Topic 13

Case Study : Dialight

Dialight × De-Facto Model + Arrhenius Analysis (Ambient / Case Temperature)

Assumptions

1) De-Facto baseline constant failure rate $\lambda_{55}°C = 2\times10^{-6}$ /h
2) Arrhenius approximation: lifetime halves for every +10 °C increase (used only for stress comparison, not warranty commitment)
3) Case temperature Tcase = Ambient Ta + Δ, where Δ is practically 20–35 °C (typical heat rise inside high-bay luminaires)

Scenarios and Results

Scenario	Ambient Ta (°C)	Δ = Tcase - Ta (°C)	Driver Case Tcase (°C)	Lifetime Reduction Factor (vs 55 °C)	Equivalent Failure Rate λ (/h)	F(10,000h)	F(50,000h)
Scenario A (Typical Industrial Zone)	40	20	60	1.41	2.83e-06	2.8%	13.2%
Scenario A (Typical Industrial Zone)	40	30	70	2.83	5.66e-06	5.5%	24.6%
Scenario B (Rated Upper Limit Reference)	55	20	75	4	8.00e-06	7.7%	33.0%
Scenario B (Rated Upper Limit Reference)	55	30	85	8	1.60e-05	14.8%	55.1%
Scenario C (Dialight Rated Ta Upper Limit)	65	25	90	11.3	2.26e-05	20.3%	67.7%
Scenario C (Dialight Rated Ta Upper Limit)	65	35	100	22.6	4.53e-05	36.4%	89.6%
Scenario D	80	25	105	32	6.40e-05	47.3%	95.9%

(Extreme Hotspot/Misuse)							
Scenario D (Extreme Hotspot/Misuse)	80	35	115	64	1.28e-04	72.2%	99.8%

Key Interpretations

• At Ta = 65 °C (Scenario C) with Δ = 25–35 °C, Tcase ≈ 90–100 °C. Compared to the 55 °C baseline, lifetime is reduced by ~11–32×. De-Facto model predicts cumulative failure rate F(10,000h) ~20–45%.

• At Ta = 80 °C (Scenario D) with Tcase 105–115 °C, lifetime is reduced by ~32–74×. Cumulative failure rate F(10,000h) can reach 47–73%, confirming that driver-based systems face severe risks in high-temperature zones.

• Driverless/capacitor-free architectures eliminate high sensitivity to Tcase. Alternatively, remote driver placement in cooler zones can improve λ and F(t), though with trade-offs in cost and safety.