

# MSC Nastran™ Embedded Fatigue

## What is MSC Nastran Embedded Fatigue (NEF)?

Fatigue failures are often identified through testing. However, since the advent of FE based stress solvers, starting with Nastran in the 1960's, attention has focused on the concept of FE based fatigue calculation procedures. MSC Fatigue (1990) was the first such commercial package and spawned a proliferation of similar commercial FE based tools. These methods, both test and FE based, treat the fatigue calculation process as a post processing task and this has been an accepted convention throughout.

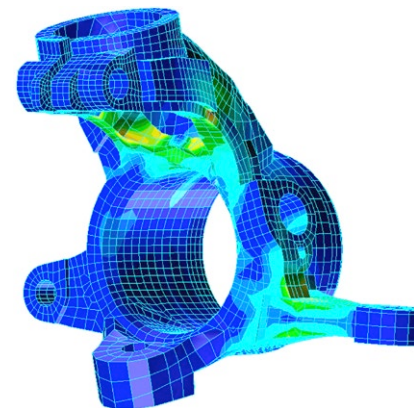
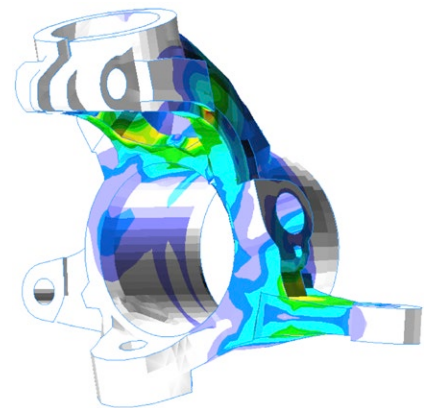
MSC Nastran Embedded Fatigue (NEF) breaks this convention by coupling the stress and fatigue calculation process into one simultaneous operation. This new immersed capability has wide ranging implications in relation to the way fatigue and reliability is handled within large mechanical engineering organizations. By combining the 2 separate processes into one simultaneous process the need for any kind of intermediate data is removed. Such intermediate files can sometimes be a limiting factor in the size of model that can be handled. With NEF there is no limit, theoretically, to the size of model that can be handled (practically this will be governed by normal Nastran model size limitations).

Also, by embedding the process with MSC Nastran, the analyst can include the materials and loading information with the model data in the Nastran input file. This means that model portability becomes much easier. Another significant new capability will be created by enabling optimization procedures to be coupled with fatigue as the constraint, via a SOL200 type analysis. And finally, because the fatigue process is far more transparent (within this solver embedded process) it will open up the opportunity for an analyst to request fatigue results output with every stress run.

## About MSC Software's Fatigue and durability products

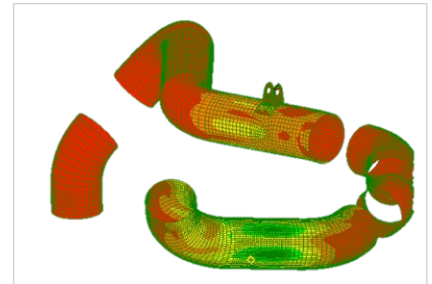
MSC Software has been at the forefront of FE based fatigue and durability products for over 25 years. MSC Fatigue (coupled with Patran) was created in 1990 as a tool for calculating both fatigue damage and crack growth rates from FE models. Adams is a vital tool for modeling the loads that are an essential input to the fatigue calculation process. Marc can be used to calculate arbitrary crack directions and rates in non-uniform geometries and can also be used to generate the Compliance Functions needed for the crack growth module of MSC Fatigue.

Marc can also be used to generate nonlinear stress-strain data for use in a subsequent Low Cycle Fatigue calculation. Digimat is a powerful tool for handling, converting and processing the materials data needed for a subsequent fatigue calculation. Actran can be used to process acoustic response data for inputting to MSC Fatigue. MSC Nastran acts as the stress tool of choice in most large mechanical engineering companies and now MSC Nastran Embedded Fatigue combines these stresses with the often-required fatigue calculation.



## Fatigue capabilities in MSC Nastran

- Stress-life solver (full capabilities similar to MSC Fatigue)
- Strain-life solver (full capabilities similar to MSC Fatigue)
- Factor of safety (FOS) analysis (both S-N & E-N)
- Multi axial responses processed using critical plane method
- Parallel processing (up to 100 threads)
- Utilities tools
- Multiple Fatigue analysis can be performed in a single job submittal
- Fatigue analysis of spot and seam welds
- Support of RPC files
- Block loading in Fatigue analysis
- 2-Pass and 3-Pass Fatigue analysis
- Fatigue analysis with multiaxial assessment



## Supported MSC Nastran solution types

- SOL 101 – statics
- SOL 103 – normal modes
- SOL 112 – modal transient
- SOL 200 – optimization (ANALYSIS=STATICS only)

## Pre and post support

Patran 2013 and beyond supports pre and postprocessing using either the MASTER/DBALL or OP2 file attachment capability or import of FEF or FER files. For alternative Pre & Post tools, one of the alternative output formats specified above may be used (MSC is not responsible for these alternative output formats but provides them as a convenience to the user).

## Available documentation

- MSC Nastran quick reference guide (QRG) with NEF entries
- MSC Nastran Embedded Fatigue user's guide with worked examples
- MSC Nastran release guide

## Licensing

- Additional License required
- Available in Master key plus

## Results formats

- MASTER/DBALL file
- Output2 (OP2) file
- F06 (ASCII output) file
- Comma delimited CSV (Excel) file
- FEF (Patran results) file
- FER (Design Life) file
- Universal (UNV) file

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Our technologies are shaping urban and production ecosystems to become increasingly connected and autonomous – ensuring a scalable, sustainable future.

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