



Capability Chart winLIFE 2022



Modules	Description	Details	Limitations	Remarks
winLIFE FKM QUICKCHECK	<i>Static Strength Assessment, Fatigue Strength Assessment:</i> Using <i>FKM-guideline</i> and advanced procedures for welded and non-welded structures with local stresses based on FEA.	<i>Static, endurance limit and fatigue strength assessment</i> according to FKM (for the point of evaluation) Extensions to FKM: Detection of the critical point by analyzing all nodes of the surface. A worst-case analysis is done to identify the critical stress combination for which the utilization ratio is predicted	For local stresses only, nominal stresses are not supported	Static and fatigue assessment strongly according to the FKM-guideline. Critical point detection out of all surface nodes using powerful methods extending the FKM guideline.
winLIFE BASIC	<i>Basic fatigue analysis:</i> elementary methods for proportional load-cases	Powerful analysis according to nominal stress method, local elastic stress or local strain approach. Project management system, material database included	One load only	This module is the prerequisite for the use of all other winLIFE modules with exception to FKM QUICKCHECK
winLIFE MULTIAXIAL	<i>Multiaxial module:</i> Multiaxial fatigue analysis by use of the critical plane approach Biaxial fatigue analysis. Classification Matrix for nonlinear conditions.	2D or 3D Critical Plane Approach with uniaxial equivalent stress hypothesis, superposition und extrapolation. a) static unit load-cases, (nonlinear conditions can be simulated by use of the Classification Matrix) b) modal stresses and modal coordinate time-history c) nonlinear FE-analysis extensions d) several concepts for seam weld fatigue analysis	max. 1000 parallel load-histories	BASIC module is required as prerequisite
winLIFE MULTIAXIAL MULTICORE	As winLIFE Multiaxial but with speed optimization by use of all processor cores	Simultaneous calculation because the nodes to be calculated are divided between several cores. Calculation speed increased 4x with 8 cores, 2.9x with 4 cores		20 % price increase over winLIFE MULTIAXIAL
winLIFE CRACKGROWTH	Crack Propagation using nominal stresses	Calculating Crack Growth in Mode I according to Paris and Erdogan Ratwani	Currently limited to nominal stresses	BASIC module is required as prerequisite
winLIFE GEARWHEEL & BEARING	Fatigue analysis: Calculation for component parts necessary for calculating gearwheels and bearings. It is recommended to use it together with the ZAR-software of HEXAGON	User must know characteristics of gearwheels. Use of HEXAGON Software recommended.		
winLIFE VIEWER4WINLIFE	<i>Viewer4winlife:</i> Integrated graphical pre- and postprocessor for the visualization of fatigue results as well as of FEA results (stresses, displacements) Automatic seam weld detection Analysis attribute assignment	Direct reader of stresses and displacements out of native ANSYS, ABAQUS, Adams, Simcenter/MS/Autodesk-NASTRAN, FEMAP, Permas and RecurDyn result-files. Visualization of the FEA and fatigue analysis results of winLIFE like damage sum, equivalent amplitude, safety factor as contour plot. Subsequent determination of the related stress gradient. Unit conversion during FEA import. Attribute assignment e.g., surface roughness by use of node and element sets.		
winLIFE RANDOM FATIGUE	Fatigue calculation based on PSD results	Results of node stresses given as PSD are used for fatigue analysis		
winLIFE STATISTIC	Getting relations between single parameters and fatigue life in between a parameter range	Creating combinations of parameters (DOE), automatic calculation of variants, multiple nonlinear regression analysis, and graphical presentation of results. Investigating Sensitivity and robustness!		



Software	Description	Details	Limitations	Remarks
<i>User Interface</i>	Windows standard	- Each project in one window allows parallel working projects - Masks for input/output with detailed description the parameters - Data tree for fast access for power users	Windows 7 or higher	max. 2000 projects simultaneously
<i>User database</i>	User defined S-N curves can be stored in a user-library	For single user: SQL Server Express LocalDB (V15.0) Multi-User access to a central Microsoft SQL Server (2008R2 or higher) Extension of the database content by user defined data		
<i>S-N curve database</i>	S-N curve database FKM-guideline release 2003, 2012 und 2020			
<i>Material database</i>	Database including 1400 e-N curves according to Chr. Boller T. Seeger			
<i>Documentation</i>	Printable version (PDF) and online-version	Extensive manual as PDF and/or supplied online help as a chm help file		
<i>Installations</i>	Licensing via hardlock dongle. Terminal server installation possible	Single-user license via local hardlock dongle or Network-hardlock dongle for multi-user access. Or VPN-Access to the STZ-License server		
<i>Training</i>	Video examples on the internet and on the winLIFE-CD	https://www.stz-verkehr.de/examples-video.html		
<i>Seminars</i>	6 different one-day seminars are held triple per year in the Ulm area (germany)	Dates, Agenda and Registration https://www.stz-verkehr.de/seminare.html	English seminars on request once per year	Inhouse-Seminars are held worldwide
<i>winLIFE application fields</i>	Automotive, Civil Engineering, Wind turbines, Shipbuilding, Education (Universities)			Special discounts for universities (teaching purposes)
<i>Project automation</i>		Projects can be automatically generated to perform parametric studies		
<i>Graphics</i>	Full user control over all graphs	The layout, the choice of scale and the labeling of graphics can be changed in winLIFE in such a way that no additional software is required to document the results.		
<i>Graphic-Export</i>	1.) Export each graphic to the clipboard 2.) Export of each graphic to a *.png file			
<i>Report</i>	Report to PDF-file	The user can specify a selection of the elements to be displayed in the report and generate this report automatically.		



Concept	Description	Details	Limitations	Remarks
<i>Analysis Types</i>	Single FE load case	Based on a single FE load case, the nodal stresses or (in exceptional cases) element stresses are scaled using the load-time function and the fatigue life is calculated using the notch stress or the local strain concept.	One load case	
	Superposition of multiple (max. 1000) FE load cases	Scaling of FE unit load cases using the (measured) load-time functions and superposition of the elastic stress tensors to calculate the stress and damage accumulation in the critical cutting plane	Max. 1000 static (or modal) FE load-cases allowed	
	Analysis of transient FEA or MBD results	The stress tensor as a function of time (or calculation step) is taken from the FEA or MBD simulation for each node of interest and used as the basis for the fatigue calculation.	limited to max. 20000 nodes, no limitation regarding the duration.	Method to solve dynamic and/or nonlinear problems
	Usage of (strain) measurement data	Flexible import of nearly all kinds of strain gauge rosettes data		
	Standalone operation without FEA/MBD connection	“Classic” fatigue calculation for one point without FEA, using engineering mechanics		winLIFE
<i>winLIFE FEA/MBD Software Interfaces</i>	ABAQUS, ANSYS, MSC ADAMS Simcenter/MSC/Autodesk-NASTRAN FEMAP, PERMAS, RECURDYN	Direct data import of native FE result data from the FE software listed (see description). Parameterizable tool for FE results import based on ASCII files. Subsequent calculation of the related stress gradient. Subsequent calculation of a mesh-independent structural stress.		In addition to the actual fatigue life results and attributes, FE results (stresses, displacements) are also displayed.
<i>Fatigue calculation methods until crack</i>	Nominal stress: (S-N- curves, can be transformed to any failure probability),	approaches for Miner rules: - original, elementary, according to Haibach, Liu-Zenner - Mean stress correction either by S-N-curve transformation (Hück et al.) or according to FKM (amplitude transformation) or modified FKM (Sonsino)		
	Local stress: (S-N-curves, can be transformed to any failure probability) Influences of temperature, roughness and the related stress gradient according to the FKM-guideline can be considered	Equivalent stress definition : - normal stress - normal stress / STM - Tresca - mod. v. Mises with various sign conventions - Findley		
	Local strain approach: (e-N- curves) 50% failure probability	Damage parameter: Smith Watson Topper, Bergmann, Socie, Fatemie Socie Neuber: original, according to Sonsino		Interactive animation of stress strain path and Neuber rule for education
<i>Crack propagation analysis</i>	LEBM (linear elastic fracture mechanics) with nominal stresses for mode I	Paris equation , Erdogan-Ratwani		

<i>Load definition via</i>	Load time history (max. 1000 parallel functions per each multiaxial project)	- tabular definition of the individual loads via keyboard - integrated sine load generator - measured load-time history (any length)	Duration is limited by the hard disk memory available	
	Load spectrum	- tabular definition of the spectrum via a value triple of mean, amplitude and quantity. - standard spectrum-generator for gauss, straight-line and p-spectra. - Usage of external load spectra		
	Rainflowmatrix	Rainflow matrices can be generated from load-time functions or read in as an external load.		
	Torque and speed load history	Residence time count is performed		For gearwheel and bearing
	Strain measurements	Rosette data of any required configuration can be imported (ASCII-format required)		
	Power Spectral Density	The PSD of acceleration acts on the structure and the response spectra of the stresses on each node need to be calculated by FEA. A damage equivalent load spectrum is created for each node. And this is used for the damage accumulation.	Direct import for NASTRAN and PERMAS	The user must understand the theory behind the procedure to get appropriated results.
<i>Load split for rotating components</i>	The measured load is divided into several split loads for each rotation.	The load split enables the fatigue calculation of rotating parts by superposition of unit load cases.		
<i>Nonlinear analysis</i>	Classification Matrix for nonlinear relations	By dividing it into several load areas, non-linearities and/or friction can be easily calculated.		
<i>Container project</i>	Use of multiple load scenarios	Several (<1000) load scenarios can be automatically calculated and weighted via a container project		
<i>Partial load analysis</i>	Automatic investigation of the load influence	Load combinations are generated automatically to assess the influence of individual loads.		
<i>Data handling</i>	Load data can be changed interactively: - Removal of a drift in measurement data - Multiplication / addition of values - Removal of needle-like peaks Modification of the elements of the Rainflow matrix	The cleaning of measurement data is easily possible. However, "what if" scenarios can also be examined, for example by specifically modifying the Rainflow-Classification matrix.		
<i>Classification Methods</i>	Rainflow counting Range Mean Pair count / Range pair count Residence time count (Gearwheel, Bearing) Level crossing	Different procedures to consider the residuum available Range Mean Pair count with or without mean influence		
<i>S-N curve generators based on static material properties</i>	Hück, Thrainer, Schütz			
	Haibach			
	FKM			
	GL (shipbuilding) / GL (wind energy)			
<i>e-N curve generators based on static material properties</i>	UML	Uniform Material Law		
	Universal slopes / Modified universal slopes	Integrated database according to Chr. Boller t. Seeger		

Special	Description	Details	Limitations	Remarks
<i>Seam welds</i>	Nominal stress concept (FKM)			
	Nominal stress concept GL (ship building, wind energy)			
	Structural stress concept (GL (ship building, wind energy), FKM and Marquis)	Automatic selection of welds and calculation of mesh independent structural stress.		
	Rx-Concept	A concept conforming FE mesh must be used (according to IIW, DVS, etc.)		
	Hot-Spot screening method	Screening method for hot-spots, fast and efficient		
<i>Special module</i>	Gearwheel	Flank and root life curve generator available.	Special parameters of the design of the wheels must be known.	Connection to Hexagon software available and recommended.
	Bearing	Calculation based on the fatigue data of the manufacturer		
<i>Batch Procedure</i>	batch procedure can be used to define a calculation stream	A batch process can be simply created by the user- interface or manually by a script.		
<i>External call of winLIFE</i>	You can start winLIFE from the shell or from other programs with parameters	An integration in a batch process together with other software (FEA, optimization, driveline-simulation is possible. And helps to automate the calculation procedure especially in the case of huge structures.		Many winLIFE customers make extensive use of these options.
<i>Superposition</i>	Single projects can be superimposed	Those types of open projects which lead to the same type of classification (e.g. Rainflow, residence time count) for fatigue life calculation are proposed for superposition. It is checked automatically if the conditions are met (Number of classes, width, etc.).		
<i>Extrapolation</i>	An extrapolation (of one project) is possible			
<i>Automatic calculation of the related stress gradients</i>	The related stress gradient is calculated based on the FE-model	For each surface node the related stress gradient is calculated automatically while reading the result data form FEA. The S-N curve can be modified locally by using the related stress gradient.		
<i>Result presentation - one project</i>		<ul style="list-style-type: none"> - Protocol file - Results of classification methods - Mohr's circle for each time step - equivalent stress history for each plane - DEL (Damage Equivalent Load) - angle of 1st principal stress for each time step - relation of 1st and 2nd principal stresses - S-N curve including load amplitude and damage - Haigh-diagram including load and damage - Rainflow-Matrix including damage - Range Mean Pair count including damage - Export file for data transfer to FEA (simple to use ASCII file) - contour plot of the stresses on the FE-model 		
<i>Projectmanagement</i>	Up to 2000 parallel projects	The graphs of many projects can be shown in one graphic for comparison purpose		