QUICK FATIGUE TOOL FOR MATLAB®

User Settings Reference Guide

Version Information

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Contents

1. Job file options

1.1 Overview

The job file contains a list of options which define a specific analysis. The options are separated into the following categories:

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Job files are created either from the template located in *Project**job**template_job.m*, or from a user-defined text file. Guidance on creating and submitting jobs for analysis is provided in Section 2.4 “Configuring and running an analysis” of the *Quick Fatigue Tool User Guide*.

If the user modified the template job file and wishes to revert back to the original, a back-up template is contained in *Application_Files**default**default_job.m*.

1.2 Job file options table

The following table provides a description of each option in the job file.

1.2.1 Job definition

Option	Usage
JOB_NAME	Specify the name of the analysis job. This is also the name given to the results output directory. *Job file usage:* **JOB_NAME**='*job name*'
JOB_DESCRIPTION	Specify a description of the analysis. *Job file usage:* **JOB_DESCRIPTION**='*job description*'
CONTINUE_FROM	Specify the name of the job onto which field data from the current job will be superimposed. *Job file usage:* **CONTINUE_FROM**='*job name*'
DATA_CHECK	Specify the analysis type. *Job file usage:* **DATA_CHECK**={0.0 | 1.0} Run the pre-processor and the analysis processor: **DATA_CHECK**=0.0 Run the pre-processor only: **DATA_CHECK**=1.0 The job files are checked for consistency and no fatigue analysis is performed. The message (*.msg*) file is still written to the output directory.

1.2.2 Material

MATERIAL	Specify the materials used for analysis. The *.mat* file extension is optional. *Job file usage for a single analysis group:* **MATERIAL**='*material-name*.mat' *Job file usage for n analysis groups:* **MATERIAL**={'*material-1*.mat',… , '*material-n*.mat'}
USE_SN	Specify the source of the stress-life data. *Job file usage:* **USE_SN**=**{**0.0 | <u>1.0</u>**}** Use Basquin (fatigue strength) coefficients $\sigma_f{}'$ and b: **USE_SN**=0.0 Use stress-life ($S-N$) data points: **USE_SN**=1.0
SN_SCALE	Specify uniform scale factosr for S-values on the stress-life curve. *Job file usage for a single analysis group:* **SN_SCALE**=k *Job file usage for n analysis groups:* **SN_SCALE**=[k_1,… , k_n] This option must be used in conjunction with stress-life ($S-N$) data points: **USE_SN**=1.0

SN_KNOCK_DOWN	Specify individual scale factors for S-values on the stress-life curve. *Job file usage for a single analysis group:* **SN_KNOCK_DOWN**={'*knockdown-file-name.**'} *Job file usage for n analysis groups:* **SN_KNOCK_DOWN**={'*knockdown-file-name-1.**',…, [ ],…, '*knockdown-file-name-n.**'} Square brackets ([ ]) are used to indicate groups for which no knockdown factors are defined. This option must be used in conjunction with stress-life ($S - N$) data points: **USE_SN**=1.0

1.2.3 Loading

DATASET	Specify stress data for fatigue analysis. *Job file usage for uniaxial load history:* **DATASET**=' ' *Job file usage for simple loading:* **DATASET**='*dataset-file-name.**' *Job file usage for multiple load history (scale and combine):* **DATASET**={'*dataset-file-name-1.**',…, '*dataset-file-name-n.**'} *Job file usage for dataset sequence loading:* **DATASET**={'*dataset-file-name-1.**',…, '*dataset-file-name-n.**'} Unless the loading is a dataset sequence, this option must be used in conjunction with **HISTORY**.

HISTORY	Specify load history data for fatigue analysis. *Job file usage for uniaxial load history:* **HISTORY**={'*history-file-name.**' | [h_1,..., h_n]} *Job file usage for simple loading:* **HISTORY**={'*history-file-name.**' | [h_1,..., h_n]} *Job file usage for multiple load history (scale and combine):* **HISTORY**={'*history-file-name-1.**',..., '*history-file-name-n.**'} Simple and scale and combine loadings must be used in conjunction with **DATASET**. For scale and combine loading, this option can be defined by any combination of load history files and numerical inputs. *Job file usage for dataset sequence loading:* **HISTORY**=[ ]
UNITS	Specify the units of the stress data. *Job file usage:* **UNITS**={'user' | 'pa' | 'kPa' | 'MPa' | 'psi' | 'ksi' | 'Msi'} If **UNITS**='user', a conversion factor must also be specified with **CONV**.
CONV	Specify the conversion factor for user-defined units. *Job file usage:* **CONV**=k The stress dataset units are converted according to the following relation: $[Pa] = k \cdot [dataset]$
LOAD_EQ	Specify the loading equivalence in terms of a unit and its magnitude. *Job file usage:* **LOAD_EQ**={k, '*unit*'} The default load equivalence is 1.0 repeat.

SCALE	Specify load history scale factors. *Job file usage for uniaxial load history and simple loading:* **SCALE**=k Every point in the load history is scaled by k. *Job file usage for multiple load history (scale and combine):* **SCALE**=[k_1,…, k_n] Every point in load history n is scaled by k_n. *Job file usage for dataset sequence loading:* **SCALE**=[k_1,…, k_n] Every point in dataset n is scaled by k_n.
OFFSET	Specify load history offset values. *Job file usage for uniaxial load history and simple loading:* **OFFSET**=k Every point in the load history is offset by k. *Job file usage for multiple load history (scale and combine):* **OFFSET**=[k_1,…, k_n] Every point in load history n is offset by k_n. This option cannot be used with dataset sequence loading.
REPEATS	Specify the number of repeats of the loading. *Job file usage:* **REPEATS**=k

1.2.4 High frequency loading

HF_DATASET	Specify high frequency stress data for fatigue analysis. *Job file usage for uniaxial load history:* **HF_DATASET**=' ' *Job file usage for simple loading:* **HF_DATASET**='*dataset-file-name.**' *Job file usage for multiple load history (scale and combine):* **HF_DATASET**={'*dataset-file-name-1.**',…, '*dataset-file-name-n.**'} *Job file usage for dataset sequence loading:* **HF_DATASET**={'*dataset-file-name-1.**',…, '*dataset-file-name-n.**'} Unless the loading is a dataset sequence, this option must be used in conjunction with **HF_HISTORY**.

HF_HISTORY	Specify high frequency load history data for fatigue analysis. *Job file usage for uniaxial load history:* **HF_HISTORY**={'*history-file-name.**' | [h_1,…, h_n]} *Job file usage for simple loading:* **HF_HISTORY**={'*history-file-name.**' | [h_1,…, h_n]} *Job file usage for multiple load history (scale and combine):* **HF_HISTORY**={'*history-file-name-1.**',…, '*history-file-name-n.**'} Simple and scale and combine loadings must be used in conjunction with **HF_DATASET**. For scale and combine loading, this option can be defined by any combination of load history files and numerical inputs. *Job file usage for dataset sequence loading:* **HF_HISTORY**=[ ]

HF_TIME	Specify the time period for the low and high frequency data sets. *Job file usage:* **HF_TIME**={t_1, t_2} t_1 is the time period of the low frequency data t_2 is the time period of the high frequency data This option must be used in conjunction with **HF_DATASET** and **HF_HISTORY**.

HF_SCALE	Specify load history scale factors for high frequency loading. *Job file usage for uniaxial load history and simple loading:* **HF_SCALE**=k Every point in the load history is scaled by k. *Job file usage for multiple load history (scale and combine):* **HF_SCALE**=[k_1,…, k_n] Every point in load history n is scaled by k_n. *Job file usage for dataset sequence loading:* **HF_SCALE**=[k_1,…, k_n] Every point in dataset n is scaled by k_n. This option must be used in conjunction with **HF_DATASET** and **HF_HISTORY**.

1.2.5 Abaqus RPT / dataset file

PLANE_STRESS	Specify how Quick Fatigue Tool treats the element format of stress datasets. *Job file usage:* **PLANE_STRESS**={0.0 | 1.0} Allow datasets with 3D elements only: **PLANE_STRESS**=0.0 Allow datasets with 2D and 3D elements: **PLANE_STRESS**=1.0

1.2.6 Analysis

GROUP	Specify analysis groups for individual property assignments. *Job file usage:* **GROUP**={'*group-file-name-1.**',…, '*group-file-name-n.**'} Use the DEFAULT parameter to specify a group containing items which are not excluded by any preceding group: **GROUP**={'*group-file-name-n.**',…, 'DEFAULT'} Use of the DEFAULT parameter by itself includes all analysis items in a single group.
ALGORITHM	Specify the fatigue analysis algorithm. *Job file usage:* **ALGORITHM**=**{**'DEFAULT' | 'UNIAXIAL STRAIN' | 'SBBM' | 'NORMAL' | 'FINDLEY' | 'INVARIANT' | 'WELD' | 'NASALIFE' | 'UNIAXIAL STRESS' | 'USER'**}** The parameters of **ALGORITHM** are described in Section 6.1 “Analysis algorithms” of the *Quick Fatigue Tool User Guide*.
MS_CORRECTION	Specify the mean stress correction. *Job file usage:* **MS_CORRECTION**=**{**'DEFAULT' | 'MORROW' | 'GOODMAN' | 'SODERBERG' | 'WALKER' | 'SWT' | 'GERBER' | 'RATIO' | 'NONE'**}** Specify a user-defined mean stress correction: **MS_CORRECTION**='*user-msc-file-name*.msc' The parameters of **MS_CORRECTION** are described in Section 7.1 “Mean stress corrections” of the *Quick Fatigue Tool User Guide*.

ITEMS	Specify the analysis region. *Job file usage:* **ITEMS**={'ALL' | 'SURFACE' |'MAXPS' | *'file-name.*'* | [k_1,…, k_n]} Analyse all items: **ITEMS**='ALL' Restrict the analysis region to surface elements from an Abaqus Output Database (*.odb*) file: **ITEMS**='SURFACE' When the SURFACE parameter is specified, this option must be used in conjunction with **OUTPUT_DATABASE**, **PART_INSTANCE** and **RESULT_POSITION**. Restrict the analysis region to the item with the largest principal stress range: **ITEMS**='MAXPS' Restrict the analysis region to items listed in a text file: **ITEMS**='*file-name.**' Restrict the analysis region to a list of item IDs: **ITEMS**=[k_1,…, k_n] When **ITEMS** is defined as a list of item IDs, Quick Fatigue Tool uses k to search the row numbers of the stress dataset. Since the order of dataset items can be arbitrary, the ID k_n does not necessarily correspond to element n.

DESIGN_LIFE	Specify the design life of the component. *Job file usage:* **DESIGN_LIFE**=**{**'CAEL' | k**}** Specify the design life as the material's constant amplitude endurance limit: **DESIGN_LIFE**='CAEL' If the analysis contains multiple group definitions with **GROUP**, the constant amplitude endurance limit is taken from the material defined in the last group. Specify a user-defined design life: **DESIGN_LIFE**=k The design life is given in cycles to failure (N_f).
FACTOR_OF_STRENGTH	Enable Factor of Strength (FOS) iterations. *Job file usage:* **FACTOR_OF_STRENGTH**=**{**0.0 | 1.0**}**

FATIGUE_RESERVE_FACTOR	Specify the life envelope for the Fatigue Reserve Factor (FRF) calculation. *Job file usage for a single analysis group:* **FATIGUE_RESERVE_FACTOR**=**{**1.0 | 2.0 | 3.0 | '*frf-file-name*.msc'**}** Specify the Goodman envelope: **FATIGUE_RESERVE_FACTOR**=1.0 Specify the Goodman B envelope: **FATIGUE_RESERVE_FACTOR**=2.0 If the proof stress is not defined, the standard Goodman envelope will be used by default. Specify the Gerber envelope: **FATIGUE_RESERVE_FACTOR**=3.0 Specify a user-defined FRF envelope: **FATIGUE_RESERVE_FACTOR**='*frf-file-name*.msc' *Job file usage for n analysis groups:* **FATIGUE_RESERVE_FACTOR**={k_1,…, k_n} This value of k can be any combination of FRF envelope files and numerical inputs.

HOTSPOT	Save items below the design life to a text file. *Job file usage:* **HOTSPOT**=**{**0.0 | 1.0**}** This option must be used in conjunction with **DESIGN_LIFE**.

1.2.7 Surface finish / notch effects

KT_DEF

Specify the surface finish of the component.

Job file usage for a single analysis group:
KT_DEF={K_t | '*kt-file-name*.kt' | '*ktx-file-name*.ktx'}

Define the surface finish as the surface finish factor:
KT_DEF=K_t

Define the surface finish as a function of R_a data:
KT_DEF='*kt-file-name*.kt'

Define the surface finish as a function of R_z data:
KT_DEF='*ktx-file-name*.ktx'

Job file usage for n analysis groups:
KT_DEF={k_1,…, k_n}

The value of k can be any combination of R_a data files, R_z data files and numerical inputs.

Unless the surface finish is defined as the surface finish factor, this option must be used in conjunction with **KT_CURVE**.

KT_CURVE

Specify the curve given by R_a or R_z data.

Job file usage for a single analysis group:
KT_CURVE=k

If **KT_DEF** is specified for R_a data, k is the surface finish curve. If **KT_DEF** is specified for R_z data, k is the surface roughness.

Job file usage for n analysis groups:
KT_CURVE ={k_1,…, [ ],…, k_n}

Square brackets ([ ]) are used to indicate groups for which the surface finish is defined as the surface finish factor, K_t.

The value of k can be any combination of R_a data files, R_z data files and numerical inputs.

This option must be used in conjunction with **KT_DEF**.

NOTCH_CONSTANT	Specify the fatigue notch factor, K_f, as a function of K_t. The method used to calculate K_f is specified by the notchSensitivityMethod environment variable. *Job file usage for a single analysis group:* **NOTCH_CONSTANT**=k *Job file usage for n analysis groups:* **NOTCH_CONSTANT**=[k_1,…, k_n] Unless notchSensitivityMethod is specified as *Peterson* or *Notch sensitivity*, this option must be used in conjunction with **NOTCH_RADIUS**. This option is ignored if the calculated surface finish factor is 1.0.
NOTCH_RADIUS	Specify the notch root radius. *Job file usage for a single analysis group:* **NOTCH_RADIUS**=k *Job file usage for n analysis groups:* **NOTCH_RADIUS**=[k_1,…, k_n] Use *Peterson* or *Notch sensitivity* to calculate K_f: **NOTCH_RADIUS**=[ ] Unless notchSensitivityMethod is specified as *Peterson* or *Notch sensitivity*, this option must be used in conjunction with **NOTCH_CONSTANT**.

RESIDUAL	Specify an in-plane residual stress. *Job file usage for a single analysis group:* **RESIDUAL**=k The residual stress is applied uniformly to all analysis items. *Job file usage for n analysis groups:* **RESIDUAL**=[k_1,…, k_n] The residual stress, k_n, is applied uniformly to group n. Positive values of k correspond to a tensile residual stress; negative values are compressive. The residual stress is given in megapascals (MPa).

1.2.8 Virtual strain gauges

GAUGE_LOCATION	Define virtual gauges to simulate a rectangular rosette strain gauge at selected analysis items. *Job file usage:* **GAUGE_LOCATION**={'$m_1.s_1$', '$m_2.s_2$',…, '$m_n.s_n$'} '$m_n.s_n$' is the main and sub position ID of the location of gauge n. The IDs must be separated by a decimal point. For integration point or element-nodal positions, m_n is the element number and s_n is the integration point/node number. For centroidal or unique nodal positions, m_n is the centroid/node number, and s_n is always 1.0. This option must be used in conjunction with **GAUGE_ORIENTATION**.

GAUGE_ORIENTATION	Specify gauge orientations for virtual strain gauges. *Job file usage:* **GAUGE_ORIENTATION**={$[\alpha_1, \beta_1, \gamma_1]$, $[\alpha_2, \beta_2, \gamma_2]$,…, $[\alpha_n, \beta_n, \gamma_n]$} α_n is the angle measured counter clockwise from the positive global (Cartesian) x-direction to rosette arm A of gauge n. β_n is the angle measured counter clockwise from rosette arm A to B of gauge n. γ_n is the angle measured counter clockwise from rosette arm B to C of gauge n. Angles are measured in degrees. Define gauge orientations using flags instead of angles: **GAUGE_ORIENTATION**={'RECTANGULAR' | 'DELTA'} The parameter RECTANGULAR corresponds to gauge angles $[\alpha, \beta, \gamma]$ = [0, 45, 45]. The parameter DELTA corresponds to gauge angles $[\alpha, \beta, \gamma]$ = [30, 60, 60].

1.2.9 Output requests

OUTPUT_FIELD	Specify a field data output request. *Job file usage:* **OUTPUT_FIELD**={0.0 | 1.0}

OUTPUT_HISTORY	Specify a history data output request. *Job file usage:* **OUTPUT_HISTORY**={0.0 | 1.0}

OUTPUT_FIGURE	Specify a MATLAB figure output request. *Job file usage:* **OUTPUT_ FIGURE**={0.0 | 1.0}

1.2.10 Abaqus ODB interface

OUTPUT_DATABASE	Specify an Abaqus Output Database (*.odb*) file to associate with the fatigue analysis. *Job file usage:* **OUTPUT_DATABASE**='*odb-file-name*.odb' This option is required if **ITEMS**='SURFACE', and when fatigue results are written to the *.odb* file. This option must be used in conjunction with **PART_INSTANCE**, **EXPLICIT_FEA**, **STEP_NAME** and **RESULT_POSITION**.
PART_INSTANCE	Specify the part instance in the Abaqus *.odb* file to which field data is written. *Job file usage:* **PART_INSTANCE**='*part-instance*' Specify multiple part instances for results output: **PART_INSTANCE**={'*part-instance-1*',…, '*part-instance-n*'}
EXPLICIT_FEA	Specify the analysis procedure which was used to calculate the FE stresses. *Job file usage:* **EXPLICIT_FEA**={0.0 | 1.0} Specify output for a valid Abaqus/Explicit *.odb* file: **EXPLICIT_FEA**=1.0 Specify output for a valid Abaqus/Standard *.odb* file: **EXPLICIT_FEA**=0.0 Quick Fatigue Tool requires this information from the user in order to avoid errors from the Abaqus Python API.
STEP_NAME	Specify the name appended to the results ODB step. *Job file usage:* **STEP_NAME**='*step-name*' This option is not compulsory. If the ODB step name is not specified, Quick Fatigue Tool uses a default step name.

RESULT_POSITION	Specify the results position of the exported field data. *Job file usage:* **RESULT_POSITION**={'ELEMENT NODAL' | 'UNIQUE NODAL' | 'INTEGRATION POINT' | CENTROID'}

1.2.11 BS 7608 weld definition

WELD_CLASS	Specify the $S_r - N$ curve for the BS 7608 analysis algorithm. *Job file usage:* **WELD_CLASS**='*weld-identifier*' Specify the $S_r - N$ curve as the weld class: **WELD_CLASS**={'B' | 'C' | 'D' | 'E' | 'F' | 'F2' | 'G' | 'W' | 'S' | 'T'} Specify the $S_r - N$ curve as an axially-loaded bolt: **WELD_CLASS**='X' Specify the $S_r - N$ curve as user-defined data: **WELD_CLASS**={'*user-weld-file-name*.sn', ['ROW' | 'COL']} The ROW and COL parameters tell Quick Fatigue Tool in which direction the user-data should be read. If the $S_r - N$ curve is specified as user-defined data and the second parameter is omitted, the COL parameter is assumed. This option must be used in conjunction with **DEVIATIONS_BELOW_MEAN**, **FAILURE_MODE** and **CHARACTERISTIC_LENGTH**.

YIELD_STRENGTH	Specify the yield strength of the weld plate material for BS 7608 analysis. *Job file usage:* **YIELD_STRENGTH**=k The yield strength is given in megapascals (MPa). This option is not compulsory. If the yield strength is not specified, Quick Fatigue Tool does not define the extrapolation limit for large cycles.

UTS	Specify the ultimate tensile strength of the bolt section for BS 7608 analysis *Job file usage:* **UTS**=k The ultimate tensile strength is given in megapascals (MPa). This option is only required for axially-loaded bolts.
DEVIATIONS_BELOW_MEAN	Specify the number of standard deviations below the mean $S_r - N$ curve for BS 7608 analysis. *Job file usage:* **DEVIATIONS_BELOW_MEAN**=k
FAILURE_MODE	Specify the crack initiation criterion for BS 7608 analysis. *Job file usage:* **FAILURE_MODE**={'NORMAL' | 'SHEAR' | 'COMBINED'}
CHARACTERISTIC_LENGTH	Specify the characteristic length for BS 7608 analysis. *Job file usage:* **CHARACTERISTIC_LENGTH**=k The characteristic length is given in millimetres (mm). If **WELD_CLASS** is specified as a weld, the characteristic length defines the plate thickness. If **WELD_CLASS** is specified as an axially-loaded bolt, the characteristic length defines the bolt diameter. This option is not required if the characteristic length is unimportant. If the characteristic length is not specified, Quick Fatigue Tool will not correct the loading for the effect of plate thickness (or bolt diameter).

SEA_WATER	Specify the environmental conditions for BS 7608 analysis. *Job file usage:* **SEA_WATER**={0.0 | 1.0} Specify fresh air as the environment: **SEA_WATER**=0.0 Specify sea water as the environment: **SEA_WATER**=1.0 If the environmental condition is specified as fresh air, Quick Fatigue Tool does not apply the correction for salt water corrosion.

1.2.12 Additional material data

B2	Specify the secondary Basquin exponent, $b2$, to be used above a user-defined knee point. *Job file usage:* **B2**=k This option must be used in conjunction with **B2_NF**.
B2_NF	Specify the life above which the secondary Basquin's exponent, $b2$, is used. *Job file usage:* **B2_NF**=k
UCS	Specify the ultimate compressive strength. *Job file usage:* **UCS**=k The ultimate compressive strength is given in megapascals (MPa). This option is not compulsory. The ultimate compressive strength is used by **FATIGUE_RESERVE_FACTOR** to normalize the compressive side of the FRF envelope. If the ultimate compressive strength is not specified, Quick Fatigue Tool uses the ultimate tensile strength to normalize compressive cycles for the FRF calculation.

2. Environment variables

2.1 Overview

The environment file contains a list of variables which define the general behaviour of Quick Fatigue Tool. Environment variables are applied *globally* and *locally*. Global environment variables define the behaviour of the program for all analysis jobs executed in the current Quick Fatigue Tool directory, whereas local environment variables define the behaviour of the program for a specific job.

Environment variables are created using the *setappdata()* method:

```
setappdata(0, 'environment-variable-name', value)
```

2.2 Global environment file

The global environment variables are contained in *Application_Files**default**environment.m*. Changes made to this file will affect all jobs submitted in the current working directory. In the event that the user wishes to revert to the original environment settings, a list of environment variables with their default values can be found in *Application_Files**default**default_environment.m*.

2.3 Local environment files

Local environment variables may be defined for a particular job. This is done by making a copy of the global environment file and placing it in *Project**job*. Alternatively, the user may create a blank text file and specify only the environment variables they wish to define for that job. However, for the analysis to run properly, the global environment file must always be available.

The local environment file must obey the naming convention *<jobName>_env.m*, otherwise it will not be processed by Quick Fatigue Tool.

2.4 Processing of environment variables

At the beginning of each analysis, Quick Fatigue Tool searches *Application_Files**default* for the global environment file. It then searches for any files named *<jobName>_env.m* in the MATLAB search path, followed by *Project**job*. Local environment settings supersede global environment settings, and environment files placed in *Project**job* supersede all other environment files.

Before each analysis, it is compulsory for all environment variables to be defined. Even if the user specifies non-default values in a local environment file, the global environment file must still exist and contain all of the variables. If the global environment file is modified or lost, and the default environment file is no longer available, the fastest way to recover the settings is to re-download the application from the MATLAB File Exchange.

2.5 Environment variables table

The following table provides a description of each variable in the environment file.

2.5.1 Load gating

Variable	Usage
gateTensors	Specify the gating criterion for tensor histories. *Environment file usage:* **gateTensors**={0.0 | 1.0 | 2.0} Retain all data points in the tensor history: **gateTensors**=0.0 Gate tensors as % of maximum tensor value: **gateTensors**=1.0 This setting must be used in conjunction with **tensorGate**. Gate tensors using Nielsony's method: **gateTensors**=2.0
tensorGate	Specify the tensor gating value. *Environment file usage:* **tensorGate**=k The gating value is given as the percentage of the maximum value in the tensor history (%). This setting is only required if **gateTensors**=1.0.

gateHistories	Specify the pre-gating criterion for load histories. *Environment file usage:* **gateHistories**={0.0 | 1.0 | 2.0} Retain all data points in the load history: **gateHistories**=0.0 Gate tensors as % gate: **gateHistories**=1.0 This setting must be used in conjunction with **historyGate**. Gate tensors using Nielsony's method: **gateHistories**=2.0
historyGate	Specify the history gating value. *Environment file usage:* **historyGate**=*k* The gating value is given as the percentage of the maximum value in the load history (%). This setting is only required if **gateHistories**=1.0.
noiseReduction	Specify noise reduction to be applied to the load history. *Environment file usage:* **noiseReduction**={0.0 | 1.0} This setting must be used in conjunction with **numberOfWindows**.
numberOfWindows	Specify the number of averaging windows used by the noise reduction algorithm. *Environment file usage:* **numberOfWindows**=*k*

2.5.2 Group definition

groupDefinition	Specify how Quick Fatigue Tool recognises analysis groups. *Environment file usage:* **groupDefinition**={0.0 | 1.0} Program controlled: **groupDefinition**=0.0 If the group definition file does not contain position IDs, the group is treated as an item ID list. Always treat the group as a subset of the FEA model: **groupDefinition**=1.0

2.5.3 Surface detection

searchRegion	Specify the scope of the surface detection algorithm. *Environment file usage:* **searchRegion**={0.0 | 1.0} Search elements within the dataset file(s): **searchRegion**=0.0 This setting only applies when **RESULT_POSITION**={'ELEMENT NODAL' | 'CENTROID'}. Search elements within the ODB part instance: **searchRegion**=1.0
shellFaces	Specify how the surface detection algorithm treats shell elements. *Environment file usage:* **shellFaces**={0.0 | 1.0} Treat the shell surface as the whole shell: **shellFaces**=0.0 Treat the shell surface as free shell faces: **shellFaces**=1.0

2.5.4 Mean stress correction

modifiedGoodman

Specify the formulation for the Goodman mean stress correction.

Environment file usage for a single analysis group:
modifiedGoodman=**{**0.0 | 1.0**}**

Use the standard Goodman envelope:
modifiedGoodman=0.0

Use the modified Goodman envelope:
modifiedGoodman=1.0

This setting requires a value for the proof stress. If no proof stress is available, the standard Goodman envelope is used by default.

Environment file usage for n analysis groups:
modifiedGoodman=[k_1,… , k_n]

goodmanMeanStressLimit

Specify the horizontal (mean stress) axis intercept for the Goodman mean stress correction.

Environment file usage for a single analysis group:
goodmanMeanStressLimit=**{**'UTS' | 'PROOF' | 'S-N' | k**}**

Limit the Goodman envelope to the ultimate tensile strength:
goodmanMeanStressLimit='UTS'

Limit the Goodman envelope to the proof stress:
goodmanMeanStressLimit='PROOF'

Limit the Goodman envelope to the S-N intercept (1 repeat):
goodmanMeanStressLimit='S-N'

Specify a user-defined Goodman envelope limit stress:
goodmanMeanStressLimit=k

The limit stress is given in megapascals (MPa).

This setting is ignored when **modifiedGoodman**=1.0.

Environment file usage for n analysis groups:
goodmanMeanStressLimit={k_1,… , k_n}

The value of k can be any combination of string and numerical inputs.

walkerGammaSource	Specify how the Walker gamma parameter (γ) is calculated. *Environment file usage:* **walkerGammaSource**=**{**1.0 | 2.0 | 3.0**}** Define γ from regression fit (Walker): **walkerGammaSource**=1.0 Define γ from standard values (Dowling): **walkerGammaSource**=2.0 This setting is recommended only for steel and aluminium. Specify a user-defined value of γ: **walkerGammaSource**=3.0

userWalkerGamma	Specify a user-defined value of the Walker gamma parameter when **walkerGammaSource**=3.0. *Environment file usage for a single analysis group:* **userWalkerGamma**=k *Environment file usage for n analysis groups:* **userWalkerGamma**=[k_1,…, k_n]

2.5.5 Rainflow cycle counting

rainflowAlgorithm	Specify the rainflow cycle counting algorithm. *Environment file usage:* **rainflowAlgorithm**=**{**1.0 | 2.0**}** Use De Morais method: **rainflowAlgorithm**=1.0 This method has been deprecated. The Vallance method is recommended. Use Vallance method: **rainflowAlgorithm**=2.0

rainflowMode	Specify the order of operations of rainflow cycle counting for the Stress-based Brown-Miller analysis algorithm. *Environment file usage:* **rainflowMode**=**{**1.0 | 2.0**}** Combine parameters, count cycles: **rainflowMode**=1.0 Count parameters, combine cycles: **rainflowMode**=2.0

2.5.6 Shell elements

shellLocation	Specify the default face from which to read shell element stresses in an Abaqus *.rpt* file. *Environment file usage:* **shellLocation**=**{**1.0 | 2.0**}** Use LOC 1 (SNEG): **shellLocation**=1.0 Use LOC 2 (SPOS): **shellLocation**=2.0

2.5.7 Nonlinear material properties

nlMaterial	Specify the material model to be used for stress-based fatigue analysis. *Environment file usage:* **nlMaterial**=**{**0.0 | 1.0**}** Use the linear elastic (Hookean) material model: **nlMaterial**=0.0 Use the nonlinear elastic (Ramberg-Osgood) material model: **nlMaterial**=1.0 This setting must be used in conjunction with **cssTolerance** and **cssMaxIterations**.

cssTolerance	Specify the precision of the nonlinear elastic solver. *Environment file usage:* **cssTolerance**=k The default value of k is 3e-04.

cssMaxIterations	Specify the maximum number of iterations for the nonlinear elastic solver. *Environment file usage:* **cssMaxIterations**=k The default value of k is 5.5e+06.

2.5.8 Nodal elimination

nodalElimination	Specify the nodal elimination algorithm. *Environment file usage:* **nodalElimination**=**{**0.0 | 1.0 | 2.0**}** Do not perform nodal elimination: **nodalElimination**=0.0 Perform nodal elimination based on material constant amplitude endurance limit: **nodalElimination**=1.0 Perform nodal elimination based on design life: **nodalElimination**=2.0 The design life is specified with **DESIGN_LIFE**.

thresholdScaleFactor	Specify the conditional stress scaling factor for the nodal elimination algorithm. *Environment file usage:* **thresholdScaleFactor**=k The default value of k is 0.8 (80%).

2.5.9 Yield calculation

yieldCriterion	Specify the static yield strength calculation. *Environment file usage:* **yieldCriterion**=**{**0.0 | 1.0 | 2.0**}** Do not perform yield calculations: **yieldCriterion**=0.0 Yield calculations based on the total strain energy theory: **yieldCriterion**=1.0 Yield calculations based on the shear strain energy theory: **yieldCriterion**=2.0

2.5.10 Critical plane analysis

stepSize	Specify the step size for the critical plane analysis algorithm. *Environment file usage:* **stepSize**=k The step size is given in degrees, and must be a factor of 180. The default value of k is 10.0.
checkLoadProportionality	Specify an additional check to modify the critical plane step size if the load history is proportional. *Environment file usage:* **checkLoadProportionality**=**{**0.0 | 1.0**}** Use the step size specified by **stepSize**: **checkLoadProportionality**=0.0 Check for load proportionality: **checkLoadProportionality**=1.0 If the load history is proportional, the value of **stepSize** may be overridden to decrease the analysis time. This setting must be used in conjunction with **proportionalityTolerance**.
proportionalityTolerance	Specify the tolerance angle for the load proportionality check. The load is considered to be proportional if the maximum deviation in the principal directions does not exceed this angle. *Environment file usage:* **proportionalityTolerance**=k The tolerance angle is given in degrees. The default value of k is 1.0.

cpSample	Specify the sample rate for the critical plane analysis plots. *Environment file usage:* **cpSample**=k The sample rate is given as an integer. The re-sample rate only affects the smoothness of the MATLAB figure data. It does not affect the tabulated data from which the plots are created. The default value of k is 0.0.

cpShearStress	Specify how the maximum shear stress history is determined on the critical plane. *Environment file usage:* **cpShearStress**=**{**1.0 | 2.0**}** Maximum chord method: **cpShearStress**=1.0 Maximum resultant shear stress method: **cpShearStress**=2.0

2.5.11 Sign convention

signConvention	Specify the convention for signed parameters. The signed quantity is the resultant shear stress on the critical plane when: **ALGORITHM**={'SBBM' | 'NORMAL' | 'FINDLEY' | 'WELD'} The signed quantity is the von Mises stress when: **ALGORITHM**={'NASALIFE'} The signed quantity is the effective stress when: **ALGORITHM**={'INVARIANT'} *Environment file usage:* **signConvention**={1.0 | 2.0 | 3.0} Take the sign from the hydrostatic stress: **signConvention**=1.0 Take the sign from the largest stress: **signConvention**=2.0 Take the sign from Mohr's circle: **signConvention**=3.0

2.5.12 Analysis algorithm

importMaterialState

Specify that the stress-strain configuration from the previous analysis is imported when using the Uniaxial Strain-Life algorithm with **CONTINUE_FROM**='*job name*'.

Environment file usage:
importMaterialState={0.0 | 1.0}

Reset the stress-strain configuration:
importMaterialState=0.0

Import the stress-strain configuration from the previous job:
importMaterialState=1.0

plasticSN

Specify which region(s) of the stress-life curve to consider for analysis when using the stress-based Brown-Miller analysis algorithm.

Environment file usage:
plasticSN={0.0 | 1.0}

Use elastic region of the S-N curve (σ_f', b):
plasticSN=0.0

Include plastic region of the S-N curve (σ_f', b, ε_f', c):
plasticSN=1.0

findleyNormalStress

Specify how the normal stress is matched with shear cycles for Findley's Method.

Environment file usage:
findleyNormalStress={1.0 | 2.0 | 3.0}

Use the maximum normal stress of the load history:
findleyNormalStress=1.0

Use the maximum normal stress over the maximum shear cycle:
findleyNormalStress=2.0

Use the average normal stress over the maximum shear cycle:
findleyNormalStress=3.0

stressInvariantParameter	Specify the damage parameter for the Stress Invariant Parameter algorithm. *Environment file usage:* **stressInvariantParameter**={0.0 | 1.0 | 2.0 | 3.0 | 4.0} Program controlled: **stressInvariantParameter**=0.0 von Mises: **stressInvariantParameter**=1.0 Principal: **stressInvariantParameter**=2.0 Hydrostatic: **stressInvariantParameter**=3.0 Tresca: **stressInvariantParameter**=4.0
nasalifeParameter	Specify the effective stress parameter for the NASALIFE analysis algorithm. *Environment file usage:* **nasalifeParameter**={1.0 | 2.0 | 3.0 | 4.0 | 5.0} Manson-McKnight: **nasalifeParameter**=1.0 Sines: **nasalifeParameter**=2.0 Smith-Watson-Topper: **nasalifeParameter**=3.0 R-Ratio Sines: **nasalifeParameter**=4.0 Effective: **nasalifeParameter**=5.0

2.5.13 Compressive cycles

ndCompression	Specify the treatment of fully-compressive cycles. *Environment file usage:* **ndCompression**=**{**0.0 | 1.0**}** Fully-compressive cycles can be damaging: **ndCompression**=0.0 Fully-compressive cycles are non-damaging: **ndCompression**=1.0

2.5.14 Fatigue/endurance limit

fatigueLimitSource

Specify how the fatigue limit is calculated.

Environment file usage:
fatigueLimitSource={1.0 | 2.0 | 3.0}

Calculate the fatigue limit from stress-life data:
fatigueLimitSource=1.0

If **USE_SN**=0.0, the fatigue limit is calculated from $\sigma_\infty = \sigma'_f(N_\infty)^b$, where σ_∞ is the fatigue limit stress, σ'_f is the fatigue strength coefficient, N_∞ is the constant amplitude endurance limit ($2N_f$) and b is the fatigue strength exponent.

If **USE_SN**=1.0, the fatigue limit is calculated from the S-N data points. If a user-defined value of N_∞ is found in the material, the fatigue limit is calculated interpolating the S-N curve at N_∞. If N_∞ is not explicitly defined, the fatigue limit is taken as the last S-value on the S-N curve.

Calculate the fatigue limit from the algorithm-specific equation:
fatigueLimitSource=2.0

The algorithm-specific equations only apply when **ALGORITHM**={'SBBM' | 'FINDLEY'}.

Stress-based Brown-Miller (without fatigue ductility):

$$\sigma_\infty = \sigma'_f(1.65N_\infty)^b$$

Stress-based Brown-Miller (with fatigue ductility):

$$\sigma_\infty = E\left(\frac{1.65\sigma'_f}{E}(N_\infty)^b + 1.75\varepsilon'_f(N_\infty)^c\right)$$

Findley's method:

$$\sigma_\infty = \tau^*_f(N_\infty)^b$$

Specify a user-defined fatigue limit:
fatigueLimitSource=3.0

This setting must be used in conjunction with **userFatigueLimit**.

userFatigueLimit	Specify the user-defined value of the endurance limit if **fatigueLimitSource**=3.0. *Environment file usage for a single analysis group:* **userFatigueLimit**=k *Environment file usage for n analysis groups:* **userFatigueLimit**=[k_1,…, k_n] The user-defined fatigue limit is given in megapascals (MPa). Custom values of the fatigue limit are not supported when **ALGORITHM**='WELD'.
ndEndurance	Specify whether cycles below the endurance limit can be damaging. *Environment file usage:* **ndEndurance**=**{**0.0 | 1.0 | 2.0**}** Program-controlled: **ndEndurance**=0.0 Cycles below the endurance limit are damaging: **ndEndurance**=1.0 Cycles below the endurance limit are non-damaging: **ndEndurance**=2.0 This setting must be used in conjunction with **modifyEnduranceLimit**.

modifyEnduranceLimit	Specify endurance limit modification for damaging cycles. *Environment file usage:* **modifyEnduranceLimit**={0.0 | 1.0} Damaging cycles do not affect the endurance limit: **modifyEnduranceLimit**=0.0 Damaging cycles reduce the endurance limit: **modifyEnduranceLimit**=1.0 The endurance limit is only modified if **ndEndurance**=2.0. This setting must be used in conjunction with **enduranceScaleFactor** and **cyclesToRecover**.
enduranceScaleFactor	Specify the amount by which the endurance limit is scaled after a damaging cycle. *Environment file usage:* **enduranceScaleFactor**=k The default value of k is 0.25 (25%). This setting is only enforced if **modifyEnduranceLimit**=1.0.
cyclesToRecover	Specify the number of non-damaging cycles before the endurance limit returns to its original value, if **modifyEnduranceLimit**=1. *Environment file usage:* **cyclesToRecover**=k The default value of k is 50. This setting is only enforced if **modifyEnduranceLimit**=1.0.

2.5.15 Factor of strength

fosTarget	Specify the target for Factor of Strength (FOS) calculations. *Environment file usage:* **fosTarget**={1.0 | 2.0} Target FOS towards design life: **fosTarget**=1.0 This setting defines the FOS target as the life specified by **DESIGN_LIFE**. Target FOS towards infinite life (N_∞): **fosTarget**=2.0 This setting defines the FOS target as the constant amplitude endurance limit defined in the material.
fosMaxValue	Specify the maximum FOS value that can be reported. *Environment file usage:* **fosMaxValue**=k The default value of k is 2.0.
fosMaxFine	Specify the upper bound of the region in which fine FOS increments are performed. *Environment file usage:* **fosMaxFine**=k The default value of k is 1.5.
fosMinFine	Specify the lower bound of the region in which fine FOS increments are performed. *Environment file usage:* **fosMinFine**=k The default value of k is 0.8.

fosMinValue	Specify the minimum FOS value that can be reported. *Environment file usage:* **fosMinValue**=k The default value of k is 0.5.
fosCoarseIncrement	Specify the step size for FOS iterations outside the fine region. *Environment file usage:* **fosCoarseIncrement**=k The default value of k is 0.1.
fosFineIncrement	Specify the step size for FOS iterations within the fine region. *Environment file usage:* **fosFineIncrement**=k The default value of k is 0.01.
fosMaxCoarseIterations	Specify the maximum coarse FOS iteration stop condition. *Environment file usage:* **fosMaxCoarseIterations**=k The default value of k is 8.0.
fosMaxFineIterations	Specify the maximum fine FOS iteration stop condition. *Environment file usage:* **fosMaxFineIterations**=k The default value of k is 12.0.

fosTolerance	Specify the FOS tolerance stop condition. The solution is accepted if the calculated FOS is within this percentage of the target life. *Environment file usage:* **fosTolerance**=k The limit stress is given in percent ($\%$). The default value of k is 5.0.
fosBreakAfterBracket	Specify the FOS bracket stop condition. *Environment file usage:* **fosBreakAfterBracket**={0.0 | 1.0} Continue FOS calculations after the calculated life crosses the target life: **fosBreakAfterBracket**=0.0 Accept the solution if the calculated life crosses the target life: **fosBreakAfterBracket**=1.0
fosAugment	Specify augmented FOS iterations. *Environment file usage:* **fosAugment**={0.0 | 1.0} Disable augmentation: **fosAugment**=0.0 Enable augmentation: **fosAugment**=1.0 If the current FOS increment meets the threshold criterion, the increment is scaled by a specified factor. This setting must be used in conjunction with **fosAugmentThreshold** and **fosAugmentFactor**.

fosAugmentThreshold

Specify the threshold value for augmented FOS iterations.

Environment file usage:
fosAugmentThreshold=k

The next FOS increment is scaled if the following condition is satisfied:

$$\frac{N_i - N_{i-1}}{N_t} < k$$

Where N_i is the current calculated FOS value, N_{i-1} is the previously calculated FOS value and N_t is the target life.

The default value of k is 0.2.

fosAugmentFactor

Specify the scale factor for augmented FOS iterations.

Environment file usage:
fosAugmentFactor=k

The default value of k is 5.0.

fosDiagnostics

Specify diagnostic output for the FOS calculation.

Environment file usage:
fosDiagnostics={0.0 | 1.0}

Do not write diagnostic output:
fosDiagnostics=0.0

Create a MATLAB figure of the FOS iteration history:
fosDiagnostics=1.0

This setting is ignored if **ITEMS** is defined for a single item.

2.5.16 Fatigue reserve factor

frfInterpOrder	Specify the interpolation order for user-defined Fatigue Reserve Factor (FRF) data. *Environment file usage:* **frfInterpOrder**={'NEAREST' | 'LINEAR' | 'SPLINE' | 'PCHIP'} Use nearest neighbour interpolation: **frfInterpOrder**='NEAREST' Use linear interpolation: **frfInterpOrder**='LINEAR' Use spline interpolation: **frfInterpOrder**='SPLINE' Use PCHIP interpolation: **frfInterpOrder**='PCHIP' This option is only required when **FATIGUE_RESERVE_FACTOR**='*frf-file-name*.msc'.

frfNormParamMeanT	Specify the normalization parameter of tensile mean stress data for user-defined FRF envelopes. *Environment file usage for a single analysis group:* **frfNormParamMeanT**={'UTS' | 'UCS' | 'PROOF' | k} Normalize the data with the ultimate tensile strength: **frfNormParamMeanT**='UTS' Normalize the data with the ultimate compressive strength: **frfNormParamMeanT**='UCS' Normalize the data with the proof stress: **frfNormParamMeanT**='PROOF' Specify a user-defined normalization parameter: **frfNormParamMeanT**=k *Environment file usage for n analysis groups:* **frfNormParamMeanT**={k_1,..., k_n} The value of k can be any combination of string parameters and numerical values.

frfNormParamMeanC	Specify the normalization parameter of compressive mean stress data for user-defined FRF envelopes. *Environment file usage for a single analysis group:* **frfNormParamMeanC**={'UTS' | 'UCS' | 'PROOF' | k} Normalize the data with the ultimate tensile strength: **frfNormParamMeanC**='UTS' Normalize the data with the ultimate compressive strength: **frfNormParamMeanC**='UCS' Normalize the data with the proof stress: **frfNormParamMeanC**='PROOF' Specify a user-defined normalization parameter: **frfNormParamMeanC**=k *Environment file usage for n analysis groups:* **frfNormParamMeanC**={k_1,..., k_n} The value of k can be any combination of string parameters and numerical values.

frfNormParamAmp	Specify the normalization parameter of amplitude data for user-defined FRF envelopes. *Environment file usage for a single analysis group:* **frfNormParamMeanAmp**={'LIMIT' | k} Normalize the data with the fatigue limit: **frfNormParamMeanAmp**='LIMIT' Specify a user-defined normalization parameter: **frfNormParamMeanAmp**=k *Environment file usage for n analysis groups:* **frfNormParamMeanAmp**={k_1,..., k_n} The value of k can be any combination of string parameters and numerical values.

frfTarget	Specify the target for the FRF calculations. *Environment file usage:* **frfTarget**={1.0 | 2.0} Target FRF towards design life: **frfTarget**=1.0 This setting defines the FRF target as the life specified by **DESIGN_LIFE**. Target FRF towards infinite life (N_∞): **frfTarget**=2.0
frfMaxValue	Specify the maximum FRF value that can be reported. *Environment file usage:* **frfMaxValue**=k The default value of k is 10.0.
frfMinValue	Specify the minimum FRF value that can be reported. *Environment file usage:* **frfMinValue**=k The default value of k is 0.1.
frfDiagnostics	Diagnostic output for the FRF calculation when user-defined envelopes are specified. *Environment file usage:* **frfDiagnostics**={[ ] | [k_1,…, k_n]} Do not write diagnostic output: **frfDiagnostics**=[ ] Create MATLAB figures for the FRF calculation at items k_1 to k_n: **fosDiagnostics**=[k_1,…, k_n]

2.5.17 Notch factor

notchFactorEstimation	Specify the fatigue notch factor approximation method. This variable must be used in conjunction with **KT_DEF**. *Environment file usage:* **notchFactorEstimation**={1.0 | 2.0 | 3.0 | 4.0 | 5.0 | 6.0} Peterson: **notchFactorEstimation**=1.0 Peterson B: **notchFactorEstimation**=2.0 Neuber: **notchFactorEstimation**=3.0 Harris: **notchFactorEstimation**=4.0 Heywood: **notchFactorEstimation**=5.0 If **notchFactorEstimation**={2.0 | 3.0 | 4.0 | 5.0}, **NOTCH_CONSTANT**, **NOTCH_RADIUS** must be specified. Notch sensitivity: **notchFactorEstimation**=6.0 This setting must be used in conjunction with **NOTCH_CONSTANT**.

2.5.18 Eigensolver

eigensolver	Specify the Eigensolver used to calculate the principal stress history. *Environment file usage:* **eigensolver**={1.0 | 2.0} Default MATLAB solver: **eigensolver**=1.0 Luong: **eigensolver**=2.0

2.5.19 MATLAB figure appearance

defaultLineWidth	Specify the default line width for MATLAB figures. *Environment file usage:* **defaultLineWidth**=k The default value of k is 1.0.
defaultFontSize_XAxis	Specify the default font size of the horizontal axis for MATLAB figures. *Environment file usage:* **defaultFontSize_XAxis**=k The default value of k is 12.0.
defaultFontSize_YAxis	Specify the default font size of the vertical axis for MATLAB figures. *Environment file usage:* **defaultFontSize_YAxis**=k The default value of k is 12.0.
defaultFontSize_Title	Specify the default font size of the title for MATLAB figures. *Environment file usage:* **defaultFontSize_Title**=k The default value of k is 14.0.
defaultFontSize_Ticks	Specify the default font size of axis ticks for MATLAB figures. *Environment file usage:* **defaultFontSize_Ticks**=k The default value of k is 12.0.

XTickPartition	Specify the number of vertical partitions for MATLAB figures. *Environment file usage:* **XTickPartition** =k The default value of k is 4.0.
gridLines	Specify grid lines for MATLAB figures. *Environment file usage:* **gridLines**={'OFF' | 'ON'}
numberOfBins	Specify the number of range bins used for the Rainflow cycle histogram. *Environment file usage:* **numberOfBins**=k The number of bins, k, must be an integer.

2.5.20 Output individual control

figure_<*name*>

Specify individual variables to plot as a MATLAB figure.

Environment file usage:
figure_<*name*>={0.0 | 1.0}

Worst cycle (all items) Haigh diagram:
figure_ANHD=1.0

All cycles (worst item) Haigh diagram:
figure_HD=1.0

Knock-down S-N curve (per material):
figure_KDSN=1.0

von Mises stress history (worst item):
figure_VM=1.0

Principal stress histories (worst item):
figure_PS=1.0

Principal strain histories (worst item):
figure_PE=1.0

Normal and shear stress histories (worst item):
figure_CNS=1.0

Damage parameter history (worst item, critical plane):
figure_DPP=1.0

Damage history (worst item, critical plane)
figure_DP=1.0

Life history (worst item, critical plane):
figure_LP=1.0

Maximum shear stress history (worst item, critical plane):
figure_CPS=1.0

Maximum normal stress history (worst item, critical plane):
figure_CPN=1.0

Cumulative damage (worst item):
figure_DAC=1.0

Rainflow histogram (worst item):
figure_RHIST=1.0

	Stress range cycle distribution (worst item): **figure_RC**=1.0 Uniaxial load history: **figure_SIG**=1.0 Stress tensor histories (worst item): **figure_LH**=1.0
figureFormat	Specify non-default file format for MATLAB figures. *Environment file usage:* **figureFormat**=**{**'fig' | 'png' | 'jpg' | '*'**}** Write MATLAB figures: **figureFormat**='fig' Write .png images: **figureFormat**='png' Write .jpeg images: **figureFormat**='jpg' User-specified file: **figureFormat**='*extension label*'
figureVisibility	Specify figure visibility during postprocessor operations. *Environment file usage:* **figureVisibility**=**{**'OFF' | 'ON'**}** Do not display figures during postprocessor: **figureVisibility**='OFF' Allow figures to display during postprocessor: **figureVisibility**='ON'

file_F_OUTPUT_<*name*>	Specify individual field data files. *Environment file usage:* **file_F_OUTPUT_<*name*>**={0.0 | 1.0}
	Field output (all items): **file_F_OUTPUT_ALL**=1.0
	Field output (worst item): **file_F_OUTPUT_ANALYSED**=1.0
file_H_OUTPUT_<*name*>	Specify individual history data files. *Environment file usage:* **file_H_OUTPUT_<*name*>**={0.0 | 1.0}
	Load histories: **file_H_OUTPUT_LOAD**=1.0
	Cycle histories: **file_H_OUTPUT_CYCLE**=1.0
	Critical plane histories: **file_H_OUTPUT_ANGLE**=1.0
	Tensors histories: **file_H_OUTPUT_TENSOR**=1.0
fieldFormatString	Specify the print format for field output. *Environment file usage:* **fieldFormatString**='*identifier*' The default format is float ('f').
historyFormatString	Specify the print format for history output. *Environment file usage:* **historyFormatString**='*identifier*' The default format is float ('f').

echoMessagesToCWIN	Specify echo of the message file to the command window. *Environment file usage:* **echoMessagesToCWIN**=**{**0.0 | 1.0**}** Write message to message file only: **echoMessagesToCWIN**=0.0 Echo message file output to the command window: **echoMessagesToCWIN**=1.0

2.5.21 Application data

cleanAppData	Specify when the application data should be cleaned. *Environment file usage:* **cleanAppData**=**{**1.0 | 2.0 | 3.0 | 4.0**}** Clean the application data before each analysis: **cleanAppData**=1.0 Clean the application data after each analysis **cleanAppData**=2.0 Clean the application data before and after each analysis **cleanAppData**=3.0 Never clean the application data: **cleanAppData**=4.0

2.5.22 Workspace caching

workspaceToFile	Specify caching of analysis data. Workspace variables and application data are into a MATLAB binary (.mat) file for debugging purposes. This variable must be used in conjunction with **workspaceToFileInterval**. *Environment file usage:* **workspaceToFile**=**{**0.0 | 1.0 | 2.0 | 3.0**}** Do not cache analysis data: **workspaceToFile**=0.0 Cache analysis data every k analysis items: **workspaceToFile**=1.0 Cache analysis data at k evenly spaced analysis items: **workspaceToFile**=2.0 Cache analysis data from user-selected analysis item IDs: **workspaceToFile**=3.0

workspaceToFileInterval	Specify the frequency, k, at which analysis data is cached when **workspaceToFile**=**{**1.0 | 2.0 | 3.0**}**. *Environment file usage:* **workspaceToFileInterval**=**[**k | **{**'OVERLAY' | 'RETAIN'**}]** If **workspaceToFile**=**{**1.0 | 2.0**}**, k is the interval number. If **workspaceToFile**=3.0, k is an analysis item ID list: **workspaceToFileInterval**=[k_1,…, k_n] Overwrite the cache (single file): **workspaceToFileInterval**={k, 'OVERLAY'} Retain a cache file for each value of k (multiple files): **workspaceToFileInterval**={k, 'RETAIN'}

2.5.23 Abaqus ODB interface

autoExport_ODB	Specify the master control for the Abaqus ODB interface. *Environment file usage:* **autoExport_ODB**={0.0 | 1.0} Do not export field data to an *.odb* file: **autoExport_ODB**=0.0 Allow field data to be exported to an *.odb* file: **autoExport_ODB**=1.0
autoExport_stepType	Specify the ODB step for exported field data. *Environment file usage:* **autoExport_stepType**={1.0 | 2.0} Export field data to a new step: **autoExport_stepType**=1.0 Export field data to an existing step: **autoExport_stepType**=2.0
autoExport_autoPosition	Specify how the ODB interface determines the results element position. *Environment file usage:* **autoExport_autoPosition**={0.0 | 1.0} User specifies the results position: **autoExport_autoPosition**=0.0 Allow ODB interface to choose the results position: **autoExport_autoPosition**=1.0 This setting is only recommended if the results position is unknown.

autoExport_upgradeODB	Specify whether the model ODB file should be upgraded before results export. *Environment file usage:* **autoExport_ upgradeODB**={0.0 | 1.0} Do not upgrade the *.odb* file: **autoExport_ upgradeODB**=0.0 Upgrade the *.odb* file before results export: **autoExport_ upgradeODB**=1.0 This setting must be used in conjunction with **autoExport_abqCmd**.

autoExport_abqCmd	Specify the Abaqus API version used by the ODB Interface. *Environment file usage:* **autoExport_ abqCmd**='*abaqus-idendification-string*' The Abaqus identification string is the name of the batch file which is used to launch Abaqus. This is usually located in *<Abaqus_installation_directory>**Commands*. If **autoExport_ upgradeODB**=1.0, the ODB interface will attempt to upgrade the model *.odb* file to the version specified by **autoExport_abqCmd**. The default value of '*abaqus-idendification-string*' is '*abaqus*'.

autoExport_createODBSet	Specify an Abaqus ODB set containing the elements and nodes defined in the field data. *Environment file usage:* **autoExport_createODBSet**={0.0 | 1.0} Do not write an element/node set to the *.odb* file: **autoExport_createODBSet**=0.0 Write the element/nodes from the field data to the *.odb* file: **autoExport_createODBSet**=1.0 If the result position is unique nodal, a set of these nodes is written to the *.odb* file. If the result position is element-nodal position, a set of these elements and nodes is written to the *.odb* file. If the result position is integration point or centroidal, a set of these elements is written to the *.odb* file. This option must be used in conjunction with **autoExport_ODBSetName**.
autoExport_ODBSetName	Specify the name of the ODB element/node set if **autoExport_createODBSet**=1.0. *Environment file usage:* **autoExport_ODBSetName**={ [ ] | *'name'*} Use a default set name: **autoExport_ODBSetName**=[ ] Specify a user-defined set name: **autoExport_ODBSetName**='*name*'

autoExport_executionMode	Specify the export execution mode. *Environment file usage:* **autoExport_executionMode**={1.0 | 2.0 | 3.0} Create the *.odb* file, discard the Python script: **autoExport_executionMode**=1.0 Create the *.odb* file, retain the Python script: **autoExport_executionMode**=2.0 Write the Python script only; do not create the *.odb* file: **autoExport_executionMode**=3.0
autoExport_selectionMode	Specify the output variable selection type. *Environment file usage:* **autoExport_selectionMode**={1.0 | 2.0 | 3.0} Request output variables from a list: **autoExport_selectionMode**=1.0 The output variable selection is taken from the definitions of **autoExport_*<field>***. Request preselected defaults: **autoExport_selectionMode**=2.0 The following variables are requested by default: **ALGORITHM**='WELD': LL, SMAX, WCM, WCA Field data is not exported for the following analyses: **ALGORITHM**={'UNIAXIAL STRESS' | 'UNIAXIAL STRAIN'} All other analyses: LL, FRFR, FRFV, FRFH, FRFW, SMAX, WCM, WCA If the Factor of Strength or yield calculations are enabled, the FOS and $YIELD$ variables are automatically written to the ODB. Request all available output variables: **autoExport_selectionMode**=3.0

autoExport_<*field*>	Specify the fields to be written to the *.odb* when **autoExport_selectionMode**=1.0. *Environment file usage:* **autoExport_<*field*>**=**{**0.0 | 1.0**}** LOG10 (Life): **autoExport_LL**=1.0 Life: **autoExport_L**=1.0 Damage: **autoExport_D**=1.0 Damage (at design life): **autoExport_DDL**=1.0 Factor of Strength **autoExport_FOS**=1.0 Endurance safety factor **autoExport_SFA**=1.0 Fatigue Reserve Factor (radial): **autoExport_FRFR**=1.0 Fatigue Reserve Factor (vertical): **autoExport_FRFV**=1.0 Fatigue Reserve Factor (horizontal): **autoExport_FRFH**=1.0 Fatigue Reserve Factor (worst of three): **autoExport_FRFW**=1.0 Maximum stress: **autoExport_SMAX**=1.0 Maximum stress (normalized by proof stress): **autoExport_SMXP**=1.0 Maximum stress (normalized by ultimate tensile strength): **autoExport_SMXU**=1.0 Triaxiality factor: **autoExport_TRF**=1.0

Worst cycle mean stress:
autoExport_WCM=1.0

Worst cycle stress amplitude:
autoExport_WCA=1.0

Worst cycle damage parameter:
autoExport_WCDP=1.0

Worst cycle arctangent:
autoExport_WCATAN=1.0

Yield flag:
autoExport_YIELD=1.0

3. Material keywords

3.1 Overview

This section describes all of the keywords that are available for defining materials in a text file format in Quick Fatigue Tool. Materials are defined by lines in the text file. Three types of input lines are used in a material text file: *keyword* lines, *data* lines, and *comment* lines. A carriage return is required at the end of each line in a material text file.

- Keyword lines introduce options and often have *parameters*, which appear as words or phrases on the keyword line. Parameters can stand alone or have a value, and they may be required or optional.
- Data lines, which are used to provide numeric or alphanumeric entries, follow most keyword lines.
- Any line that begins with stars in columns 1 and 2 (**) is a comment line. Such lines can be placed anywhere in the file. They are ignored by Quick Fatigue Tool.

3.2 Keyword lines

The following rules apply when entering a keyword line:

- The first non-blank character of each keyword line must be a star (*).
- The keyword must be followed by a comma (,) if any parameters are given.
- Blanks on a keyword line are ignored.
- Keywords and parameters are not case sensitive.
- Keywords and parameters need not be spelled out completely, but there must be enough characters given to distinguish them from other keywords and parameters that begin in the same way.
- You should not use case as a method of distinguishing values. For example, Quick Fatigue Tool does not distinguish between the following definitions:

  *USER MATERIAL, NAME=STEEL
  *USER MATERIAL, NAME=Steel

3.3 Data lines

Data lines are used to provide data that are more easily given in lists than as parameters. Most options require one or more data lines; if they are required, the data lines must immediately follow the keyword line introducing the option. The following rules apply when entering a data line:

- All data lines must be separated by comas (,). An empty data field is specified by omitting data between commas.
- Empty data fields at the end of a line can be ignored.
- Floating point numbers can be given with or without an exponent. Any exponent, if input, must be preceded by E and an optional (-) or (+), as per the usual MATLAB syntax.

3.4 Material keywords table

The following table provides a description of each material keyword and their associated parameters.

*USER MATERIAL

Begin the definition of a material.

This option is used to indicate the start of a material definition.

Required parameter:

NAME

Set this parameter to a label that will be used to refer to the material with the job file option MATERIAL.

There are no data lines associated with this option.

*DESCRIPTION

Provide a description of the material.

This option is used to provide a summary for the material.

There are no parameters associated with this option.

Data line to provide a description:

First line:

1. The description.

Repeat this data line as often as necessary to define the material description.

*DEFAULT ALGORITHM

Specify the default analysis algorithm.

This option is used to specify the analysis algorithm which is used when ALGORITHM=default in the job file.

Required, mutually exclusive parameters:

{UNIAXIAL STRESS | UNIAXIAL STRAIN | SBBM | NORMAL | FINDLEY | INVARIANT | NASALIFE**}**

Uniaxial Stress-Life, Uniaxial Strain-Life, Stress-based Brown-Miller, Normal Stress, Findley's Method, Stress Invariant Parameter, and NASALIFE, respectively.

There are no data lines associated with this option.

*DEFAULT MSC

Specify the default mean stress correction.

This option is used to specify the mean stress correction which is used when MS CORRECTION=default in the job file.

Required, mutually exclusive parameters:

{MORROW | GOODMAN| SODERBERG| WALKER| SWT| GERBER| RATIO | NONE**}**

There are no data lines associated with this option.

*CAEL

Specify the constant amplitude endurance limit.

This option is used to specify the constant amplitude endurance limit of the material. This is the life below which Quick Fatigue Tool assumes the material experiences no fatigue damage.

There are no parameters associated with this option.

Data line to define the constant amplitude endurance limit:

First (and only) line:

1. The constant amplitude endurance limit ($2N_f$).
2. A flag (1 or 0) indicating if this variable is active in the material.

*REGRESSION

Specify the regression algorithm.

This option is used to specify the regression algorithm for undefined material properties.

Required, mutually exclusive parameters:

{UNIFORM | UNIVERSAL | MODIFIED | 9050 | NONE**}**

Uniform Law (Baumel & Seeger), Universal Slopes (Manson), Modified Universal Slopes (Muralidharan), 90/50 Rule, none, respectively.

There are no data lines associated with this option.

*MECHANICAL

Specify mechanical constants.

This option is used to define mechanical properties.

There are no parameters associated with this option.

Data lines to define mechanical properties:

First line:

1. Young's Modulus (E).
2. Poisson's ratio (ν).
3. Ultimate tensile strength (σ_U).
4. Yield (proof) stress (σ_Y).

Second (optional) line:

1. A flag (1 or 0) indicating if E is active in the material.
2. A flag (1 or 0) indicating if ν is active in the material.
3. A flag (1 or 0) indicating if σ_U is active in the material.
4. A flag (1 or 0) indicating if σ_Y is active in the material.

*FATIGUE

Specify fatigue properties.

This option is used to define fatigue properties. Fatigue properties can be supplied as constants for the stress-life and strain-life equations, and/or as test data defining the stress-life curve.

Required, mutually exclusive parameters:

{CONSTANTS | TEST DATA**}**

Data lines to define fatigue properties (CONSTANTS):

First line:

1. Fatigue strength coefficient ($\sigma_f{}'$).
2. Fatigue strength exponent (b).
3. Fatigue ductility coefficient ($\varepsilon_f{}'$).
4. Fatigue ductility exponent (c).

Second (optional) line:

1. A flag (1 or 0) indicating if $\sigma_f{}'$ is active in the material.
2. A flag (1 or 0) indicating if b is active in the material.
3. A flag (1 or 0) indicating if $\varepsilon_f{}'$ is active in the material.
4. A flag (1 or 0) indicating if c is active in the material.

Data lines to define fatigue properties (TEST DATA):

First line:

1. First N-value.
2. Corresponding S-value for the first load ratio.
3. Corresponding S-value for the second load ratio.

Continue this data line until the S-values are provided for all load ratios.

Second line:

1. Second N-value.
2. Corresponding S-value for the first load ratio.
3. Corresponding S-value for the second load ratio.

Repeat this data line as often as necessary to define all N-values. A minimum of two N-values is required.

*R RATIOS

Specify load ratios for S-N data.

This option is used to define a list of load ratios. It is only required if the **TEST DATA** parameter is used with ***FATIGUE** and more than one S-value is provided for each N-value.

There are no parameters associated with this option.

Data line to define load ratios:

First (and only) line:

1. First load ratio.

Continue this data line until the load ratios are provided for all S-N curves.

*CYCLIC

Specify cyclic properties.

This option is used to define cyclic hardening properties. These properties are required for the following features in Quick Fatigue Tool:

- plasticity correction;
- yield calculation; and
- damage calculation for Multiaxial Gauge Fatigue analysis.

There are no parameters associated with this option.

Data lines to define cyclic properties:

First line:

1. Cyclic strain hardening coefficient (K').
2. Cyclic strain hardening exponent (n').

Second (optional) line:

1. A flag (1 or 0) indicating if K' is active in the material.
2. A flag (1 or 0) indicating if n' is active in the material.

*NORMAL STRESS SENSITIVTY

Specify the normal stress sensitivity constant for Findley's Method.

This option is used to define the normal stress sensitivity constant, k, if ALGORITHM=findley in the job file.

Required, mutually exclusive parameters:

{USER | SOCIE | GENERAL | DANGVAN | SINES | CROSSLAND**}**

Data line to specify a user-defined value of k (USER):

First (and only) line:

1. Normal stress sensitivity constant (k).

Data line to define k based on the general formula (GENERAL):

First (and only) line:

1. Reference load ratio (R_i).
2. Tensile fatigue limit at R_i.
3. Torsional fatigue limit at $R = -1$.

Data line to define k based on the Dang Van formula (DANGVAN):

First (and only) line:

1. Tensile fatigue limit at $R = -1$.
2. Torsional fatigue limit at $R = -1$.

Data line to define k based on the Sines formula (SINES):

First (and only) line:

1. Tensile fatigue limit at $R = -1$.
2. Torsional fatigue limit at $R = -1$.
3. Ultimate tensile strength.

Data line to define k based on the Crossland formula (CROSSLAND):

First (and only) line:

1. Tensile fatigue limit at $R = -1$.
2. Torsional fatigue limit at $R = -1$.

*CLASS

Specify the material class.

This option is used to specify the material class.

If ALGORITHM=findley in the job file, the material class is used along with the normal stress sensitivity constant, k, to determine the value of the modified fatigue shear strength coefficient, ${\tau_f}^*$.

If ndEndurance = 0 in the environment file, the material class is used to determine whether damage is calculated below the material's endurance limit.

Required, mutually exclusive parameters:

{WROUGHT STEEL | DUCTILE IRON| MALLEABLE IRON| WROUGHT IRON | CAST IRON | ALUMINIUM | OTHER**}**

There are no data lines associated with this option.

*END MATERIAL

End the definition of a material.

This option is used to indicate the end of a material definition.

There are no parameters or data lines associated with this option.