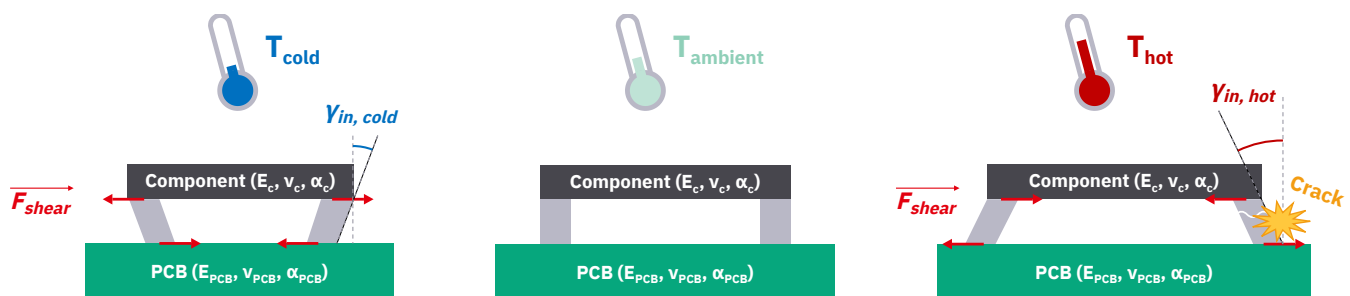


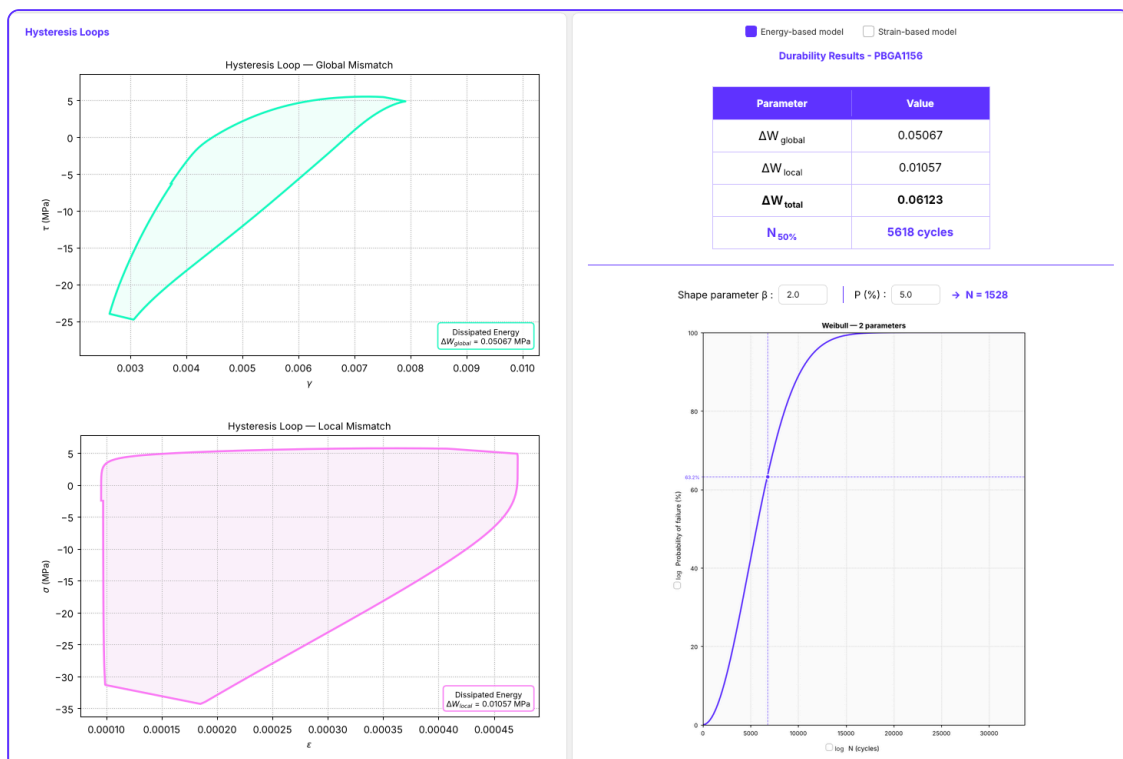
SOLDER JOINT THERMOMECHANICAL FATIGUE

Quick and accurate solder joint durability results.

HookeXpert solves the hysteresis loop of the critical solder joint of your electronic assembly and gives its median life and failure probability, with fatigue laws calibrated on real test results. Where long and costly finite element analyses used to be needed, it gives an answer in minutes, saving engineering time and money.



Behaviour of an electronic assembly during thermal cycling, leading to a solder joint fatigue crack.



Results screen: hysteresis loops, dissipated energy, $N_{50\%}$ and Weibull distribution (PBGA1156, SAC305, 2.2 mm PCB, -55/125 °C).

5

guided tabs, from the board to the life assessment

7

component families, SAC305 and SnPb

240

thermal cycling tests behind the fatigue laws

Five guided tabs, from PCB design to solder joint durability results.

01

PCB

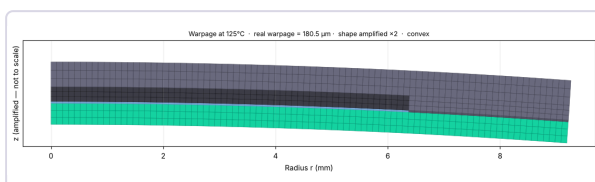
Build the stack-up layer by layer from manufacturer laminates and prepregs, with the copper content of each layer, or pick a board from the database. HookeXpert computes the Young's modulus (E), flexural modulus (E_f) and coefficient of thermal expansion (CTE) from $-55\text{ }^{\circ}\text{C}$ to $125\text{ }^{\circ}\text{C}$, as well as the density (ρ), thermal conductivity (λ) and specific heat (c_p).

Type	Cu thickness (µm)	Cu content (%)	Glass fabric 1	λ	Glass fabric 2	λ	Insulating layer (mm)	Resin content (%)
Electroplated Cu	0							
Cu layer 1	35	100						
Prepreg			276 (54% RC)	2			0.244	54
Cu layer 2	35	100						
Laminate			7628	2			0.360	41
Cu layer 3	35	100						
Prepreg			7628 (44% RC)	1	276 (54% RC)	1	0.314	48
Cu layer 4	35	100						
Laminate			7628	2			0.360	48
Cu layer 5	35	100						
Prepreg			276 (54% RC)	2			0.244	54
Cu layer 6	35	100						
Electroplated Cu	0							
Solder mask								

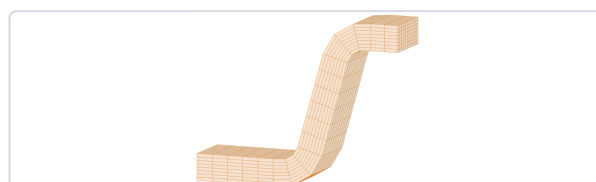
02

Component

WLP, BGA / CSP, CLCC, QFN / DFN, chip resistors and capacitors, leaded components. Built-in modules compute the properties of new packages: axisymmetric finite elements for BGA / CSP, rule of mixtures for QFN / DFN, beam and solid 3D finite element models for lead stiffness.



BGA / CSP module: warpage at $125\text{ }^{\circ}\text{C}$.



Leaded module: solid 3D mesh of a gull-wing lead.

03

Solder

SAC305: unified viscoplastic Chaboche law. SnPb: plasticity and hyperbolic sine creep. Both models are identified on measured hysteresis loops. Solder joint height and critical section are entered by the user, with proposed values for some packages.

04

Thermal cycles

Define $T_{\min}$, $T_{\max}$, ramp and dwells, or import a measured chamber profile from an Excel workbook.

05

Results

Global (shear) and local (tension) hysteresis loops, dissipated energy ΔW , strain range $\Delta \gamma$, median life $N_{50\%}$ and the life at any failure probability (Weibull). Load sharing between balls is taken into account in arrays.

PCB viewer

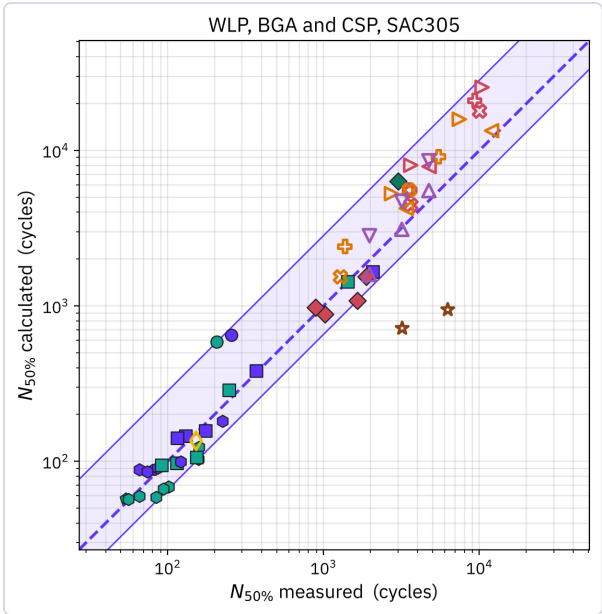
Gerber and ODB++ files open directly in HookeXpert to inspect the board layout.

AF calculator

Acceleration factors from Norris-Landzberg models: a real mission profile, including the FIDES 2022 profiles, is converted into an equivalent number of accelerated thermal cycles.

Every fatigue law is fitted on thermal cycling test results.

For each component family and solder alloy, HookeXpert computes the damage quantity of every calibration test with its own solver, then fits a straight line in log-log scale against the measured median life per unit critical area. Each law is then confirmed against validation tests that were not used for the fit.



WLP, BGA and CSP, SAC305: median life calculated by HookeXpert against measured median life, with the calibration scatter band. Filled symbols: calibration tests. Open symbols: validation tests. Validation points outside the band lie on the conservative side: their measured life is longer than the calculated life.

Family	Solder alloy	Tests
WLP, BGA, CSP	SAC305	55
BGA, CSP	SnPb	19
CLCC	SAC305	50
CLCC	SnPb	15
QFN, DFN	SAC305	16
QFN, DFN	SnPb	8
Leaded	SAC305	9
Leaded	SnPb	6
Chip resistors	SAC305	39
Chip resistors	SnPb	9
Chip capacitors	SAC305	9
Chip capacitors	SnPb	5
Total		240

Number of thermal cycling tests per law. Tests come from published studies, on boards from 0.8 to 3.2 mm thick, with cycles such as -55/125, -40/125, 0/100 and -20/65 °C.

Transparent physics

Every equation, constant and assumption is written in the user manual, with its references.

Visible scatter

Each law is shown with its calibration points and scatter band, so you know how far to trust an assessment.

Fast comparisons

Compare boards, packages, solder alloys and thermal cycles in minutes to choose the most robust design.

A complete tool, with expert support when you need it.

HookeXpert perpetual license

A single, complete package: all component families, SAC305 and SnPb solder alloys. Node-locked to one workstation.

Maintenance

First year included, then renewable annually: software updates, new fatigue laws, database releases and software assistance.

Expert services

Customisation

Fatigue laws calibrated on your own test results, PCB materials, solder alloys or components, and integrated into a dedicated version of HookeXpert.

Technical support

Expert review of your input data, modelling choices and results.

Training

On site or remote.

For whom

Companies that design and manufacture electronic equipment for harsh environments, in sectors such as aeronautics, space, defence and automotive.

Delivered with

The desktop application, the user manual with the full theory, the fatigue models document, and the databases of PCBs, materials and components.

FIRST STEP

Request a live demonstration

See HookeXpert run on one of your own cases, in a remote session with our expert.

LAUNCH OFFER

Request a quote

Preferential terms for our first customers, for orders placed before 30 June 2027.

Tell us about your equipment and your needs: number of computers, customisation, support and training. We send you a quote tailored to your project.

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