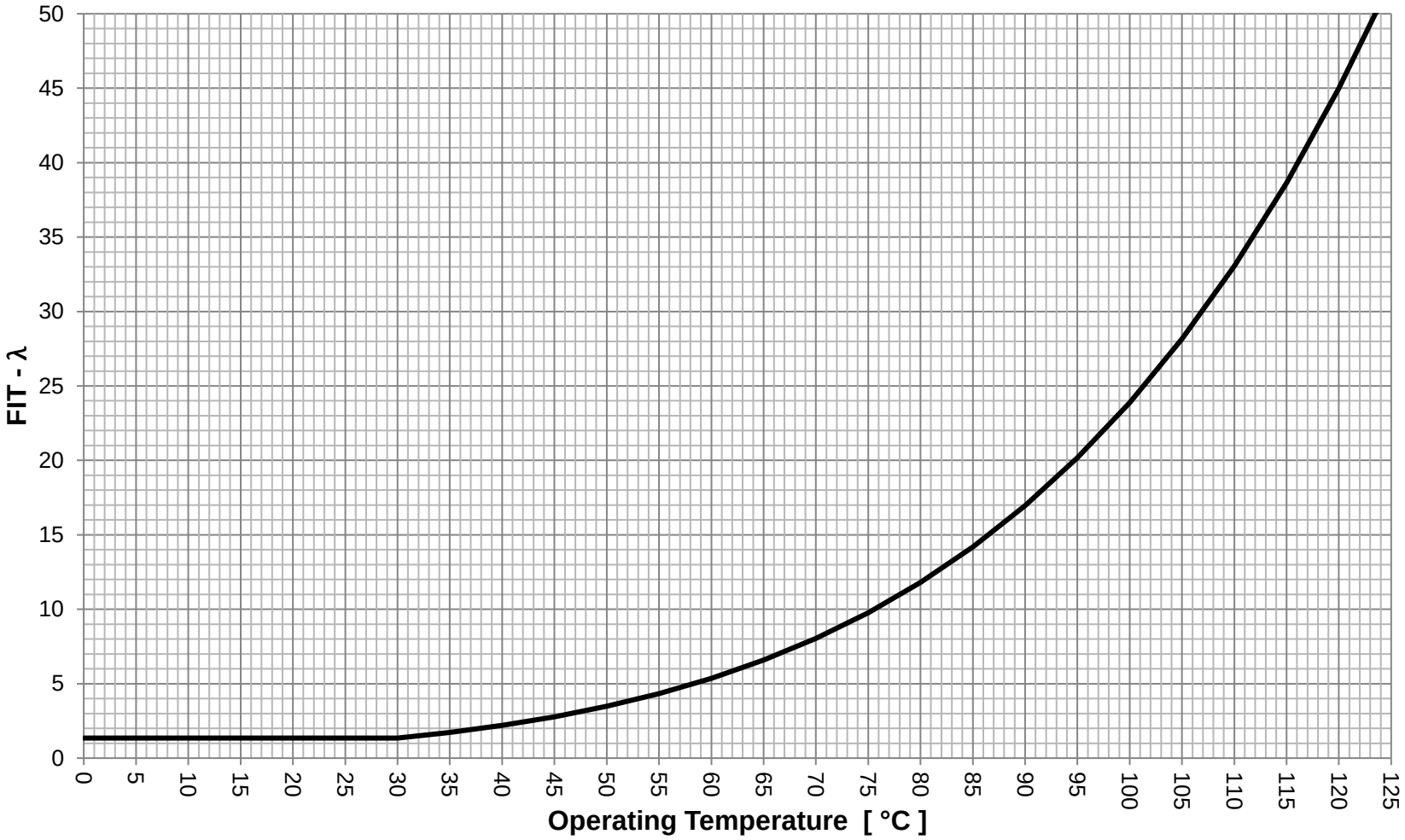


* The FIT rate is given for the listed number of pins. Multiply the FIT value *per pin* by the number of used pins. (Exclude “no connects”.)

For example, curve *bm* gives the FIT rates for a 1-pin connector. For a 5-pin connector, multiply the graph values by 5 to obtain the FIT rate.

For example, curve *bk* gives the FIT rates for a 10 pin connector. For a 12-pin connector, multiply the graph values by 1,2 to obtain the FIT rate. For a 6-pin connector, multiply the *bk* graph values by 0,6 to obtain the FIT rate.

5.15 Table λ-Values

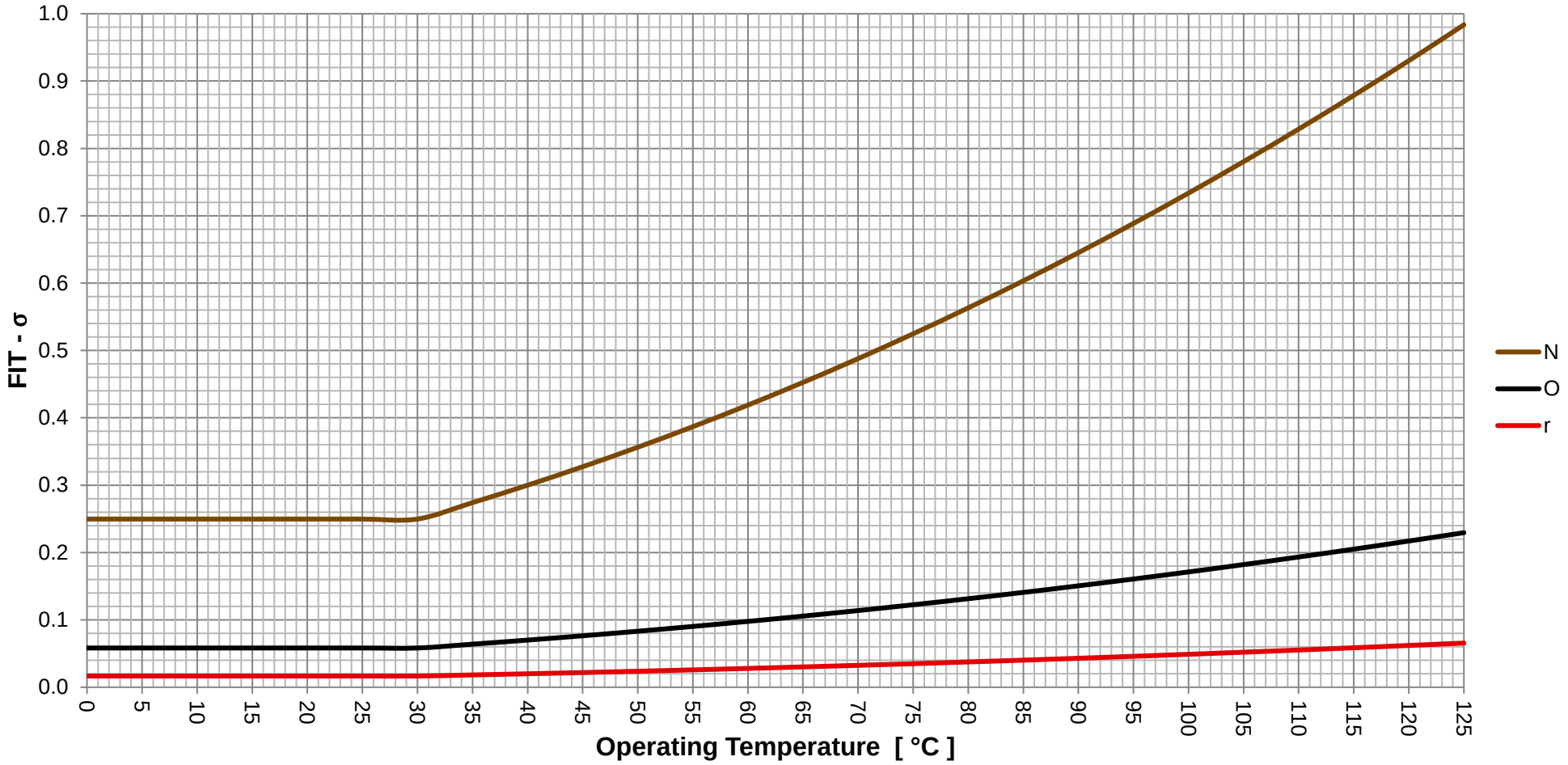


* The FIT rate is given for the listed number of pins. Multiply the FIT value per pin by the number of used pins.

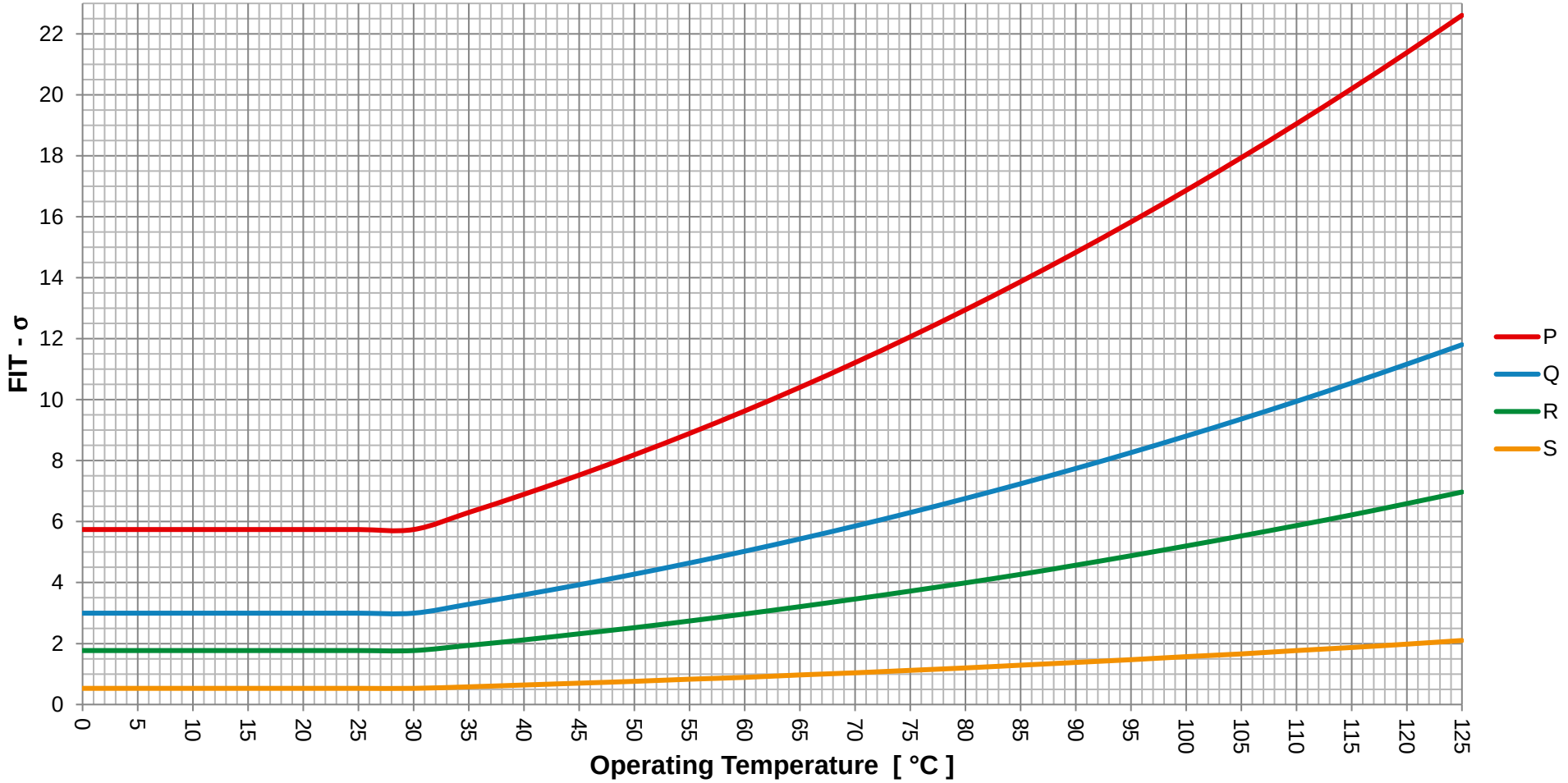
For example, curve *bn* gives the FIT rates for a 1-pin connector. For a 5-pin connector, multiply the graph values by 5 to obtain the FIT rate.

6 σ Tables

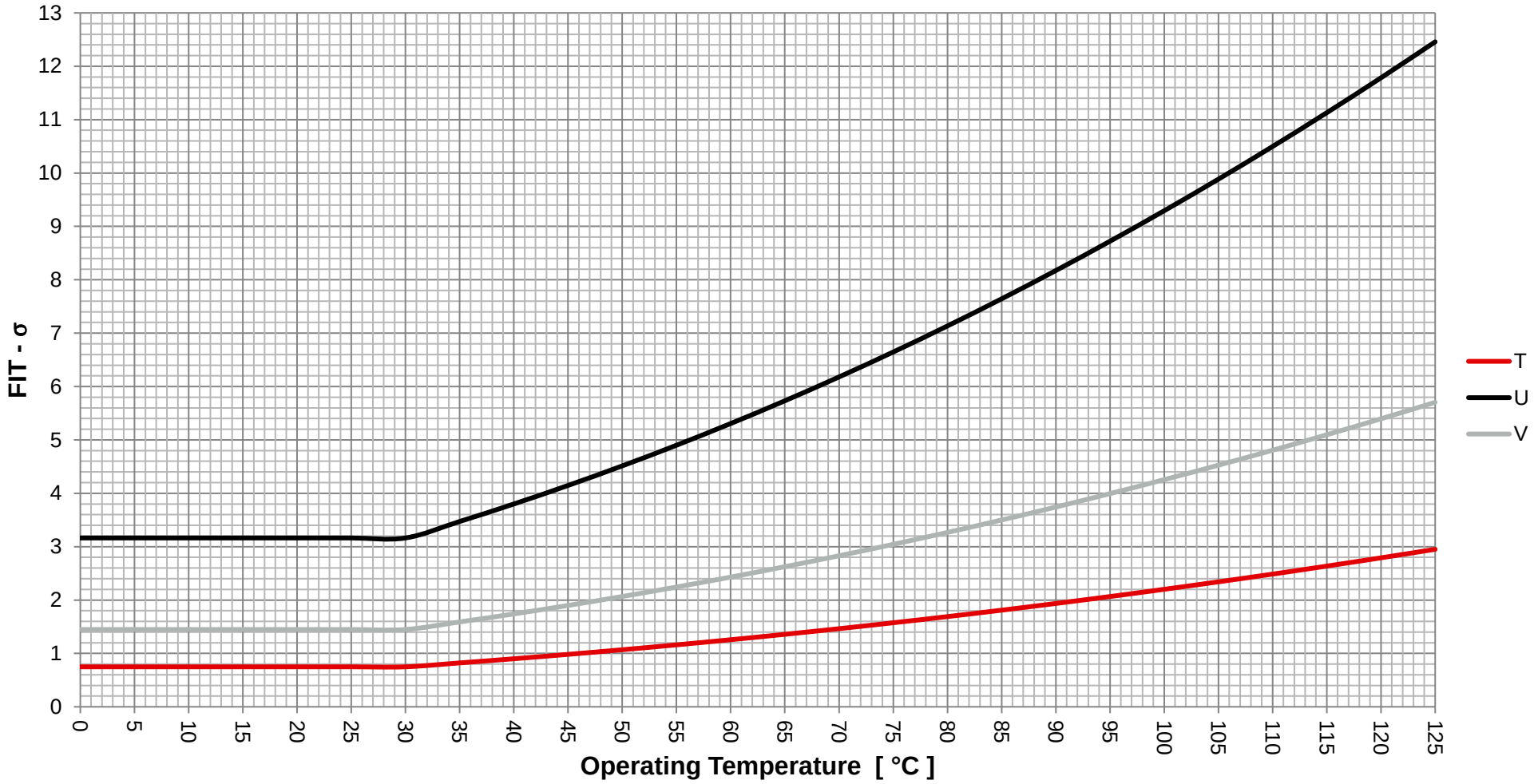
6.1 Table σ-Values



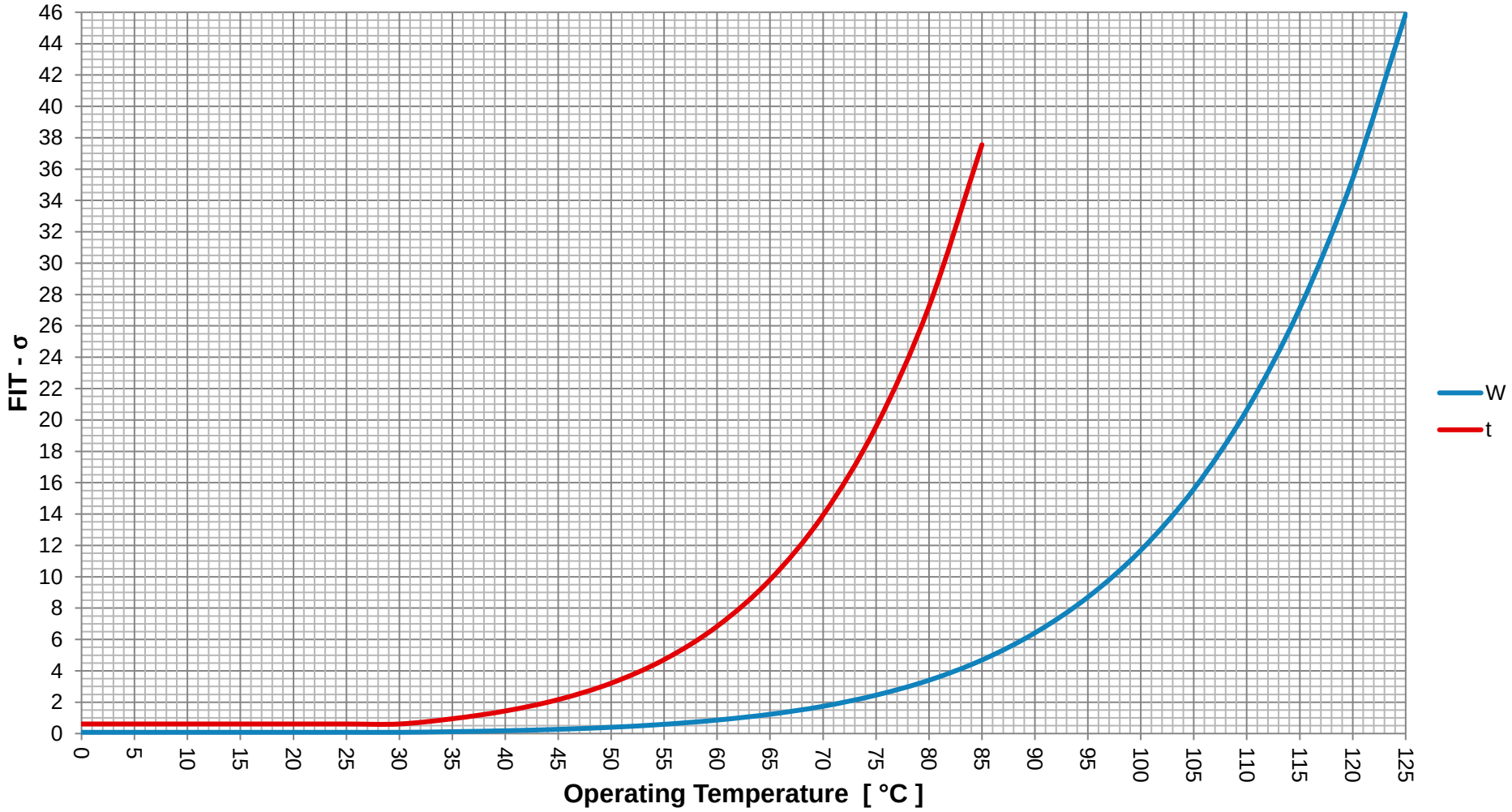
6.2 Table σ-Values



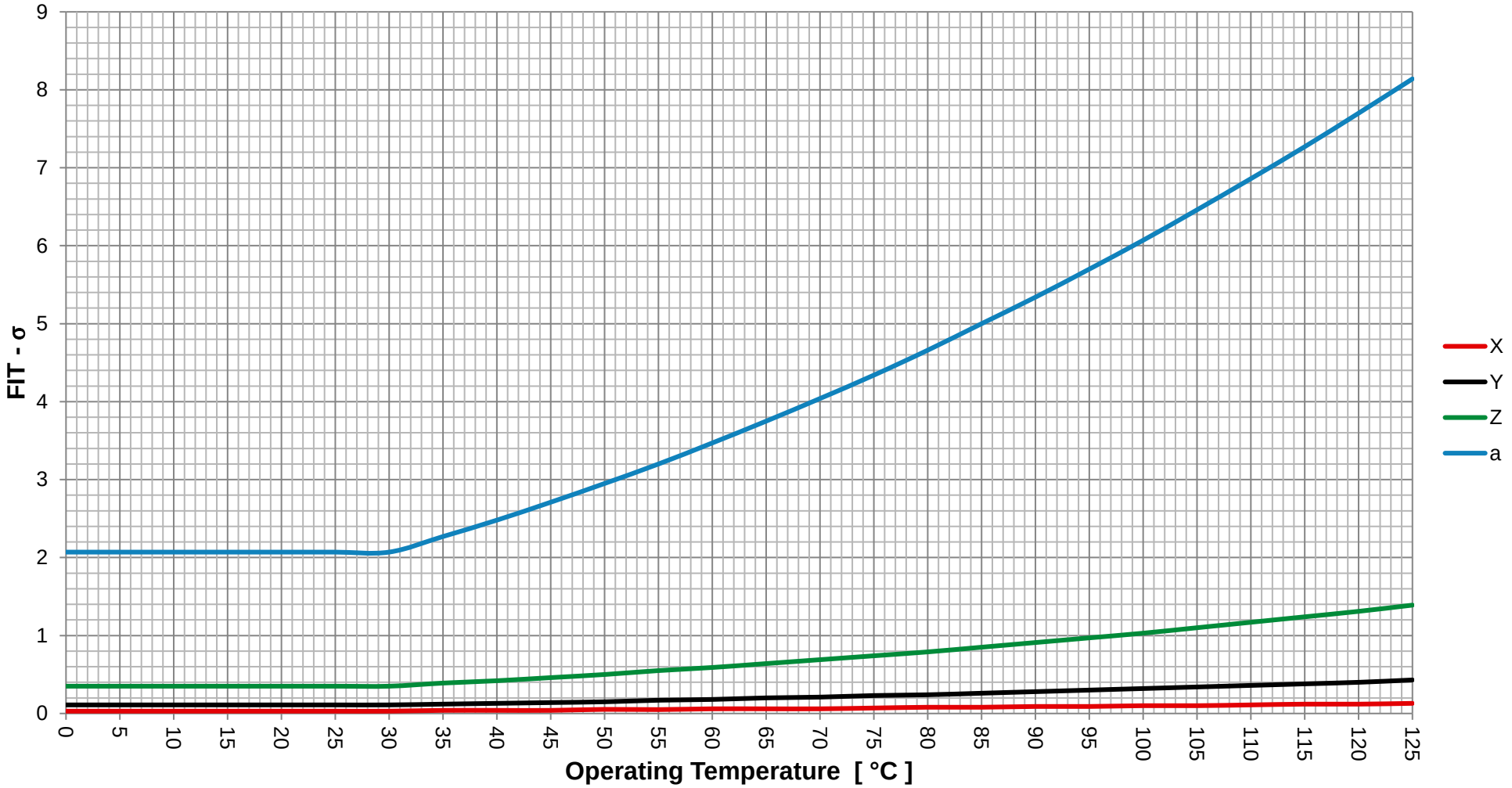
6.3 Table σ-Values



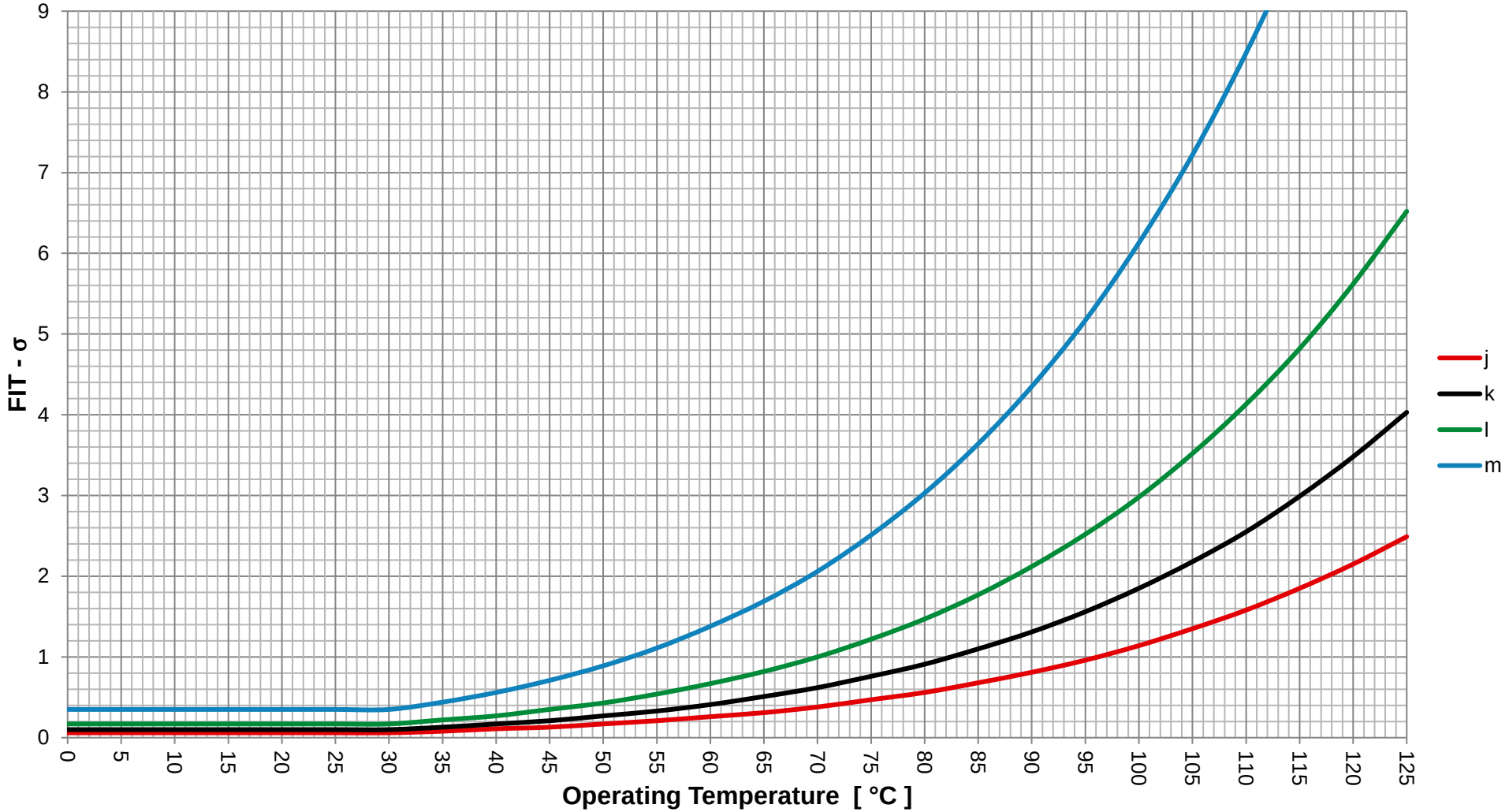
6.4 Table σ-Values



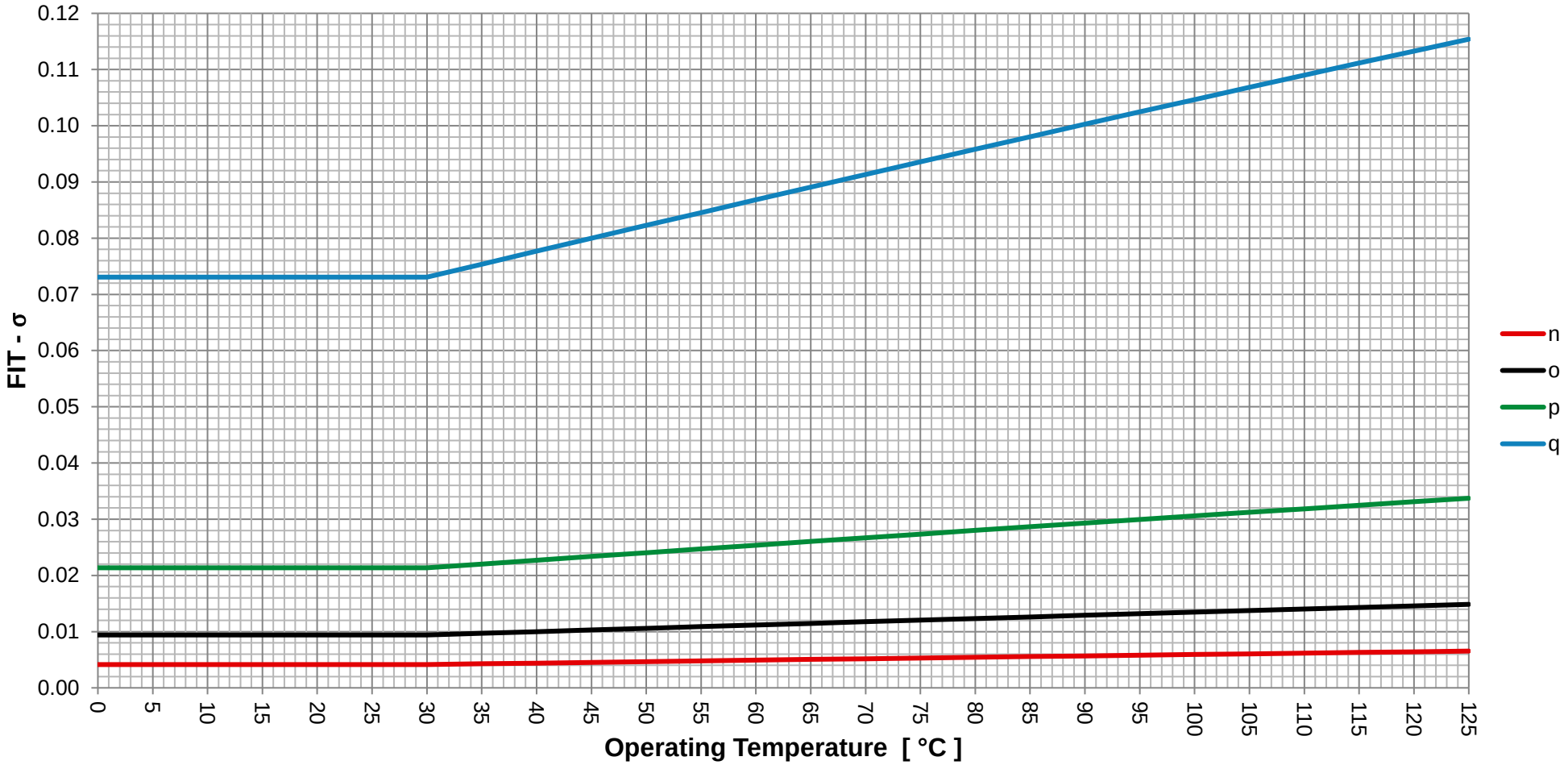
6.5 Table σ-Values



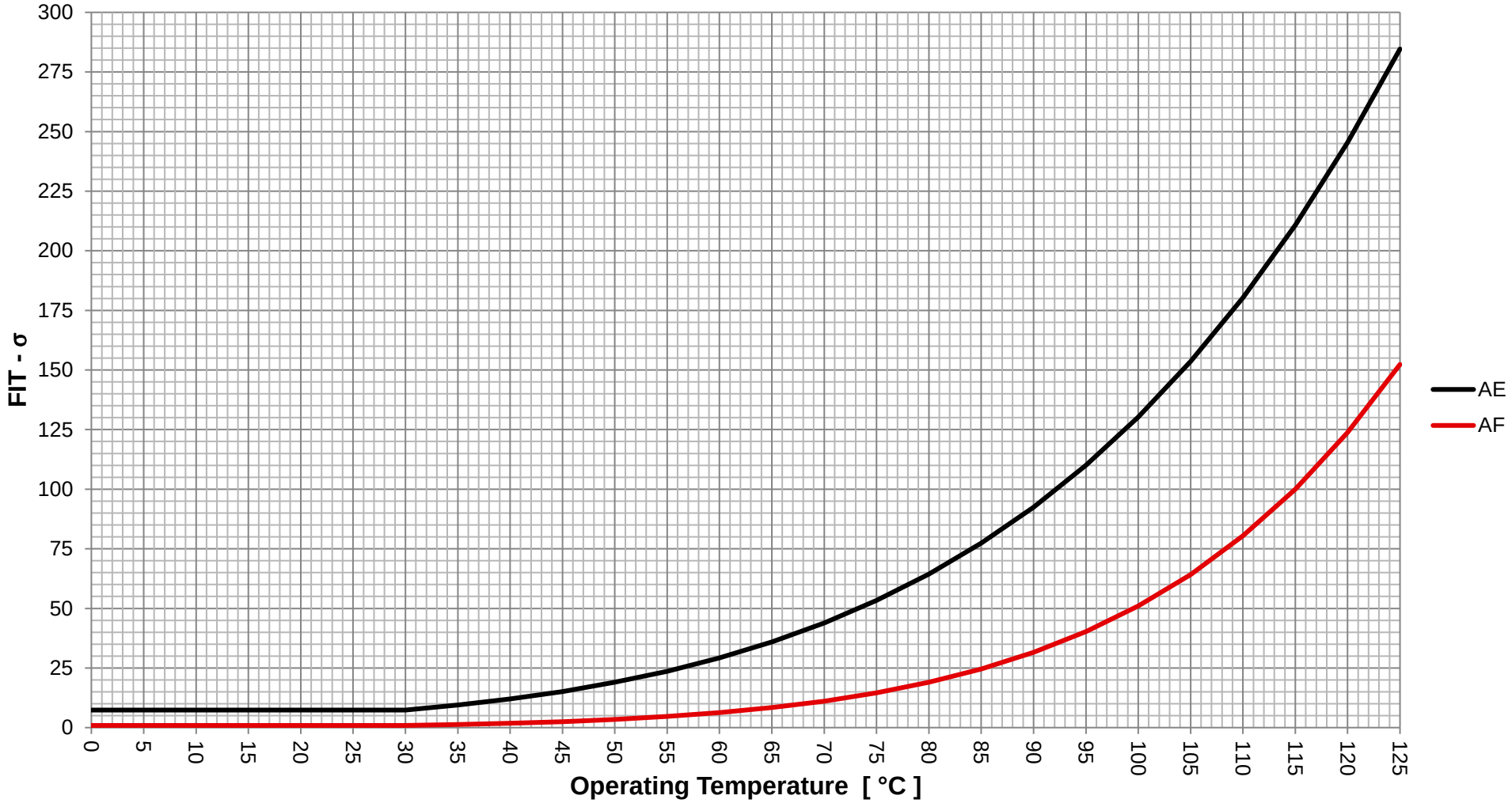
6.6 Table σ-Values



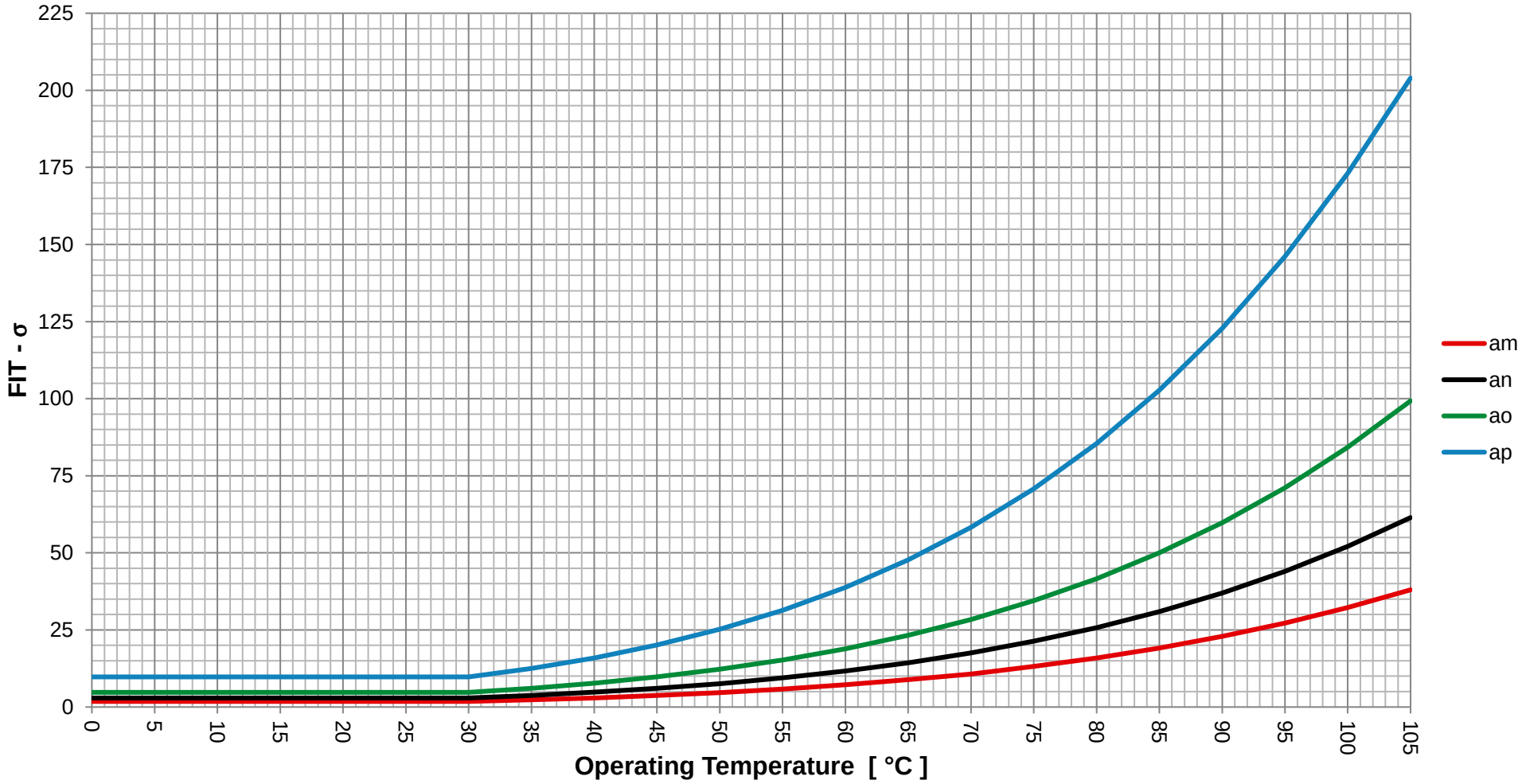
6.7 Table σ-Values



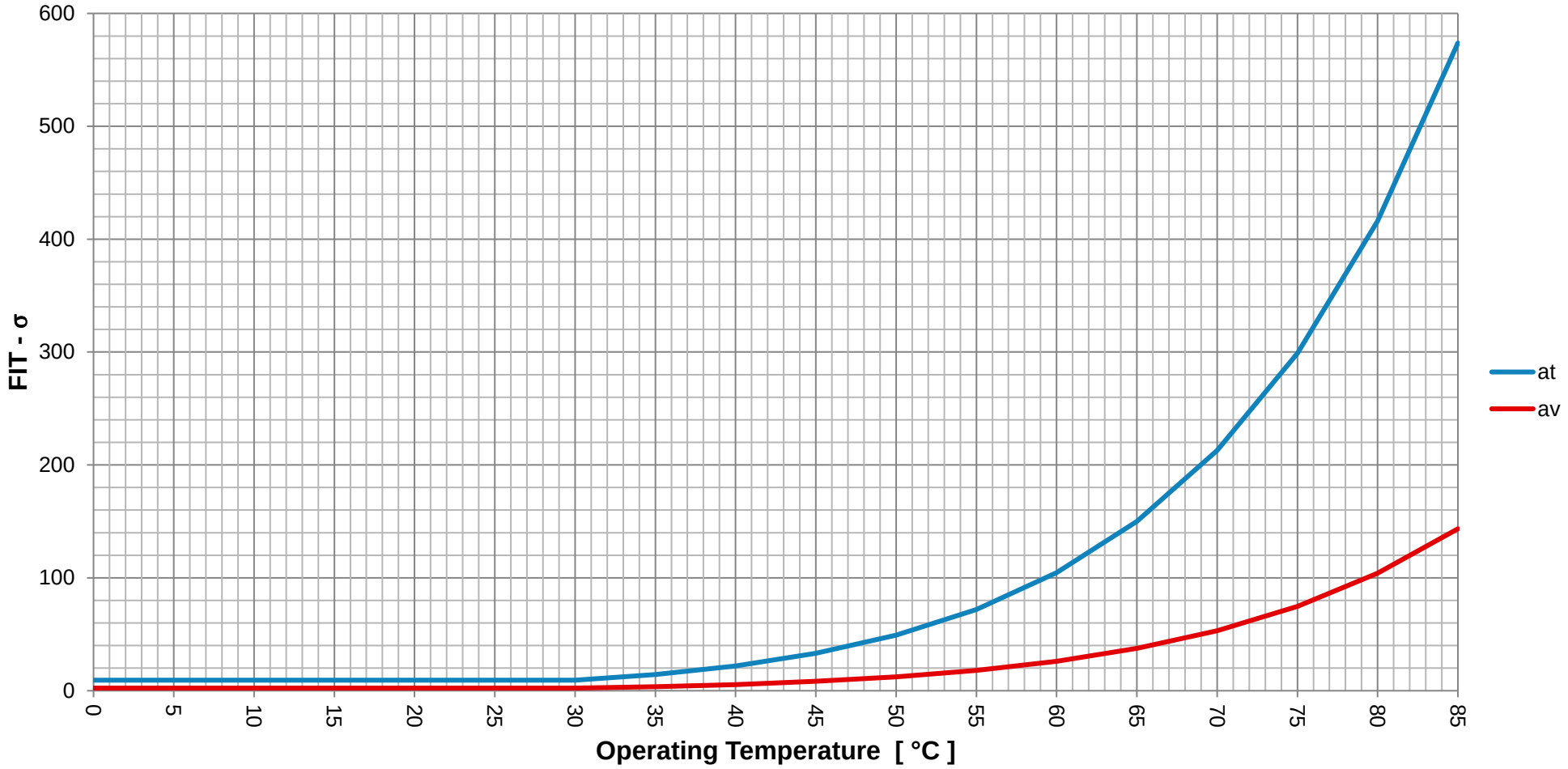
6.8 Table σ-Values



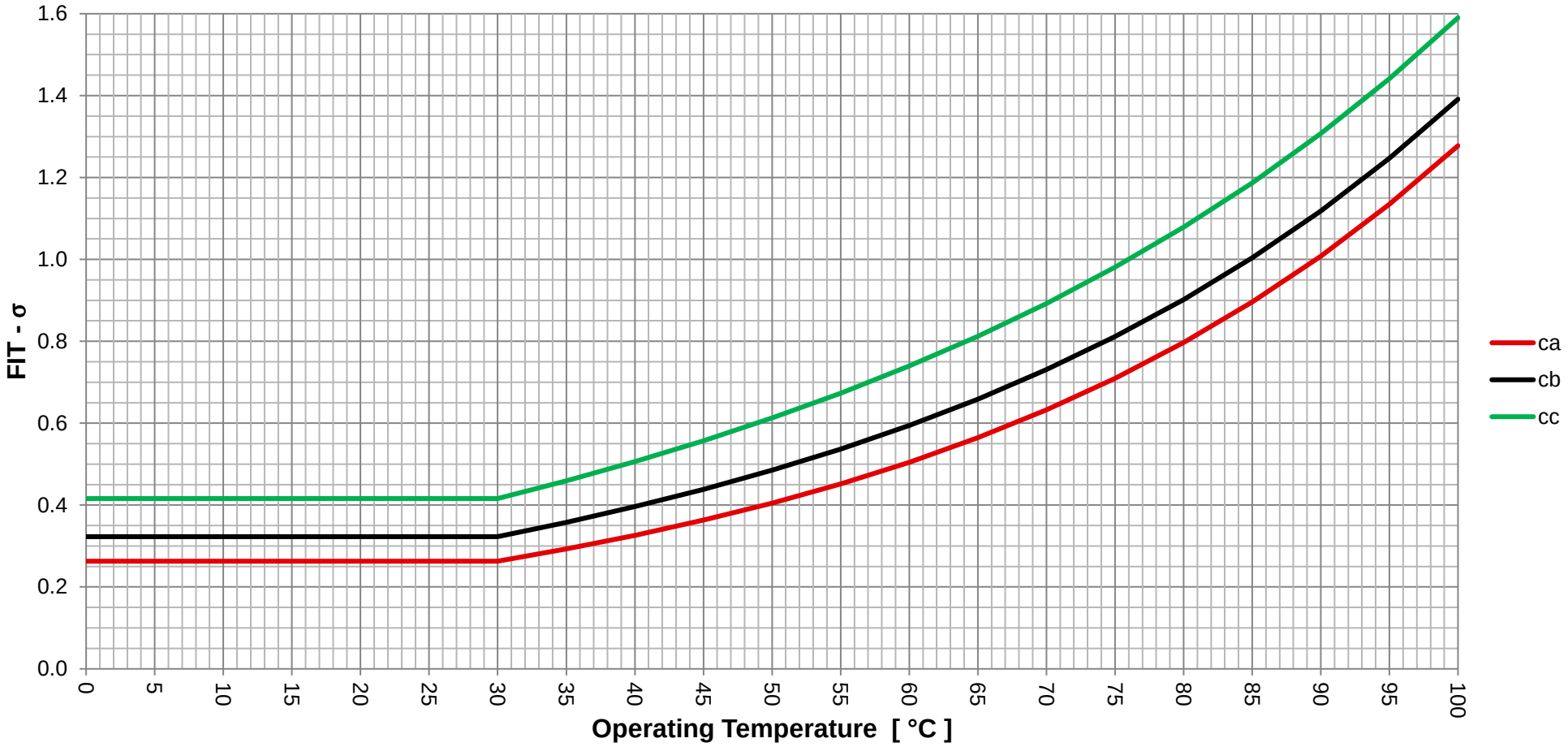
6.9 Table σ-Values



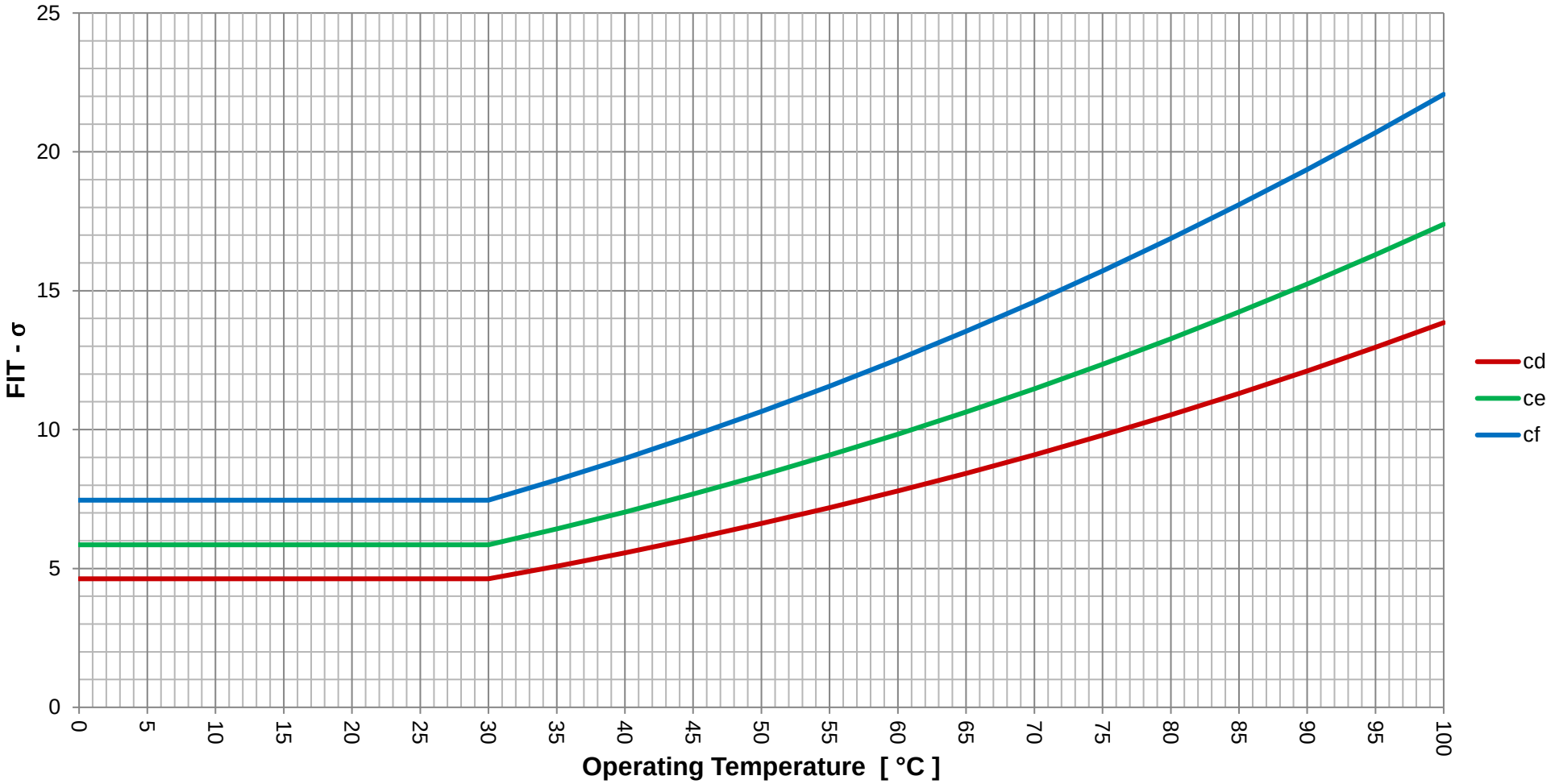
6.10 Table σ-Values



6.11 Table σ-Values

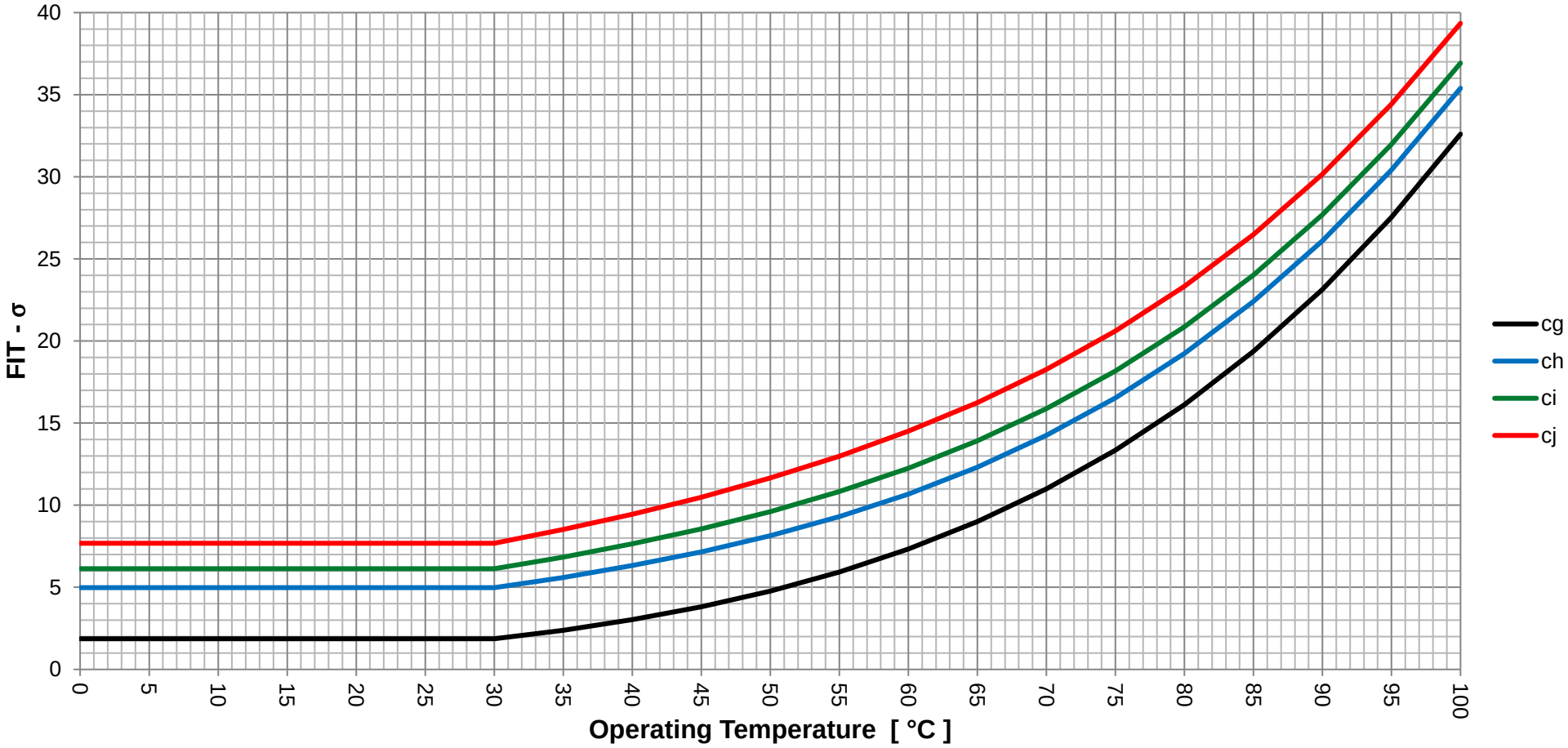


6.12 Table σ-Values

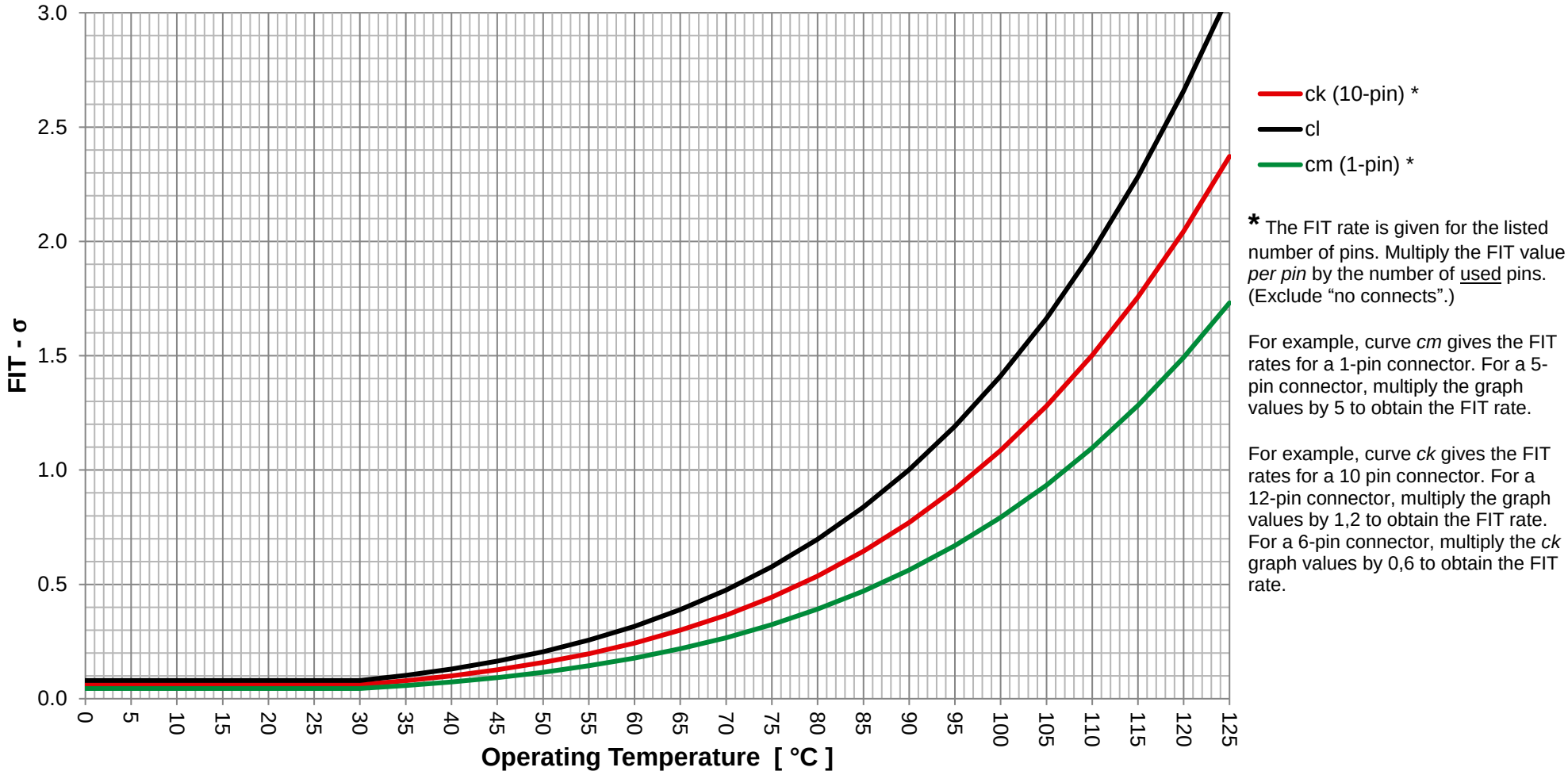


6.13 Table σ-Values

Failures of connectors are counted as one failure per mated *pair*. The FIT rate of WE-CLFS using connectors considers the terminals as 50% of the mated connection pair. The failure rate of the female connectors that are mated to the terminals in this component should be counted at 50%.



6.14 Table σ-Values

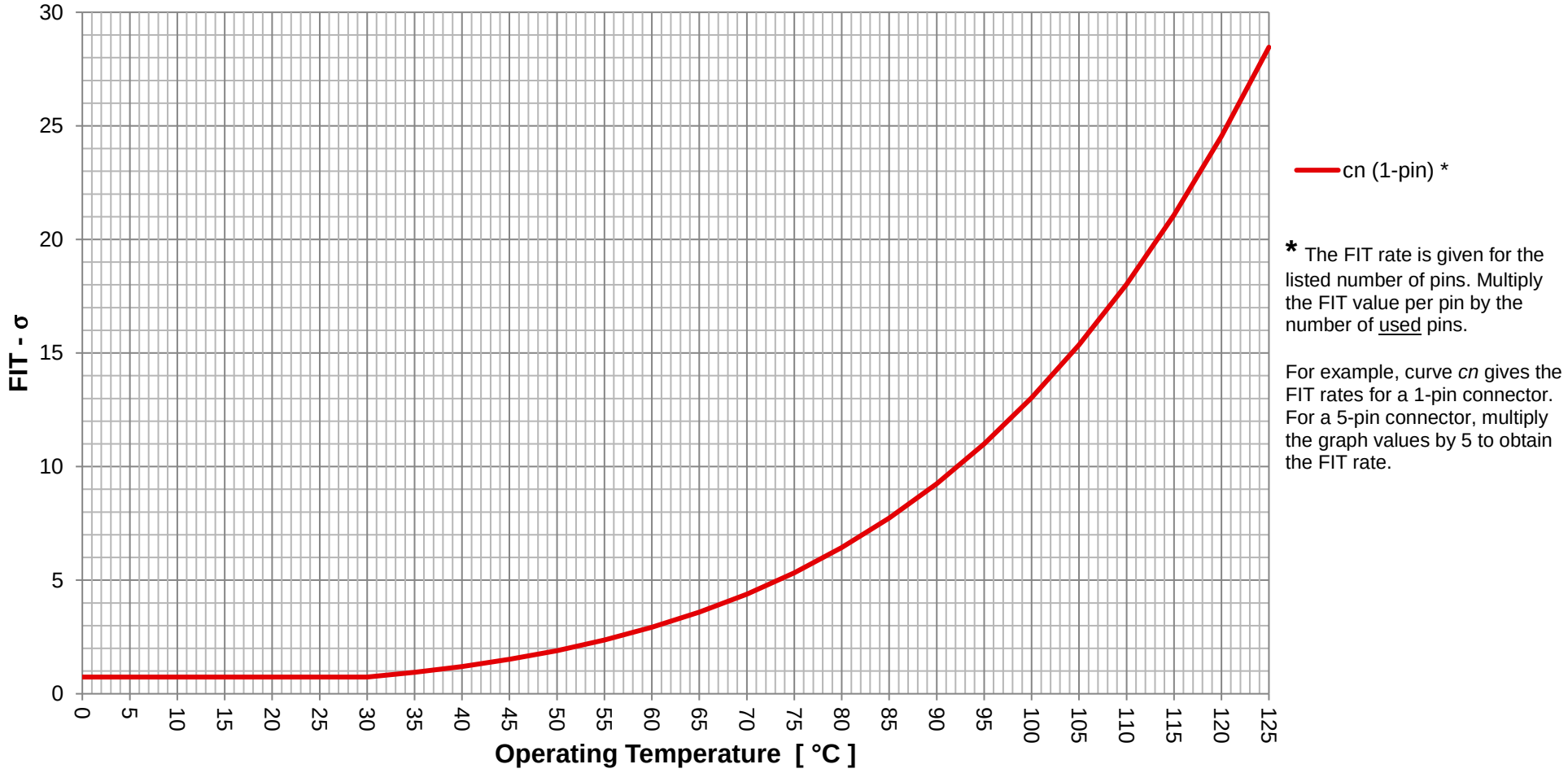


* The FIT rate is given for the listed number of pins. Multiply the FIT value *per pin* by the number of used pins. (Exclude “no connects”.)

For example, curve *cm* gives the FIT rates for a 1-pin connector. For a 5-pin connector, multiply the graph values by 5 to obtain the FIT rate.

For example, curve *ck* gives the FIT rates for a 10 pin connector. For a 12-pin connector, multiply the graph values by 1,2 to obtain the FIT rate. For a 6-pin connector, multiply the *ck* graph values by 0,6 to obtain the FIT rate.

6.15 Table σ-Values



* The FIT rate is given for the listed number of pins. Multiply the FIT value per pin by the number of used pins.

For example, curve *cn* gives the FIT rates for a 1-pin connector. For a 5-pin connector, multiply the graph values by 5 to obtain the FIT rate.

7 Upper Confidence Level Calculation

Based on the Telcordia SR-332 Issue 3 estimations and by assuming that the failure rate follows a gamma distribution the UCL (Upper Confidence Level) can be calculated with given mean λ and standard deviation σ like following:

$$\text{shape } \kappa = (\lambda/\sigma)^2$$

$$\text{scale } \theta = \sigma^2/\lambda$$

The UCL is the P% quantile of the gamma distribution and can be calculated by the inverse cumulative gamma distribution with the shape κ and scale θ parameters as following:

$$\lambda_{P\%UCL} = G^{-1}(P/100\,;\kappa;\,\theta)$$

If the shape parameter is >100 the UCL can also be calculated by using the P% quantile of the normal distribution, by inverse cumulative distribution of normal distribution with mean λ and standard deviation σ:

$$\lambda_{P\%UCL} = N^{-1}(P/100\,;\lambda;\,\sigma)$$

8 Example: FIT-Calculation for WE PD2 with 90% UCL

a) WE-PD2 @ 20°C operating temperature

Values according to tables: λ= 0,75 FIT / σ= 0,25 FIT

$$\text{shape } \kappa = (0{,}75/0{,}25)^2 = 9$$

$$\text{scale } \theta = 0{,}25^2/0{,}75 = 0{,}083333 \text{ FITs}$$

$$\lambda_{90\%\text{UCL}} = \text{G}^{-1}(90/100\,;\ 9;\ 0{,}083333) = \underline{1{,}08 \text{ FITs}}$$

The FIT for a WE-PD2 and an UCL of 90% would be 1,08 FITs at 20°C operating temperature.

In Microsoft Excel this can could be solved with following formulas:

European Version: "=GAMMAINV(0,9;9;0,083333)"
American Version: "=GAMMAINV(0.9,9,0.083333)"

b) WE-PD2 @ 60°C operating temperature

Values according to tables: λ= 1,26 FIT / σ= 0,42 FIT

$$\text{shape } \kappa = (1{,}26/0{,}42)^2 = 9$$

$$\text{scale } \theta = 0{,}42^2/1{,}26 = 0{,}14 \text{ FITs}$$

$$\lambda_{90\%\text{UCL}} = \text{G}^{-1}(90/100\,;\ 9;\ 0{,}14) = \underline{1{,}82 \text{ FITs}}$$

The FIT for a WE-PD2 and an UCL of 90% would be 1,82 FITs at 60°C operating temperature.

In Microsoft Excel this can be solved with following formulas:

European Version: "=GAMMAINV(0,9;9;0,14)"
American Version: "=GAMMAINV(0.9,9,0.14)"

9 FAQ

9.1.1 *What is the Failure Rate λ?*

The Failure Rate λ describes the failure performance of a product throughout the test or product life cycle.

FIT and MTBF are figures to describe the failure rate and these are used for reliability / availability calculations.

9.1.2 *What is FIT?*

A FIT value describes the „Failures in Time“ and is a key figure for the reliability of a product. The FIT value describes the number of predicted failures / defects for an operating time of 10^9h / 114.000 years.

9.1.3 *What is MTBF?*

MTBF is the short term for Meantime Between Failures and is defined as expected value of the failure free time between two defects /failures.

9.1.4 *How do I convert the Fit values to MTBF or the other way around?*

Due to the fact that MTBF and FIT are just 2 different kinds to describe a failure rate they can be converted by the formula given below:

$$MTBF = \frac{10^9 h}{FIT}$$

Remark:
The FIT reliability data provided within this document are predictions and will not be guaranteed by WE. Due to a large variance of possible mission profiles and applications WE may not provide FIT data for all products.