

v5.1 NASFLA Additions & Changes:

New Stress Intensity Factor Models (also in NASSIF):

- TC14, displacement controlled through edge crack, polynomial solution
- TC15, through edge crack in variable thickness plate, univariant weight function solution
- SC19, surface crack in plate weight function solution with capability to handle bivariant, non-symmetric stress distribution and off-center crack; improves upon SC15

Improvements and Additions to Existing Stress Intensity Factor Models/Features:

- TC11 (through crack in plate weight function model) modified to allow for off-center cracks
- Geometry limits for SC17 (surface crack in plate weight function solution) expanded; maximum a/c is now 8, maximum a/t is now 0.95, maximum crack offset is now 90% from the plate center.
- New crack shape transitions from CC09 to TC12; from SC17 to CC09, TC11 or TC12; from SC18 to CC08 or TC13; and EC02 to SC17
 - New Appendix D documents transitions that are available in NASFLA.
- Accuracy of CC08, SC17, SC18 improved for very shallow cracks.
- Optimum point spacing and user-defined point spacing for univariant stress gradient input for TC11, TC12, TC13, CC08, SC17, SC18, EC02
- Ability to directly enter static residual stress fields for univariant weight function solutions TC11, TC12, TC13, CC08, SC17, SC18 and EC02 in NASFLA using optimum-point spacing.
- New and/or recast net-section yield (NSY) expressions were implemented for standard and weight function models, improving efficiency and accuracy of implementation:
 - New NSY solutions were implemented for the following 15 crack cases: TC11, TC12, TC13, TC15, CC08, CC09, CC10, EC02, SC02, SC04, SC06, SC10, SC17, SC18, and SC19.
 - NSY solutions were modified and re-coded for the following 28 crack cases: TC01, TC02, TC03, TC04, TC05, TC08, TC09, TC10, CC01, CC02, CC03, CC04, CC05, CC07, SC01, SC05, SC07, SC08, SC09, SC11, SC12, SC13, SC14, SC15, SS08, SS09, SS10, and SS11.
 - Appendix B was completely rewritten documenting the improvements to the net section stress computations.
- DT01 and DT02 tabular input limits increased from 25 to 50 points
- Solution speed improved for bivariant weight function models (CC09, CC10, SC19).

- The binary backup scheme for expanded reference solutions has been replaced by a more efficient interpolation scheme for selected univariant weight function solutions (CC08, SC17, SC18). The new scheme greatly reduces the start-up time for setting up the expanded reference solutions.
- Added stress gradient input echo/output for all weight function solutions.
- Crack case TC15: Added thickness variation echo/output.
- Crack case EC02: Added "X = x/t" to the bitmap diagram.
- Crack case TC14: Expanded bitmap image to contain "u" and "v" indicators.

Fixes & Changes to Stress Intensity Factor Models:

- Crack case SC10:
 - Removed the term "nonlin stress" from the crack case description.
- Crack case TC11:
 - Removed the term "embedded" from the crack case description.
 - Added additional printed output and corrected input issue with symmetric and non-symmetric options.
- Crack cases CC08, SC17, TC13:
 - If "Crack plane stress definition from" radiobox set to User Input and "# of stress distributions" radiobox was greater than 1, and a shakedown method was selected, the # of stress distributions was not being reset to 1, causing an overlap of screen controls.
- Crack cases CC09, CC10, SC18, SC19:
 - An issue was resolved for several geometries when the crack increment was very small during crack growth analysis. In these cases, the crack growth increment for each step was insufficient to trigger an updated stress intensity factor calculation for the new crack length. In extreme cases, the stress intensity factor was not updated for the majority of the crack growth analysis.
- Crack Case CC10:
 - Corrected compiler error resulting in CC10 producing invalid SIF results.
- Crack case TC14:
 - Deactivated "Check throughout this block for crack instability at limit stress?" checkbox, since this option is incompatible with this case's displacement boundary conditions.
 - Assigned stress quantity labels on Load Blocks tab from "S0, S1, S2, S3" to displacements "D0, D1, D2, D3".
 - Added additional output for displacement table and fixed D0 and D1 output
 - Updated bitmap in GUI to correct variable definitions.
- Crack case TC15:
 - Added additional output to echo the thickness variation and stress distribution tables.
- Crack case SC17; New crack case limits:
 - $|(W/2)-B|/(W/2) \leq 0.9$, and $c/\text{Min}(B, |W-(B/2)|) > 1$.
- Crack case SC18:

- The printed output was corrected and now prints crack length in the correct columns.
- Crack case PS02:
 - Application would crash when any entry was made in the coefficients fields on the Geometry tab. This has been corrected
- Subroutines related to the original weight-function solutions were modified to allow algebraic (instead of absolute-value) summing of the stress intensity factors that arise from each of the stress distributions. This was done to avoid violating the superposition principle, observed when running the NASFLA module using crack case SC06.

New Spectrum Features and Changes:

- Alternative Downing-Socie cycle counting algorithm (a variation on the standard ASTM rainflow method)
- Automatic/flexible choosing of bin sizes for spectrum visualization (exceedence diagrams and histograms)
- High/low and low/high sorting capability added to spectrum editing options

Fixes to Spectrum Generation & Cycle Counting Routines:

- Corrected error in Spectrum File Generator which prevented files from being generated.
- Bug in the Range-Pair cycle counting algorithm which resulted in originally unpaired points (Step 5 in ASTM standard) not being paired correctly was corrected. This fix affects both the modified and ASTM Range-Pair cycle counting options.

Fixes to Input/Output Items:

- Stress factors were not being properly displayed in the output window for the spectrum visualization function "Statistical Analysis" for cases with non-sequential stress quantities (ex: CC02).
- Clarified error messages for post-processing Residual Strength calculations: No stresses can be negative, reference stress and Kc entry must be positive.
- Updated output printing to align column data for transitioning crack.
- Crack case SC18: corrected output headers for crack tips.
- Scale factor S3 is now correctly displayed in the output window when running a statistical analysis on a load spectrum.
- If neither checkbox: "Blocks represent flights" nor "Blocks represent flight hours" are checked, the results in the output window will no longer make reference to flights or flight hours.
- Application would crash when plotting Optimum Point Spacing (OPS) data, and attempting to save plot data to a text file. This has been corrected.
- Input files containing more than 50 rows of OPS data will now be properly loaded.

- Shakedown input error for OPS was fixed and the GUI table limit increased to 500.
- Added additional output to print material ID code in .out1 file.
- Corrected and added additional output for descriptions of crack cases TC14, TC15, and SC19.
- Corrected printed output to print correct variables to .out2 columns for the following two crack transitions: EC02 to SC17 and SC17 to CC09.
- Corrected unacceptable loss of precision when saving manually entered material constant, Cth, to file.

Other NASFLA Items:

- Plotting capability to display univariant stress gradient input
- Residual strength diagram capability for DT01 model
- Residual strength diagram capability implemented for all through cracks (except for TC14), corner cracks, surface cracks, embedded cracks, and some of standard specimens (SS08, SS09, SS10, and SS11).
- Enhancements to residual strength diagram plotting (legends, etc.)
- All post-transition stress calculations verified
- Ability to erase a column from tabular input
- Corrected situation where multiple instances of a GUI were writing to the same batch file.
- Changed the Hermite interpolating code to allow proper running when the number of data pairs, NDAT, equals 3.
- Removed threshold check when the exponent p in the NASGRO crack growth equation equaled zero, fixing a bug where even if p was zero, results were affected by changes to DK1.

v5.1 NASMAT Additions & Changes:

NASGRO equation fits performed within NASMAT can now be automatically saved and recalled via NASFLA for user-defined material IDs that are consistent with the NASA material ID convention.

Buttons and text boxes on the NASMAT curve fit page were rearranged and grouped in a more logical fashion.

The dialog box used to obtain Walker fit data limits and line limits was modified to have a default line limit from 1.0E-9 to 1.0E-02.

NASMAT no longer plots a “weighted R” curve after performing a curve fit.

The appearance of the pages used to work with the toughness data was improved to eliminate some previously confusing displays.

A pdf file can now be displayed from the NASMAT toughness GUI that provides definitions of the various fracture toughness test specimens by clicking on the "Specimen Definitions" on the toughness data page.

Four new materials were added to the database and changes were made to the files that contain material properties and curve fit constants for one material. Refer to Help/Recent Changes in NASMAT for details.

NASGRO material file corrected for ID: M2IF11AB11, which was not being displayed.

Added new material ID: P4MB20AB1.

v5.1 NASBEM Fixes & Additions:

Over two dozen bugs were fixed and a number of minor features were added.

Stress calculations can now be performed in the vicinity of the crack in a cracked zone.

Added capability to allow a crack to be modeled in an infinite boundary.

A button was added to the calculations page that gives the user the ability to display tabular results of stress calculations.

A feature was added to restore saved files so that when an existing input file is loaded, stress calculations can be performed without the need to perform other calculations.

A few simple tutorial examples for NASBEM have been developed and will be available for download from the NASGRO website and eventually incorporated into the manual at a later date.

v5.1 NASFORM Fixes & Additions:

Errors were corrected in some of the fatigue ductility coefficients in the Dowling strain-life data.

The spectrum length limit was increased from 28,000 to 2,800,000 to allow strain-life calculations for longer spectrums.