



Application & Technical Support

Harsh Environments



NEW

OPERATING IN HUMID AMBIENT

- A capacitor operating in moist ambient *absorbs humidity*
 - humidity enters from the leads-sealing and/or box-sealing contact surfaces and gradually reaches the winding

POSSIBLE CONSEQUENCES

- The humidity absorption can cause gradual *electrodes oxidation* leading in medium-long term to the capacitor damage or failure
- If voltage is applied, *electrochemical corrosion* may occur, destroying the metallization and causing capacitance drop, overheating, swelling of the capacitor's body and potentially ending up to short-circuit and relevant damage up to explosion and burning
 - the potential related ageing effect strongly depends on the capacitor design and material, and on the amplitude of the applied voltage

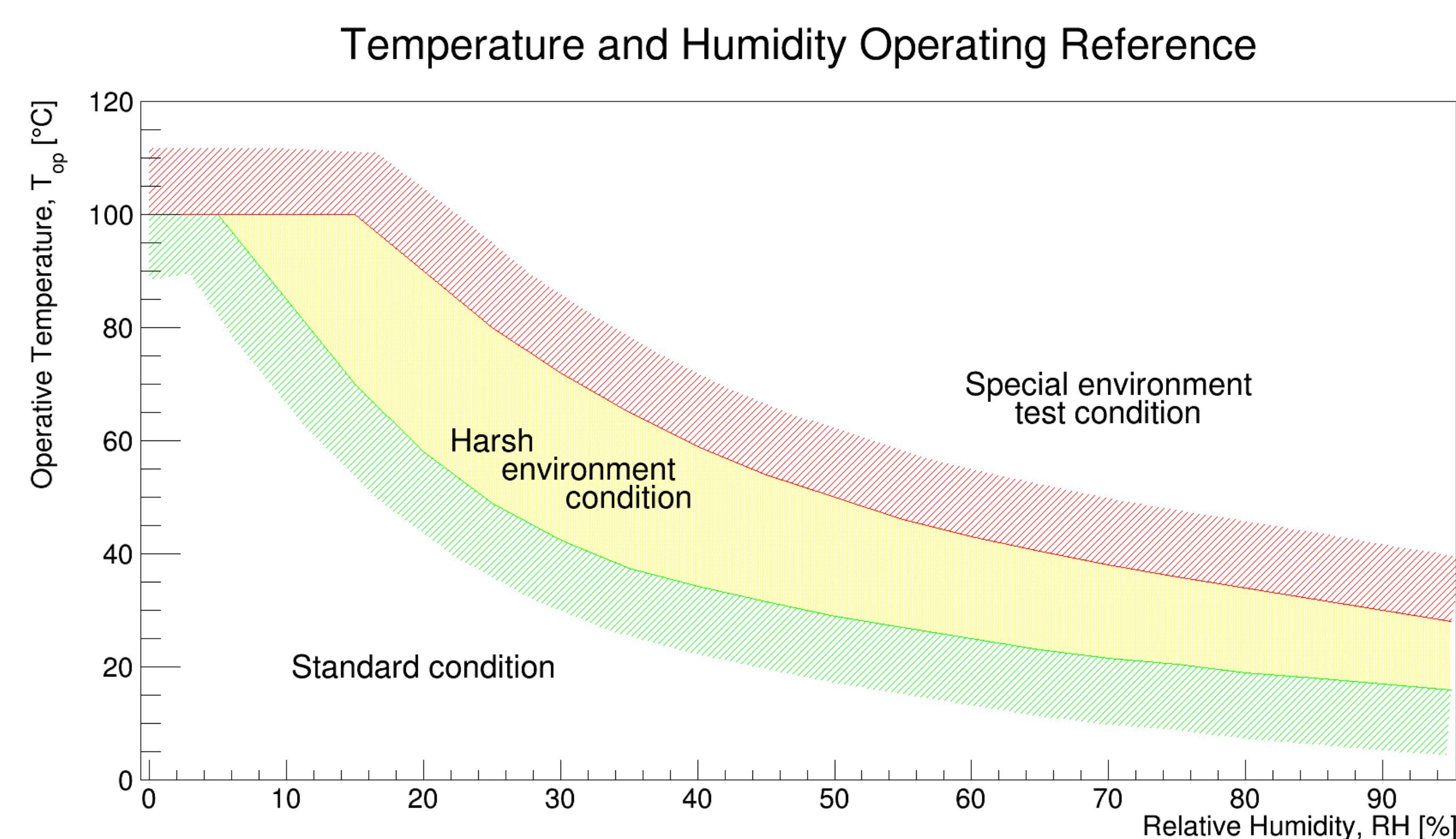
CAPACITOR CHARACTERISTICS

- Capacitors eventually modify their characteristics according to environmental conditions
 - the magnitude and speed of the modifications depend on dielectric, design and protecting material
 - with special design and insulation materials the speed of this process can be slowed, but not completely eliminated



WARNINGS

- The combination of *high operating temperature and high humidity levels*, even more *with AC voltage* operation and with high energy density design is a particularly dangerous and critical situation
 - fast ageing of the capacitor, with related relevant main parameters variation, body distortion, decrease of the expected life and rapid increase of the failure probability
- This possible critical situation shall be taken into account, in particular if units are supposed to be used in tropical countries or at critical environmental and climatic conditions



TYPICAL TESTS

- Most common tests adopted to evaluate high humidity and temperature performances for harsh environment are
 - 40°C / 93% RH:** standard damp heat steady state test (IEC60068-2; IEC 384-1; AEC Q-200 ref., cockpit, biased = voltage applied)
 - 60°C / 93% RH:** damp heat steady state test (IEC60384-17:2019, 56 days, Grade III high robustness under high humidity, biased = voltage applied)
 - 85°C / 85% RH:** extreme environmental condition of the THB (Temperature Humidity Biased) test. Very rarely reachable condition in real-life applications adopting film capacitors (IEC60068-2-67; IEC 384-1; AEC Q-200 ref., Level 1, biased)
- Possible intermediate levels, usually corresponding to high stress levels but more realistic operating conditions and real usage
 - 70°C / 70% RH; 60°C / 60% RH
- Testing capacitors upon the most severe test classes (**85/85/1000**: 85°C, 85% RH, 1000h), a typical effect could be the box bulging, even if with electrical parameters still within admitted variations and not corresponding to real electrical damages

ICEL PRODUCTS - THZ

- THZ** – this series represents a fundamental innovation and solution for power applications at operating conditions with *harsh environments*
- ICEL S.r.l. R&D and technical office developed special materials design and execution to guarantee excellent performances in *AC-Power applications* up to high voltage ratings, combined with very good performances in harsh environments
- Together with the high ratings and performances, THZ was also designed to guarantee *reasonable dimensions and prices*, compared to the existing AC-Power series
- A slight de-rating of the maximum AC rated voltage ensures the **AEC Q-200 85/85/1000 (Level 1)** test compliance
- THZ series also passes the **AEC Q-200 cockpit test**, the **70/70/1000** test and the **IEC60068-2-67 humidity load test** (Test Cy) at full ratings
- The new THZ series is the starting point for the development of further new types which will complete ICEL S.r.l. offer for harsh environment applications



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